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Cyclical Multiplier and Zero Low Bound Effects of Government Expenditure on Economic Growth: Evidence for Greece

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Abstract

This study explores the impact of government expenditure multipliers on economic growth utilizing an Autoregressive Distributed Lag (ARDL) approach. We provide evidence on the short-term dynamics as well as the long-run expenditure multiplier effects on economic growth for the Greek economy over the period 1960-2014. We find that the size of the multiplier does not differ substantially over the phases of the business cycle. Our results also indicate that irrespective of the scale of inflation, government expenditure positively affects economic growth, whilst inconclusive evidence is obtained in the case of exceptionally low interest rates.

Keywords: Government Expenditure; Multiplier Effects, Zero Low Bound, Recession; ARDL

JEL classification: C36; E62.

I. Introduction

According to traditional Keynesian theory, government expenditure is associated with multiplier effects that could potentially lead to output gains for economic systems. However, the demise of Keynesianism in the early 1970s had a profound impact on macroeconomic policy in terms of the policy choices made by governments to manage their economies. The relative importance given by authorities to monetary policy vis-à-vis fiscal policy has been undoubtedly one of the most prominent features of recent developments in contemporary economic policy. In this context, some commentators argue that fiscal policy has come to be regarded as ineffectual and hence, demoted to a second class policy option (see for instance Blanchard and Perotti, 2002; Baxter and King, 1993). Inevitably, a heated debate has been raging ever since in relation to the effectiveness of government expenditure and in particular the efficacy of government financing during the cyclical phases of the business cycle.

The outbreak of the global financial crisis in 2007/08 ushered in an era of renewed speculation concerning the role of fiscal policy in stimulating economic activity. Particular attention has been focused on the impact of austerity measures on the Greek economy (for more on this see Alexiou and Nellis, 2013, 2016).

In this context, the dilemma that many advanced economies are currently facing is as follows: should government spending be used to counteract the cyclical contraction of aggregate demand or should it be used to ensure that the fiscal budget is balanced? The answer to this question depends on the efficacy of fiscal policy and most importantly the size of the multiplier effect. Undoubtedly, the existing long-standing disagreement amongst economists regarding the size of the multiplier depends on a number of factors such as the conduct of monetary policy, the size of the marginal propensity to consume as well as the marginal propensity to import, etc. In the wake of the financial crisis new research evidence has emerged suggesting that the size of the multiplier may vary with economic conditions - higher in times of recessions and lower in periods where the economy is close to full capacity.

Ever since the onset of the global financial crisis, central banks' policy interest rate has been close to zero, i.e. the zero lower bound (ZLB). Rare as it might be, the ZLB is a situation where policymakers cannot lower interest rates further to fight a looming recession. In this context, it is legitimate to assume that the economy might exhibit unpredictable dynamics at the ZLB. As very low interest rates are bound up with deflationary conditions, prospective increases in the real interest rate are expected to adversely affect consumption in an already recession-stricken economic environment (Haltom and Sarte, 2011). Given this uncommon situation, there has been little if any investigation of fiscal policy in the ZLB state.

This study contributes to the existing literature by providing short run dynamic as well as long run expenditure multiplier effects on economic growth for the Greek economy over the period 1960-2014. In particular, we estimate three different models in which government expenditure interactions allow us to gauge the impact of fiscal policy in times of contraction and expansion as well as during periods when the economy approaches the zero lower bounds for inflation and interest rates. To this end, we use the Autoregressive Distributed Lag (ARDL) approach to cointegration.

The rest of the paper is organized as follows: Section 2 elaborates on the theoretical aspects of fiscal policy whilst Section 3 touches on the existing empirical approaches and evidence on fiscal multipliers. Section 4 sets out the methodological framework whilst Section 5 presents as well as discusses the emerging evidence. Finally, Section 6 provides some concluding remarks.

II. Theoretical Considerations

The effectiveness of fiscal policy is often explored in the context of the size of the multiplier, i.e. by how much output changes following an increase in government spending or tax cuts.

The concept of the fiscal multiplier as means of boosting GDP through increases in public investment was first introduced by Kahn in 1931 and further advanced by Keynes in 1936. According to Chick (1983), when output in the short-run falls below the full employment level, any reduction in wages will not be able to positively affect production and thus GDP. In times of recession, GDP growth can be effectively brought about by increases in the overall demand. However, given that consumption is a passive component of aggregate demand - as it predominantly depends on income - whilst the autonomous part changes slowly over time, the only way aggregate demand can be galvanized could be either through new private and public investment. In this context, during recessionary periods when 'animal spirits' are relatively low, an increase in public investment is ideally a potential policy initiative that promotes recovery. The generated new income instigated by changes in public investment expenditure is referred to as the *fiscal multiplier effect*.

The transformation of monetarism, particularly in the 1990s - into what many commentators call the New Neoclassical synthesis or the New Economic Consensus (NEC) - has had considerable implications for the conduct of monetary policy (Snowdon and Vane, 2005; Goodfriend, 2004). This new policy orientation looks upon the setting of interest rates as the primary policy instrument in the context of inflation targeting. More specifically, Arestis and Sawyer (2003) argue that 'the central bank sets its discount rate with a view to achieving the set inflation target, but the discount rate can be considered as set relative to an "equilibrium rate" so that the problem of aggregate demand deficiency appears to be effectively dispensed with' (p.4). This type of monetary policy is based on a Taylor's rule setting of the discount rate (Taylor, 1993) which is considered to be the best policy option to tackle both inflation and unemployment. They go on to challenge the effectiveness of monetary policy in the NEC setting and suggest that fiscal policy is a more potent policy option for offsetting major changes in the level of aggregate demand and therefore has to be reinstated as the dominant policy approach. In the same spirit, post-Keynesians have advocated the restitution of fiscal policy via Abba Lerner's functional finance approach, i.e. self-financing of governments to meet explicit objectives (see for example Arestis and Sawyer, 2003; Bell 1999; Forstater, 1999). In this context, Tcherneva (2008) argues that functional finance can be used to increase aggregate demand, closing the GDP gap as well as to secure full employment through direct job creation. (for a more comprehensive critique on the conduct of monetary policy in the New Consensus see also Kriesler and Lavoie, 2007 and Arestis, 2009).

In a different spirit, Giavazzi and Pagano (1990) in a study on the impact of expansion of the cyclically-adjusted primary balance in Denmark and Ireland found that there is a correlation between reductions in government spending, private consumption and economic growth. In other words, they argue that significant reductions in government spending will stimulate, via private spending, economic activity. This effect prevails when agents expect a further reduction in government spending and taxation because of a sharp reduction in government spending. For Guajarado *et al.* (2011), however, the expansionary effect of fiscal consolidation is overstated as changes in the cyclically-adjusted primary balance may be the outcome of other developments such as non-policy changes or a boom in the stock market – hence the biased results in favour of expansionary fiscal contraction.

The literature on the impact of public investment expenditure on economic activity is substantial. Prior to reviewing some of the existing empirical studies in this area it would be helpful to briefly touch on the theoretical aspects of the competing schools of thought. According to Qazizada and Stockhammer (2014), in calculating the multiplier Keynesian economists take into account the marginal propensity to consume, the marginal propensity to import and the weighted average of income tax. With the emergence of monetarism in 1968, Friedman developed the *permanent income hypothesis* on the basis of which consumption expenditure predominantly depends on permanent income that economically active citizens of a country are expected to have during their lifetimes and not on their current income – as advocated by Keynesians. Thus Friedman argues that an increase in public investment financed by an increase in government borrowing causes long-term interest rates and the cost of capital to increase which in turn crowds out investment, i.e. the so-called *crowding out effect*. It is in this sense that Friedman sustains that the economy, in the case of full crowding out, will end up back at the same level of GDP prior to the increase in public investment - but this time shouldered with more government debt.

In this context, Barro (1989a), representing the neoclassical school of thought, introduced the concept of the Ricardian Equivalence whereby an increase in public investment is perceived by the public as a future increase in taxation, hence stifling consumption expenditure, i.e. the multiplier effect will be zero. The latter provided the platform upon which Real Business Cycle models were developed using a stochastic mathematical framework suggesting that the multiplier effect is less than one if public expenditure is financed by taxes and zero if it is financed by deficit spending (see for instance Barro, 1989b).

Furthermore, the new Keynesian school of thought by exposing to scrutiny the existing tenets of the neoclassical analytical framework - in terms of failing markets, rigidity of prices and wages, transfer costs and asymmetric information (Greenwald and Stiglitz, 1987) - questioned the significance of the Ricardian equivalence, which was premised on the mere existence of rational consumers and perfect markets. In view, therefore, of the inherent limitations of the neoclassical model, expansionary fiscal policy assumes a great significance as a short run policy expedient to be used during economic downturns.

III. Empirical Approaches and Evidence on Fiscal Multiplier effects

Until the onset of the financial crisis in 2007/08, the main model extensively used for calculating the impact of public investment on the economy was the Neo-Keynesian Dynamic Stochastic General Equilibrium Model (DSGE) according to which only part of consumers' behaviour is rational. In so far as wages and prices are rigid in a downward direction, an increase in public expenditure in the short run will cause income and, hence, consumption to grow. It should be noted that this type of analysis only entails short-term effects given the neoclassical limitations and constraints of fiscal policy as well as the fact that monetary policy is tied to the Taylor rule, i.e. a monetary-policy rule that stipulates how much the central bank should manipulate the nominal interest rate in response to changes in inflation, output or other economic conditions. The corresponding multipliers are therefore much lower than the Keynesian ones.

However, one of the weaknesses of the DSGE models was their failure to factor in critical parameters in the analysis, such as the structure and operation of the financial system, hence providing erroneous predictions and most importantly incorrect economic policy options to deal with the recent economic crisis - with the exception of the Eurozone countries, most advanced economies relied on polices that fall outside the policy recommendations implied by the DSGE model.

Regarding the methodological approaches concerning the evaluation of the multipliers, three frameworks can be found in the empirical literature: the DSGE, the Vector Auto-Regressive (VAR) and the single equation models.

The models pertaining to the DSGE approach impose a number of ad-hoc restrictions during the process of modelling; for instance, state intervention is assumed to have detrimental effects on the economic environment, hence the negative bias attached to the multiplier effects.

The VAR modelling approach is not limited by theoretical rigidities and hence offers a more efficient data selection process relative to other techniques. It should be stressed, however, that on the downside of this approach one has to consider a) the inability to establish any causal correlation between the variables and b) the use of the maximum number of variables required given the complexity of the modelling process. A case in point is the study by Blanchard and Perotti (2002) where only three variables are included in the estimation, i.e. GDP, public spending and taxes.

Finally, the single equation approach has the advantage that it can incorporate numerous variables in the model to be estimated without any theoretical limitations whilst at the same time, by using various techniques such as Two Stage Least Squares (2SLS) and the Generalized Method of Moments (GMM), endogeneity problems can be dealt with efficiently.

In the above approaches the estimated multipliers are derived on the basis of linear modelling of the underlying equations. Amidst a number of studies in the area, Gechert and Mentges (2013) argue that excluding financial variables from these models leads to a systematic underestimation of the multipliers, whilst for Burriel *et al*. (2010), the incorporation of the debt-to-GDP ratio in the analysis considerably affects the magnitude of the multiplier. Moreover, using VAR modelling, Gali *et al*. (2007) and Fatas and Mihov (2001) provide evidence on the basis of which the impact of expansionary fiscal policy on the US economy is statistically significant. Ratto *et al.* (2009), using a DSGE approach, report smaller multiplier effects whilst Acconcia *et al*. (2011), using single equation modelling, provide estimates for the multipliers for Italy that range between 1.2 and 1.4. In more recent studies, the modelling is conducted in a cyclical context, hence generating multiplier estimates for periods when economies experience recession and booms respectively.

In studies where nonlinearity is explored, Parker (2011) investigates the nonlinearity of the multiplier in the two phases of the cycle and a period where the interest rate is close to zero whilst Auerbach and Gorodnichenko (2011), using a VAR approach, generate evidence on the basis of which the multiplier for the US economy is 2.3 in a downswing and almost zero in the recovery phase. Similarly, De Cos and Moral-Benito (2013) report nonlinear evidence for the Spanish multipliers of 1.4 and 0.6 whilst a study by Thomakos (2012) suggests that the Greek multipliers are 1.32 and 0 for a recession and boom respectively. Moreover, Christiano *et al.* (2011), using a DSGE model for periods when the policy-determined interest rate is close to zero, find the multipliers to range between 1.6 and 2.3 whilst Qazizada and Stockhammer (2014) establish multipliers that range from 2.5 to 3 in a recession and from 1 to 1.5 in a boom (a summary of pertinent studies on the impact of government expenditure multipliers in economic growth is also provided in Table II in the Appendix).

In view of the preceding empirical evidence it can be deduced that the results reported in various studies in the existing literature, to a certain extent, depend on the model, data and econometric methodology utilized (Marglin and Spiegler, 2013). In this context, Perry and Vernengo (2014) in a study on the fiscal multipliers during the Great Depression argue that problems inherent in conventional measures of fiscal multipliers might be the reason why fiscal policy was regarded as ineffective.

In the section below we empirically investigate the size of government expenditure multipliers for the Greek economy during the phases of the business cycle and in the unusual context of a zero lower bound state.

IV. Empirical Investigation

In assessing the impact of government spending on output, we estimate three regression equations, the general form of which is expressed as follows:

$$y_t = \beta_0 + \beta_1 X_t + \beta_2 fce_t + \beta_3 \begin{cases} (fce * g)_t \\ (zinf * g)_t \\ (zint * g)_t \end{cases} + \beta_4 \begin{cases} [(1-fce) * g]_t \\ [(1-zinf) * g]_t \\ [(1-zint) * g)_t \end{cases} + \varepsilon_t \quad (1)$$

where β_0 is the constant; β_1, β_2 β_3 and β_4 are the slope coefficients; ε_t is the error term satisfying the usual assumptions, and the subscript *t* stands for time; y_t denotes GDP growth; X_t is a vector of other control variables such as population growth, inflation, domestic credit to the private sector, international trade and real interest rates. The variable *fce* is sourced from the Federal Reserve Bank of St. Louis's website. It is constructed in accordance with the OECD's composite index of leading indicators, denoting periods of output contraction from the midpoint of the period of the peak and ending at the midpoint of the period of the trough. In other words, *fce* is a variable capturing periods of contraction from the period following the peak through the trough; (*fce* * *g*) and [(*1* – *fce*)**g*] are interaction variables reflecting the impact of spending during contraction and the impact of spending during expansion respectively. The coefficients of these two parameters are therefore crucial in this analysis as they reflect the elasticities, capturing the impact of spending in periods of contraction and expansion respectively.

To explore further the expenditure effects on economic growth when inflation or interest rates approach zero, two dummy variables have been constructed: *zinf* and *zint* taking the value of 1 when inflation and interest rates are less than 2 and 1 respectively. These are then interacted with government expenditure to assess the impact of the latter under the two regimes. The data used in this study have been obtained from various sources (see Table I in the Appendix for sources and definitions of variables).

a) *The Methodology*

The present study employs cointegration techniques and error correction modelling (ECM). We first make sure that the data series exhibit the right order of integration. The Augmented Dickey-Fuller test has been extensively used in empirical studies as the first-line test when determining the order of integration. More recent studies, however, indicate that in the presence of a structural break, the standard ADF tests are biased towards the non rejection of the null hypothesis (Perron, 1997).

Having established the order of integration we then test the cointegration of the series utilizing the bounds-testing approach within the ARDL framework. In recent years, a great deal of research has been conducted proposing different methodologies on how to investigate long-run equilibrium between time series variables. On the univariate front, cointegration techniques such as the ones by Engle and Granger (1987) and Phillips and Hansen (1990) have been applied. As for multivariate cointegration, Johansen (1988) and Johansen and Juselius (1990) full information maximum likelihood procedures are extensively used in empirical studies. The Autoregressive Distributed Lag (ARDL), introduced originally by Pesaran and Shin (1999) and further extended by Pesaran *et al*. (2001) and Narayan (2005) also deals with single cointegration. This method is thought to have certain econometric advantages over other single cointegration procedures. More specifically, endogeneity problems and the inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger method are avoided; the long and short-run parameters of the model are estimated simultaneously and all variables are assumed to be endogenous. This approach also obviates the need to establish the order of integration amongst the variables, *i.e*. the Pesaran *et al*. (2001) method can be implemented regardless of whether the underlying variables are I(0), I(1) or fractionally integrated. It should be stressed however that one major drawback of the ARDL approach to cointegration is that it fails to provide robust results when dealing with I(2) variables.

To implement the ARDL approach, equation (1) is transformed to a conditional error correction version of GDP growth and its determinants:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\,\Delta y_{t-1} + \sum_{i=1}^{p} \beta_{2i}\,\Delta X_{t-1} + \beta_3 \Delta fce_t + \beta_4 \Delta \begin{cases} (fce * g)_t \\ (zinf * g)_t \\ (zint * g)_t \end{cases} +$$

$$\beta_5\, \Delta \begin{cases} [(1-fce)*g]_t \\ [(1-zinf)*g]_t \\ [(1-zint)*g]_t \end{cases} +\beta_6 y_{t-1} + \beta_7 X_{t-1} + \beta_8 fce_t + \beta_9 \begin{cases} (fce*g)_t \\ (zinf*g)_t \\ (zint*g)_{t} \end{cases}_t$$

$$+\beta_{10} \begin{cases} [(1-fce)*g]_t \\ [(1-zinf)*g]_t \\ [(1-zint)*g]_t \end{cases} + \varepsilon_t \qquad (2)$$

In equation (2), $\beta_1,\ldots,\beta_5$ represents the short-run dynamics of the model, β_6, and β_{10} represents the long-run relationship; Δ is the first difference operator and p is the optimal lag length.

Next, the joint hypothesis that the long-run multipliers of the lagged level variables are all equal to zero, against the alternative that at least one is non-zero, will be tested. If a cointegrating relationship exists, then the null hypothesis should be rejected. The long-run relationship amongst the variables is tested by means of a bounds testing procedure coined by Pesaran *et al*. (2001). This procedure is based on the F-test and is the first stage of the ARDL cointegration method. The order of lags in the ARDL model are selected by either the Akaike (AIC) selection criterion or the Schwartz Information Criterion (SIC) before the selected model is estimated by ordinary least squares. The lag length that minimizes the AIC is selected.

Finally, the speed of adjustment (λ) to long-run equilibrium after a shock is captured by the error correction representation which is conveyed in the following form:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\, \Delta y_{t-1} + \sum_{i=1}^{p} \beta_{2i}\, \Delta X_{t-1} + \beta_3 \Delta fce_t + \beta_4 \Delta \begin{cases} (fce*g)_t \\ (zinf*g)_t \\ (zint*g)_t \end{cases}$$

$$+\beta_5\, \Delta \begin{cases} [(1-fce)*g]_t \\ [(1-zinf)*g]_t \\ [(1-zint)*g]_t \end{cases} + \lambda EC_{t-1} \qquad (3)$$

The error correction component (EC) is represented by:

$$EC = y_t - \beta_0 - \sum_{i=1}^{p} \beta_{1i}\, \Delta y_{t-1} - \sum_{i=1}^{p} \beta_{2i}\, \Delta X_{t-1} - \beta_3 \Delta fce_t - \beta_4 \Delta \begin{cases} (fce * g)_t \\ (zinf * g)_t - \\ (zint * g)_t \end{cases}$$

$$\beta_5\, \Delta \begin{cases} [(1 - fce) * g]_t \\ [(1 - zinf) * g]_t \\ [(1 - zint) * g]_t \end{cases} \qquad (4)$$

V. Discussion of results

The initial step in analyzing the time series data properties is to test for unit roots by applying a unit root with a break test (see Table I). The results suggest that we can proceed with the ARDL methodology, i.e. there is a clear rejection of the hypothesis that the data are I(2), which is important for the legitimate application of the bounds test.

Insert Table I

We then proceed with the specification and estimation of an ARDL model on the basis of which the model which minimizes SIC will be chosen. The main purpose of estimating the ARDL model is to use it as the basis for applying the bounds tes*t*.

Insert Table II

As we can see in Table II, the F-statistics for all the bounds test clearly exceed the 1% critical value for the upper bound. Accordingly, we strongly reject the Null hypothesis of '*no long-run relationship*'. The selection of the ARDL specifications in all three models were based on the SIC. The maximum lag length was set to 4.

The short-run specifications of all three estimated models provide insightful dynamic information on the underlying relationships of economic growth and the other of the independent variables. The respective diagnostic and statistical tests indicate that our estimated coefficients are robust and free from any problems associated with the error term (see Table III).

Insert Table III

As the focal point of our analysis is on the impact of expenditure multiplier effects on economic growth, the impact of the rest of the control variables used in this study will be treated as of secondary importance and therefore are presented here for the sake of completeness but are mentioned only in passing. It should be stressed however that the significance and impact of the control variables are generally in line with what theory would predict.

In all three models the overall impact of the lagged dummy interactions of government expenditure on economic growth are found to be positive and significant. The coefficient of the error correction term (EC_{-1}) is found to be statistically significant in all three estimated models, hence, confirming the existence of a long-run relationship. More specifically, the negative and strongly significant error correction component indicates a relatively speedy adjustment from disequilibria of the previous years' shock, back to the long-run equilibrium in the current year.

As can be observed in Table IV, there is not a significant difference between the values of government expenditure multipliers over the contraction and expansion phases of the business cycle - the size of the multiplier in contraction is 1.4 whilst in expansion it is 1.5. This finding can be rationalized if we take into account the fact that public spending has always been the driving force of the Greek economy irrespective of the phase of the economic cycle.

In view of the heated debate on the efficacy of central banks policy to stimulate the economy when inflation and interest rates get close to zero, we empirically explore the ZLB state, i.e. when inflation and interest rates and very low. The current argument would suggest that government spending multipliers will be larger at the lower bound compared to 'normal' times. Table IV reports the results associated with the ZLB state. Model 2 investigates the impact of government spending for the periods when the inflation rate is less than 2% and model 3 investigates spending for the periods when the nominal short-term interest rate falls below the

1% mark. In model 2 the impact of the dummy interactions is found to be positive and significant during both phases of the cycle whilst in model 3 the generated evidence associated with low interest rates is inconclusive. As emphasized by Christiano *et al.* (2011), the effects of fiscal policy at ZLB hinge on the following two assumptions: a) downward price pressures cause deflation over time and b) aggregate spending is highly sensitive to changes in the real interest rate. In practice, however, it would be difficult to assess the extent to which either of these conditions hold.

Insert Table IV

It should be stressed that the overall effect of a fiscal expansion very much depends on the state of the economy. Keynes (1936) implied that a reduction in wages that follows moderate austerity measures might have some galvanizing effects on the economy in so far as profitability is restored. If, however, the austerity measures are deep and prolonged then the effects might be disastrous, hence, creating a chaotic economic environment where the relationships between economic variables may no longer hold. (for a comprehensive discussion on the economic consequences of falling wages (wage trap), see also Tsoulfidis, 2010). In this context, the fact that the IMF had to revise their estimates for the Greek economy in 2012 might signify that the stage of the business cycle that Greece was in at the time of the recession was not given the required policy weight. In particular, when it became apparent that Greece's first bailout programme was not working, the IMF and eurozone leaders agreed to a second €172bn bailout. The programme, having assumed a low multiplier (0.5) from tax rises and government spending cuts, failed to translate the optimism into their growth forecasts (IMF, 2013) (for more on growth forecast errors and fiscal multipliers see also Blanchard and Leigh, 2013 where the authors argue that Europe's austerity policies were founded on faulty assumptions). In all likelihood, the recessionary economic environment that Greece has been experiencing for many years might usher in a period of contractionary fiscal expansion – with negative multiplier effects – in so far as consumers' and investors' confidence is undermined by fiscal sustainability concerns. It is in this context that many commentators argue that a sustainable public debt should be dealt with prior to the implementation of any effective government spending policy initiative.

VI. Concluding remarks

The standard growth specification models utilized in this study consist of a number of control variables – *inter alia* population growth, trade, private sector debt, inflation and short-term real interest rates – as well as expenditure interaction variables that capture the effects of fiscal policy on economic growth. We provide estimates for the government spending multipliers over contractions and expansions for the Greek economy using annual time series data spanning the period 1960-2014. We also explore the zero lower bound (ZLB) theory by subjecting government expenditure to interactions with dummies, capturing periods of low levels of both inflation and nominal interest rates. We find that both in the short-run as well as in the long-run, fiscal policy is an effective option that can be applied to stimulate economic activity. As far as the size of the government expenditure multipliers is concerned we find that they do not differ substantially over the phases of the cycle. Potentially, such a finding might be due to the fact that public spending has always been a key policy instrument of policy makers in Greece that has been adopted irrespective of the phase of the economic cycle.

Spilimbergo *et al*. (2009) argue that there are other objective factors that influence the size of multipliers: "The size of the multiplier is larger if: a) 'leakages' are few (i.e., only a small part of the stimulus is saved or spent on imports), b) the monetary conditions are accommodative (i.e., the interest rate does not increase as a consequence of the fiscal expansion), and c) the country's fiscal position after the stimulus is sustainable" (p. 2).

In the case of Greece the last two factors – namely the ECB's monetary policy stance and the sustainability of Greek debt – are of great significance. In particular, the ECB has always pursued inflation targeting rather than GDP growth which is in accordance with the Taylor's rule on conducting monetary policy. However, in the aftermath of the 2007/08 crisis and the concomitant deflationary spiral, attention has been shifted to GDP targeting as well. As far as the second factor is concerned - debt sustainability - we would argue that this is not sustainable and more steps should be taken to ensure its viability.

Finally, the evidence we present here also indicates that the in the low-inflation bound regime the expenditure interactions positively affect economic growth, whilst inconclusive evidence is obtained in the case of a low interest rate regime. Notwithstanding, it should be appreciated that fiscal policy may not be the only galvanizing alternative at the ZLB. Many commentators have suggested that central monetary authorities can potentially influence longer-term interest rates by purchasing large amounts of long-term assets, hence committing to higher inflation targets or to finding ways to mimic the conditions of negative interest rates. The effectiveness of these however are the subject of intense and ongoing debate.

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TABLES

Table I: Unit Root Test with Breakpoint

	ADF			
Variables	Levels t-stat (p-values)	First Difference t-stat (p-values)	T_B	Order of integration
gdp	-5.004 (0.001)*	-	2007	I(0)
g	-5.614 (0.001)*	-	1979	I(0)
inf	-1.722 (0.414)	-7.013 (0.01)*	1973	I(1)
cre	-2.608 (0.866)	-6.887 (0.01)*	1998	I(1)
x/m	-3.342 (0.478)	-7.272 (0.001)*	1982	I(1)
pop	-3.661 (0.301)	-6.727 (0.001)*	1976	I(1)
int	-2.771 (0.800)	-9.276 (0.01)*	1975	I(1)

Notes: Vogelsang (1993) asymptotic one-sided p-values are given in parenthesis; T_B denotes the break date; (****), (**), (*) denote significance at 1%, 5% and 10% levels respectively; lag length was determined by the SIC (maximum lag length: 10); respective dummies have been used accordingly to capture the breaks suggested by the test.

Table II: Bounds test for cointegration

	Model 1		**Model 2(inf<=2)**		**Model 3(int<=1)**	
F-statistic	*10.88*		*4.81*		*8.26*	
Critical Value Bounds	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
at 1% significance level	*2.96*	*4.26*	*2.96*	*4.26*	*2.96*	*4.26*

Table III. ARDL estimation results: Short-run dynamics and error correction

	Model 1		**Model 2 (inf<=2)**		**Model 3 (int<=1)**	
	ARDL(3,4,3,4,2,4,3,4)		*ARDL(3,4,4,3,4,4,4,3)*		*ARDL(4,3,4,1,1,4,1,4)*	
Variables	*coefficient*	*t-statistic*	*coefficient*	*t-statistic*	*coefficient*	*t-statistic*
D(gdp(-1))	-0.011	(-0.086)	0.335	(1.86)*	0.022	(0.24)
D(gdp(-2))	-0.212	(-3.69)***	-0.151	(-1.21)	-0.003	(-0.30)
D(gdp(-3))					0.301	4.57***
D(cre)	-0.151	(-2.52)***	-0.192	(-1.84)	-0.261	(-4.43)***
D(cre(-1))	-0.165	(-2.64)***	-0.357	(-3.04)***	-0.227	(-2.85)***
D(cre(-2))	0.038	(-0.71)	0.03	(0.33)	0.208	(3.31)***
D(cred(-3))	0.088	(1.88)*	0.132	(1.57)		
D(pop)	1.552	(1.81)*	2.936	(1.87)*	2.061	(1.72)
D(pop(-1))	-5.378	(-3.71)***	1.355	(0.58)	-2.382	(-1.98)*
D(pop(-2))	2.231	(2.96)***	-4.277	(-1.83)*	1.501	(1.31)
D(pop(-3))			1.012	(1.92)*	-1.302	(-1.65)
D(x/m)	0.051	(3.98)***	-0.191	(-1.58)	-0.089	(-6.85)***
D(x/m(-1))	0.009	(0.99)	-0.092	(-2.48)***		
D(x/m(-2))	-0.027	(-0.86)	0.137	(3.34)***		
D(x/m(-3))	-0.017	(-2.69)***				
D(inf)	-0.431	(-7.02)***	-0.191	(-1.15)	-0.521	(-7.49)***
D(inf(-1))	0.146	(0.15)	-0.242	(-1.57)		
D(inf(-2))			0.209	(1.49)		
D(inf(-3))			-0.436	(-3.56)***		
D(int)	-0.252	(-4.06)***	-0.362	(-2.55)***	-0.333	(-4.52)***
D(int(-1))	0.121	(1.45)	-0.074	(-0.44)	0.201	(2.63)***
D(int(-2))	0.09	(1.19)	0.145	(0.91)	-0.045	(-0.56)
D(int(-3))	0.09	(1.23)	-0.199	(-1.28)	0.177	(2.45)***
Interactions of Government Spending with Contraction Dummy (fce)						
D(fce*g)	0.097	(0.43)				
D(fce*g(-1))	-0.621	(-1.97)*				
D(fce*g(-2))	1.13	(4.78)***				
D[(1-fce)*g]	-0.082	(-0.37)				
D[(1-fce)*g(-1)]	-0.515	(-1.67)				
D[(1-fce)*g(-2)]	1.055	(4.39)***				
D[(1-fce)*g(-3)]	0.177	(3.36)***				
Interactions of Government Spending with Nominal Lower Bound (zinf)						
D(zinf*g)			0.015	(0.33)		
D(zinf*g(-1))			-0.062	(-2.14)**		
D(zinf*g(-2))			1.268	(3.57)***		
D(zinf*g(-3))			-1.627	(-3.31)***		
D[(1-zinf)*g]			0.209	(1.83)*		
D[(1-zinf)*g(-1)]			0.328	(2.35)***		
D[(1-zinf)*g(-2)]			-0.251	(-1.65)		

Interactions of Government Spending with Nominal Lower Bound (zint)						
D(zint*g)					-1.726	(-5.19)***
D(zint*g(-1))					0.511	(1.51)
D(zint*g(-2))					0.292	(0.99)
D(zint*g(-3))					2.044	4.19***
D[(1-zint)*g]					0.123	(2.13)**
D(fce)	-3.655	(-5.37)***	-4.052	(-4.48)***	-3.799	(-7.16)**
D(zinf)			-1.599	(-4.09)***		
D(zint)					-2.814	(-6.45)***
EC_{-1}	-1.377	(-7.23)***	-1.014	(-3.58)***	-0.971	(-7.65)***
R^2 - adjusted	*0.97*		*0.92*		*0.96*	
F-statistic	*51.36*		*16.87*		*38.67*	
DW-statistic	*2.181*		*2.024*		*2.213*	

Note: (***), (**), (*) denote significance at 1%, 5% and 10% levels respectively

Table IV. Long-run estimates

	Model 1		*Model 2 (inf<=2)*		*Model 3 (int<=1)*	
Variables	*coefficient*	*t-statistic*	*coefficient*	*t-statistic*	*coefficient*	*t-statistic*
cre	-0.013	(-0.42)	0.044	(0.81)	-0.057	(-2.92)***
pop	-0.656	(-1.04)	0.031	(0.01)	1.653	(1.46)
x/m	-0.021	(-1.88)*	-0.058	(-1.22)	-0.062	(-4.19)***
inf	-0.503	(14.26)***	0.118	(0.67)	-0.389	(-7.96)***
int	-0.219	(-4.39)***	0.071	(0.42)	-0.348	(-5.98)***
fce*g	0.228	(4.48)***				
(1-fce)*g	0.254	(3.18)***				
zinf*g			0.971	(3.13)***		
(1-zinf)*g			0.618	(2.08)*		
zint*g					-0.206	(-0.94)
(1-zint)*g					0.061	(0.65)
fce	-2.654	(-3.54)***	-3.99	(-2.74)***	-3.914	(-4.46)***
constant	12.313	(13.412)***	1.723	(0.32)	14.962	(8.35)***
Long-run Government Expenditure Multipliers[1]						
Contraction multiplier	**1.4**			***Expansion multiplier***	**1.5**	

Diagnostic tests for the underlying ARDL specifications			
Serial Correlation	0.167	0.519	0.231
Normality	0.768	0.362	0.562
Heteroscedasticity	0.425	0.143	0.267

Note: [1] The multipliers have been calculated using the formula: $\varepsilon = \frac{\Delta GDP}{\Delta G}\frac{G}{GDP}$, $\frac{\Delta GDP}{\Delta G} = \varepsilon \frac{GDP}{G}$; the G/GDP ratio over the entire period is 0.16; (***), (**), (*) denote significance at 1%, 5% and 10% levels respectively.

APPENDIX

Table I. Definition of variables

Variables	*Definition*	*Source*
gdp	Real GDP Growth Rate	AMECO
G	Government Final Expenditure, Growth rate	AMECO
cre	Domestic Credit to Private Sector / GDP	World Bank
pop	Population growth rate	AMECO
x/m	Ratio of exports over imports	AMECO
inf	Inflation rate	AMECO
int	Short term real interest rates	Bank of Greece
nint	Nominal short term interest rate	Bank of Greece
fce	Periods of contraction from the period following the peak through the trough	Federal Reserve Bank of St. Louis
zinf	Dummy variable: when inflation < 2%	Author
zint	Dummy variable: when nominal interest rates are < 1%	Author

Table II. Summary of recent studies estimating government expenditure multiplier effects

Country/ies	***Author(s)***	***Spending multiplier estimates***
GREECE	Monokrousos and Thomakos (2012) (sample period: 2000 – 2012)	1.32 (during recession) near zero (during normal times)
GREECE	IMF (2013) (sample period: 2008 – 2013)	0.5 (during recession) > 1 (revised figure - during recessions)
ITALY	Acconcia *et al*. (2011) (sample period: 1990-1999)	1.2 - 1.4
SPAIN	De Cos and Moral-Benito (2013) (sample period: 1986 – 2012)	1.4 (during recession) 0.6 (during normal times)
USA	Perotti (2005) (sample period: 1960 – 2001)	1.29 - 1.4 (in the pre-1980s) 0.36 - 0.28 (in the post-1980s)
USA	Gali *et. al*. (2007); (sample period: 1948 - 2003)	0.78 - 1.74
USA	Fatas and Mihov (2001) (sample period: 1960 – 1996)	0.7 - 1.74
USA	Christiano *et al*. (2011) (sample period: 2000 – 2010)	1.6 - 2.3 (when zero-bound) < 1 (when nominal interest rate follows Taylor rule)
USA	Blanchard and Perotti (2002) (sample period:1960 – 1997)	0.9 - 1.29
EMU	Burriel *et al*. (2010) (sample period: 1981 – 2007)	0.87 - 0.85
56 Countries	Turini *et al* (2012) (sample period: 1970 – 2008)	0.8 (during recession) 0.2 (during normal times)
98 Countries	Afonso *et al*. (2010) (sample period: 1981 – 2007)	0.6 - 1.1 (multipliers during recession and normal times not statistically different from each other)
21 Advanced economies	Qazizada and Stockhammer (2014) (sample period: 1979 – 2011)	1 (during expansion); up to 3 (during contractions); no difference in the impact of spending during nominal zero lower bound periods.

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