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INSTITUTIONAL CHANGES IN THE EURO-ZONE AND THE GREEK DEBT CRISIS

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Abstract
This study attempts to quantify the effects of the implicit restrictive monetary policy, exercised by the European Central Bank (ECB) in Greece, during the world financial crisis. An autoregressive distributed lags (ARDL) testing approach is used to verify the existence of a long-run relationship between GDP, total money supply and government expenditure in the Greek economy from 2002 to 2013. The main findings suggest that the institutional settings of the ECB should allow the use of monetary policy during periods of monetary crisis. Money supply in the Greek economy is in a positive relationship to the GDP. If the institutional settings of the ECB were different, allowing money supply to remain stable during the crises, a significant portion of the GDP decline would have been averted.

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1. Introduction: The Deep Economic Crisis and the problem of Public Debt

The Greek economy is in the midst of a deep crisis, as a result of a large fiscal deficit, huge debt and a continued erosion of its competitive position. The global crisis amplified the cumulated negative effects of these chronic weaknesses and accelerated the downturn of the economy.

The crisis that the Greek economy is facing today is all-encompassing and multi-faceted. Therefore, it calls for a bold response of the same kind: sustainable, on-going and convincing fiscal consolidation, especially on the expenditure side, coupled with ground breaking *structural reforms* aimed at improving the operation of markets and enhancing competitiveness.

Most importantly, Greece must break the behavioral pattern, attitudes and policies that have brought the country to its present situation. Politicians also must change attitudes by trying to implement the structural reforms needed, without considering the short-term political cost and their survival on the political scene. A lot has been done, most of which should have been done decades ago e.g. the opening of the so called 'closed' professions, deregulation of shopping times, the licensing system for taxis and lorries, the reform and increase in the efficiency of the public health system, the reform of the supplementary pension system etc. However, some reforms failed to be completed owing to the attitudes of politicians, who continue taking into account pressures applied from special interest groups and/or considering short-term political cost.[1] Therefore, the debt crisis has caused serious problems to Greek society. These problems have to be resolved soon.

The purpose of this paper is not to argue that Greece is without blame for the crisis and its results. It goes without saying that the structural reforms for increasing market efficiency have to be completed and they should have been completed at the same time that were implemented in the rest of the E.U. states during the 60's and the 70's. It is argued however, that the severe effects of the financial/debt crisis on

1. An example of ill-implemented structural reforms is the system of licensing taxis, where in principle the issuance of new taxi licenses is allowed by the reformed intuitional framework but in practice no new taxi license can be issued because strict population criteria are set which do not permit new licenses. Another ill-implemented measure is the so called 'Athena' project for the reform of the higher education sector. The minister, instead of using criteria that are internationally accepted in academia for restructuring higher education establishments, in order to minimise the political cost, chose to debate the project with local politicians. The project resulted in many non-rational choices: departments with one, two or no members of staff at all, departments in the engineering faculty which accept students with a background in literature (!) and Institutions with two identical departments e.g. two Departments of Business Administration in the same Faculty.

the welfare of the Greek people could have been alleviated, if the Eurozone had had a different approach (different institutional settings) in dealing with the 2008 world financial crisis.

The paper proceeds as follows: section 2 reviews the literature on the Greek crisis, section 3 attempts a historical overview of the crisis, with proposals as to what could have been done differently on the part of the Greek government, section 4 provides evidence, using an econometric model, of the effects of the decrease in the money supply (money stock) due to the EU policies on the GDP and section 5 presents the conclusions.

2. Literature review of the Greek crisis

In the literature analyzing the causes of the crisis and the possible remedies, there are papers that point the finger at the Greek governments, indicating as a solution to the crisis a possible exit from the Eurozone. Additionally, there are papers that try to analyze the institutional framework of the Eurozone and the attitude of Europe (i.e. mainly Germany) towards the Greek crisis. This strand of papers indicate that the solution to the crises does not rest with Greece alone but with the institutional changes that have to be made in the Eurozone.

De Grauwe (2010) argues that the crisis was allowed to unfold because of hesitation and ambiguities by both the Eurozone governments and the ECB. The Eurozone governments failed to give a clear signal about their readiness to support Greece. The failure to do so mainly resulted from disagreements, among member state governments, concerning the appropriate response to the Greek crisis. The ECB, in turn, created ambiguities about the eligibility of the Greek government debt as collateral in liquidity provision (*ibid*, p. 2).

The same author (De Grauwe: 2011) further argues that there is a need for a fundamental restructuring of the Eurozone's institutions. In that restructure it is essential that the ECB take on the full responsibility as lender of last resort in the government bond markets of the Eurozone. Without this guarantee, the government bond markets in the Eurozone cannot be stabilized and crises will remain endemic. Moreover, he argues that further steps towards political unification must be taken, without which effective control of national government deficits and debts cannot be implemented. Liquidity provision should be performed by a central bank and the governance of moral hazard by another institution which will act as the supervisor to the system.

Kouretas and Vlamis (2010) argue that the Eurozone governments failed to give a clear signal, indicating their readiness to support Greece, while the Greek fiscal crisis was escalating. Additionally, the institutional setting of the EU resulted in a lack of solidarity funds at supranational level. Since the Eurozone is a monetary union and not an economic one there is no federal budget. Therefore, monetary policy is set at a supranational level by the ECB, but fiscal policy is still in the hands of national policy makers. Whenever a crisis occurs at the EU periphery, there is no adjustment mechanism to deal with such a crisis at a supranational level. Katsimi and Moutos (2010) conclude that fiscal discipline, within the Eurozone, should be the top and only priority of policymaking. Current account imbalances within the Eurozone, should also feature in any reform of the structure of economic governance.

Featherstone (2011) argues that when the market crisis erupted, the European Union's Council of Ministers and the ECB failed to provide a timely and effective response. The implications are threefold: the constraints on domestic reform proved immutable to EU stimuli; the 'euro' is more vulnerable to crisis than previously acknowledged; and the early discussion on 'euro' governance reform suggests that its underlying philosophy has not shifted significantly towards more effective 'economic governance'. Within Greece, the unprecedented external monitoring and policing of its economy –though matched by some initial successes– raises in the longer term sensitive issues of legitimacy and governability, with uncertain prospects for avoiding further crises.

Arghyrou and Tsoukalas (2011) on the other hand, argue that either Greece will introduce the reforms necessary to address the initial source of the crisis, *i.e.* deteriorating fundamentals, allowing the country to stay in the European Monetary Union (EMU), or Greece will not promote any reforms, in which case the only option will be to leave the euro. EMU periphery economies have diverged so much from those of core EMU countries that either they cannot sustain, or markets consider that they are not able to sustain, the cost of reforms necessary to stay in the Eurozone. They propose a temporary split of the euro into two currencies, both run by the ECB. The hard euro will be maintained by the core EMU members, whereas the periphery EMU countries will adopt the weak euro for a suitable period of time. The plan involves a one-off devaluation of the weak euro versus the strong one simultaneously with the introduction of far-reaching reforms and rapid fiscal consolidation in the periphery EMU countries.

Sklias and Maris (2013) focus on the poor political and institutional performance over the last three decades in Greece. They argue that the Greek crisis has important political elements, owing to which the crisis will persist; the economic factors have contributed to the crisis but they are not the root causes, which can be found only within the political and institutional model of development and the mode of Greek governance.

To conclude, most of the authors recognize that the institutional framework of the Eurozone and the attitude of Europe towards the Greek crisis has affected the development and evolution of the crisis. It is pointed out that the solution does not rest with Greece alone but with the institutional changes that have to be made in the Eurozone.

3. An historical overview of the crisis

3.1 Some facts about the Greek debt crisis

The Greek debt crisis began when Greece was borrowing heavily to cover its increasing budget deficits and financial markets realized that, at that pace, the debt would not be manageable. Table 1 presents the increase in the budget deficits produced by the Greek government from 2003 to 2010. It can be seen that the deficit rocketed in 2009. This was, mainly, due to the adjustment in the measurement methodology made by the newly elected Greek government[2]. The spread of Greek government bonds against the interest rates of German government bonds was rapidly increasing. When it reached 7% the government decided that borrowing from the financial markets was not an option, because the debt would not be sustainable.

2. The deficit of the state-owned enterprises was included in the public deficit.

Table 1: GDP, Public revenues, expenses and debt (in mil. Euros, current prices

Year	GDP	Revenues	Expenses	Deficit	Public Debt	% GDP
2003	153,045	37,500	40,735	-3,235	179,008	117.00%
2004	164,421	40,700	45,414	-4,714	198,832	120.90%
2005	196,609	42,206	48,685	-6,479	209,723	118.90%
2006	213,085	46,293	50,116	-3,823	224,162	105.10%
2007	228,180	49,153	55,733	-6,580	237,742	104.20%
2008	239,141	51,680	61,642	-9,962	260,439	108.90%
2009	**237,494**	**48,491**	**71,810**	**-30,866**	**298,524**	**125.68%**
2010	231,000	52,700	66,188	-19,473	340,680	147.48%

Source: Greek Ministry of Finance

As a result, the Greek government signed a 'memorandum' with the E.U. and the International Monetary Fund (IMF) for borrowing 110 billion euros, in order to cover the immediate operational needs of the Greek state. At the same time, the Greek government agreed to take immediate action for the rapid reduction of the budget deficit and to make the necessary structural changes in the economy, in order to increase its competitiveness.

There are some points that have to be made, regarding this first agreement between the Greek government and the international lenders:

- The huge increase in the budget deficit in 2009 (it more than tripled in one period) was mainly the result of the change in the accounting methodology, used by the Greek government. The world financial markets were in turmoil due to the unprecedented financial crisis that started in the US in 2008. Obviously, it was a very bad time to make the change in the accounting methodology that resulted in an increase of the public deficit by 7% of the GDP[3].
- The Greek government did not bargain at all with the international lenders over the terms of the loan. It has to be pointed out that at that time it was in the interest of all the core EU countries to find a solution regarding the Greek debt, without proceeding to a haircut or leaving Greece to become bankrupt, since their banking sector, as can be seen from Table 2, was exposed to

3. The deficit before the adjustment was about 9% and after the adjustment it rocketed to 16% of GDP.

Greek government bonds. The largest amount was held by the banking sector of France, followed by Switzerland and Germany.

Table 2: Distribution of Greek public bonds in 2007

Country	**Public bonds, in million euros**
France	58,040
Switzerland	49,205
Germany	33,258
USA	12,624
United Kingdom	9,494
Holland	9,115
Portugal	7,936
Ireland	6,543
Japan	6,498
Italy	6,447
Other countries	33,610
Total	**232,770**

Source: World Bank

This is a conclusion reached by other researchers as well (e.g. Gocaj *et.al.,* 2013) and the references therein): a possible Greek default in 2008 threatened the entire euro area, due to the integrated nature of European banking. Germany and France held almost half of all European exposures to those countries and a Greek default would spread panic to German and French banks and the world financial system.

- In 2009, the Greek government did not attempt to proceed to an auction of new bonds due to the high spreads prevailing in the world financial markets. It preferred to sign an agreement (memorandum) with the EU and the IMF for the borrowing of 110 billion euros. This was a political decision. There was not an unsuccessful auction of Greek government bonds in the financial markets, but it was a political decision of the government that led to the signing of the memorandum. Further, the effects of the terms of this first memorandum on the Greek economy (and more importantly on Greek society) were not calculated correctly; the effects of the austerity policy measures on the GDP were greatly underestimated, as the IMF recently has admitted. Moreover, the roadmap set by the IMF was completely unrealistic: the im-

plementation of the austerity measures would have allowed Greece to re-enter the financial markets in 2014.

- Tables 3 and 4 show the uses of this first loan of 110 billion Euros. It is observed that (a) in 2011, the total interest is almost equal to the public deficits. (b) EU-IMF loans were not for paying public sector deficits but for the rescue of the European banks holding Greek bonds. Since, the total amount of the EU-IMF loans was approximately 1/3 of the total Greek public debt it was obvious that this deal was not made to help towards a solution to the Greek debt problem.

Table 3: GDP, Deficit and Interests

	GDP Million Euros	Interests Million Euros	Interests/ GDP	Deficit Million Euros	Interests/ Deficit
2009	237,494	12,325	5,19%	32.299	38,15%
2010	227,994	13,209	5,79%	18.467	71,53%
2011	222,066	15,800	7,12%	16.877	93,62%

Source: Budget for 2011, Ministry of Finance

Table 4: Maturing of Public bonds and EU-IMF loans

Year	Debt in public bonds maturing (In bil. Euros)	EU-IMF loans (In bil. Euros)
2010	15,80	38,00
2011	31,30	40,00
2012	31,70	24,00
2013	24,90	8,00
Total	**103,70**	**110,00**

Source: Bloomberg– Greek Ministry of Finance

According to the Treaty on the European Union (the Maastricht Treaty convergence criteria for the creation of the Euro-zone) inflation rates in the member states should be no more than 1.5 percentage points higher than the average of the three best performing (lowest inflation) member states of the EU. Additionally, the ratio of the annual government deficit to GDP must not exceed 3%. Further, the ratio of gross government debt to GDP must not exceed 60% at the end of the preceding fiscal year. The purpose of setting these criteria was to maintain price stability

within the Eurozone. However, the Eurozone is a non-optimal monetary union; the 'golden rule' of monetary unions is that the exchange rates and interest rates should be closer to the needs of the weakest economies and not to those of the strongest. In Greece, for almost a decade after the creation of the Eurozone, government deficit and public debt criteria were not met and no effective measures were enforced by the EU to make Greek governments converge to the target values.

- It is the opinion of many researchers who have analyzed the causes of the Greek crisis (see section 2 above), that the institutional setting of the Eurozone and the non-intervention of the ECB have a considerable responsibility for the severity of the effects of the crisis - even the outbreak of the crisis itself. The ECB institutionally is not allowed to function as a 'Central' Bank, thus the financing of the debts of the member-states is subject to the evaluation rating of the financial markets. Although, Eurozone countries have transferred (abolished) monetary policy to the ECB, fiscal policy is not co-ordinated among the member states. Therefore, Greece: (a) does not have the ability to devalue its currency to compensate for lost competitiveness. The adjustment should be made by the labour market, (b) cannot exercise monetary policy because all Eurozone countries have transferred it to the ECB, (c) has a 'friendly' to crises GDP structure because the services sector, where productivity increases are difficult, accounts for most of GDP, (d) even if there is a surplus in the budget, it will not be possible to repay the huge external debt, approximately 160% of GDP.

The crisis would have been avoided (not only the Greek crisis but the debt crises of Portugal and Ireland as well) and there would have been no need for these countries to enter the 'Troika' probation if the ECB had acted as a central bank, *i.e.* if it had followed the example of the Federal Reserve Bank of the USA, increasing the money base by 2 to 2.5 trillion euros. If that were the case, government bond spreads (of the PIGS[4]! countries) would not be high and there would be no need for memorandums, haircuts and the huge decrease in standards of living. The argument against this policy comes mainly from Germany (adopted also by other central European countries) and it is summarized by the motto: '*what about inflation?*'. DeGrauwe (2011) has shown that there is a difference between money base and money stock (M3). In the real economy, what matters (the level of prices including)

4. During the period of the crisis Portugal, Italy, Greece and Spain were named PIGS, an acronym formed by their initials.

is the money stock and not the money base. But it is the money base that is affected by the central bank and that is what concerns the financial markets. So, the argument for the inflation increase is not valid. But even if it were, why is 4% inflation considered to be an 'evil' thing if GDP growth is high and unemployment low?

3.2 The Roots of the crisis

The crisis in the Greek economy stems mainly from chronic problems, but also reflects the impact of the global crisis, which has entered a second, difficult phase, despite a recovery in economic activity worldwide. Apart from its other woes, the Greek economy faces an unprecedented confidence and credibility deficit.
Countries like Greece, with twin deficits and debts, face the risk of a much more difficult and slower exit from the crisis and of a protracted period of low growth. The main features of the crisis can be summarized as follows:

First, the accumulated negative repercussions of chronic weaknesses and distortions as well as macro-economic imbalances have now emerged in full force, as the factors that had previously concealed them, *i.e.* factors that fostered strong economic growth over the 1996-2007 period, have now been exhausted. The explosive fiscal imbalances have been compounded by a major credibility problem, which spread from Greek statistics to its economic policy and to its overall reputation.

Second, the effects of the global crisis on Greece's real and financial sectors are manifesting themselves with some lag. Due to the domestic distortions, Greece may not be able to reap the full benefits of the recovery that has begun to gain traction in the rest of the world.

Third, the crisis in the European and the global economy has entered a second phase, characterized by a recovery that is proceeding at a faltering pace and is uneven across countries. In this phase, the dominant question is how to address the surge in fiscal deficits and debts in all the advanced economies, attributable to the fiscal stimulus and credit support packages.

All the above factors have contributed to the confidence and credibility deficit that Greece faces today, the negative assessments of its recent performance and negative forecast of its medium-term prospects, taking into account its chronic structural weaknesses and macroeconomic imbalances.

4. A model to examine one facet of the crisis: the reduction in Money Supply (money stock)

In Keynesian type models, the monetary sector of the economy plays an important role in determining the level of income (or GDP) with the well-known interaction of the IS and LM curves. Economic policy can be exercised by using fiscal or monetary tools. Supply and demand for money affect the level of real interest rate which in turn, affects the level of investment and thus the GDP of the economy.

In principle, in the Eurozone, monetary policy is exercised by the European Central Bank (ECB). Nominal base interest rates are controlled by the ECB and therefore, the real base interest rate for each country is that set by the ECB, accounting for inflation. Commercial banks can borrow from the ECB using as collateral government bonds and/or other assets, so the real interest rate that determines investment in a Eurozone economy is that set by the ECB plus the profit margin of the commercial bank accounting for inflation. So, money supply is regulated by the commercial bank sector of the economy. In the Greek economy, before the crisis, the financing of government budget deficit was a significant factor, affecting the economy's money supply because government bonds were bought in the open market by commercial banks and then they were used by them as collateral in order to borrow money from the ECB. The ECB institutionally, does not have the right to intervene in the government bond market nor can it buy government bonds directly from member states.

After the crisis, Greek banks were on the one hand cut-off from the ECB and on the other, owing to the great uncertainty caused by statements and scenarios that Greece would (or could) exit the Eurozone, faced a considerable flow of deposits to financial institutions abroad. As a result, the money sector of the economy experienced a considerable decrease in money supply (see Figure 1). If this had happened to a non-Eurozone economy interest rates would have increased and the central bank would have intervened by increasing money supply. But in a Eurozone country interest rates are regulated by the ECB and the ECB cannot institutionally increase money supply. As a result, a mild increase occurred in commercial banks' interest rates (in all kinds of loans, investment, consumer and mortgages) on **existing** loans. Due to the sharp decrease in the money supply banks simply did not have money for **new** loans. There has been a gap between money supply and demand since, interest rates could not increase rapidly as they were regulated by the ECB and at the set level of interest rate there had been not enough money supply to meet

demand. So, healthy enterprises could not receive short-term loans for working capital, for acquiring material crucial for their production process, consumer loans were completely stopped and no new mortgages were provided for houses.

In order to examine the effect of the change in money supply caused by the Greek debt crisis and the Eurozone institutional settings on the real economy, GDP was taken to be affected by the total money supply of the economy. The other explanatory variable that was put in the model was total government expenditure. Of course, government expenditure (G) is part of the total GDP produced in a country (the other elements being private consumption, investment and the external sector of the economy). It was decided to include it as an explanatory variable because of its multiplying effect on GDP properties. A positive and statistically significant coefficient is expected for this variable. A further reason for using these variables only was that these two variables are the main variables for exercising economic policy (*i.e.* monetary and fiscal). Therefore, the model used is:

$$GDP_t = f(Ms_t, G_t) + e_t;$$

where GDP is gross domestic product, Ms money supply, G total government expenditure, e is the disturbance term which is assumed to be an independent and identically distributed random variable, t indicates time. The estimated final model was in double logarithmic form:

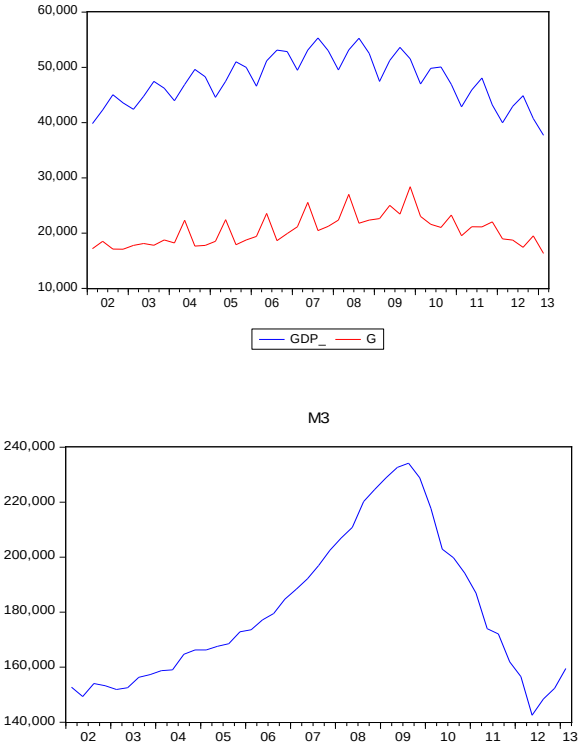
$$lnGDP_t = a_0 + b_1 lnMs_t + b_2 lnG_t + e_t \quad \textbf{(1)}$$

The model was estimated in a double logarithmic form for two reasons: (a) to reduce the variability of the data and (b) to interpret the estimated coefficients of the explanatory variables as elasticities. The sample period was from January 2002 to January 2013, quarterly data were used and the sample size was 45 observations.

4.1 Data description

The aim of the authors is to show the effect of the decrease in money supply, due to the Eurozone institutional settings, on GDP. The GDP series, in constant 2005 prices, were extracted from the database of the Hellenic Statistical Authority (ELSTAT) for the period of 2002q1 to 2013q1. Data for total government expenditure were extracted from the same database. As a measure of money supply, the M3 has been used for the Greek economy. Quarterly data for M3 have been extracted from the Bank of Greece database. Real money supply was calculated using the inflation rate reported by Eurostat for the Greek economy.

Figure 1: Money Supply, Government Expenditure and GDP in the Greek Economy



Source: GDP and government expenditure data was extracted from the Hellenic Statistical Authority (ELSTAT); money supply (m3) data was extracted from the Bank of Greece. Graphs are produced by the authors.

The above figure shows the raw data used. Quarterly GDP and government expenditure was not seasonally adjusted. For this reason, the D1, D3 and D4 dummies were included. It is seen that from 2009 to 2012, *i.e.* in just two years, real money supply for the Greek economy has been reduced by 39.15% (peak at 2009q3, min at 2012q2).

4.2 Estimating methodology

In order to examine the long-run relationship (co-integration) between the GDP and the explanatory variables of total money supply (M3) and government expenditure (G) a cointegration analysis has been used. Before examining the existence of co-

integration between the variables we must analyze first, the order of integration of the variables considered. This analysis is usually done using the ADF (Dickey, Fuller, 1981) or the P-P (Phillips, Perron, 1988) unit root test. The P-P unit root test was used to test the series for stationarity.

Table 5: Phillips-Peron unit root test results

	Level	First Difference
GDP	-1.59	-11.86*
Total Money Supply (M3)	-1.01	-3.92*
Government Expenditure (G)	-3.74*	-17.98*

Notes: The values refer to Phillips-Perron adj. t-test statistic. The asterisk indicates statistical significance of at least 5% level.

Source: Authors' estimations

The values of the P-P test are presented in Table 5. The null hypothesis (H_0) of a unit root (non-stationarity) is tested against the alternative. H_0 was rejected at 5% level of statistical significance for G and therefore, it is concluded that it is I(0). The GDP and M3 variables were found to be I(1); the null hypothesis was rejected at 5% level at the first difference.

When there are only I(1) variables, the maximum likelihood approach of Johansen and Juselius (1990) can be used. In our case the system contains I(0) and I(1) variables and therefore, the Autoregressive Distributed Lag modeling (ARDL) suggested by Pesaran *et al.* (1999, 2001) will be used. The ARDL method can be applied on a time series data irrespective of whether the variables are I(0) or I(1) (Pesaran and Pesaran, 1997), it generally provides unbiased estimates of the long-run model and validates the t-statistics even when some of the regressors are endogenous (Laurenceson and Chai, 2003). However, it is necessary to check that the variables are not I(2) because, in this case, ARDL would produce spurious results (Oteng-Abayie *et.al.*, 2006). As can be seen from the above Table, the variables are either stationary on their level or at their first difference.

Following Pesaran *et.al.* (1999, 2001) the ARDL representation of equation (1) is:

$$\Delta lnGDP_t = a_0 + \vartheta lnGDP_{t-1} + \sum_{i=1}^{\mu} \theta_i DL_{i,t-1} + \sum_{j=1}^{p} a_j \Delta lnGDP_{t-j} + \sum_{i=1}^{\mu} \sum_{j=0}^{p} \beta_{ij} \Delta DL_{i,t-j} + \tau T + \delta_1 D1 + \delta_3 D3 + \delta_4 D4 + \omega_t \quad \textbf{(2)}$$

where Δ is the first-difference operator, *GDP* is Gross Domestic Product in constant prices, *DL*=(*ln* M3, *ln* G) is the vector with the explanatory variables; M3 is total money supply in real terms and G represents total government expenditure, in constant prices, *D1*, *D3*, *D4* are seasonal dummies, *T* time trend, ω is a white noise error term, μ=2 is the number of explanatory variable, ϑ, θ_i are the coefficients that represent the long-run relationship, a_j, β_{ij} are the coefficients that represent the short-run dynamics of the model and p is the number of lag length.

The ARDL method to co-integration requires[5]: First, equation (2) is estimated and the lag order of the ARDL is determined using the appropriate lag selection criterion. To find the order of the ARDL model 8^{μ} 7=448 regressions were estimated. Second, a test was conducted that the errors in equation (2) are serially independent. The Lagrange Multiplier (LM) test was used to test the null hypothesis that the errors in equation (2) are serially independent against the alternative that there are autoregressive or moving average relationships in the errors. Then, the model is tested for stationarity (*i.e.* dynamic stability). The requirement is that the inverse roots of the AR polynomials lie strictly inside the unit circle. In our case, the plot of the inverse roots of the AR polynomial was made. Fourth, from equation (2) a test for the existence of long-run relationship was made. This is called the 'bounds testing' approach to co-integration and it is associated to the hypothesis testing $H_0: \vartheta = \theta_1 = \theta_2 = 0$; *i.e.* the long-run relationship does not exist against the alternative $H_1: \vartheta \neq \theta_1 \neq \theta_2 \neq 0$ *i.e.* the long-run relationship exists. Fifth, assuming that the bound test, described above, is conclusive and there is a cointegrating relationship, the coefficient and its statistical significance of the Error Correction Term (ECT) can be found by estimating:

$$\Delta lnGDP_t = a_0 + \sum_{j=1}^{p} a_j \Delta lnGDP_{t-j} + \sum_{i=1}^{\mu}\sum_{j=0}^{p} \beta_{ij} \Delta DL_{i,t-j} + eECT_{t-1} + \omega_t \quad \textbf{(3)}.$$

The coefficient of the error correction term, *e*, should be negative and statistically significant meaning that there is a co-integration between the dependent and the explanatory variables. The value of this coefficient shows the percentage change of any disequilibrium between the dependent and the explanatory variables is corrected within one period (one quarter).

Finally, the long-run impact of the explanatory variables on the dependent vari-

5. For a more detailed description of the steps of the ARDL method see, among others, Serenis *et.al.* (2014)

able is calculated using the expression (Bardsen 1989):

$$\hat{\gamma}_i = -\frac{\hat{\theta}_i}{\hat{\vartheta}} \qquad \textbf{(4)};$$

where $\hat{\theta}_i$ and $\hat{\vartheta}$ are the estimated long-run coefficients in equation (2). The $\hat{\gamma}_i$s show how the dependent variable, in our case the logarithm of GDP, responds in the long-run to any change in the explanatory variables *i.e.* the logarithm of real money supply and real government expenditure. However, the $\hat{\gamma}_i$s provide a single value to quantify the long-run effect and they do not provide any information about the degree of variability associated to them (Gonzalez-Gomez *et.al.*, 2011). Further, confidence intervals for each coefficient cannot be constructed using traditional statistical inference because they do not follow the normal distribution since they are calculated as the division of two normal variables. Following Efron and Tibshirani (1998) the bootstrap method, which is a non-parametric method, can be used in order to calculate empirically confidence intervals without assuming a specific distribution of the γ_is. In our case this was made for 95% level of statistical significance. If the zero is contained in the interval then the effect of the explanatory variable will not be statistically significant.

4.3 The Results

The lag order of the ARDL model, found with the procedure described in the section above, is (5, 7, 5)[6]; the first number represents the distributed lags of *ln*M3, the second the distributed lags of *ln*G and the third the distributed lags of *ln*GDP. The results are presented in the following Table 6.

The Lagrange Multiplier (LM) test was used to test the null hypothesis that the errors in equation (3) are serially independent. The F-statistic of the LM test had a value of 1.345 and it was not statistically significant so the null hypothesis of no-serial correlation was not rejected.

The Breusch-Pagan-Godfrey heteroskedasticity test was also performed; the F-statistic had a value of 0.459, it was not statistically significant and the null hypothesis of homoschedasticity was failed to be rejected.

6. For the determination of the lag order of the ARDL model the maximum number of eight lags (p=8) in equation (2) was considered.

Table 6: ARDL results for the effects of money supply on GDP for the Greek Economy

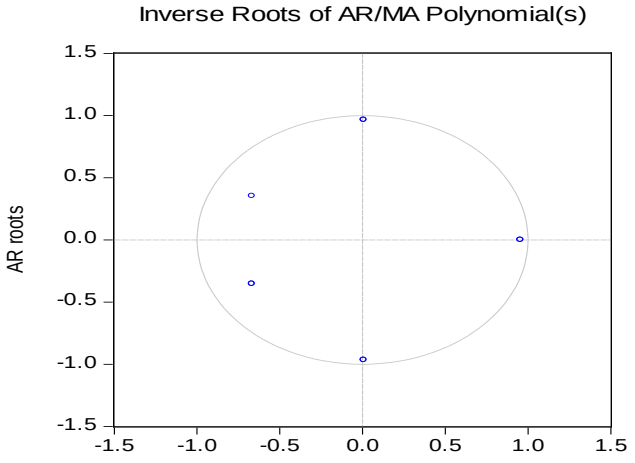
Dependent Variable: *Δ ln GDP*							
Variable	Coefficient	Std. Error	t-Statistic	Variable	Coefficient	Std. Error	t-Statistic
ln gdp_{t-1}	**-0.766438**	0.156520	-4.896727	*Δ ln g*	0.138097	0.086663	1.593485
ln $m3_{t-1}$	**0.483125**	0.052092	9.274485	*Δ ln* g_{t-1}	**0.894573**	0.188119	4.755353
ln g_{t-1}	**0.528499**	0.197864	2.671020	*Δ ln* g_{t-2}	**0.628638**	0.099805	6.298656
@trend	-0.016316	0.033876	-0.481656	*Δ ln* g_{t-3}	**0.962983**	0.173261	5.557993
constant	8.612315	5.935252	1.451045	*Δ ln* g_{t-4}	**0.263718**	0.073452	3.590370
D1	-0.263691	0.236862	-1.113268	*Δ ln* g_{t-5}	**0.641258**	0.092911	6.901850
D3	0.169312	0.338806	0.499731	*Δ ln* g_{t-6}	**0.158913**	0.070911	2.241039
D4	-0.140977	0.195767	-0.720125	*Δ ln* g_{t-7}	**0.285381**	0.041991	6.796318
Δ ln m3	**0.619314**	0.124947	4.956600	*Δ ln* GDP_{t-1}	-0.360410	0.179147	-2.011811
Δ ln $m3_{t-1}$	**-0.402802**	0.094050	-4.282835	*Δ ln* GDP_{t-2}	-0.220459	0.279754	-0.788046
Δ ln $m3_{t-2}$	**-0.953564**	0.152074	-6.270394	*Δ ln* GDP_{t-3}	**0.179368**	0.067600	2.653381
Δ ln $m3_{t-3}$	**-0.763895**	0.197031	-3.877023	*Δ ln* GDP_{t-4}	**0.648922**	0.051400	12.62498
Δ ln $m3_{t-4}$	**0.733105**	0.259717	2.822708	*Δ ln* GDP_{t-5}	**0.506824**	0.042597	11.89817
Δ ln $m3_{t-5}$	**-1.197831**	0.230873	-5.188262	ect_{t-1}	**-0.291051**	0.085142	-3.418418

Notes: The period examined is 2002q1 to 2013q1; GDP is Gross Domestic Product in constant prices, M3 is total money supply in real terms, G is real total government expenditure, D1, D3, D4 are seasonal dummies. The results for ECT are from the estimation of (3) in step 4. Statistically significant coefficients of at least 5% level of statistical significance are presented in bold.

Source: Authors' estimations

The next step was to establish the dynamic stability of the model. When a model has AR terms it will be dynamically stable when the roots of the AR polynomials lie strictly outside the unit circle or the inverse roots of the AR polynomials lie strictly inside the unit circle. In our case, the plot of the inverse roots of the AR polynomial was made and it is seen in Figure 2, below:

Figure 2: Dynamic stability test



Source: Authors' estimations

All the inverse roots of the AR polynomials lie strictly inside the unit circle, therefore the model is stationary.

The next step was to test for the existence of long-run relationship between the dependent and the explanatory variables. The Wald 'bounds test', described in the fourth step above, was performed and its results are reported in Table 7. According to the computed F-statistic which is higher than the appropriate upper bound of the critical value, the null hypothesis of no-cointegration is rejected and the alternative is adopted and it is concluded that there is a long run relationship between the variables. In other words, total money supply and government expenditure are affecting the long-run dynamic of the GDP.

Table 7: Wald 'bounds test' for the existence of co-integration Wald Test
Equation: ARDL_5_7_5

Test Statistic	Value	df	Probability
F-statistic	12.61930*	(3, 13)	0.0004
Chi-square	37.85789	3	0.0000

Null Hypothesis: C(1)=C(2)=C(3)=0

Note: Restrictions are linear in coefficients; the asterisk indicates statistical significance at least 5% level.

Source: Authors' estimations

After establishing, by the Wald test, that there is a cointegrating relationship, the coefficient and its statistical significance of the Error Correction Term (ECT) was estimated and they are presented in Table 6. The coefficient of the ECT, *e*, should be negative and statistically significant meaning that there is a co-integration between the dependent and the explanatory variables. The value of this coefficient shows the percentage change of any disequilibrium between the dependent and the explanatory variables is corrected within one period (one quarter). In our case the sign of the ECT coefficient is of the expected value, it is negative, and it is statistically significant. Its value of 0.29 shows that any disequilibrium between the dependent and the explanatory variables is corrected in less than a year.

Table 8: Long-run impact of money supply (M3) and government expenditure (G) on GDP

Explanatory variable	$\hat{\gamma}_i$	Confidence interval
lnM3	0.63035*	[0.451829 0.808873]
lnG	0.68955*	[0.295618 1.08349]

Note: The bootstrap confidence interval was calculated using the accelerated bias-corrected method using 10,000 replications and a confidence interval of 95%.

Source: Authors' estimations

Finally, the long-run impact of the explanatory variables to the dependent variable is calculated using the expression given in (4). The $\hat{\gamma}_i$s show how the dependent variable, in our case the logarithm of GDP, responds in the long-run, to any change in the explanatory variables *i.e.* the logarithm of real money supply and real government expenditure. The results are reported in Table 8. A detailed analysis of this table allows us to reach some important conclusions about the Greek economy: (a) the elasticity of GDP in respect to the total money supply is estimated to be 0.63; this means that there is a positive impact of the money supply on GDP in the Greek economy for the period examined. Further, it means that a 1% increase (or decrease) in the money supply will lead to a 0.63% increase (or decrease) in GDP. The confidence interval calculated according to the bootstrap technique is (0.45 0.81), thus the impact of money supply on GDP in the Greek economy is statistically significant since it does not include the value of zero. This is an important result, because it shows that the recession during the period of the crisis was deepened

by the steep decrease in money supply. It shows further, that if the institutional setting of the ECB were different, allowing the application of monetary policy to keep money supply stable during the crisis, a significant portion of the GDP decline would have been prevented. (b) The elasticity of GDP in respect to government expenditure is 0.69, meaning that a 1% change in government expenditure will affect GDP by 0.69% in the same direction. That is, if there is a 1% decrease in government expenditure GDP will be decreased by 0.69% or to rephrase, for each percentage cut in government expenditure there will be an approximately 0.7% recession in the Greek economy. The confidence interval calculated according to the bootstrap technique is (0.30 1.08), thus the impact of government expenditure on GDP in the Greek economy is statistically significant since it does not include the value of zero. This is an expected result, in the methodological construction of the GDP government expenditure is a part of it. However, the high value of the coefficient (approximately 0.7) shows the large impact of government expenditure on the total GDP produced in Greece.

A final point can be made from Table 8; the IMF has recently admitted that the effects of the austerity policy measures from the cut in government expenditure (G) on the GDP were greatly underestimated. The multiplier for the government expenditure was calculated by the IMF to be about 0.5 while now it has admitted that the multiplier for G is ranging from 1.5 to 1.7. From the elasticity[7] estimated for G in Table 8, the multiplier (d*GDP*/d*G*) for G can be calculated and it has the value of approximately 1.60 proving that the IMF was indeed wrong in its original estimations.[8]

5. Conclusions: Institutional changes – a solution to the problem

This study attempts to quantify the effects of the implicit restrictive monetary policy exercised by the ECB in the case of Greece, during the world financial crisis. We considered the ARDL bounds testing approach to verify the existence of a long-run relationship between the GDP and the total money supply and government expenditure in the Greek economy for the period from the formation of the Eurozone to the first quarter of 2013. The main findings are of interest to professional economists and policy makers in the EU and provide an indication that the institutional

7. $e_G = {dGDP}/{dG} \cdot {G}/{GDP}$; for the calculation of the multiplier, *G* and *GDP* values are taken to be the average values of the period.
8. The multiplier for *M3* has a value of approximately 0.17.

settings of the Eurozone and specifically the ECB should allow the application of monetary policy, in times of crisis, in order to mitigate the effects of recession. Monetary policy is a powerful tool in influencing Greek GDP. If the institutional setting of the ECB were different, allowing the application of monetary policy so that money supply remained stable during the crisis, a significant portion of the GDP decline would have been prevented. Furthermore, the high value of the elasticity of the GDP to G (approximately 0.7) shows the large impact of the government expenditure on the total GDP produced in Greece.

To conclude:

- The ECB should be allowed to control the monetary base with Eurobond issues in order to provide a solution to the Eurozone debt crisis and opportunity for a fiscal policy alignment.
- The axiom that the ECB should promote stability against growth should be reconsidered.
- Eurobonds will provide Greece (and other Eurozone countries with public debt problems) with the necessary time to make the required structural reforms and to sell other assets (e.g. public property) to reduce debt.

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