Asymmetric Fiscal Policy Shocks

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Abstract

We empirically test the effects of unanticipated fiscal policy shocks on the level and growth rate of real output and reveal different types of asymmetries in fiscal policy implementation. The data used are quarterly U.S. observations over the period 1967:1 to 2011:4. In doing so, we use six alternative vector autoregressive systems in order to construct the fiscal policy shocks. These systems differ in the method of identification, the use or not of exogenous variables and in the type of exogenous monetary variables used. From each one of these six systems we extracted four types of shocks: a negative and a positive government spending shock and a negative and a positive government revenue shock. These six sets of unanticipated fiscal shocks were used next to empirically examine their effects on the level and growth rate of real GDP in two sets of regressions: one that assumes only contemporaneous effects of the shocks on output and one that is augmented with four lags of each fiscal shock.

Keywords: Fiscal Policy, Asymmetric Effects, VAR

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1. Introduction

In this paper we empirically test the existence of non-linearities that may be associated with the conduct of fiscal policy. In doing so, we try to detect two types of fiscal policy asymmetries: first, whether equal in magnitude contractionary or expansionary fiscal shocks have the same multiplier impact on real output, and second whether theoretically equal –in terms of their impact on the government budget fiscal policy tools, such as a tax cut or an increase in government spending, have the same impact on output.

Fiscal and monetary policies are the cornerstones of policymaking. However, until 2000 the main bulk of empirical research was dedicated solely to the effects of monetary policy. In the aftermath of the global crisis of 2008 there is a growing debate of whether governments should run fiscal stimulus packages in order to restore previous growth rates or run an austerity program to reduce deficits and in the long-run debt as a percent of GDP. Recently for example, highly indebted Eurozone countries (Greece, Ireland, Portugal and Spain) are required to implement fiscal austerity measures in order to balance their balance sheets. In this context it is interesting to see whether and how Keynesian principles may apply.

According to (Bertola and Drazen, 1993), governments should choose fiscal stimulus packages if they accept a positive and above unity fiscal multiplier regardless of the debt to GDP ratio. Keynesian economics assert that government spending and tax cuts, directly affect disposable private income and through the channel of active demand the economy tracks itself back to a growth path. The fiscal multiplier under Keynesian beliefs is well above unity as there is no crowding out effect and the wealth effect is not so strong. Due to various rigidities in the markets (labor, goods and services), this fiscal stimulus during recessions and fiscal contraction during boom times accordingly, is necessary and appropriate in order to restore equilibrium. Although, the exact value of the multiplier depends on various other factors, such as the simultaneous usage of monetary policy, the openness of the economy, the exchange rate regime e.t.c. its sign, however, is not under question: we expect a positive impact on GDP from an increase in government spending.

The neoclassical school on the other hand, asserts that government spending or tax cuts have no impact on GDP due to the Ricardian equivalence (Barro 1974). Agents fully anticipate the debt burden of the fiscal stimulus, expecting higher taxes in the future (wealth effect). Thus, in order to smooth out their level of consumption they save more now reducing current private consumption. There is a crowding out effect of the private sector that fully offsets the increase of the demand from the public sector which renders the fiscal multiplier to zero. This is more apparent in periods of growth, since then the probability of a more efficient usage of resources from the government is lower than it is during a recession. On the other hand, there is room for a low positive multiplier during recessions, since resources are underused.

There is also a new class of research pointing to an exactly different direction than that of Keynesian economics: these find that the multiplier of fiscal contraction is positive and vice versa. This is known as contractionary fiscal expansion effect or expansionary fiscal contraction due mostly to a wealth effect that is, consumers put more weight to future consumption than to current one. At this notion, Alesina and Perotti (1997) and Giavazzi and Pagano (1990) among others, state that fiscal contraction based on expenditure cuts maybe expansionary if it is accompanied by a currency devaluation or by agreements with the unions. The greater this adjustment is the more is being anticipated by the agents leading to more powerful results. Furthermore, a tax increase in order to accommodate a deficit has the exact opposite results than a decrease of government spending because it reduces the competitiveness of the economy. This view is enhanced by Blanchard (1990), who states that fiscal consolidation may reduce uncertainty for the future leading to an increase in household's wealth today. This can be achieved through the decrease of interest rates as a result of the reduction of the risk premium of government bonds (Alesina and Ardagna 2009).

In their seminal paper, Bertola and Drazen (1993), postulate that the sign of the fiscal multiplier depends on the GDP to debt ratio. In a hypothetical economy, where all agents are rational, and GDP to debt ratio is low, an increase of the government spending will be neutral to the real economy, featuring a Ricardian or even a negative effect. If the GDP to debt ratio is relatively large a fiscal consolidation signals a trial of the government to stabilize the economy and thus lifting future uncertainty leading to a positive multiplier or to an anti – Keynesian effect.

According to the above, the fiscal multiplier for an increase in government expenditures can range between negative and positive values and be large or small. According to the above, we can identify five potential sources of non – linearities/asymmetries of fiscal policy: a) the phase of the business cycle, b) the GDP to debt ratio, c) the sign of the shock (positive versus negative shocks of the same instrument), d) the nature of the shock (spending versus revenues), e) the magnitude of the shock.

In this paper, we try to estimate the value of the fiscal multiplier taking into account the sign and the nature of the shock. Using VAR analysis with identified structural errors, a new dataset for the U.S. economy and running various tests, we come along some very interesting results. We cannot reject asymmetries in government spending, where negative shocks are statistically significant while positive shocks are not. On the contrary, positive government revenue shocks appear more significant than negative shocks. It is evident from the identified systems that shocks that improve the government's budget such as a negative government spending shock or a positive government revenue shock have asymmetric impact on GDP and the growth rate of GDP. Moreover, negative government spending shocks (SGN) appear significant in all systems with the exception of a system using simple sum in a Cholesky decomposition.

Thus, in general shocks that improve the government's budget have significant impact and are not neutral on the level and the growth rate of real GDP. Finally, negative government expenditure shocks have a larger impact on the GDP level and growth than positive ones and negative revenue shocks.

The remainder of this paper is organized as follows: Section 2 presents the empirical literature review, Section 3 provides a detailed description of the data and the methodology used. The main results are presented in Section 4 and Section 5 concludes.

2. Literature Review

Despite this divergence of opinions, the empirical research is too narrow and is divided between linear and nonlinear policy analysis. Linear analysis covers most of the research, while nonlinear analysis is being implemented only in recent years. Empirical research focused into fiscal policy in the last decade following mostly the seminal work of Blanchard and Perotti (2002) in a VAR analysis which was built upon the innovative work of Sims

(1980) in VAR analysis. Blanchard and Perotti (2002) introduced a new method of identification of structural errors using institutional information on tax and transfer system and under the main assumption, among others, that fiscal policy is a rather long process using quarterly data introduce their restrictions and identify structural fiscal shocks that are exogenous to the rest of the VAR variables. They conclude that, the U.S. economy experiences Keynesian effects regarding the sign of fiscal multipliers as well as there are asymmetries between tax and government purchases multipliers but not asymmetries of the effects on the output of a positive versus a negative change in taxes. Tagkalakis (2008) using an unbalanced yearly panel data set (1970-2002) of nineteen OECD countries, confirmed that in the presence of binding liquidity constraints during recessions both positive government spending and negative tax shocks have stronger stimuli effects on private consumption than in expansions. In a different analytical framework Leeper et al. (2010) show that government investment is contractionary in the short run, at worst, and has a muted impact, at best. This is mainly due to substantial time to build lags. The results over the long run are conditional upon the productivity of the public capital. Pereira and Lopes (2010) examining U.S. quarterly data over the 1965:2 to 2009:2 period in a Blanchard-Perron identification mode into a Bayesian simulation procedure, they find that policy effectiveness has come down substantially. More specifically, this trend is more evident for taxes net of transfers than for government expenditures, although, fiscal multipliers keep Keynesian signs. Cogan et al. (2009), focusing on an empirically estimated macroeconomic model for the U.S., find that the government spending multipliers are much less in new Keynesian that in old Keynesian models. The multipliers are less than one as consumption and investment are crowded out. On the other hand, Romer and Romer (2010), using new sources of data such as presidential speeches, executive-branch documents and Congressional reports, identify the size, timing and principal motivation for all major post-war tax policy actions. Their main findings indicate a very large effect of tax changes on output and on investments. This multiplier is well above unity, being in stark contrast with the findings of previous empirical researches. Barro and Redlick (2009), estimate a multiplier regarding responses of U.S GDP to changes in defence spending between 0.6-0.7. As they point out in their paper, the exact volume of the multiplier is subject to economic slack, reaching unity as unemployment rate is quite high, around 12%. Positive tax rate shocks have significantly negative effects on real GDP growth. Mountford and Uhlig (2009), incorporating a VAR analysis and using new restrictions to identify revenue and spending shocks, as well as taking into account business cycle and monetary shocks, conclude that deficit financed tax cuts are the best fiscal policy to improve GDP, finding a very large multiplier. Gali et al. (2007), show that in an economy in which for some households (named rule of thumb consumers) consumption equals labor income and there exist sticky prices, it is possible that government spending shocks positively affect consumption. In this way, wealth effects are totally overshadowed by the sensitivity to current disposable income. Aggregate demand is partly insulated from the negative wealth effect generated by the higher levels of taxes needed to finance the fiscal expansion.

In a non-linear framework, Baum and Koester (2011), using a threshold VAR model, analyse the effects of fiscal policy on economic activity over the business cycle for Germany. They derive a fiscal multiplier around 0.7 for both revenues and spending in a linear model. When they take into account the phase of the business cycle, they find a spending multiplier around unity in boom times and 0.36 in recessions. There are also non linearities regarding the sign of government intervention through spending. With respect to revenue shocks they find less diverging results for both the phase of the business cycle and the type of fiscal policy implemented (expansionary or contractionary).

As it is clear from the above, empirical research spans a wide range of tests, including linear and non–linear models concerning the phase of the business cycle, the financial constraint of the agents, the nature and the sign of the fiscal intervention. Most of these studies, converge to fiscal multiplies below unity with the spending multiplier being of greater importance than the tax multiplier. In what follows we try to unfold the impact of fiscal policy using quarterly data for the U.S economy for government spending, total government revenue, GDP (level and growth rate) and monetary variables such as the Treasury bill rate and the money supply. In this study we introduce three main innovations: first, to the best of our knowledge the Divisia monetary aggregates have not yet been used to previous research pertaining to fiscal policy. Second, following Cover's (1992) procedure of identifying monetary policy shocks we extract the unanticipated fiscal policy shocks on government spending and revenue. Finally, we explicitly test for the asymmetric effects on the level and growth rate of real GDP of a contractionary and expansionary fiscal policy. We come up with four key findings; first, all fiscal multipliers are below unity but with signs as predicted by Keynesian theory. Second, government expenditures have a larger impact as compared to the tax policy; third, negative government spending shocks are more significant than positive spending shocks and finally, shocks that improve or worsen the government's budget and deficit have asymmetric effects on GDP. All these results are in line with previous studies and are robust through many tests using structural identification proposed by Blanchard and Perotti (2002) and Cholesky decomposition.

3. The Data

In this study we use quarterly data that span the period 1967Q1 to 2011Q4. The range of the data sample is limited by the availability of the monetary aggregates. The data are taken from the St. Louis Federal Reserve Economic Data (FRED) service. These include the Gross Domestic Product, government consumption expenditures and gross investment, government current receipts and the 3-month Treasury bill rate[2]. All initial data are in current values and they are transformed –with the exception of the Treasury-bill rate- to real series by using the implicit price deflator of the GDP with 2005 as the base year. The two monetary aggregates used in this study are the official simple-sum aggregates in the MZM level of aggregation as they are reported by the Federal Reserve Bank of St. Louis and the Divisia MZM aggregates both in real terms. The Divisia monetary aggregate series are from the new Divisia monetary aggregates maintained within the Center of Financial Stability (CFS) program Advances in Monetary and Financial Measurement (AMFM), called CFS Divisia aggregates and documented in Barnett et al. (2013). We use both types of monetary aggregates in an effort to see whether our results are affected by the so-called "Barnett critique". In this regard, Barnett (1980) argues that official simple-sum monetary aggregates, constructed by the Federal Reserve, produce an internal inconsistency between the implicit aggregation theory and the theory relevant to the models and policy within which the resulting data are nested and used.

[2] The relevant FRED codes are GDP, GCEC, GRECPT and TB3MS respectively.

That incoherence has been called the Barnett Critique [see, for example, Chrystal and MacDonald (1994) and Belongia and Ireland (2013)], with emphasis on the resulting inference and policy errors and the induced appearances of function instability. All variables in the levels have unit roots according to augmented Dickey- Fuller test and results are available upon request. Following Sims (1980) and Sims et al. (1990), we do not difference our data despite the presence of a unit root. As it is argued, the main objective of a VAR analysis is the interrelationships among the variables, not the estimation of the parameters. Furthermore, the above authors claim useful information is "through away" with the use of differences concerning the co movements of the data. On the contrary, growth rates are stationary according to augmented Dickey-Fuller test. Finally, all data with the exception of the Treasury-bill rate are transformed to natural logarithms

4. Empirical Model and Identification

As it was previously mentioned, we use a structural VAR model and two different methods of identification of the structural errors, a Choleski ordering and a Blanchard-Perotti (2002) identification procedure. The basic reduced form VAR specification in order to identify the structural errors is:

$$Y_t = A_0 + A(L_q)Y_{t-1} + BZ_t + U_t \ , \tag{1}$$

where Y_t is a three dimensional vector of endogenous variables, government revenue (r), government spending (g) and Gross Domestic Product (GDP) and Z_t is a two dimensional vector in the three exogenous monetary variables, the 3-month Treasury bill rate (TB3) and the monetary aggregate, where we use alternatively a simple-sum and a CFS Divisia in the MZM level of aggregation. The exogenous variables vector is two dimensional because we use each monetary aggregate separately along with the TB3 variable. U_t represents the three dimensional vector of reduced form residuals with the corresponding ordering [t_t,g_t,GNP_t] and finally A_0 is the intercept coefficient vector, $A(L_q)$ is a four lag polynomial and B are the exogenous variables coefficients vector. A four years lag length is chosen as there is a seasonality pattern in the response of taxes to output (Blanchard-Perotti, 2002).

4.1 Cholesky decomposition

As it is well known, reduced form errors have only forecasting value and no economic interpretation and for that reason the structural errors should be identified. First we do so by applying a Cholesky decomposition and we run three alternative systems: one with no exogenous variables in the VAR, and two more systems with exogenous variables the TB3 rate and alternatively the simple-sum and CFS Divisia monetary aggregates at the MZM level of aggregation.

4.2 Blanchard-Perotti Identification

The second method used is the Blanchard-Perotti (2002) method of structural identification. As they well document in their seminal paper, the innovations in the fiscal variables, taxes and revenues are a linear combination of three types of shocks, a) the automatic response of these fiscal variables to output (automatic stabilizers), b) the discretionary effects of revenues to spending shocks and vice versa, c) the random fiscal shocks which are to be identified. Thus, the equation system is:

$$t_t = a_1 \varepsilon_t^{GNP} + a_2 \varepsilon_t^{G} + \varepsilon_t^{T}$$

$$g_t = b_1 \varepsilon_t^{GNP} + b_2 \varepsilon_t^{T} + \varepsilon_t^{G}$$

$$GNP_t = c_1 \varepsilon_t^{T} + c_2 \varepsilon_t^{G} + \varepsilon_t^{GNP}$$

In order to set the appropriate restrictions Blanchard and Perotti further assume that the first set of shocks (a_1 and b_1 for taxes and spending respectively) can be estimated as the elasticity of fiscal variables to output shocks as it takes more than a quarter for a fiscal policy measure to be decided and be implemented. As a measure for tax elasticity on output, $a_{1,}$ we take into consideration Blanchard-Perotti's calculations who report an average value of 2. As for the spending multiplier, $b_{1,}$ this is set to zero, as the main component of primary government spending, unemployment transfers is included in net revenues[3]. Then, contemporaneous effect of fiscal variables to output (c_1 and c_2) need to be estimated. Again in line with Blanchard et al (2002) and Baum et al. (2011), we use the cyclically adjusted reduced form fiscal policy shocks and we estimate the third equation of the equation system 2. Finally, under the assumption that revenue decisions come first, a_2 is set to zero. This is so, because a_2 represents the discretionary response of revenues to spending.

We extract both fiscal policy structural errors for each case, namely three different cases, in which a) no exogenous variables are taken into account, b) two exogenous variables, the TB3 and the simple-sum aggregate in the MZM level and c) two exogenous variables, the TB3 and the CFS Divisia MZM aggregate.

5. The Empirical results

Following Cover (1992), from each of the above six systems we extract the residual series from the equations of government spending and government revenue. These represent the unanticipated fiscal shocks. The series of the negative government spending shocks equals the government spending shock if the latter is negative otherwise it is equal to zero. The series of the positive government spending shocks equals the government spending shock if this is positive and otherwise it is equal to zero. In the same manner we construct the negative and positive government revenue shocks. Formally:

$$SGN_t = -1/2\,[|GSS_t| - GSS_t]$$

$$SGP_t = 1/2\,[|GSS_t| + GSS_t],$$

where GSS_t is the government spending shock extracted as described above. In a similar manner we construct the negative and positive government revenue shocks SRN_t and SRP_t.

5.1 Systems with contemporaneous shocks

In the previous section we extracted four series of unanticipated fiscal policy shocks, from each one of the six systems considered in this study. For each system these are the negative and positive government spending shocks and the negative and positive government revenue shocks series or SGN_t, SGP_t, SRN_t and SRP_t respectively. In order to investigate the possible existence of fiscal asymmetries, following Cover (1992), we run the following regression with each of the six sets of unanticipated fiscal policy shocks:

$$y_t = a_0 + \sum_{i=1}^{4} a_i y_{t-i} + \gamma\, tb3_t + \beta_1 SGN_t + \beta_2 SGP_t + \beta_3 SRN_t + \beta_4 SRP_t + e_t, \quad (1)$$

[3] For an extended presentation see Blanchard et al (2002) and Baum et al. (2011).

where y_t is the GNP at period t, y_{t-i} are four lags of the output, SGN_t, SGP_t, SRN_t and SRP_t are the extracted unanticipated fiscal shocks to the economy as discussed above and a_0, γ and β_i are parameters to be estimated. In these systems we assume that only current fiscal policy shocks affect the real output level and growth rate and thus we include no lagged values of the fiscal shocks. We also estimate equation (1) with the growth rate of real output as the dependent variable. The empirical results are presented in Tables X and X for the level and growth rate of real output respectively. The estimated coefficients and the reported p-values of the fiscal policy shocks provide evidence on the significance and magnitude of the multipliers of the various fiscal shocks on the level and growth rate of real GNP. Moreover, at the lower part of Tables X-X we report the tail areas of the F-tests performed in testing for fiscal policy asymmetries. First, we test the null hypothesis that the multiplier of a negative government spending shock is equal to the multiplier of a positive government spending shock ($H_0: \beta_1 = \beta_2$) or in other words that a contractionary government spending shock has a symmetric effect on output as an equal expansionary government spending shock. Second, in a similar manner, we test for symmetric effects of the expansionary and contractionary government revenue shocks ($H_0: \beta_3 = \beta_4$). Next, we try to investigate whether equivalent in terms of their impact on government deficit fiscal policies have symmetric effects on the level and growth rate of real GNP. First, we test policies that increase the deficit, positive government spending and negative government revenue shocks ($H_0: \beta_2 = \beta_3$) and finally shocks that lead to fiscal consolidation, a decrease in government spending and an increase in government revenue shock ($H_0: \beta_1 = \beta_4$).

According to Tables X-X we have some interesting results. We detect some asymmetries across all six systems with respect to the government revenue shocks. It appears that in general while positive government spending shocks appear statistically insignificant even at the 0.10 significance level, across all systems, negative such shocks are statistically significant but with an estimated coefficient far below unity and ranging from 0.239 (not statistically significant) in system 3 to 0.430 in system 6. The coefficients of SGN and SGP have the signs expected by theory, i.e. a decrease in government spending leads to lower output and the opposite. The coefficients on government revenue shocks depend on the identification method used. In systems 1,3 and 4 where a Cholesky decomposition was used, all coefficients are positive and when a Blanchard-Perotti identification is used in systems 2, 5 and 6, all coefficients are negative. These results are conflicting and the signs on the systems 2,5 and 6 are consistent with Keynesian theory. The coefficients for the expansionary and contractionary government revenue shocks (SRN, SRP) lead to the conclusion that although both policies appear significant in most of the six systems tested here, the results are much stronger for the contractionary government revenue shocks. Both government spending and revenue tests show that in general contractionary unanticipated fiscal policy shocks have asymmetric effects and appear to affect real output more than expansionary fiscal shocks, no matter if these are associated with the contraction is implemented through spending or revenue.

Moving to the F-tests we observe that the null hypothesis of symmetric effects of expansionary and contractionary government spending shocks ($H_0: \beta_1 = \beta_2$) cannot be rejected across all six systems. The null hypothesis of symmetry in the effects to real output of a negative vs. a positive revenue shock is rejected only in systems 1 and 3 at the 0.05 level. Testing the null hypothesis of symmetry between fiscal policy shocks that lead to an increase in the government deficit, i.e. a positive spending and a negative revenue shock ($H_0: \beta_2 =$

β_3), we see that this is rejected only in systems 2 and 5 and only at the 0.10 level of significance. The hypothesis of symmetry between fiscal consolidation policy shocks, i.e. a negative spending and a positive revenue shock ($H_0: \beta_1 = \beta_4$) are rejected in three out of our six systems (at the 0.01 level in systems 2 and 6 and at the 0.05 level in system 5). In general, the systems that include fiscal policy shock series that are generated in a Blanchard-Perotti identification setting provide evidence in support of asymmetric effects in equivalent policies that lead to an increase or a reduction of the government's budget. Finally, the results of the same tests on the systems with the growth rate of the real GNP as the dependent variable as seen on Table X appear qualitatively the same.

5.2 Systems augmented with lagged shocks

In this section we augment the regressions run in equation (X) by assuming that not only the current values of the explanatory variables affect the level and growth rate of GDP but also four lags that correspond to a year's worth of historical information. The estimated equation is now becomes:

$$y_t = a_0 + \sum_{i=1}^{4} a_i\, y_{t-i} + \sum_{i=0}^{4} (\gamma_i\, tb3_{t-i} + \beta_{1i}\, SGN_{t-i} + \beta_{2i}\, SGP_{t-i} + \beta_{3i}\, SRN_{t-i} + \beta_{4i}\, SRP_{t-i}) + e_t \quad (2)$$

with similar specification as equation (1). The results from running equation (2) in all of our six systems are presented in Table X for the level of real GNP and Table X for the growth rate of real GNP. The estimated coefficients and the reported p-values of the contemporaneous and lagged fiscal policy shocks provide evidence on the significance and magnitude of the multipliers of the various fiscal shocks on the level and growth rate of real GNP. In the lower part of Tables X-X we report the tail areas of the F-tests performed in testing for fiscal policy asymmetries. In this specification with contemporaneous and four lagged fiscal shocks we are able to perform the following tests: First, we test the null hypothesis that the coefficient of a contemporaneous negative government spending shock is equal to the coefficient of a contemporaneous positive government spending shock ($H_0: \beta_{10} = \beta_{20}$) or in other words that a contractionary government spending shock has a symmetric effect on output as an equal expansionary government spending shock. In a similar manner, we test for symmetric effects of the expansionary and contractionary government revenue shocks with the null hypothesis ($H_0: \beta_{30} = \beta_{40}$). Next, we test whether equivalent in terms of their impact on government deficit fiscal policies have asymmetric effects on the level and the growth rate of real GDP. First, policies that increase the deficit, i.e. positive government spending and negative government revenue shocks ($H_0: \beta_{20} = \beta_{30}$) and second, shocks that lead to fiscal consolidation, a decrease in government spending and an increase in government revenue ($H_0: \beta_{10} = \beta_{40}$). Moreover, we perform F-tests that all lagged coefficients of the unanticipated fiscal policy shocks are jointly equal to zero: $H_0: \beta_{j0} = \beta_{j1} = \beta_{j2} = \beta_{j3} = \beta_{j4} = 0,\ j = 1, \dots, 4$. Finally, in the last two rows of Tables X-X we test for asymmetric cumulative effects of contractionary and expansionary unanticipated fiscal policy shocks:

$$H_0: \beta_{j0} + \beta_{j1} + \beta_{j2} + \beta_{j3} + \beta_{j4} = \beta_{j+1\,0} + \beta_{j+1\,1} + \beta_{j+1\,2} + \beta_{j+1\,3} + \beta_{j+1\,4}\ , \quad j = 1,3$$

Tables X-X summarize the regressions results and the hypotheses testing evidence. According to these a positive government spending shock lagged two quarters [SGP(-2)], is statistically significant across all six systems and in both the level and the growth rate of real GNP as the dependent variable. Although this significance is in line with the Keynesian multiplier, the interesting result is that the coefficient appears negative across all twelve models. Contrary to the Kyenesian multiplier, an unanticipated positive government spending shock appears to reduce both the level and the growth rate of real output two quarters later. The contemporaneous positive revenue shock (SRP_t) appears statistically significant in the first four of our six systems both when the level and the growth rate of output is of concern. The sign of this coefficient in the systems that it is significant is opposite of what was expected with the exception of system 2. A positive sign implies that an unanticipated increase in government revenue has a positive contemporaneous effect on real output. Contemporaneous negative government revenue shocks (SRN_t) appear statistically significant in all systems where the shocks are extracted from a Blanchard-Perotti identification (systems 2,5,6). Moreover, the sign of respective coefficients are as expected: they appear all negative, implying that a negative revenue shock[4] will have a positive impact on the level and growth rate of output. Thus, there is evidence of another asymmetry: that both a positive and a negative contemporaneous government revenue shock have a positive effect on real output. An explanation of this apparent asymmetry may be that economic agents perceive any changes in government revenue as a result of an activist fiscal policy intervention that will benefit the economy and the increase in output is the result of the consumers and investors discounting this expected result and acting with optimism for the future. The F-tests in the lower part of Tables X-X show that the null hypothesis of symmetric effects of expansionary and contractionary government spending shocks ($SGN_t = SGP_t$) cannot be rejected across all six systems in both the level and the growth rate of real output. The null hypothesis of symmetry in the effects to real output of a negative vs. a positive revenue shock ($SRN_t = SRP_t$) is rejected only in the systems where we get the fiscal shock employing a Cholesky decomposition. We get no rejections in the systems where fiscal shocks are extracted from a Blanchard-Perotti identification. Also from the F-tests portion of Tables X-X we can observe that in the structurally identified systems (2,5,6) fiscal policy shocks that decrease the deficit (SGN_t, SRP_t) are not symmetric with rejections of the null that range from tail values 0.069 to 0.001. Shocks that increase the deficit (SGP_t, SRN_t) appear in general not asymmetric either with the exception of system 6. The rejections have p-values 0.046 and 0.012. The results in the case of output growth rates in Table X are qualitatively in the same direction. Furthermore, the joint null hypothesis that all the coefficients of a j type shock are all equal to zero, i.e. $H_0: \beta_{j0} = \beta_{j1} = \beta_{j2} = \beta_{j3} = \beta_{j4} = 0,\ j = 1, \dots, 4,$ is most strongly rejected for $j = 4$, a positive government revenue shock. The rest of the shocks do not, in general, appear jointly significant. Finally, the null that the sum of the coefficients of a negative spending shock is equal to the sum of the coefficients of a positive government spending shock cannot be rejected in both the level and growth rate of output. This is evidence against asymmetry of these shocks and in line with Keynesian theory. The null that the sum of the coefficients of a negative revenue shock is equal to the sum of the coefficients of a positive revenue shock is generally rejected in the systems with Choleski identification (systems 1,3,4) implying asymmetries and cannot be rejected in all systems structurally identified in both the level and growth rate of output pointing to no asymmetric effects.

6. Conclusions

The aim of this paper was to empirically test the effects of fiscal policy shocks on the level and growth rate of real output and reveal possible asymmetries in fiscal policy

[4] Multiplied by a negative coefficient

implementation. The data are quarterly over the period 1967:1 to 2011:4. In doing so, we used six alternative vector autoregressive systems in order to construct the fiscal policy shocks. These systems differ in the method of identification, the use or not of exogenous variables and in the type of exogenous monetary variables used. From each one of these six systems we extracted four types of shocks: a negative and a positive government spending shock and a negative and a positive government revenue shock. These six sets of unanticipated fiscal shocks were used next to empirically examine their effects on the level and growth rate of real GDP in two sets of regressions: one that assumes only contemporaneous effects of the shocks on output and one that is augmented with four lags of each fiscal shock. Our results are summarized as follows:

In the regressions with no lagged shocks we detect asymmetry in the effects of government spending shocks. Positive government spending shocks –contrary to Keynesian theory- do not affect real output or its growth rate as they appear insignificant in all six systems. Negative government spending shocks are significant but with a coefficient far below unity ranging from 0.239 to 0.430. A formal F-test though, of symmetric effects cannot be rejected across all systems. This may be the result of the statistically significant but small coefficients on the negative spending shocks. We also find evidence of an asymmetry between contractionary government revenue shocks that appear to affect real output significantly more than expansionary shocks contrary to what we expect from Keynesian theory. The F-tests provide evidence of such asymmetry in only two of the six systems that when we measure the effect on the level of GDP and in three systems when we measure the effect on the growth rate of GDP. The hypothesis of symmetry between fiscal consolidation policy shocks is rejected in all Blanchard-Perotti identified systems. In general, the systems that include shocks generated from a Blanchard-Perotti setting provide evidence in support of asymmetric effects in equivalent policies that either lead to an increase or a reduction of the government's deficit.

Finally in the regressions with lagged shocks, in general unanticipated government revenue shocks appear to affect output more than government spending shocks. Another interesting result is that both a negative and a positive contemporaneous government revenue shock (except system 2) have a positive effect on real output's level and growth rate. This unexpected asymmetry may be explained by the hypothesis that economic agents perceive any changes in government revenue as a result of an activist fiscal policy intervention that will benefit the economy and thus the increase in output is the result of the consumers and investors discounting this expected result and acting with optimism from today. Furthermore, we detect asymmetries in the effects of negative and positive revenue shocks in all systems from a Cholesky identification. From the structurally identified systems we find asymmetry between in fiscal policies that decrease the deficit. Testing for each type of shock the joint significance of the current and lagged values we conclude that only the positive government revenue shocks appear highly significant in four out of the six systems. Finally, The null that the sum of the coefficients of a negative revenue shock is equal to the sum of the coefficients of a positive revenue shock is generally rejected in the systems with Choleski identification implying asymmetries and cannot be rejected in all systems structurally identified in both the level and growth rate of output.

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Table 1. Systems Employed

Systems	Identification Method	Endogenous Variables r_t	g_t	GDP	Exogenous Variables TB3	Simple-Sum MZM	CFS Divisia MZM
System 1	Choleski	✓	✓	✓			
System 2	Blanchard-Perotti	✓	✓	✓			
System 3	Choleski	✓	✓	✓	✓	✓	
System 4	Choleski	✓	✓	✓	✓		✓
System 5	Blanchard-Perotti	✓	✓	✓	✓	✓	
System 6	Blanchard-Perotti	✓	✓	✓	✓		✓

Table 2. Fiscal Policy Shocks on the Level of Real GDP

	System 1			System 2			System 3			System 4			System 5			System 6		
	Coefficient	prob.		Coefficient	prob.		Coefficient	prob.		Coefficient	prob.		Coefficient	prob.		Coefficient	prob.	
C	0.025	0.005	***	0.027	0.004	***	0.020	0.033	**	0.023	0.017	**	0.027	0.007	***	0.029	0.004	***
Y(t-1)	1.284	0.000	***	1.243	0.000	***	1.293	0.000	***	1.283	0.000	***	1.266	0.000	***	1.255	0.000	***
Y(t-2)	-0.085	0.423		-0.086	0.442		-0.099	0.384		-0.102	0.368		-0.101	0.395		-0.088	0.453	
Y(t-3)	-0.199	0.061	*	-0.177	0.112		-0.206	0.070	*	-0.198	0.080	*	-0.177	0.131		-0.176	0.130	
Y(t-4)	-0.004	0.951		0.016	0.818		0.008	0.906		0.013	0.852		0.008	0.914		0.003	0.962	
TB3	-0.001	0.003	***	0.000	0.060	*	0.000	0.039	**	0.000	0.036	**	-0.001	0.023	**	-0.001	0.016	**
SGN	0.261	0.040	**	0.368	0.005	***	0.239	0.150		0.262	0.099	*	0.328	0.050	*	0.430	0.007	***
SGP	0.152	0.279		0.151	0.305		0.105	0.564		0.187	0.279		0.222	0.228		0.074	0.682	
SRN	0.091	0.086	*	-0.100	0.064	*	0.036	0.579		0.107	0.110		-0.134	0.049	**	-0.135	0.041	**
SRP	0.314	0.000	***	-0.245	0.000	***	0.315	0.000	***	0.248	0.000	***	-0.129	0.097	*	-0.174	0.032	**
F-Tests																		
SGN=SGP		0.636			0.369			0.665			0.798			0.734			0.236	
SRN=SRP		0.018	**		0.142			0.017	**		0.200			0.965			0.749	
SGP=SRN		0.679			0.099	*		0.717			0.661			0.063	*		0.258	
SGN=SRP		0.704			0.000	***		0.665			0.937			0.013	**		0.001	***

Note: *, ** and ***, denote a rejection of the null hypothesis at the 0.10, 0.05 and 0.01 levels respectively

Table 3. Fiscal Policy Shocks on the Growth Rate of Real GDP

	System 1			System 2			System 3			System 4			System 5			System 6		
	Coefficient	prob.		Coefficient	prob.		Coefficient	prob.		Coefficient	prob.		Coefficient	prob.		Coefficient	prob.	
C	0.004	0.011	**	0.006	0.000	***	0.003	0.080	*	0.004	0.026	**	0.005	0.008	***	0.006	0.001	***
DY(t-1)	0.303	0.000	***	0.264	0.000	***	0.309	0.000	***	0.300	0.000	***	0.287	0.000	***	0.277	0.000	***
DY(t-2)	0.207	0.004	***	0.161	0.028	**	0.197	0.008	***	0.187	0.013	**	0.168	0.029	**	0.172	0.025	**
DY(t-3)	-0.003	0.970		-0.020	0.782		-0.019	0.800		-0.021	0.769		-0.016	0.835		-0.013	0.865	
DY(t-4)	0.031	0.641		0.023	0.744		0.037	0.600		0.028	0.689		0.028	0.698		0.030	0.677	
TB3	0.000	0.047	**	0.000	0.537		0.000	0.215		0.000	0.258		0.000	0.239		0.000	0.206	
SGN	0.260	0.045	**	0.362	0.007	***	0.245	0.145		0.270	0.092	*	0.333	0.051	*	0.434	0.008	***
SGP	0.137	0.338		0.135	0.368		0.103	0.579		0.185	0.290		0.220	0.240		0.071	0.699	
SRN	0.070	0.191		-0.126	0.019	**	0.020	0.766		0.088	0.192		-0.150	0.029	**	-0.154	0.021	**
SRP	0.337	0.000	***	-0.232	0.001	***	0.336	0.000	***	0.269	0.000	***	-0.107	0.171		-0.147	0.070	*
F-Tests																		
SGN=SGP		0.601			0.354			0.649			0.773			0.722			0.234	
SRN=SRP		0.005	***		0.288			0.007	***		0.098	*		0.717			0.957	
SGP=SRN		0.653			0.091	*		0.666			0.598			0.056	*		0.231	
SGN=SRP		0.583			0.000	***		0.605			0.996			0.018	**		0.001	***

Note: *, ** and ***, denote a rejection of the null hypothesis at the 0.10, 0.05 and 0.01 levels respectively

Table 4. Fiscal Policy Shocks on the Level of Real GDP using Four Lags

	System 1			System 2			System 3			System 4			System 5			System 6		
	Coef.	prob.		Coef.	prob.		Coef.	prob.		Coef.	prob.		Coef.	prob.		Coef.	prob.	
C	0.028	0.012	**	0.027	0.020	**	0.025	0.026	**	0.029	0.008	***	0.030	0.008	***	0.029	0.010	**
Y(-1)	1.169	0.000	***	1.317	0.000	***	1.218	0.000	***	1.157	0.000	***	1.275	0.000	***	1.285	0.000	***
Y(-2)	0.067	0.609		-0.057	0.685		0.070	0.607		0.085	0.514		0.029	0.832		0.033	0.813	
Y(-3)	-0.118	0.363		-0.333	0.016	**	-0.222	0.104		-0.156	0.232		-0.332	0.018	**	-0.324	0.023	**
Y(-4)	-0.124	0.149		0.068	0.456		-0.070	0.430		-0.091	0.282		0.022	0.806		0.000	0.997	
TB3	0.000	0.631		0.000	0.751		0.001	0.239		0.001	0.267		0.000	0.566		0.000	0.741	
TB3(-1)	-0.002	0.006	***	-0.001	0.147		-0.003	0.001	***	-0.003	0.002	***	-0.003	0.004	***	-0.003	0.006	***
TB3(-2)	0.000	0.976		-0.001	0.449		0.000	0.933		0.000	0.959		0.000	0.703		0.000	0.615	
TB3(-3)	0.002	0.047	**	0.002	0.033	**	0.002	0.022	**	0.002	0.030	**	0.002	0.015	**	0.002	0.016	**
TB3(-4)	0.000	0.560		-0.001	0.439		-0.001	0.378		-0.001	0.459		-0.001	0.205		-0.001	0.182	
SGN	0.185	0.149		0.307	0.020	**	0.167	0.327		0.221	0.164		0.252	0.125		0.422	0.009	***
SGN(-1)	-0.169	0.192		-0.105	0.438		-0.066	0.701		-0.108	0.499		0.044	0.794		-0.020	0.903	
SGN(-2)	0.006	0.961		-0.009	0.949		0.021	0.905		-0.052	0.752		-0.066	0.698		-0.042	0.804	
SGN(-3)	-0.318	0.016	**	-0.156	0.252		-0.264	0.126		-0.224	0.169		-0.204	0.230		-0.075	0.651	
SGN(-4)	0.034	0.792		0.199	0.131		0.100	0.561		0.039	0.809		0.176	0.293		0.155	0.341	
SGP	0.204	0.156		0.177	0.243		0.133	0.493		0.233	0.185		0.287	0.124		0.102	0.582	
SGP(-1)	-0.024	0.871		-0.110	0.472		-0.118	0.543		-0.010	0.956		-0.280	0.139		-0.134	0.468	
SGP(-2)	-0.350	0.014	**	-0.290	0.055	*	-0.488	0.010	***	-0.351	0.040	**	-0.371	0.046	**	-0.371	0.042	**
SGP(-3)	-0.033	0.821		-0.002	0.991		-0.261	0.161		-0.257	0.133		-0.155	0.405		-0.275	0.134	
SGP(-4)	-0.064	0.646		-0.059	0.691		-0.052	0.770		-0.068	0.685		-0.070	0.697		-0.017	0.923	
SRN	0.078	0.149		-0.136	0.014	**	0.019	0.781		0.079	0.240		-0.198	0.004	***	-0.201	0.003	***
SRN(-1)	0.016	0.762		0.020	0.720		-0.023	0.740		0.018	0.786		0.041	0.557		0.037	0.590	
SRN(-2)	0.055	0.298		0.096	0.082	*	0.035	0.598		0.052	0.439		0.110	0.113		0.070	0.299	
SRN(-3)	0.021	0.700		0.007	0.903		0.006	0.932		-0.007	0.916		0.045	0.513		0.037	0.574	
SRN(-4)	0.036	0.501		-0.007	0.898		0.014	0.845		0.039	0.563		0.012	0.860		0.045	0.486	
SRP	0.311	0.000	***	-0.188	0.009	***	0.334	0.000	***	0.292	0.000	***	-0.074	0.339		-0.093	0.265	
SRP(-1)	0.139	0.038	**	0.138	0.054	*	0.044	0.589		0.106	0.153		0.087	0.269		0.129	0.126	
SRP(-2)	0.084	0.186		-0.074	0.307		0.038	0.628		0.099	0.166		-0.032	0.683		0.017	0.840	
SRP(-3)	-0.017	0.777		-0.131	0.070	*	0.007	0.925		0.051	0.460		-0.088	0.261		-0.051	0.531	
SRP(-4)	0.036	0.535		0.053	0.423		-0.007	0.925		0.040	0.536		0.042	0.575		0.048	0.539	

Table 4 (continued). Fiscal Policy Shocks on the Level of Real GDP using Four Lags

	System 1		System 2		System 3		System 4		System 5		System 6	
F-Tests												
SGN=SGP	0.934		0.597		0.917		0.970		0.911		0.301	
SRN=SRP	0.016	**	0.613		0.011	**	0.063	*	0.298		0.394	
SGP=SRN	0.400		0.046	**	0.565		0.413		0.012	**	0.109	
SGN=SRP	0.368		0.001	***	0.342		0.679		0.069	*	0.004	***
joint SGN=0	0.098	*	0.092	*	0.627		0.468		0.419		0.166	
joint SGP=0	0.150		0.346		0.067	*	0.122		0.087	*	0.204	
joint SRN=0	0.481		0.114		0.989		0.770		0.033	**	0.037	**
joint SRP=0	0.000	***	0.017	**	0.001	***	0.000	***	0.682		0.523	
Σ SGN = Σ SGP	0.994		0.306		0.298		0.613		0.236		0.108	
Σ SRN = Σ SRP	0.075	*	0.402		0.100		0.069	*	0.765		0.822	

Note: *, ** and ***, denote a rejection of the null hypothesis at the 0.10, 0.05 and 0.01 levels respectively

Table 5. Fiscal Policy Shocks on the Growth Rate of Real GDP using Four Lags

	System 1			System 2			System 3			System 4			System 5			System 6		
	Coef.	prob.		Coef.	prob.		Coef.	prob.		Coef.	prob.		Coef.	prob.		Coef.	prob.	
C	0.001	0.550		0.005	0.051	*	0.003	0.294		0.002	0.433		0.006	0.055	*	0.006	0.044	**
DY(-1)	0.210	0.018	**	0.345	0.000	***	0.245	0.008	***	0.194	0.030	**	0.316	0.001	***	0.321	0.001	***
DY(-2)	0.283	0.002	***	0.296	0.001	***	0.318	0.001	***	0.279	0.002	***	0.348	0.000	***	0.358	0.000	***
DY(-3)	0.151	0.085	*	-0.042	0.650		0.082	0.370		0.105	0.232		0.000	0.999		0.019	0.839	
DY(-4)	-0.015	0.857		-0.044	0.621		-0.019	0.824		-0.006	0.945		-0.070	0.415		-0.052	0.553	
TB3	0.000	0.544		0.000	0.657		0.001	0.170		0.001	0.177		0.001	0.435		0.000	0.614	
TB3(-1)	-0.003	0.006	***	-0.001	0.145		-0.003	0.001	***	-0.003	0.002	***	-0.003	0.004	***	-0.003	0.007	***
TB3(-2)	0.000	0.877		-0.001	0.490		0.000	0.884		0.000	0.875		0.001	0.598		0.001	0.539	
TB3(-3)	0.002	0.037	**	0.002	0.020	**	0.002	0.020	**	0.002	0.031	**	0.003	0.010	**	0.002	0.011	**
TB3(-4)	0.000	0.700		-0.001	0.478		-0.001	0.455		0.000	0.597		-0.001	0.186		-0.001	0.174	
SGN	0.165	0.205		0.296	0.027	**	0.147	0.395		0.204	0.210		0.245	0.141		0.419	0.011	**
SGN(-1)	-0.194	0.141		-0.129	0.345		-0.092	0.598		-0.126	0.441		0.014	0.935		-0.044	0.798	
SGN(-2)	-0.013	0.922		-0.032	0.819		-0.002	0.989		-0.071	0.670		-0.088	0.611		-0.068	0.695	
SGN(-3)	-0.331	0.014	**	-0.174	0.208		-0.274	0.118		-0.225	0.176		-0.212	0.219		-0.086	0.611	
SGN(-4)	0.043	0.758		0.214	0.126		0.115	0.518		0.057	0.738		0.226	0.195		0.185	0.276	
SGP	0.191	0.193		0.154	0.316		0.151	0.442		0.251	0.163		0.281	0.137		0.091	0.628	
SGP(-1)	-0.045	0.761		-0.136	0.378		-0.100	0.613		-0.014	0.938		-0.281	0.147		-0.142	0.451	
SGP(-2)	-0.370	0.011	**	-0.310	0.042	**	-0.474	0.013	**	-0.354	0.043	**	-0.374	0.048	**	-0.377	0.042	**
SGP(-3)	-0.038	0.796		-0.025	0.870		-0.250	0.186		-0.256	0.145		-0.163	0.388		-0.286	0.124	
SGP(-4)	-0.069	0.630		-0.065	0.668		-0.035	0.849		-0.067	0.701		-0.056	0.758		-0.013	0.944	
SRN	0.060	0.270		-0.162	0.003	***	0.005	0.944		0.056	0.412		-0.223	0.001	***	-0.226	0.001	***
SRN(-1)	-0.002	0.971		0.004	0.945		-0.034	0.631		0.000	0.998		0.035	0.623		0.027	0.705	
SRN(-2)	0.033	0.539		0.082	0.140		0.026	0.708		0.031	0.656		0.104	0.141		0.063	0.357	
SRN(-3)	-0.004	0.939		-0.006	0.918		-0.009	0.896		-0.033	0.629		0.044	0.539		0.032	0.637	
SRN(-4)	0.012	0.824		-0.033	0.539		-0.008	0.912		0.008	0.903		-0.019	0.780		0.016	0.805	
SRP	0.328	0.000	***	-0.176	0.015	**	0.348	0.000	***	0.307	0.000	***	-0.052	0.501		-0.071	0.395	
SRP(-1)	0.140	0.041	**	0.147	0.045	**	0.046	0.581		0.103	0.178		0.107	0.180		0.152	0.074	*
SRP(-2)	0.076	0.261		-0.069	0.344		0.030	0.719		0.090	0.230		-0.018	0.822		0.031	0.718	

	System 1			System 2			System 3		System 4		System 5		System 6	
SRP(-3)	-0.025	0.703		-0.130	0.078	*	0.004	0.955	0.045	0.541	-0.087	0.281	-0.046	0.585
SRP(-4)	0.045	0.461		0.053	0.460		0.009	0.906	0.051	0.438	0.058	0.451	0.064	0.425

Table 5 (continued). Fiscal Policy Shocks on the Level of Real GDP using Four Lags

	System 1		System 2		System 3		System 4		System 5		System 6	
F-Tests												
SGN=SGP	0.914		0.568		0.990		0.878		0.909		0.296	
SRN=SRP	0.006	***	0.891		0.006	***	0.033	**	0.158		0.224	
SGP=SRN	0.394		0.047	**	0.465		0.310		0.010	**	0.098	*
SGN=SRP	0.254		0.002	***	0.255		0.556		0.101		0.007	***
joint SGN=0	0.091	*	0.087	*	0.614		0.491		0.364		0.158	
joint SGP=0	0.134		0.301		0.091	*	0.126		0.097	*	0.201	
joint SRN=0	0.859		0.064	*	0.993		0.954		0.023	**	0.027	**
joint SRP=0	0.000	***	0.023	**	0.001	***	0.000	***	0.667		0.447	
Σ SGN = Σ SGP	1.000		0.279		0.405		0.678		0.251		0.115	
Σ SRN = Σ SRP	0.019	**	0.774		0.042	**	0.021	**	0.784		0.419	

Note: *, ** and ***, denote a rejection of the null hypothesis at the 0.10, 0.05 and 0.01 levels respectively