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Fiscal Multipliers in Good Times and Bad Times

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Abstract

This paper estimates the magnitudes of government spending and tax multipliers within a regime-switching framework for the U.S economy during the period 1949:1-2006:4. Our results show that the magnitudes of spending multipliers are larger during periods of low economic activity, while the magnitudes of tax multipliers are larger during periods of high economic activity. We also show that the magnitudes of fiscal multipliers got smaller for episodes of low growth, while they got larger for episodes of high growth in the post 1980 period.

Keywords: Fiscal Multipliers, Regime Switching.

JEL Classification: E32, E62, H21, H30, H56

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1 Introduction

The role of fiscal policy in stabilizing business cycles came under scrutiny by researchers and policymakers about three decades ago. As argued by Beetsma and Guilidori (2011), expansionary fiscal policies implemented in response to oil price shocks did not provide the desired results and therefore raised concerns regarding the efficiency of fiscal policy during business cycles. Moreover, fiscal consolidations in Europe during the 1980s, contrary to Keynesian wisdom, led to an increase in output in the short-run and in the long-run and therefore led economists and policymakers to question the established theories regarding fiscal policy. Recent studies, including Alesina et al. (2002) explain this puzzling result with the fact that, certain fiscal shocks, namely shocks to government wages and salaries, can have non-Keynesian effects. They show that negative shocks to government wages and salaries result in an increase in economic activity both in the short-run and in the long-run by decreasing labor demand and wages, and therefore increasing business profits and investment.

With the global financial crisis of 2008 turning into a global recession, there has been a revival of interest in the effects of fiscal policy on major macroeconomic variables. Especially in the U.S., with President Obama's fiscal stimulus package, there is a heated discussion regarding the effectiveness of fiscal policy as an economic stimulus tool. In Europe, similarly, fiscal consolidations in many countries pushed economies deeper into recession, quite differently from what we observed in the 1980s.This particular observation certainly suggests that the magnitude- and even the sign- of fiscal multipliers might change during the business cycle.

There are different approaches in estimating tax and spending multipliers, but the two most common approaches employ structural macroeconometric models or vector autoregressive (VAR) models. Among these two approaches, the VAR models occupy a more prominent role in the recent literature.

The studies using VARs identify fiscal shocks either by employing the structural VAR approach or the narrative approach. The structural VAR approach uses either economic theory or institutional information to identify the variance/covariance matrix, and therefore the fiscal innovations (Blanchard and Perotti, 2002 and Perotti, 2002). The multipliers estimated with this approach are close to (in most cases less than) unity. Perotti (2002) also argues that the tax multipliers tend to be negative but small, despite some evidence on positive tax multipliers. Finally, he argues that the U.S. is an outlier in many dimensions, so the responses to fiscal shocks estimated on U.S. data are often not representative of the average OECD country. Most VAR studies reach the conclusion that the post-1980 fiscal multipliers are smaller (Perotti, 2002 and Favero and Giavazzi, 2009). This particular result is generally interpreted as fiscal policy becoming more ineffective over the years - most probably due to increased labor and capital mobility.

The narrative approach, identifies exogenous fiscal shocks by a narrative based dummy (Ramey and Shapiro, 1998) or the defense news measure (Ramey, 2011) or the exogenous tax measure (Romer and Romer, 2010a). While Ramey and Shapiro (1998) use large exogenous increases in defense spending, like the Vietnam War, the Korean War and the Carter-Reagan military build-up to identify shocks to fiscal policy and Ramey (2011) constructs a new defense news variable which measures the present discounted value of expected change in military spending, Romer and Romer (2010b) use information from the official U.S. budget documents to classify exogenous tax changes. Ramey (2011) estimates the spending multipliers to be between 0.6 and 1.2, while Romer and Romer (2010a) find that an exogenous tax increase of 1 percent of GDP lowers real GDP by almost 3 percent.

Among the more recent studies that do not use VARs, Barro and Redlick (2011) estimate defense spending multipliers with two-stage least squares, using annual data for different samples where the estimated multipliers lie between 0.6 and 0.7.

The approaches mentioned above, with the exception of Auerbach and Gorodnichenko (2012), employ linear models in estimating the tax and spending multipliers. A common characteristic of these studies is that the magnitude of the multipliers does not vary over the business cycle. Auerbach and Gorodnichenko (2012) employ a regime switching VAR where transitions across recessions and expansions are smooth. By imposing the restriction that the U.S. economy is in recession 20 % of the time, they estimate that the total spending multiplier is 0.57 during expansions and 2.45 during recessions, while the defense spending multiplier is 0.8 during expansions and 3.56 during recessions.

In this paper, we investigate empirically whether fiscal multipliers are quantitatively different in magnitude during "good times" and "bad times". To do so, we use a multiple regime framework first suggested by Hamilton (1989). We contribute to the literature by estimating the benchmark regression of Barro and Redlick (2011) within a Markov-Switching framework. Government spending multipliers are identified from variations in the defense news variable constructed by Ramey (2011) and the tax multipliers are identified from the exogenous tax variable constructed Romer and Romer (2010a).

Ramey (2011) shows that defense spending accounts for almost all of the volatility of government spending, but also argues that shocks to government spending or defense spending can be anticipated ahead of actual spending. This has important implications because anticipated future changes in government spending can affect current economic activity. She shows that the standard VAR shocks do not reflect news about defense spending accurately and that the Ramey-Shapiro war dates Granger-cause the VAR shocks. Ramey (2011) also acknowledges that the simple dummy variable approach does not exploit the potential quantitative information available regarding the news about military spending and for this purpose constructs a new measure of defense news variable, which reports the anticipated changes in defense spending. We use this measure to identify shocks to government spending and to calculate the spending multipliers.

One major obstacle in calculating tax multipliers is endogeneity. As GDP increases, we observe an increase in tax revenues and vice versa. This makes the calculation of tax multipliers very difficult. Romer and Romer (2010b) argue that most changes in revenues are endogenous responses to non-policy developments. They analyze federal tax actions from 1945 to 2007 and identify four categories. Of these four categories, spending-driven and countercyclical tax changes are defined as endogenous tax changes, while deficit-driven long-run tax changes are categorized as exogenous tax changes. We use the exogenous tax changes in estimating the tax multipliers.

The non-linear model employed in this paper separates periods of high and low states of the world for the endogenous variable (the change in real GDP per capita scaled by the real GDP per capita of the previous period, which can also be interpreted as per capita growth), and therefore allows us to estimate separate fiscal multipliers for periods of low growth, and periods of high growth. We find that the spending multiplier is 2.91 for periods of low growth and 0.13 for periods of high growth, while the tax multiplier is -0.19 for periods of low growth and -0.66 for periods of high growth. Our results show that the magnitudes of the spending multipliers are larger during episodes of low growth, while the magnitudes of tax multipliers are larger during episodes of high growth - a result that emphasizes the importance of non-linearities for fiscal multipliers. Moreover, the non-linear framework used in this study provides larger multipliers for periods of high growth and smaller multipliers for periods of low growth during the post-1980 era when compared to the whole sample period, which indicates that previous findings about the post-1980 multipliers might be biased since they do not differentiate between different states of the economy.

The remainder of the paper is organized as follows: Section 2 discusses the methodology employed in the paper. Section 3 presents the empirical analysis and results. Section 4 concludes.

2 Methodology

We propose an alternative way of detecting the causality dynamics between lagged fiscal policy instruments and economic growth. The regime-switching model considered in this paper[1] allows for shifts in the mean, for periods of high economic growth and low economic growth, and is given by:

$$y_t = \mu(s_t) + \sum_{i=1}^{4} \boldsymbol{\gamma}_i y_{t-i} + \beta_1(s_t)x_{t-1} + \beta_4(s_t)z_t + \beta_6(s_t)w_{t-1} + \sigma(s_t)\varepsilon_t, \tag{1}$$

$$\mu(s_t) = \sum_{i=1}^{2} \mu^{(i)}\mathbf{1}\{s_t = i\},\ \sigma(s_t) = \sum_{i=1}^{2} \sigma^{(i)}\mathbf{1}\{s_t = i\},\ \ (t \in \mathbb{T})$$

where y_t = change in real GDP per capita scaled by the real GDP per capita of the previous period, x_t = real present discounted value of expected change in defense spending per capita scaled by the real GDP per capita of the previous period, z_t = change in real exogenous tax liabilities per capita scaled by the real GDP per capita of the previous period, and w_t = squared government bonds spread. Given that s_t is unobserved, estimation of (1) requires restrictions on the probability process governing s_t; it is assumed that s_t follows a first-order, homogeneous, two-state Markov chain. This means that any persistence in the state is completely summarized by the value of the state in the previous period. Therefore, the regime indicators $\{s_t\}$ are assumed to form a Markov chain on $\mathbb{S}$ with transition probability matrix $\mathbf{P'} = [p_{ij}]_{2\times2}$, where

$$p_{ij} = \Pr(s_t = j|s_{t-1} = i), \qquad i, j \in \mathbb{S}, \tag{2}$$

and $p_{i1} = 1 - p_{i2}$ $(i \in \mathbb{S})$, where each column sums to unity and all elements are non-negative. The probability law that governs these regime changes is flexible enough to allow for a wide variety of different shifts, depending on the values of the transition probabilities. For example, values of p_{ii} $(i \in \mathbb{S})$ that are not very close to unity imply that structural parameters are subject to frequent changes, whereas values near unity suggest that only a

[1] The model is based on the Markov switching representation proposed by Hamilton (1989, 1990).

few regime transitions are likely to occur in a relatively short realization of the process. $\{\varepsilon_t\}$ are i.i.d. errors with $\mathsf{E}(\varepsilon_t) = 0$ and $\mathsf{E}(\varepsilon_t^2) = 1$. $\{s_t\}$ are random variables in $\mathbb{S} = \{1, 2\}$ that indicate the unobserved state of the system at time t. It is assumed that $\{\varepsilon_t\}$ and $\{s_t\}$ are independent. Also, note that the independence between the sequences $\{\varepsilon_t\}$ and $\{s_t\}$ implies that regime changes take place independently of the past history of $\{y_t\}$.

We are interested in documenting estimates of the low-high phase growth rates, μ^l and μ^h, but mainly in investigating the extent to which fiscal policy instruments are associated with the low-high phase growth rates. Autoregressive terms (up to four lags) are also considered. Therefore, the parameters vector of the mean equation (1) is defined by $\mu^{(i)}$ $(i = 1, 2)$, which are real constants. The autoregressive terms $\sum_{i=1}^{4} \boldsymbol{\gamma}_i$, $\beta_1 = \left(\beta_1^l, \beta_1^h\right)$, $\beta_4 = \left(\beta_4^l, \beta_4^h\right)$, and $\beta_6 = \left(\beta_6^l, \beta_6^h\right)$ measure the impact of change in real government purchases per capita, average marginal tax rate, and squared spreads respectively. The parameter vector is estimated by maximum likelihood. The density of the data has two components, one for each regime, and the log-likelihood function is constructed as a probability weighted sum of these two components. The maximum likelihood estimation is performed using the EM algorithm described by Hamilton (1989, 1990).

3 Empirical Analysis

3.1 Data

The variables employed in this paper consist of the change in real GDP per capita scaled by the real GDP per capita of the previous period (y_t), the real present discounted value of expected change in defense spending per capita scaled by the real GDP per capita of the previous period (x_t), the change in real exogenous tax liabilities per capita scaled by the real GDP per capita of the previous period (z_t), and squared government bonds spread (w_t). These variables are constructed as follows:

y_t = (Change in Nominal GDP scaled by Nominal GDP of the previous period/ GDP Deflator) / Total Population, including armed forces overseas;

x_t = (Nominal present discounted value of expected change in defense spending scaled by nominal GDP of the previous period / GDP Deflator) / Total Population, including armed forces overseas;

z_t = (The change in nominal exogenous tax liabilities scaled by nominal tax liabilities of the previous period / GDP Deflator) / Total Population, including armed forces overseas;

w_t = Spread between long-term government bonds interest rate and 3-Month Treasury Bill rate.

Nominal GDP and the GDP deflator are from the Bureau of Economic Analysis and interest rates are from the Board of Governors of the Federal Reserve System. Nominal present discounted value of expected change in defense spending and total population, including armed forces overseas are from Ramey (2011) and the change in nominal exogenous tax liabilities are from Romer and Romer (2010b). Summary statistics for the variables considered are reported in Table 1. Our dataset covers 1949:1- 2006:4 (quarterly) for a total of 232 observations.

3.2 Results

The null hypothesis of linearity against the alternative of Markov regime switching cannot be tested directly using the standard likelihood ratio (LR) test. We properly test for multiple equilibria (more than one regime) against linearity using the Hansen's standardized likelihood ratio test (1992, 1996). The value of the standardized likelihood ratio statistics and related P - values (Table 1) under the null hypothesis (see Hansen (1992, 1996) for details) provides strong evidence in favour of a two - state Markov mean-variance regime-switching specification[2].

Please Insert Tables 1, 2 and Figure 1 about here

Maximum likelihood (ML) estimates of the model described above are reported in Table 2. The model appears to be well identified, parameters are significant, and the standardized residuals exhibit no signs of linear or nonlinear dependence (Ljung-Box statistics for dependency in the first moment and for heteroskedasticity). The periods of high and low economic growth seem to be accurately identified by the filter probabilities, which clearly separates the two regimes. Figure 1 shows the plots for change in real GDP per person scaled by real GDP per person of the previous period, y_t, and its corresponding estimated filter probabilities. In deriving the results, several hypotheses are investigated: the effect of fiscal policy instruments in periods of (i) low growth $\left(\beta_1^l = 0, \beta_4^l = 0, \beta_6^l = 0\right)$ and (ii) high growth $\left(\beta_1^h = 0, \beta_4^h = 0, \beta_6^h = 0\right)$. Furthermore, by means of Akaike criterion, an autoregressive of order one was selected for y_t showing a positive effect ($\boldsymbol{\gamma}_1 = 0.249$). From the results reported in Table 2, the following points are noteworthy.

As documented in Table 2, the spending multiplier is estimated as 2.907 for periods of low growth and 0.131 for periods of high growth for the entire sample starting in 1949:1 and ending in 2006:1. These results indicate that spending multipliers are larger during episodes of low growth and smaller during episodes of high growth.

It should be noted that the spending multipliers that we have estimated are actually the multipliers associated with anticipated changes in military spending based on news. As argued by Barro and Redlick (2011), multipliers associated with non-defense purchases would be more relevant to evaluate fiscal stimulus packages, but they acknowledge that these multipliers are hard to estimate since there is a great deal of the endogeneity between the movements in non-defense spending and real GDP and therefore they estimate multipliers for defense spending. They argue that the defense spending multiplier would provide an upper bound for the non-defense multiplier. Our multipliers should be interpreted similarly. They represent an upper bound for the non-defense multiplier during periods of high and low growth.

As shown in Table 2, unlike the military news multipliers, the estimated tax multipliers are smaller for periods of low growth compared to periods of high growth, -0.194 and -0.663 respectively. This particular result implies that government expenditures are more effective policy instruments during "bad times", and taxes are more effective policy instruments during "good times". However, one should also note that the estimated multipliers are quite small, and possibly cannot justify fiscal policy in general as an effective stabilization tool in the short-run. That does not mean, however, that fiscal policy is an ineffective policy tool in the

[2] The presence of a third state has also been tested (Table 1) and rejected in favour of a two states Markov process.

long-run. One should also keep in mind that the long-term growth effects of fiscal policy are also well-documented (Kneller et al., 1999, among others).

Another interesting question is whether fiscal policy has indeed become less effective in today's globalized world with increased labor and capital mobility, as suggested by Perotti (2002). To be able to answer this question, we estimated our benchmark regression for the 1980:1- 2006:4 sub-sample. The empirical findings, which are summarized in Table 2, reveal that while the low growth multipliers got smaller (2.471 and 0.158 for expenditures and taxes respectively), the high growth multipliers got larger (0.143 and -0.4292 for expenditures and taxes respectively). This result makes sense as today's globally integrated financial markets allow capital to move more freely in response to fiscal shocks, especially when capital is more abundant.

3.3 Robustness Checks

In this section, we check the robustness of our results by using the average marginal tax rates, z_t^*, calculated by Barro and Redlick (2011). Maximum likelihood (ML) estimates are reported in Table 3. By means of Akaike criterion an autoregressive of order one was selected for y_t showing a positive effect ($\boldsymbol{\gamma}_1 = 0.301$). The estimated multipliers are qualitatively similar, and all of our results remain essentially the same. We should note that the magnitude of the multipliers, with the new tax variable become slightly smaller.

4 Conclusion

By identifying fiscal policy shocks, using the narrative approach, we estimate the magnitude of fiscal multipliers within a non-linear framework. The empirical results show that the magnitudes of the spending multipliers are larger during times of low growth, while the magnitudes of tax multipliers are larger during times of high growth. Our results imply that there is a role for fiscal policy as a stabilization tool by using the "right instrument" at the "right time". Another contribution of our paper is, contrary to the previous literature, to show that multipliers during periods of low growth get smaller, and multipliers during times of high growth get larger in the post-1980 era relative to the whole sample period. This particular result implies that the comparison of fiscal multipliers between periods in linear VAR studies might be biased. Larger multipliers during periods of high growth could be explained with the larger share of investment (and capital) in GDP during expansionary periods. Further avenues for research may include further disaggregation of fiscal shocks to find out exactly which budget items can be used to stabilize the economy during recessions (or expansions). As Perotti (2002) contends that the U.S. is an outlier in terms of response to fiscal policy actions, there is also some benefit applying our framework to other countries, given data availability.

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TABLE 1

Descriptive statistics*					
	Mean	Std. Dev.	Skewness	Kurtosis	JB
y_t	0.0051	0.0112	−0.171	4.152	13.974
x_t	0.0051	0.0491	10.388	119.241	4799.01
z_t	0.0011	0.0142	−0.562	4.328	29.297
z_t^*	−0.0001	0.0021	−2.837	18.666	2683.87
w_t	0.0003	0.0002	1.318	4.708	95.404

Markov Switching State Dimension: Hansen Test**		
Standardized LR test	Linearity vs two-states	Two states vs three-states
LR	4.365	0.2375
$M = 0$	(0.001)	(0.643)
$M = 1$	(0.002)	(0.677)
$M = 2$	(0.004)	(0.690)
$M = 3$	(0.007)	(0.715)
$M = 4$	(0.012)	(0.722)

Note: * y_t = change in real GDP per capita scaled by the real GDP per capita of the previous period, x_t = real present discounted value of expected change in defense spending per capita scaled by the real GDP per capita of the previous period, z_t = change in real exogenous tax liabilities per capita scaled by the real GDP per capita of the previous period, w_t = squared government bonds spread. z_t^* is the average marginal tax rate constructed by Barro and Redlick (2011).**The Hansen's standardized Likelihood Ratio test P-values are calculated according to the method described in Hansen (1992, 1996), using 1,000 random draws from the relevant limiting Gaussian processes and bandwidth parameter M = 0,1,. . . ,4. Test results for the presence of a third state are also reported.

TABLE 2

Maximum Likelihood Estimation Results					
Low Growth Rate			High Growth Rate		
	Parameters	S.E.		Parameters	S.E.
Sample 1949:I - 2006:IV					
μ^l	-0.001	(0.001)	μ^h	0.004	(0.002)
γ_1	0.249	(0.101)			
β_1^l	2.907	(0.976)	β_1^h	0.131	(0.061)
β_4^l	-0.194	(0.078)	β_4^h	-0.663	(0.118)
β_6^l	-1.252	(0.326)	β_6^h	-4.574	(1.087)
σ^l	0.003	(0.001)	σ^h	0.009	(0.002)
p	0.856	(0.362)	q	0.883	(0.387)
$LB_{(5)}$	2.475				
$LB_{(5)}^2$	4.129			$LogLik$	-745.187
Sample 1980:I - 2006:IV					
μ^l	0.001	(0.001)	μ^h	0.004	(0.002)
γ_1^l	0.202	(0.085)			
β_1^l	2.471	(0.992)	β_1^h	0.143	(0.055)
β_4^l	-0.158	(0.066)	β_4^h	-0.692	(0.161)
β_6^l	-1.058	(0.421)	β_6^h	-4.292	(1.662)
σ^l	0.002	(0.001)	σ^h	0.007	(0.002)
p	0.837	(0.416)	q	0.901	(0.334)
$LB_{(5)}$	3.491				
$LB_{(5)}^2$	4.001			$LogLik$	-266.348

Note: Autocorrelation and heteroscedasticity-consistent standard errors (S.E.) are reported in brackets. $\mathrm{LB}_{(5)}$ and $\mathrm{LB}^2_{(5)}$ are respectively the Ljung-Box test (1978) of significance of autocorrelations of five lags in the standardized and standardized squared residuals.

TABLE 3

Maximum Likelihood Estimation Results					
Low Growth Rate			High Growth Rate		
	Parameters	S.E.		Parameters	S.E.
Sample 1949:I - 2006:IV					
μ^l	-0.001	(0.001)	μ^h	0.004	(0.002)
γ_1	0.301	(0.115)			
β_1^l	2.632	(1.224)	β_1^h	0.103	(0.044)
β_4^l	-0.203	(0.101)	β_4^h	-0.702	(0.225)
β_6^l	-1.342	(0.552)	β_6^h	-4.226	(1.374)
σ^l	0.002	(0.001)	σ^h	0.007	(0.003)
p	0.801	(0.323)	q	0.841	(0.215)
$LB_{(5)}$	2.771				
$LB^2_{(5)}$	3.983			$LogLik$	-718.623
Sample 1980:I - 2006:IV					
μ^l	0.001	(0.001)	μ^h	0.003	(0.001)
γ_1^l	0.278	(0.116)			
β_1^l	2.244	(1.065)	β_1^h	0.121	(0.039)
β_4^l	-0.155	(0.071)	β_4^h	-0.722	(0.247)
β_6^l	-1.166	(0.431)	β_6^h	-3.691	(1.663)
σ^l	0.001	(0.001)	σ^h	0.006	(0.002)
p	0.901	(0.422)	q	0.877	(0.324)
$LB_{(5)}$	2.992				
$LB^2_{(5)}$	4.012			$LogLik$	-287.544

Notes: See Table 2

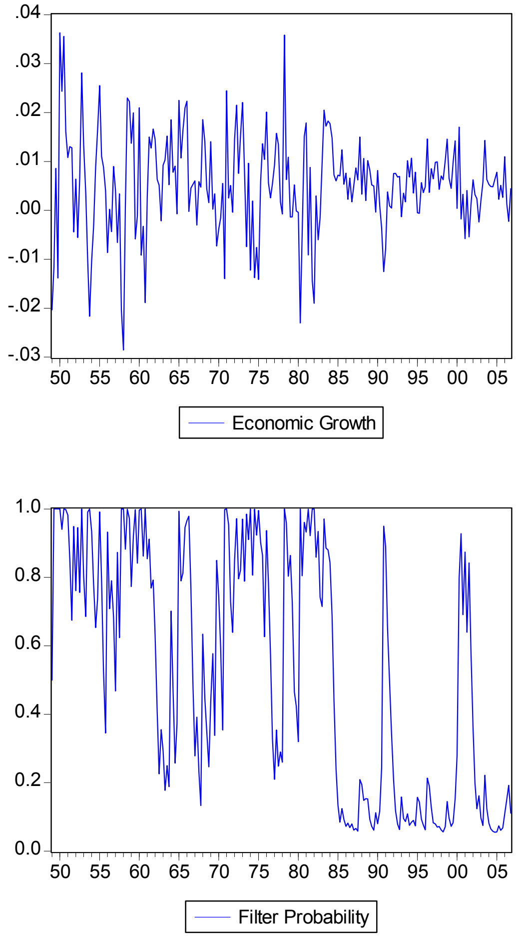

Figure 1:

Notes: Filter probability refers to the probability to be in the low state as a result of parameter estimates reported in Table 2.