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ABSTRACT

Using non-linear methods, we argue that existing estimates of government spending multipliers in expansion and recession may yield biased results by ignoring whether government spending is increasing or decreasing. In the case of OECD countries, the problem originates in the fact that, contrary to one's priors, it is not always the case that government spending is going up in recessions (i.e., acting countercyclically). In almost as many cases, government spending is actually going down (i.e., acting procyclically). Since the economy does not respond symmetrically to government spending increases or decreases, the "true" long-run multiplier for bad times (and government spending going up) turns out to be 2.3 compared to 1.3 if we just distinguish between recession and expansion. In extreme recessions, the long-run multiplier reaches 3.1.

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1 Introduction

The recent global financial crisis and ensuing recession triggered major fiscal stimulus packages throughout the industrial world as well as in several emerging markets. The effectiveness of these fiscal packages remains, however, an open question. In fact, the size of the government spending multipliers in the academic literature has varied widely, from negative values to positive values as high as 4.

Why do estimates vary so widely? An obvious explanation is the use of different methodologies. Indeed, there has been an intense debate in the literature regarding the proper identification of fiscal shocks. The widely-used identification method of Blanchard and Perotti in the context of structural vector-autoregression models (SVAR), which relies on the existence of a one-quarter lag between output and a fiscal response, has been called into question by Ramey (2011) on the basis that what is an orthogonal shock for an SVAR may not be so for private forecasters. In other words, there seems to be, at least for the United States, a non-trivial correlation between orthogonal innovations in a SVAR and private forecasts. To remedy this, Barro and Redlick (2011) and Romer and Romer (2010) have suggested, respectively, the use of a "natural experiment approach" (military buildups in the United States) or a narrative approach for the case of taxes.

Another reason for different estimates could be that the size of fiscal multipliers may depend on various characteristics of the economy in question, including degree of openness, exchange rate regime, and the state of the business cycle.[1] The latter factor appears as particularly relevant for policymakers since fiscal stimulus in industrial countries is typically undertaken in bad times and hence, one could argue, the relevant multiplier is not an "average" multiplier over the business cycle but the one that applies in bad times. There is thus reason to believe that the size of fiscal multipliers could well depend on the business cycle.

[1] See Auerback and Gorodnichenko (2010, 2012) and Ilzetzki, Mendoza, and Vegh (2013).

From a technical standpoint, dividing the classical SVAR regression samples into expansions and recessions could severely compromise the number of observations used in the analysis as well as miss inherent non-linearities in the economy's response to fiscal stimulus. A potential solution is the use of non-linear, regime-switching type regressions, which have been used in some studies for the United States and other industrial countries. Specifically, Fazzari *et al.* (2012) extend Chan and Tong's (1986) early work on Threshold Autorregresive Models (TAR) to a multivariate setting in order to create a Threshold SVAR (TSVAR) model. In a TSVAR, the parameters are allowed to switch according to whether a threshold variable crosses an estimated threshold (capacity utilization in this case). A possible drawback of this methodology lies in the potential arbitrariness of the threshold selection. In Fazzari *et al.* (2012), the threshold is estimated from the data but it could still be argued that the selection of the threshold variable itself is arbitrary.

In a related, but different, approach, Auerbach and Gorodnichenko (AG) (2010) solve the issue of threshold selection by extending early work by Granger and Teravistra (1993) on Smooth Transition Autoregressive models (STAR) in order to accommodate simultaneous equation analysis in a Smooth Transition Vector Autoregressive model (STVAR). In this model the transition across states is controlled by an underlying smooth logistic distribution with a weight (or probability) given by a moving average of real GDP growth. For the United States, Auerbach and Gorodnichenko (2010) conclude that the spending multiplier is around zero in expansions and 1.5-2.0 in recessions. Using a linear model, the estimate would be around one, thus underestimating it for recessions and overestimating it for expansions. In Auerbach and Gorodnichenko (2012), they resort to an alternative methodology – advocated by Jorda (2005) and Stock and Watson (2007) – that relies on running a separate regression for each horizon and then constructing the impulse response function. This direct projection method does not impose the dynamic restrictions implicitly embedded in VARs and can easily accommodate non-linearities in the response function. They conclude, for a panel of OECD countries, that the multiplier reaches a maximum of 3.5 during recessions and essentially zero during expansions.

This paper tackles the same question (do fiscal multipliers depend on the state of the business cycle?) but brings into the picture a new dimension, which we believe is critical for evaluating the size of fiscal multipliers in good and bad times. The new dimension is whether government spending is going up or down. To understand intuitively why this may be a critical dimension, notice that when we talk about fiscal multipliers in good and bad times, the implicit world that we have in mind is one in which fiscal policy is countercyclical (i.e.., government spending increases in bad times and falls in good times), as has traditionally been the case for industrial countries.[2] As illustrated in Table 1, however, this is not true in about 44 percent of the time![3] Specifically, by combining good/bad times with government spending going up or down, Table 1 tells us how much time the economy spends, on average, in each of the possible four states of the world (top figures in every cell, which add up to 100 percent).[4] For example, cell (1,1) indicates that industrial countries spend, on average, 29 percent of the time in good times with government spending going down. The table thus tells us that industrial countries spend, on average, 56 percent of the time in countercyclical states of the world; that is, the sum of cells (1,1) and (2,2). The rest of the time (44 percent), government spending is either going down in bad times (cell (2,1)) or going up in good times (cell (1,2)), which would constitute procyclical fiscal policy.

Furthermore, conditional on being in bad times, government spending is going down in 46 percent of the time (bottom figure in cell (2,1)). Hence, when we compute a multiplier for bad

[2] Of course, the current austerity programs in the Eurozone constitute procyclical fiscal policy, which had traditionally been observed only in developing countries (see, for instance, Kaminsky, Reinhart, and Vegh (2004), and Frankel, Vegh, and Vuletin (2013)).

[3] To tell our story, we are, of course, implicitly assuming that causation goes from the cycle to fiscal policy. Our estimates below will control for this.

[4] In Table 1, we compute the cyclical component of output and government spending using annual data and the Hodrick-Prescott filter. For the purposes of Table 1, a recession (expansion) is defined as a situation in which the cyclical component of output – the difference between the current level of output and its trend – is negative (positive). The same criterion was used for government spending.

times, we are putting in the same bag very different situations: the case of government spending going up in bad times (which we will refer to as "countercyclical fiscal multiplier") and the case of government spending going down in bad times (or "procyclical fiscal multiplier").[5] If government spending going up or down did not matter for the size of the multiplier, then this would not be a problem. If it does matter (as we will show), then we would be biasing our estimate.[6] Instead of estimating the multiplier for cell (2,2), so to speak, we would be estimating an average of the multiplier for cells (2,1) or (2,2).[7]

Our results confirm our intuition. When we compute multipliers for OECD countries for each of the four states of the world captured in Table 1, we find that the largest multiplier (after 2 and 4 semesters) corresponds to cell (2,2), reaching 2.3 after four semesters. In other words, the countercyclical fiscal multiplier in bad times is the largest of the four possible multipliers. If we ignore the distinction of government spending going up or down, the resulting multiplier is just 1.3. The bias comes from the fact that the long-run multiplier for cell (2,1) is not significantly different from zero. Hence, ignoring whether government spending is going up or down implicitly gives us an "average" of cells (2,1) and (2,2); that is, an average of the countercyclical and procyclical fiscal multipliers in bad times.

All the results reported so far refer to fiscal multipliers computed for the "median" expansion and recession. We also looked, however, at what happens in "extreme" booms and recessions. We find that the multiplier in extreme recessions is much larger than in typical recessions (almost 70 percent higher). But perhaps the most striking result when considering extreme recessions is that the impact multiplier is 1.2. In terms of the current debate on

[5]We will use an analogous terminology for good times: government spending going down (up) yields a countercyclical (procylical) fiscal multiplier.

[6]A simple theoretical example where it would matter is a situation of full employment (i.e., "good times") in a sticky-prices model. In such a case, we would expect an increase in government spending to have no effect on output (i.e., a zero multiplier) while a reduction in government spending would lead to a positive multiplier. In AG's (2010, 2012) view of the world, these two multipliers are implicitly assumed to be the same.

[7]A similar message emerges when we compute a version of Table 1 using government spending forecast errors, as shown in Table 2. In this case, expansionary (contractionary) government spending refers to a positive (negative) forecast error, and expansion (recession) is computed as explained in Section 2.

austerity in the Eurozone, this would imply that, as a result of a fiscal contraction, debt to GDP ratios would actually increase on impact.

The paper proceeds as follows. Section 2 discusses the data and the methodology that follows the direct projection method mentioned above. Section 3 presents our estimates in the following order: (i) single (or non-linear) multipliers; (ii) multipliers in expansions and recessions; (iii) multipliers when government spending is going up and down; and (iv) multipliers taking into account both recession/expansion and government spending going up or down. Section 4 presents our estimates for extreme recessions or booms and compare them with our previous estimates (which apply to the median recession or boom). Section 6 concludes.

2 Data and methodology

2.1 Data

Our sample comprises 29 OECD countries.[8] We use semiannual data for seasonally-adjusted real government spending (G), seasonally-adjusted real GDP (Y), both in logarithmic terms, and government spending forecast errors (FE^G) computed as the difference between actual, first-release series of the government spending growth rate and the forecast series prepared by professional forecasters.[9] As discussed in detail in AG (2010, 2012), FE^G provides a convenient way to identify unanticipated government purchases, which enables us to appropriately estimate fiscal multipliers. This surprise government spending shock captures unanticipated innovations in spending.

[8] The countries are Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Turkey, United Kingdom, and United States. The sample periods covers 1986-2008.

[9] The sources of data for government spending and GDP are IFS (IMF), Global Financial Data, Datastream, as well as local sources such as Central Banks.

2.2 Methodology

We follow the single-equation approach advocated by Jorda (2005) and Stock and Watson (2007), which does not impose the dynamic restrictions implicitly embedded in the SVAR methodology and can conveniently accommodate non-linearities in the response function. For this purpose, linear "local projections" (LP) of output growth on lags and current change of government expenditure and other controls are used for the construction of impulse response functions (IRF). As discussed in Jorda (2005), there are multiple advantages in the use of LP. In particular, LP (i) can be estimated by single-regression techniques (least-squares dummy variables or LSDV in our case), (ii) are more robust to potential misspecifications, and (iii) can easily accommodate highly non-linear and flexible specifications that may be impractical in a multivariate SVAR context. In all of our regression analysis, we use robust Driscoll and Kraay (1998) standard errors to correct for potential heteroskedasticity, autocorrelation in the lags, and error correlation across panels.

In our basic linear specification (Section 3.1), the accumulated response of output growth at the horizon h is estimated from the following regression:

$$\Delta Y_{i,t+h} = \alpha_{i,h} + \beta_h FE^G_{i,t} + \lambda_h(L)\Delta Y_{i,t-1} + \Psi_h(L)\Delta G_{i,t-1} + \varphi_1 T_{t,h} + \varphi_2 T^2_{t,h} + \mu_{i,t,h}, \quad (1)$$

where i and t index countries and time, respectively, α_i is the country fixed effect, $\Delta Y_{i,t+h} \equiv Y_{i,t+h} - Y_{i,t-1}$, and T controls – as in Owyang, Ramey, and Zubairy (2013) – for potential time trends. It is important to note that, in this approach, each step in the accumulated IRF is obtained from a different individual equation. We thus obtain the IRF values directly from the β_h estimated coefficients. Unlike a VAR specification, the estimated coefficients contained in the polynomial lags $\lambda(L)$ and $\Psi(L)$ are not used directly to build the IRF values but only serve as controls, "cleaning" the β_h from the dynamic effects of output and the effects of past government expenditure changes. Following standard practice, spending multipliers are then constructed by multiplying the IRF values by the mean value of Y/G.

We then follow AG (2012) and compute non-linear fiscal multipliers in economic expansions and recessions for OECD countries (Sections 3.2 and 4). For this purpose, we modify our linear specification (1) as follows:

$$\begin{aligned}\Delta Y_{i,t+h} &= \alpha_{i,h} + (1 - I(x_{i,t-1}))\, \beta_{E,h} FE^G_{i,t} + I(x_{i,t-1})\, \beta_{R,h} FE^G_{i,t} + \\ &+ (1 - I(x_{i,t-1}))\, \lambda_{E,h}(L) \Delta Y_{i,t-1} + I(x_{i,t-1})\, \lambda_{R,h}(L) \Delta Y_{i,t-1} + \\ &+ (1 - I(x_{i,t-1}))\, \Psi_{E,h}(L) \Delta G_{i,t-1} + I(x_{i,t-1})\, \Psi_{R,h}(L) \Delta G_{i,t-1} + \\ &+ \varphi_1 T_{t,h} + \varphi_2 T^2_{t,h} + \mu_{i,t},\end{aligned} \tag{2}$$

with

$$I(x_{i,t}) = \frac{e^{-\gamma x_{i,t}}}{1 + e^{-\gamma x_{i,t}}}, \quad \gamma > 0.$$

Following AG (2012), $I(.)$ is a transition function for each country that ranges between 0 (largest expansion) and 1 (deepest recession). $x_{i,t}$ is a normalized variable measuring the state of the business cycle which, using the 7-quarter moving average of the growth rate of output, is then normalized such that $E(x_{i,t}) = 0$ and $Var(x_{i,t}) = 1$ for each i.[10] The common practice in this emerging literature (e.g., Owyang, Ramey, and Zubairy (2013)) has been to evaluate the size of the spending multipliers under what we call "extreme" business cycle conditions. That is to say, the impact of fiscal policy is evaluated for the largest expansion (i.e., $I(.) = 0$) or the deepest recession (i.e., $I(.) = 1$). While relevant under some particular historical circumstances (like the deep recessions currently underway in several Eurozone countries), these extreme conditions are, by definition, rather infrequent and do not capture normal expansions or recessions. For this reason, in Section 3.2 we first compute the multipliers for what we call typical (or, more precisely, median) expansions and recessions. Defining

[10] As in AG (2012) we calibrate $\gamma = 1.5$. Results hold for small variations in the value of γ.

a typical recession or expansion is, by no means a trivial matter, as we would need to use weighted averages of $\beta_{E,h}$ and $\beta_{R,h}$ in the construction of the IRF and the corresponding multiplier. Based on the median value of x during expansions and recessions, we capture the median recession using $I(.) = 0.7$ (and, thus, $1 - I(.) = 0.3$). By the same token, we capture the median expansion using $1 - I(.) = 0.7$ (and, thus, $I(.) = 0.3$).[11] In Section 4, we will then compare the multipliers obtained under typical expansions and recessions with those obtained under extreme expansions and recessions.

To fix ideas, we now report some numbers regarding the typical and extreme business cycle conditions in our sample of OECD countries. In all cases, these figures refer to median values. The 7-quarter moving average of the growth rate of output in a typical recession is 0.3 percent, compared to -1.0 percent in an extreme recession. The corresponding figures for a typical and extreme expansion are 0.9 and 3.2 percent, respectively. As will become clear below, important policy implications will arise from comparing typical and extreme business cycle conditions, particularly regarding (i) the expansionary effect of government spending under alternative recessionary environments, and (ii) how the effectiveness of austerity packages may crucially depend upon the severity of the recessionary environment.

One of the main novelties of this paper is to assess potential asymmetric effects on output of government spending depending on whether government spending is increasing or decreasing. Before interacting this new dimension with the state of the business cycle, we first evaluate in Section 3.3 whether the size of the fiscal multiplier may depend on whether government spending is going up or down (without considering the state of the business cycle). For this purpose, we modify our linear specification (1) splitting each variable depending on whether

[11] Although the point estimates of the IRF and multipliers are straightforward to calculate (we use the weighted average of $\beta_{E,h}$ and $\beta_{R,h}$), standard errors also need to account for the covariance between $\beta_{E,h}$ and $\beta_{R,h}$. We use the following formulation for the weighted average of the standard errors: $\sigma_{a\beta_E + b\beta_R} = \sqrt{a^2\sigma^2_{\beta_E} + b^2\sigma^2_{\beta_R} + 2ab\sigma^2_{\beta_E,\beta_R}}$, where a and b represent the weights and $\sigma^2_{\beta_E}$, $\sigma^2_{\beta_R}$, $\sigma^2_{\beta_E,\beta_R}$ are drawn from the variance-covariance matrix of the regression.

forecast errors have positive ($FE^{G_{POS}}$) or negative ($FE^{G_{NEG}}$) values:[12]

$$\Delta Y_{i,t+h} = \alpha_{i,h} + \beta_h^{POS} FE_{i,t}^{G_{POS}} + \beta_h^{NEG} FE_{i,t}^{G_{NEG}} + \lambda_h^{POS}(L)\Delta Y_{i,t-1}^{POS} + \lambda_h^{NEG}(L)\Delta Y_{i,t-1}^{NEG} + \Psi_h^{POS}(L)\Delta G_{i,t-1}^{POS} + \Psi_h^{NEG}(L)\Delta G_{i,t-1}^{NEG} + \varphi_1 T_{t,h} + \varphi_2 T_{t,h}^2 + \mu_{i,t,h}. \quad (3)$$

Finally, we look into the possible interaction between recession/expansion and government spending going up or down in Section 3.4 (for typical expansions and recessions) and Section 4 (for extreme expansions and recessions). For this purpose, we modify our linear specification (1) by including the underlying elements of specifications (2) and (3):

$$\begin{aligned} \Delta Y_{i,t+h} = {} & \alpha_{i,h} + (1 - I(x_{i,t-1}))\,\beta_{E,h}^{POS} FE_{i,t}^{G_{POS}} + I(x_{i,t-1})\,\beta_{R,h}^{POS} FE_{i,t}^{G_{POS}} + \\ & + (1 - I(x_{i,t-1}))\,\beta_{E,h}^{NEG} FE_{i,t}^{G_{NEG}} + I(x_{i,t-1})\,\beta_{R,h}^{NEG} FE_{i,t}^{G_{NEG}} + \\ & + (1 - I(x_{i,t-1}))\,\lambda_{E,h}^{POS}(L)\Delta Y_{i,t-1}^{POS} + I(x_{i,t-1})\,\lambda_{R,h}^{POS}(L)\Delta Y_{i,t-1}^{POS} + \\ & + (1 - I(x_{i,t-1}))\,\lambda_{E,h}^{NEG}(L)\Delta Y_{i,t-1}^{NEG} + I(x_{i,t-1})\,\lambda_{R,h}^{NEG}(L)\Delta Y_{i,t-1}^{NEG} + \\ & + (1 - I(x_{i,t-1}))\,\Psi_{E,h}^{POS}(L)\Delta G_{i,t-1}^{POS} + I(x_{i,t-1})\,\Psi_{R,h}^{POS}(L)\Delta G_{i,t-1}^{POS} + \\ & + (1 - I(x_{i,t-1}))\,\Psi_{E,h}^{NEG}(L)\Delta G_{i,t-1}^{NEG} + I(x_{i,t-1})\,\Psi_{R,h}^{NEG}(L)\Delta G_{i,t-1}^{NEG} + \\ & + \varphi_1 T_{t,h} + \varphi_2 T_{t,h}^2 + \mu_{i,t,h}. \end{aligned} \quad (4)$$

We now proceed to report the estimates of the fiscal multipliers for our OECD sample using the four empirical specifications just outlined.

3 Estimates of spending multipliers

We first present estimates for the linear (single) multiplier, then for multipliers in recession and expansion, then for multipliers that differentiate between increases and decreases in gov-

[12] In other words, ΔY^{POS} (ΔY^{NEG}) equals ΔY if $FE^G > 0$ ($FE^G < 0$) and zero otherwise. By the same token, ΔG^{POS} (ΔG^{NEG}) equals ΔG if $FE^G > 0$ ($FE^G < 0$) and zero otherwise.

ernment spending, and finally for multipliers that take into account both expansion/recession and government spending going up or down.

3.1 Linear multiplier

As a natural first step – and following specification (1) – we compute the cumulative fiscal multiplier, which is illustrated in Figure 1. The multiplier is 0.31 on impact (and significantly different from zero) and hovers around 0.40 for the remaining three semesters. This linear (or single) multiplier provides us with a benchmark to first revisit the AG exercise of computing multipliers in expansions and recessions and later examining whether it matters if government spending is going up or down.

3.2 Multipliers in recession and expansion

Based on specification (2), we now compute the fiscal multipliers in economic expansions and recessions. Tables 1 and 2 show that OECD countries have spent about 50 percent of the time in recession and 50 percent of the time in expansion. The multipliers associated with expansion and recession are illustrated in Figure 2, panels A and B.

As in AG (2012) we find that the fiscal multiplier in recessions is larger than in expansions. In the case of recessions, the multiplier is 0.73 on impact (and significantly different from zero) and reaches a peak of 1.25 after four semesters. In contrast, in expansions the multiplier is 0.09 (and not significantly different from zero) on impact and remains insignificant for any horizon.

The critical point to emerge out of this exercise of is that one can think of the single multiplier illustrated in Figure 1 as an "average" of panels A and B in Figure 2 that masks the estimate that we are presumably most interested in (i.e., the multiplier during recessions when policymakers are trying to stimulate the economy in order to raise output and employment).

Taken at face value, the implication of this finding is clear: increasing government spending in periods of recessions would stimulate output whereas increasing it in times of expansion would have essentially no effects. Further, since we have made no distinction between increases and decreases in government spending, it would also follow that reducing government spending in recessions (as many developing countries have historically done and many industrial countries are currently doing) would be quite contractionary whereas reducing spending in good times would have little, if any, effect.

3.3 Multipliers when government spending is increasing/decreasing

Following the empirical specification (3), we will first evaluate whether government spending going up or down matters for the size of the fiscal multiplier (i.e., even before taking into account the state of the business cycle). Table 1 indicates that government spending is above the long-term trend 48 percent of the time and below such trend 52 percent of the time. In a similar vein, Table 2 indicates that forecast errors are positive ($FE^G > 0$) 57 percent of the time and negative ($FE^G < 0$) 43 percent of the time.

Figure 3 shows the fiscal multipliers associated with government spending decreases (panel A) and increases (panel B). Interestingly enough, we find that the fiscal multiplier associated with increases in government spending is larger than the one associated with decreases in government spending. In fact, the multiplier for government spending increases is 0.49 on impact (and significantly different from zero) and reaches a maximum of 1.36 after four semesters. In sharp contrast, the multiplier when government spending falls is never significantly different from zero.

When comparing these multipliers to the ones obtained in Section 3.2, interesting similarities emerge. The profile obtained for the fiscal multiplier in periods of expansion (Figure 2, panel A) is similar to the fiscal multiplier associated with decreases in government spending (Figure 3, panel A). Both multipliers are not significantly different from zero. By the same token, the profile obtained for the fiscal multiplier in recessions (Figure 2, panel B) is similar to the fiscal multipliers associated with increases in government spending (Figure 3, panel B). Both fiscal multipliers have initial values that are less than 1 (but significantly different from zero) and long-run values that are larger than 1.

3.4 Fiscal multipliers in recessions and expansions: Does it matter whether government spending is increasing or decreasing?

Motivated by the findings from Sections 3.2 and 3.3, we now follow specification (4) and look into the possible interaction between recession/expansion and government spending increasing or decreasing.

Since we know from Figure 3 that, all else equal, the multiplier is higher when government spending is going up than down, one would conjecture that we are underestimating the multiplier in recessions because, on many occasions, government spending is going down instead of up (which is the implicit expectation). To correct for this "bias," one should compute the multiplier only in situations of recessions and government spending going up (i.e., the countercyclical fiscal multiplier in bad times).

To this effect, Figure 4 depicts the multiplier for each of the four possible categories: (i) expansion and decrease in government spending (panel A); (ii) expansion and increase in government spending (panel B); (iii) recession and decrease in government spending (panel C); and (iv) recession and increase in government spending (panel D).

Perhaps not surprisingly, the largest multiplier (in the medium and long-run) corresponds to category (iv); that is, recession and increase in government spending (Figure 4, panel D). In this case, the impact multiplier is 0.68 (and significantly different from zero) and reaches 2.28 after four semesters. The long-run (i.e., after 4 semesters) fiscal multiplier in this scenario is almost twice as large (2.28 versus 1.25) than the one found in Figure 2, panel B when we just focused on recessions without distinguishing between government spending going up or down. In sum, we see that, by not differentiating between increases or reductions in government spending, we are underestimating the value of the multiplier when government spending increases in bad times, which is presumably the case that we care the most. Conceptually, the multiplier shown in Figure 2, panel B is an "average" of panels C and D in Figure 4.

In contrast, the long-run output effect of reducing government spending in a recession (Figure 4, panel C) is not significantly different from zero (and point estimates are always smaller than 1 at any time horizon). In other words, the long term effects of fiscal austerity packages that emphasize government spending cuts seem to be relatively small (particularly when executed under typical recessionary environments). The impact multiplier, however, is 0.76 (and significantly different from zero) and reaches a peak of 0.79 (and significantly different from zero) after 1 semester. But after around 2 semesters, the multiplier becomes insignificant. This implies that the short term effects of fiscal austerity packages that emphasize government spending cuts are not trivial (this result emerges only when distinguishing government increases from decreases). In other words, and all else equal, this implies that the debt to GDP ratio will, in principle, barely improve in the short-term as a one dollar spending cut will reduce GDP by around 80 cents within a one year framework. These results are consistent with the "short-run pain, long-run gain" arguments often made when considering the implications of austerity packages. As we will see in Section 4, this is not the case when evaluating the implications of fiscal austerity packages in the context of extreme recessionary environments, where the remedy could actually be worse than the disease, and debt to GDP ratios could worsen on impact as a consequence of fiscal tightening.

A similar (yet less dramatic) situation arises when considering expansions, as illustrated in Figure 4, panel A and B. Recall that when we do not differentiate between government spending going up or down, the multiplier is zero (Figure 2, panel A). Once we make this distinction, the multiplier when government spending is going up becomes significantly different from zero after about 1 semester, eventually reaching 1.13, as follows from Figure 4, panel B. In contrast, Figure 4, panel A indicates that the fiscal multiplier is essentially zero at all horizons in the case that government spending is falling during an expansion.

In sum, the picture that emerges appears to be that countercyclical fiscal policy is rather effective in smoothing out output fluctuations (due to the effect of expansionary fiscal policy in recessions) whereas procyclical fiscal policy worsens output volatility (particularly due to the effect of expansionary fiscal policy in expansions). In addition, on impact – and while having a negative effect on output – a reduction in spending may help improve the debt to GDP ratio and the so-called "fiscal space" since the reduction in output associated with a dollar cut is smaller than one. As we will see in Section 4, this is not the case when evaluating the implications of fiscal austerity packages in the context of extreme recessionary environments.

4 Typical versus extreme business cycles

This section evaluates the size of fiscal multipliers in more severe/extreme recessions (like the ones recently experienced in some OECD countries) or, alternatively, during extreme booms. First, what happens when we do not differentiate between increases and decreases in government spending? Like in typical expansions, the multiplier in extreme expansions is not significantly different from zero on impact and remains insignificant for any horizon (Figure 5, panel A). In contrast, however, the fiscal multiplier in extreme recessions (panel B) is much larger than in typical recessions; almost 70 percent higher. On impact, the fiscal multiplier in a typical recession is smaller than one (0.73) but greater than one (1.21) in an extreme recession. In the long run, while the fiscal multiplier is 1.25 in a typical recession, it reaches 2.08 in an extreme recession. In other words, the size of the fiscal multiplier significantly increases with the severity of the recession but remains zero during booms.

What happens if we also differentiate between increases and decreases in government spending? Figure 6 shows the results. Two results are worth noting. First, the size of the fiscal multiplier associated with spending increases in extreme recessions (Figure 6, panel D) is almost 40 percent larger than in typical recessions (Figure 4, panel D): the impact effect increases from 0.68 to 0.92 and the long-run effect increases from 2.28 to 3.14. This result implies that the bang (in terms of output gains) for the buck increases as the recession becomes worse.[13]

Second, the implications of spending cuts change significantly. While, as discussed in Section 3.4, our findings for typical recessions were consistent with the "short-run pain and long-run gain" arguments often heard when considering the implications of austerity packages, this is not the case when focusing on extreme recessions. In extreme scenarios, the effect on both output and, hence, on the debt to GDP ratio is still driven by the "short-run pain, long-run gain" kind of argument, but the short-run pain may actually be associated with a worsening in the debt to GDP ratio. As Figure 6, panel C shows, the effect on output of a one dollar spending cut in an extreme recession is always larger than one. While, on impact, the size of the fiscal multiplier associated with a spending decrease is 0.76 for a typical recession, it reaches 1.23 in an extreme recession. Moreover, the long run effect reaches about 1.60 (borderline not significant). This evidence is thus consistent with cases such as Greece where, in spite of large fiscal cuts, the debt to GDP ratio has increased rather than decreased.

5 Explaining the differences in observed fiscal multipliers

Given the differences observed across fiscal multipliers in Section 4, this section provides some insights on the transmission mechanisms involved that could explain such differences.[14] While the objective of this section is not to develop a theoretical model that could explain our empirical findings, we aim at showing some key underlying forces that might help rationalize

[13] This evidence is consistent with that of Vegh and Vuletin (2013) who find that pursuing countercyclical fiscal policies during GDP crises reduces the duration and intensity (measured as the fall in output from start to trough) of GDP crises.

[14] While this section focuses on extreme recessions and booms, similar results follow when analyzing the effects during typical recessions and booms. Results are not shown for the sake of brevity.

our previous findings and identify factors that could serve as the basis for future theoretical research in this area. For this purpose, we replicate the exercise of Section 4 and specification (4) but focusing on GDP components:

$$\begin{aligned}
\Delta U_{i,t+h} &= \alpha_{i,h} + (1 - I(x_{i,t-1}))\, \beta_{E,h}^{POS} FE_{i,t}^{G_{POS}} + I(x_{i,t-1})\, \beta_{R,h}^{POS} FE_{i,t}^{G_{POS}} + \\
&+ (1 - I(x_{i,t-1}))\, \beta_{E,h}^{NEG} FE_{i,t}^{G_{NEG}} + I(x_{i,t-1})\, \beta_{R,h}^{NEG} FE_{i,t}^{G_{NEG}} + \\
&+ (1 - I(x_{i,t-1}))\, \lambda_{E,h}^{POS}(L) \Delta Y_{i,t-1}^{POS} + I(x_{i,t-1})\, \lambda_{R,h}^{POS}(L) \Delta Y_{i,t-1}^{POS} + \\
&+ (1 - I(x_{i,t-1}))\, \lambda_{E,h}^{NEG}(L) \Delta Y_{i,t-1}^{NEG} + I(x_{i,t-1})\, \lambda_{R,h}^{NEG}(L) \Delta Y_{i,t-1}^{NEG} + \\
&+ (1 - I(x_{i,t-1}))\, \Psi_{E,h}^{POS}(L) \Delta G_{i,t-1}^{POS} + I(x_{i,t-1})\, \Psi_{R,h}^{POS}(L) \Delta G_{i,t-1}^{POS} + \\
&+ (1 - I(x_{i,t-1}))\, \Psi_{E,h}^{NEG}(L) \Delta G_{i,t-1}^{NEG} + I(x_{i,t-1})\, \Psi_{R,h}^{NEG}(L) \Delta G_{i,t-1}^{NEG} + \\
&+ \varphi_1 T_{t,h} + \varphi_2 T_{t,h}^2 + \mu_{i,t,h},
\end{aligned} \tag{5}$$

where U represents the log changes in real consumption, investment, and net exports.[15] This specification will help us uncover the response of the different components of aggregate demand in response to a fiscal shock. We also analyze the effect on inflation by using the following

[15] Following standard practice, spending multipliers are then constructed by multiplying the IRF values by the mean value of U/G.

specification

$$\begin{aligned}\Delta INF_{i,t+h} &= \alpha_{i,h} + (1 - I(x_{i,t-1}))\,\beta_{E,h}^{POS} FEGDP_{i,t}^{G_{POS}} + I(x_{i,t-1})\,\beta_{R,h}^{POS} FEGDP_{i,t}^{G_{POS}} \quad (6)\\ &+ (1 - I(x_{i,t-1}))\,\Theta_{E,h}^{POS}(L)\Delta INF_{i,t-1}^{POS} + I(x_{i,t-1})\,\Theta_{R,h}^{POS}(L)\Delta INF_{i,t-1}^{POS} + \\ &+ (1 - I(x_{i,t-1}))\,\Theta_{E,h}^{NEG}(L)\Delta INF_{i,t-1}^{NEG} + I(x_{i,t-1})\,\Theta_{R,h}^{NEG}(L)\Delta INF_{i,t-1}^{NEG} + \\ &+ (1 - I(x_{i,t-1}))\,\lambda_{E,h}^{POS}(L)\Delta Y_{i,t-1}^{POS} + I(x_{i,t-1})\,\lambda_{R,h}^{POS}(L)\Delta Y_{i,t-1}^{POS} + \\ &+ (1 - I(x_{i,t-1}))\,\lambda_{E,h}^{NEG}(L)\Delta Y_{i,t-1}^{NEG} + I(x_{i,t-1})\,\lambda_{R,h}^{NEG}(L)\Delta Y_{i,t-1}^{NEG} + \\ &+ (1 - I(x_{i,t-1}))\,\Psi_{E,h}^{POS}(L)\Delta G_{i,t-1}^{POS} + I(x_{i,t-1})\,\Psi_{R,h}^{POS}(L)\Delta G_{i,t-1}^{POS} + \\ &+ (1 - I(x_{i,t-1}))\,\Psi_{E,h}^{NEG}(L)\Delta G_{i,t-1}^{NEG} + I(x_{i,t-1})\,\Psi_{R,h}^{NEG}(L)\Delta G_{i,t-1}^{NEG} + \\ &+ \varphi_1 T_{t,h} + \varphi_2 T_{t,h}^2 + \mu_{i,t,h},\end{aligned}$$

where INF represents the change in CPI-based inflation rate (measured in percentage points terms). In other words, an increase of the inflation rate from 3 percent to 4 percent, represents a 1 percentage point increase in INF.

Figures 7, 8, 9, and 10 show (like Figure 6 for output) the effect of government spending on consumption, investment, net exports, and inflation. Panels B in these figures (which captures the procyclical fiscal multiplier in good times) help us in understanding the fact that an increase in government spending has no effect on output during a boom (see Figure 6, panel B). Consumption and investment multipliers are not statistically significantly different from zero and net exports are borderline significant but the size is extremely small. On the other hand, inflation (see Figure 10, panel B) responds positively to such a procyclical fiscal behavior during a boom. These results are consistent with simple Keynesian frameworks, where an increase in aggregate demand (in this case as a consequence of an expansionary fiscal shock) in situations of full employment has no impact on economic activity but increases inflation.

What happens in the other case of fiscal procyclicality; that is to say, when government spending is reduced during a recession? The sizeable and statistically significantly fall in economic activity (see Figure 6, panel C) reflects the fall in investment, net exports, and, particularly, consumption (see panels C in Figures 7, 8, and 9). Interestingly, inflation does not change (see panel C in Figure 10). These results are also consistent with simple Keynesian models where we expect output to respond to reductions in aggregate demand (consumption, investment, and net exports).

What happens when we analyze the countercyclical fiscal multipliers? Panels A in Figures 7, 8, 9, and 10 show that the lack of effect on output of a reduction in government spending during a boom (see panel A in Figure 6) is explained by the fact that a reduction in government spending is offset by increases in consumption and net exports. Moreover, unlike the case of an increase in government spending during a boom (see panel B in Figure 10), reducing government spending during a boom does not create inflationary pressures (see panel A in Figure 10). In Section 4 we also found that pursuing a countercyclical policy during a recession (i.e., increasing government spending) has a positive and statistically significantly effect on output. Panels D in Figures 7 and 8 show that this mostly occur due to an increase in consumption and investment since net exports and inflation tend to decrease (see panels D in Figures 9, and 10).

In sum, our analysis for the different components of aggregate demand is fully consistent with our conventional wisdom from Keynesian models when it comes to the procyclical multipliers (i.e., no effect on output of increases in government spending during good times and a negative effect of output from reductions in government during recessions) but points to some puzzles when it comes to countercyclical multipliers. In particular, the behavior of aggregate demand components when government spending is reduced in good times is more reminiscent of neo-classical models (where reductions in government spending crowd in private spending) than Keynesian ones.

6 Conclusions

This paper has shown that when computing fiscal multipliers in expansion and recession, it is critical to distinguish between increases and decreases in government spending. Failure to do so introduces a downward bias in the estimation of the multiplier in recession because it includes cases in which government spending has gone down in bad times, which in and of itself results in a much lower multiplier in the long run. Specifically, the long-run multiplier for recession and government spending going up is 2.3 compared to 1.3 when we just distinguish between recession and expansion.

Maybe more subtle – yet very important both for expansionary and contractionary fiscal policy – is the distinction between typical and extreme recessions. In particular, the long-run multiplier for a typical recession and government spending going up is 2.3 compared to 3.2 when focusing on an extreme recession. Moreover, while cutting spending during typical recessions reduces output by less than one, doing so in extreme recessions reduces output by more than one (at the very least in the short and medium run). Applied to the current debate on austerity in the Eurozone, this would imply that debt to GDP ratios would *increase* in response to cuts in fiscal spending.

In general, our findings raise some intriguing analytical questions. The main question would be why changes in government spending may have an asymmetric effect during a recession. Understanding why the effect may be asymmetric in good times is, in principle, much easier because in a situation of full-employment increases in government spending should have no effect whereas reductions should. In fact, our analysis based on individual components of aggregate demand is fully consistent with simple Keynesian models for the case of procyclical multipliers but not for the case of a reduction in government spending during good times, which leaves the door open for future theoretical research in the area.

References

[1] Auerbach, Alan J., and Yuriy Gorodnichenko, 2010, "Measuring the output responses to fiscal policy," unpublished manuscript (UC Berkeley).

[2] Auerbach, Alan J., and Yuriy Gorodnichenko, 2012, "Fiscal multipliers in recession and expansion," NBER Working Paper No. 17447.

[3] Barro, Robert, and Charles Redlick, 2011, "Macroeconomic effects from government purchases and taxes," *Quarterly Journal of Economics* 126, pp. 51-102.

[4] Chan, K. S. and Tong, H., 1986, "On estimating thresholds in autoregressive models," *Journal of Time Series Analysis* 7, pp. 178-190.

[5] Driscoll, John C., and Aart C. Kraay, 1998, "Consistent covariance matrix estimation with spatially dependent panel data," *The Review of Economics and Statistics* 80*,* 549-560.

[6] Steven M. Fazzari, Steven M., James Morley and Irina Panovska, 2012, "State-dependent effects of fiscal policy," INET Research Notes 3, Institute for New Economic Thinking.

[7] Frankel, Jeffrey, Carlos A. Vegh, and Guillermo Vuletin, 2013, "On graduation from fiscal procyclicality," *Journal of Development Economics* 100, 32-47.

[8] Granger, Clive W., and Timo Terasvirta, 1993, *Modelling nonlinear economic relationships* (Oxford University Press).

[9] Jorda, Oscar, 2005. "Estimation and inference of impulse responses by local projections," *American Economic Review* 95, 161-182.

[10] Kaminsky, Graciela, Carmen M. Reinhart, and Carlos A. Vegh, 2004, "When it rains it pours: Procyclical capital flows and macroeconomic policies," *NBER Macroeconomics Annual.*

[11] Ilzetzki, Ethan, Enrique G. Mendoza, and Carlos A. Vegh, 2013, "How big (small?) are fiscal multipliers? *Journal of Monetary Economics* 60, pp. 239-54.

[12] Owyang, Michael T., Valerie A. Ramey, and Sarah Zubairy, 2013, "Are government spending multipliers greater during periods of slack? Evidence from 20th century historical data," NBER Working Paper No. 18769.

[13] Ramey, Valerie, 2011, "Identifying government spending shocks: It's all in the timing," *Quarterly Journal of Economics* 126*,* 1-50.

[14] Romer, Christina, and David Romer, 2010, "The macroeconomic effects of tax changes: Estimates based on a new measure of fiscal shocks," *American Economic Review* 100, 763-801.

[15] Stock, James, and Mark Watson, 2007, "Why has U.S. inflation become harder to forecast?" *Journal of Money, Banking and Credit* 39, 1-33.

[16] Vegh, Carlos A., and Guillermo Vuletin, 2013, "The road to redemption: Policy response to crises in Latin America," paper presented at the IMF's Annual Research Conference.

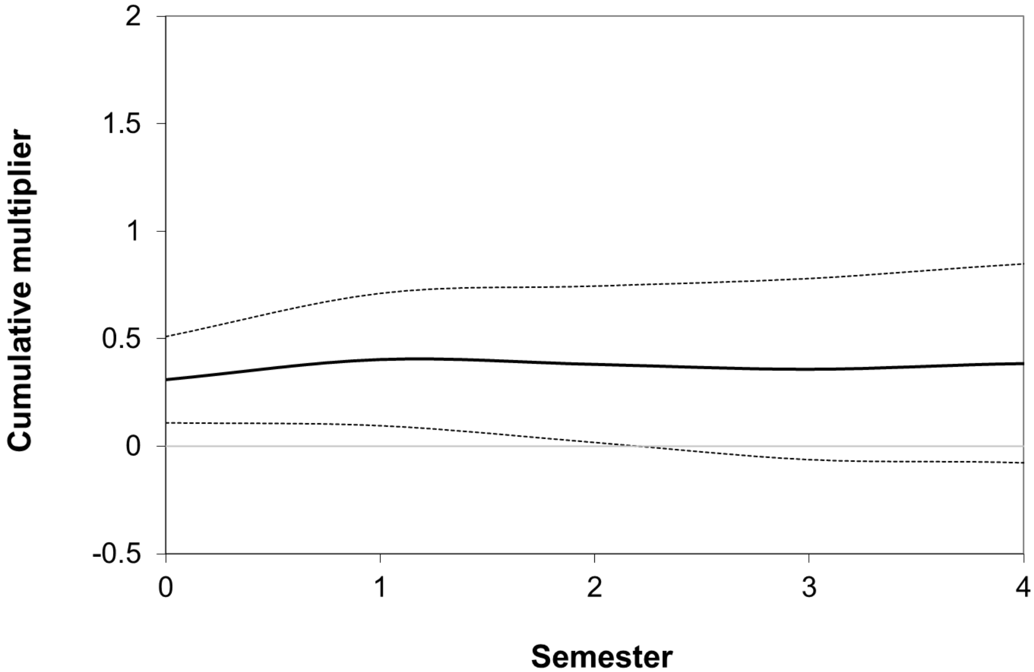
Table 1. State of the business cycle and government spending (using cyclical components of GDP and government spending)

		Government spending		
		Contractionary	Expansionary	*Total*
State of the business cycle	Expansion	29% <u>59%</u>	21% <u>41%</u>	50% <u>100%</u>
	Recession	23% <u>46%</u>	27% <u>54%</u>	50% <u>100%</u>
	Total	52%	48%	100%

Table 2. State of the business cycle and government spending (using government spending forecast errors)

		Government spending		
		Contractionary	Expansionary	*Total*
State of the business cycle	Expansion	25% <u>43%</u>	33% <u>57%</u>	57% <u>100%</u>
	Recession	18% <u>43%</u>	24% <u>57%</u>	43% <u>100%</u>
	Total	43%	57%	100%

Figure 1. GDP: Cumulative spending multiplier.
Single multiplier.

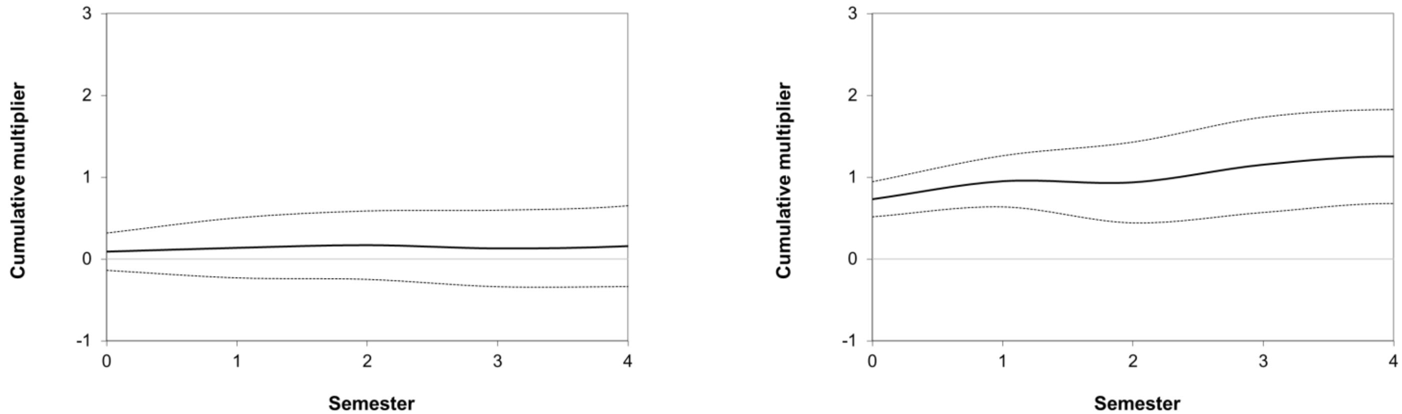


Note: Dashed lines refer to 90 percent confidence intervals.

Figure 2. GDP: Cumulative spending multiplier.
Typical economic expansions versus recessions.

Panel A. Expansions

Panel B. Recessions

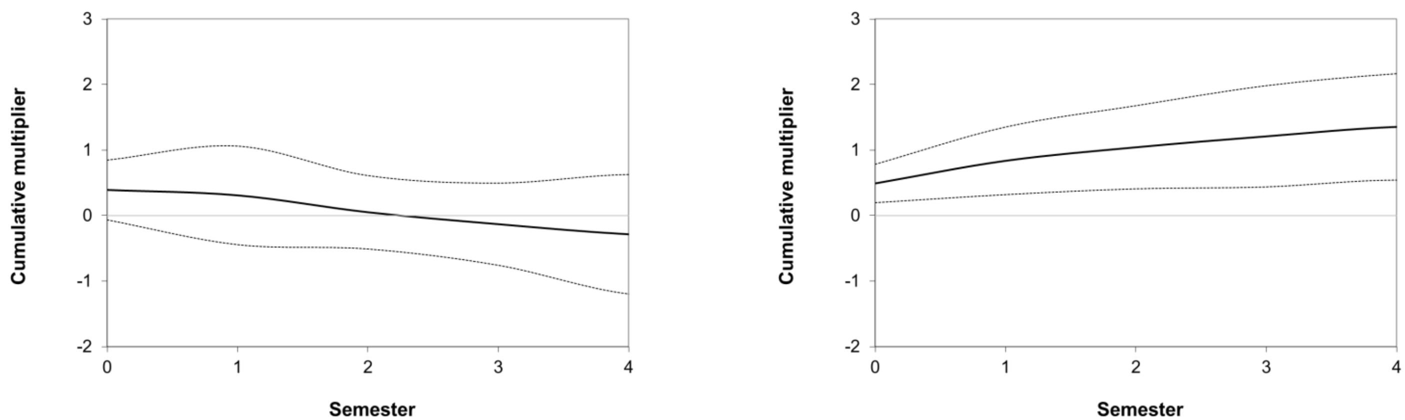


Note: Dashed lines refer to 90 percent confidence intervals.

Figure 3. GDP: Cumulative spending multiplier.
Decreases (ΔG<0) versus increases (ΔG>0) in spending.

Panel A. ΔG<0

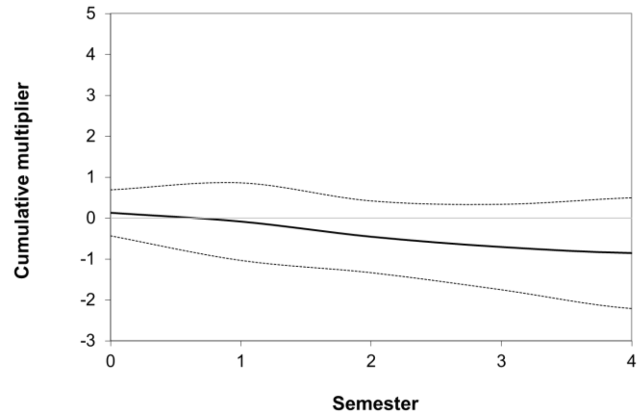
Panel B. ΔG>0



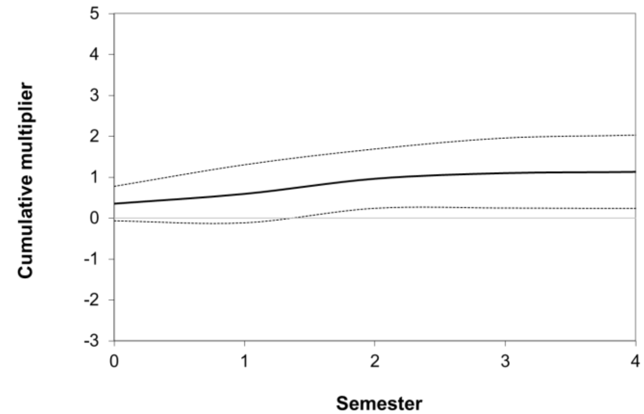
Note: Dashed lines refer to 90 percent confidence intervals.

Figure 4. GDP: Cumulative spending multiplier.
Typical economic expansions versus recessions, and decreases ($\Delta G<0$) versus increases ($\Delta G>0$) in spending.

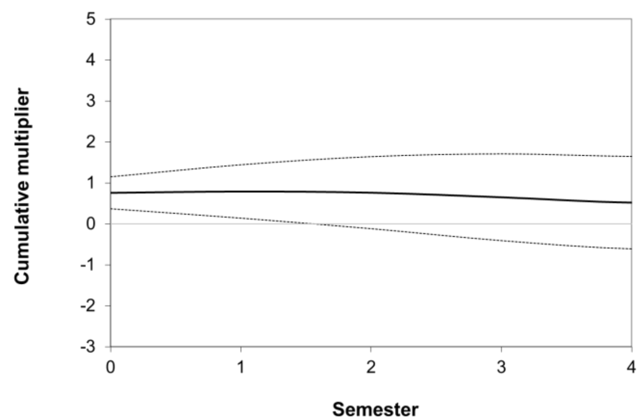
Panel A. Expansions and $\Delta G<0$



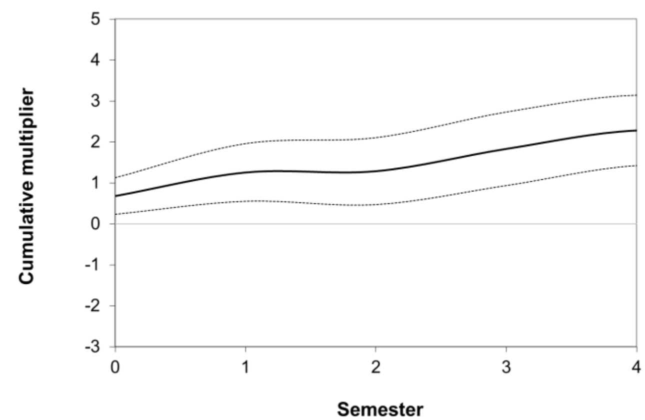
Panel B. Expansions and $\Delta G>0$



Panel C. Recessions and $\Delta G<0$



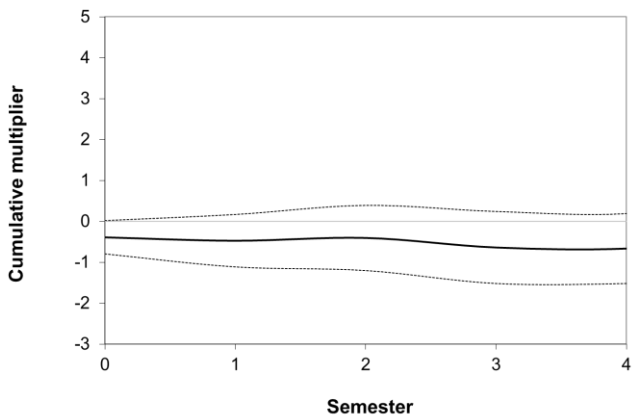
Panel D. Recessions and $\Delta G>0$



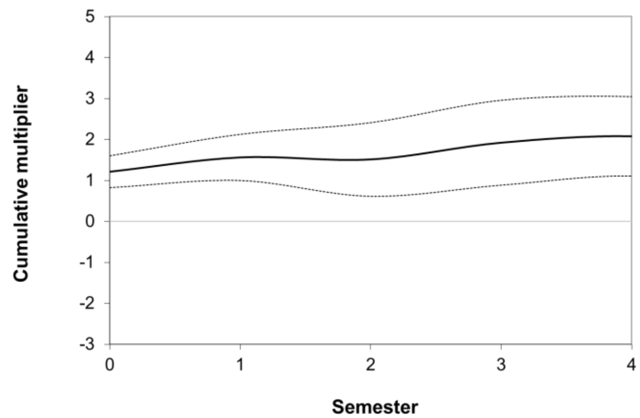
Note: Dashed lines refer to 90 percent confidence intervals.

Figure 5. GDP: Cumulative spending multiplier.
Extreme economic expansions versus recessions.

Panel A. Expansions

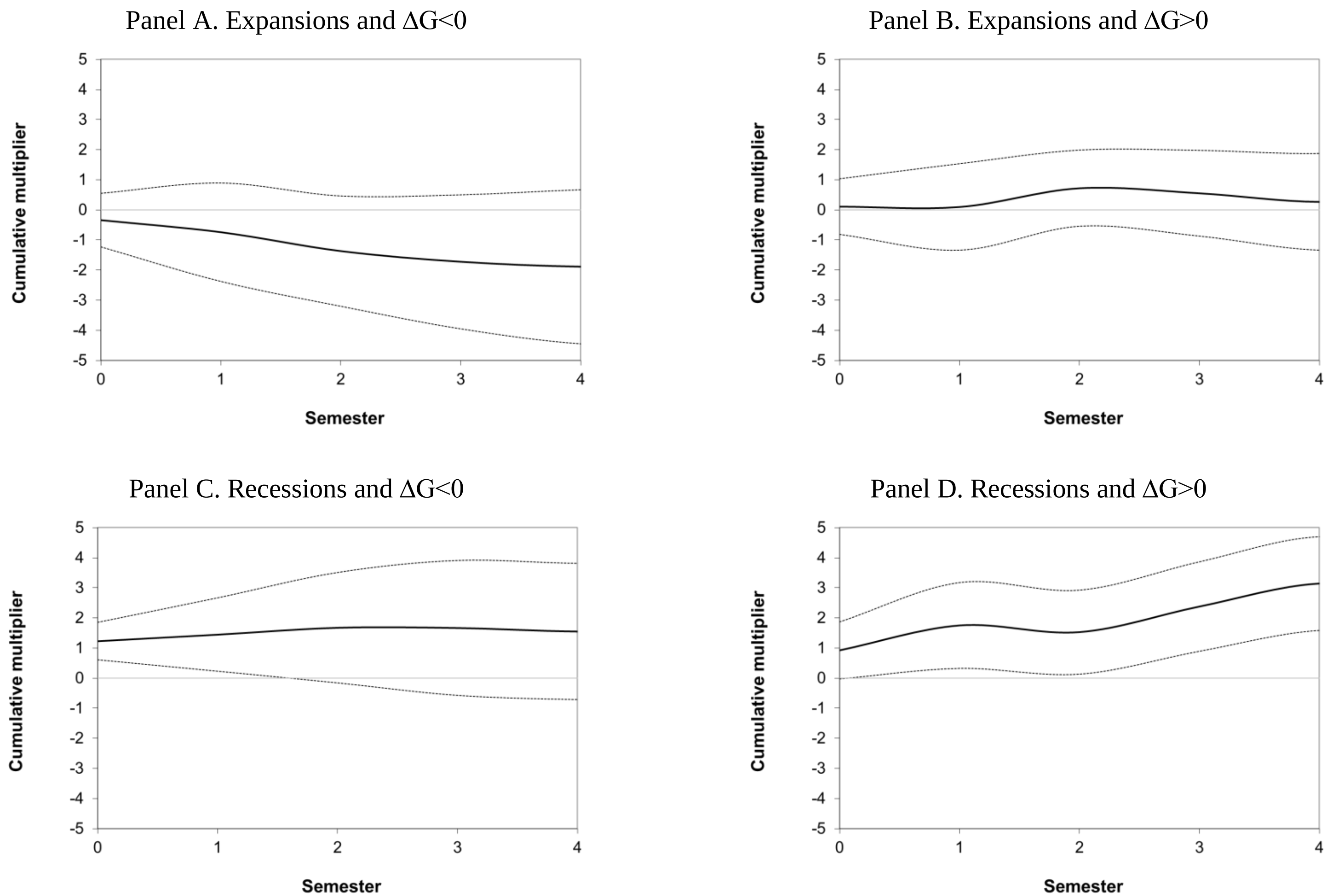


Panel B. Recessions



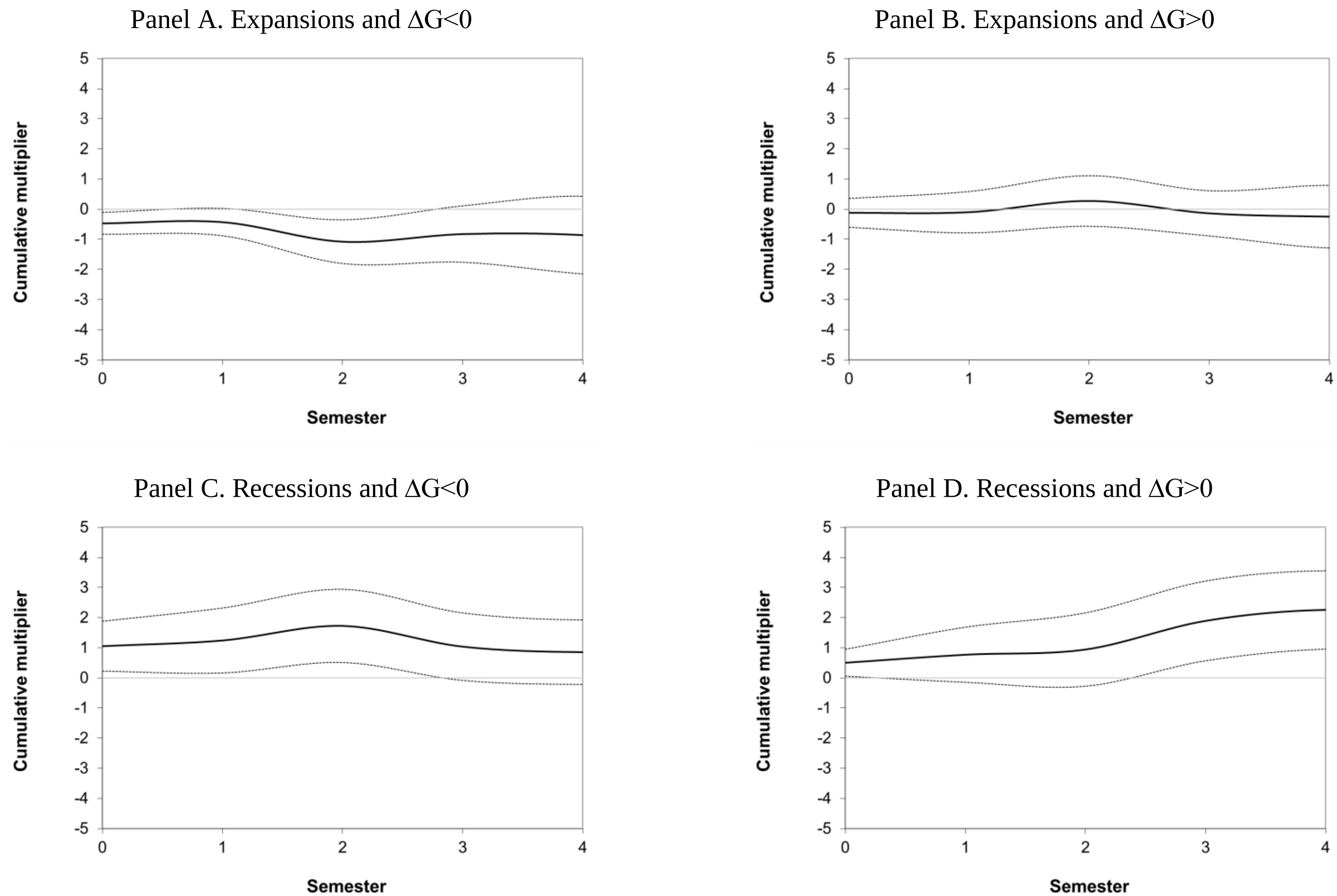
Note: Dashed lines refer to 90 percent confidence intervals.

Figure 6. GDP: Cumulative spending multiplier.
Extreme economic expansions versus recessions, and decreases (ΔG<0) versus increases (ΔG>0) in spending.



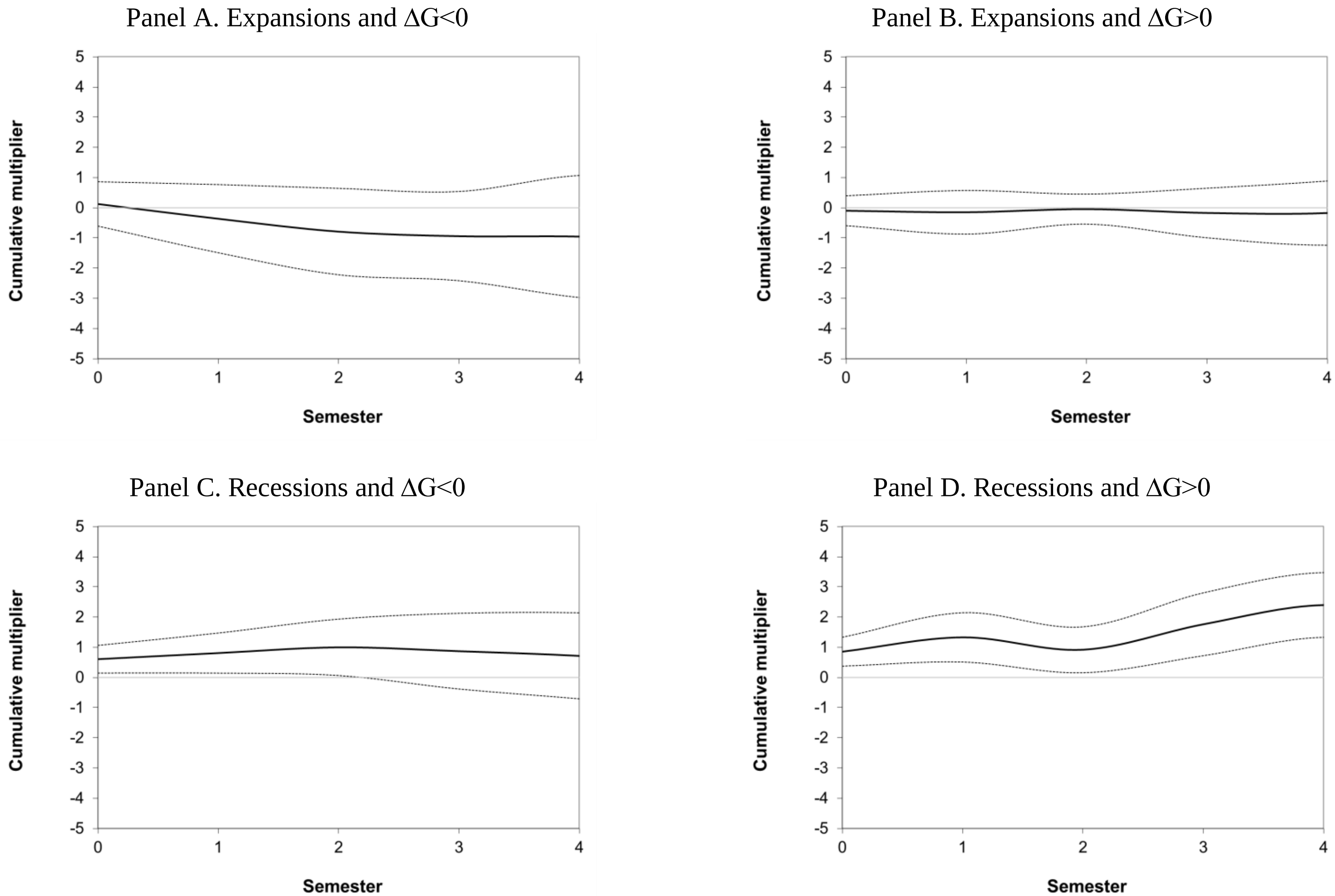
Note: Dashed lines refer to 90 percent confidence intervals.

Figure 7. Consumption: Cumulative spending multiplier.
Extreme economic expansions versus recessions, and decreases (ΔG<0) versus increases (ΔG>0) in spending.



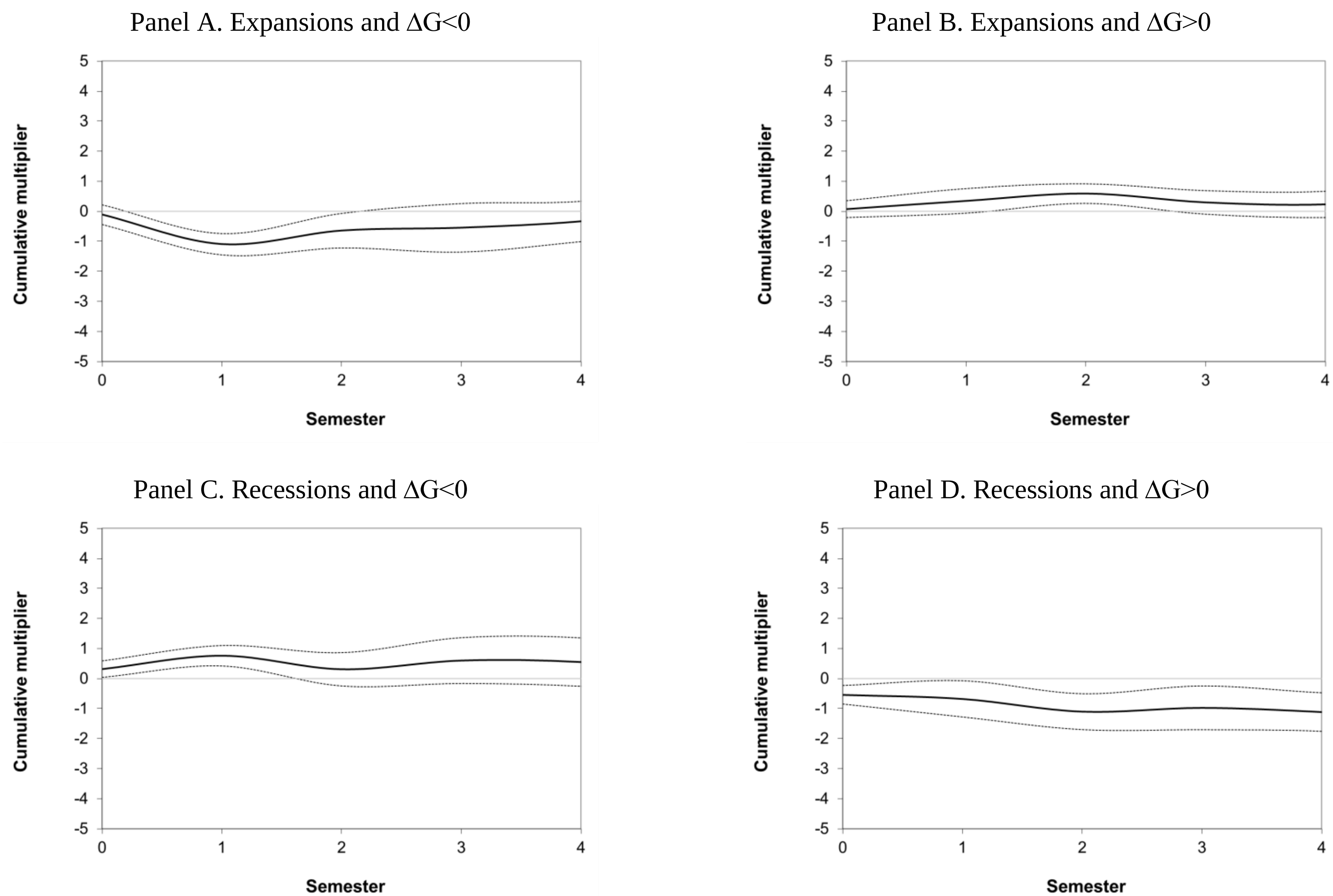
Note: Dashed lines refer to 90 percent confidence intervals.

Figure 8. Investment: Cumulative spending multiplier.
Extreme economic expansions versus recessions, and decreases (ΔG<0) versus increases (ΔG>0) in spending.



Note: Dashed lines refer to 90 percent confidence intervals.

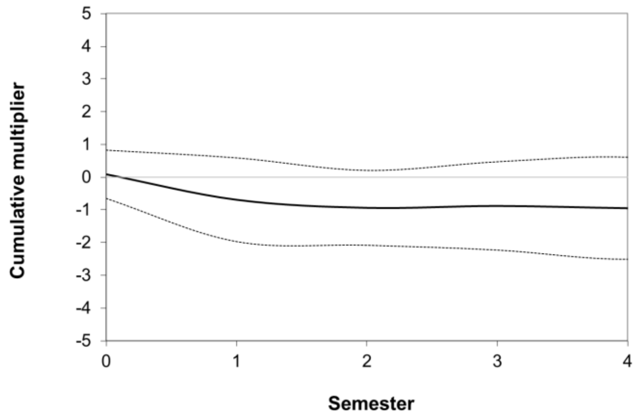
Figure 9. Net exports: Cumulative spending multiplier.
Extreme economic expansions versus recessions, and decreases (ΔG<0) versus increases (ΔG>0) in spending.



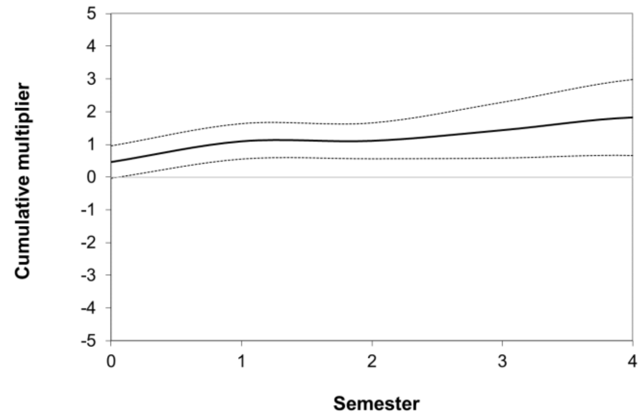
Note: Dashed lines refer to 90 percent confidence intervals.

Figure 10. Inflation: Cumulative spending multiplier.
Extreme economic expansions versus recessions, and decreases (ΔG<0) versus increases (ΔG>0) in spending.

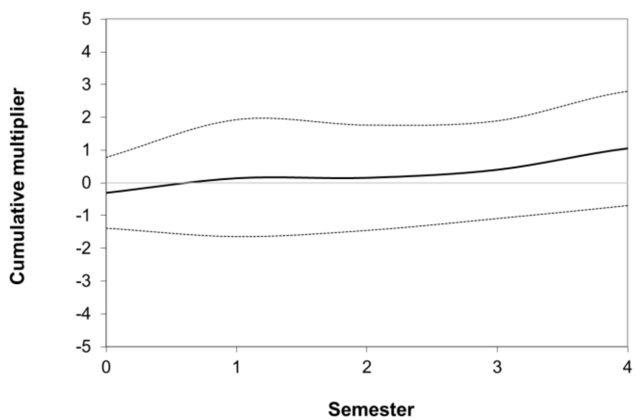
Panel A. Expansions and ΔG<0



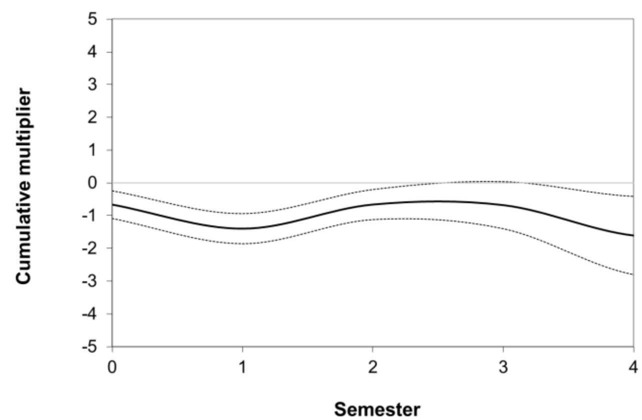
Panel B. Expansions and ΔG>0



Panel C. Recessions and ΔG<0



Panel D. Recessions and ΔG>0



Note: Dashed lines refer to 90 percent confidence intervals.