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WORKING PAPER

Heterogeneous Government Spending Multipliers in the Era Surrounding the Great Recession

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Abstract

We use a novel quarterly dataset of U.S. states to examine the dynamics and determinants of relative government spending multipliers in the decade surrounding the Great Recession. We find average multipliers that are similar to those that have been reported for the decades preceding the crisis, but this masks substantial heterogeneity. First, average cumulative multipliers were around 2 in the impact quarter, but declined to less than 1 after one year. Second, implied relative multipliers ranged between 0 and more than 4 across states at particular points in time, as well as for the same state at different moments within the sample period depending on the individual state's stance of the business cycle, household indebtedness and the interaction of both conditions. Finally, we provide evidence that, controlling for total expenditures, a mere redistribution of government spending across states did also had a significant influence on the aggregate U.S. economy due to cross-state heterogeneity of the effects.

JEL classification: C23, E32, E44, E62

Keywords: fiscal multiplier, household debt, Great Recession, regional redistribution

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1 Introduction

The impact of changes in government expenditures on economic activity has been a central question of macroeconomic research for many years. In this context, an increasing number of studies have used state-level panel data to estimate the effects of government purchases on local activity, i.e. so-called relative or local fiscal multipliers (e.g. Nakamura and Steinsson 2014; Shoag 2013; Brückner and Tuladhar 2013; Serrato and Wingender 2016; Dupor and Guerrero 2016). An advantage of this approach is that disaggregate data augments the number of observations and variation in the data substantially, which could increase the precision of the estimates. A drawback is that the results are not representative for the aggregate effects. In essence, these studies estimate relative multipliers across regions holding national effects of fiscal policy constant (Ramey 2011b).

Relative fiscal multipliers are, however, important in their own right. As demonstrated by Nakamura and Steinsson (2014), relative multipliers are powerful diagnostic tools for evaluating competing macroeconomic models. Moreover, a better understanding of relative multipliers is relevant for policymakers since business cycle fluctuations could be very diverse across regions and states. For example, annual real GDP growth in Michigan and Arizona collapsed by respectively -8.4% and -7.6% in 2009. At the same time, states like New York and Alaska recorded positive growth rates of 2.1% and 8.7%, respectively. In a currency union, local fiscal policy and redistribution of resources across subnational entities are among the few remaining policy tools for stabilizing local business cycles and smoothing asymmetric shocks.

Notwithstanding their relevance, existing studies on relative multipliers are only of limited use for policymakers in practice. In particular, such multipliers have so far been estimated with annual or lower frequency data. Given that there are implementation lags for fiscal policy and recessions typically last less than one year, it is not clear whether and how these annual multipliers are informative for dampening local economic fluctuations. Furthermore, due to the annual frequency of state-level data, state relative multipliers are typically estimated over very long sample periods (e.g. 1966-2006 in Nakamura and Steinsson 2014; 1951-2014 in Dupor and Guerrero 2016). In the meantime, however, it is well known that fiscal multipliers are not structural constants and may depend on various features of the economy that vary over time and across states (Hall 2009). Auerbach and Gorodnichenko (2012) have for example documented that increases of national government purchases are much more effective in recessions than expansions, while Bernardini and Peersman (2015) find considerably larger

aggregate multipliers in periods of private debt overhang. Both findings also receive ample theoretical support (e.g. Michaillat 2014; Canzoneri et al. 2016; Eggertsson and Krugman 2012; Andrés et al. 2015). Relative multipliers for individual states at a specific moment in time may hence substantially diverge from the average tendency. Accordingly, average relative multipliers are probably not very helpful for policymakers in real time, such as in the midst of the recent financial crisis. Finally, average relative multipliers are not useful to assess the national benefits of mere redistributions of government spending across regions, i.e. the aggregate effects of such policies on economic activity are by construction neutral.

In the present study we try to fill several of these gaps. More precisely, using a novel quarterly dataset of U.S. states over the sample period 2005Q1-2015Q4, we estimate state relative government spending multipliers and the key determinants of the multipliers in the era surrounding the Great Recession with instrumental variables panel local projection methods in the spirit of Ramey and Zubairy (2016). This period is particularly interesting given the policy and academic debates on the question whether the effects of fiscal policy were different than in normal times (e.g. Eggertsson and Krugman 2012; Blanchard and Leigh 2013; Ramey and Zubairy 2016), and the fact that this episode has been characterized by a substantial implicit relocation of government resources across states.[1] The dataset is entirely based on publicly available information that has recently been released. Specifically, we use the Regional Economic Accounts database of the Bureau of Economic Analysis (BEA) to obtain state-level GDP and government value added at a quarterly frequency, while we use the Consumer Credit Panel dataset of the Federal Reserve Bank of New York (FRBNY) to collect state-level household debt series.

These data sources have several advantages to tackle the above issues. First, it allows us to estimate relative government spending multipliers at a quarterly frequency, and analyze the macroeconomic dynamics at different horizons following the fiscal policy impulse. Second, due to the large number of observations compared to annual datasets, the multipliers can be estimated over shorter periods and still have accurate estimates. We demonstrate this is at least the case for the period surrounding the Great Recession, which has been an era with substantial variation in government spending. Third, the dataset allows us to investigate the role of several potential determinants for the size and dynamics of relative multipliers. In particular, we assess whether relative multipliers in this period depended on the stance of the

[1]For example, Chodorow-Reich et al. (2012) document that the level of federal money received by states in the context of the ARRA's Medicaid match program between 2009 and June 2010 varied between $103 dollar per person aged 16 or older in Utah and $507 in DC, with an interquartile range of $114.

business cycle, the amount of private debt, as well as the interaction of both conditions at the state level. Since business cycles and household debt have varied substantially across states during this period, there is again a lot of heterogeneity in the data that can be exploited to pin down their influence on multipliers. Finally, a quarterly dataset for state-specific government value added and GDP allows us to apply the popular Blanchard and Perotti (2002) approach to directly identify exogenous shocks to government expenditures, rather than relying on indirect methods such as the Bartik (1991) instrument approach. In sum, the results of our quarterly estimations should provide useful insights for fiscal policymakers and the stabilization of state business cycles, as well as a better understanding of the dynamics and determinants of multipliers. The latter is, in turn, helpful to assess the national consequences of fiscal redistribution policies.

The estimations reveal several new insights about relative multipliers. First, whereas state relative multipliers were on average quite similar to multipliers that have been documented in the literature for the decades preceding the crisis (e.g. Nakamura and Steinsson 2014), we uncover important within-year evolutions. In particular, we find average cumulative multipliers that are highly significant and almost 2 in the impact quarter, but quickly decline to become less than 1 after one year and around 0.7 at longer horizons.

Furthermore, we find that there has been substantial heterogeneity in the magnitude and the dynamics of relative multipliers across states and over time. Specifically, relative multipliers turned out to be considerably larger, reaching values above 3, and did not decrease at longer horizons when a state was in a (deep) recession at the moment of the shift in government expenditures. In addition, the magnitude of the multiplier was significantly influenced by the state's private indebtedness. A one standard deviation higher household debt-to-income ratio was associated with an increase of the multiplier by approximately 0.3 outside recessions, by 0.5 when the state was in a recession, and even by 1.7 in deep recessions. To demonstrate the relevance of these characteristics for multipliers in practice, we calculate the implied relative multipliers of all states at the moment when the American Recovery and Reinvestment Act (ARRA) stimulus package was enacted, and find values across states ranging between 0 and more than 4 in the medium run. Similarly, we show examples of implied relative multipliers that ranged between 0 and 4 for the same state at different points in time within the sample. These findings suggest that the business cycle and degree of private indebtedness of U.S. states are key drivers of relative multipliers and should be taken into account when designing fiscal policies.

Can we learn something about the aggregate effects of fiscal redistribution policies? The

fact that the government can move output around does not necessarily imply it can also increase aggregate activity. For example, an increase of output in one state associated with lower activity elsewhere also induces a shift in relative output (Cochrane 2012). However, the above results suggest that redistribution of government expenditures from a state with a growing economy or low household debt levels to states that are in a recession or have relatively high household debt ratios and hence larger relative multipliers, should also stimulate aggregate economic activity. To test this conjecture more directly, we construct a simple indicator that proxies changes in the regional distribution of aggregate U.S. government spending towards states in a recession or states with high household debt ratios. We then estimate the macroeconomic effects of innovations to this indicator controlling for changes in aggregate government expenditures. We find that shifts in the distribution of spending towards states that are potentially more sensitive to fiscal policy indeed had a significant positive effect on aggregate U.S. real GDP. These results indicate that mere targeted redistributions of government expenditures across states can be beneficial for the aggregate economy as well.

The rest of the paper is organized as follows. In the next section, we describe our quarterly dataset and present the results for the average (linear) state relative multipliers in the period surrounding the Great Recession. Section 3 examines the underlying drivers of state multipliers, while section 4 analyzes whether a simple redistribution of government spending across states could also influence the aggregate economy. Section 5 concludes.

2 Average relative multipliers

2.1 Quarterly state-level dataset

The analysis in this paper is based on a novel quarterly panel dataset at the level of U.S. states, covering the 50 states and the District of Colombia. The dataset draws entirely from publicly available, easily accessible and recently released time series for the individual states. We use the Regional Economic Accounts (REA) of the BEA to collect state-level quarterly data on GDP and its main components. The sample period, based on data availability, is 2005Q1-2015Q4, which allows us to estimate the dynamics of relative government spending multipliers across states during the period surrounding the Great Recession. This is an era that receives a lot of attention in the fiscal policy literature. For example, Blanchard and Leigh (2013) have shown that aggregate government spending multipliers were much larger

during the Great Recession than in normal times. In section 3, we will merge the data with household debt information obtained from the Consumer Credit Panel (CCP) of the FRBNY to examine the determinants of the multipliers during this period.[2]

Figure 1 summarizes the evolution of the key variables that will be used to estimate government spending multipliers, namely state-level government value added and gross domestic product per capita. Notice that state-level government value added is comprised of compensation of government employees and consumption of government capital. Examples are education, policy and military personnel services. Government value added is a subcomponent of government purchases that also includes government purchases of goods from the private sector, such as aircraft carriers or tanks.[3] The advantage of this component (in combination with our identification approach discussed in section 2.2) is that it implies that government production and government spending shocks effectively took place in the state and not elsewhere, while all other production in the state is carried out by the private sector. This is a more precise measure of local government spending shocks than instruments based on the Bartik (1991) allocation approach, which measures local spending shocks as national changes in e.g. military spending scaled by a state-specific scaling factor.[4] A drawback of state-level government value added is, however, that the expenditures are funded by the federal as well as the state's budget, which implies that local taxes do not necessarily remain constant in response to the shocks. In contrast to national (military) spending that is distributed across states or mere transfers from the federal government to the regions, this could potentially affect the estimations, which is a caveat that should be taken into account when interpreting the results. State-level GDP, on the other hand, covers the total contribution of private and public sectors to overall GDP and can be seen as the state counterpart of national GDP. Another advantage of the REA data is that it contains both nominal and real GDP series for the states. We can hence use state-specific GDP deflators to deflate nominal variables, rather than having to rely on national (aggregate) price indexes to do so. Finally, we use state-level population data to express real variables in per capita terms.

[2]The REA-BEA quarterly state-level data were officially released in December 2015 and the CCP-FRBNY data were publicly released in December 2016. See the data appendix for detailed information on the exact sources of the data. We are not aware of studies that have used the REA-BEA data yet. The CCP-FRBNY data have been used by Albuquerque (2017) to study the role of monetary policy for household debt cycles.

[3]See Ramey (2013) for a detailed explanation and discussion of this aggregate.

[4]For example, Dupor and Guerrero (2016) use the ratio of a state's share of national spending divided by the state's share of national income as a scaling factor to obtain an instrument for local shocks.

Figure 1 depicts the evolution of the cross-sectional averages of both aggregates over time, whereas the shaded gray areas represent respectively the 35th-65th (dark gray), the 20th-80th and the 5th-95th percentiles (light gray) of the individual states. Besides non-negligible average volatility over time, the graphs reveal considerable cross-state heterogeneity in the signs and magnitudes of the changes in both aggregates within the sample period. In addition to the quarterly frequency, the large extent of variation coming from the use of disaggregate data is a key advantage of our dataset to obtain precise and reliable relative spending multipliers for this period.

2.2 Methodology

We examine the dynamics of the cumulative government spending multiplier, which is the ratio of the cumulative changes in gross domestic product and government spending at time $t+h$ induced by a government spending shock at time t. By taking into account the entire volume of government spending between t and $t+h$ induced by the initial shock, this indicator is a fair measure of the medium-run effects of fiscal shocks on economic activity. Following Ramey (2016), we directly estimate the cumulative multiplier over a two-year horizon ($H = 8$) using the following instrumental variables model, which is based on Jorda's (2005) local projections methods:

$$\sum_{l=0}^{h} \tilde{g}_{it+l} = \beta_h^{1S} \tilde{g}_{it} + \gamma_h^{1S}(L) ctr_{it-1} + \alpha_{ih}^{1S} + \delta_{th}^{1S} + \varepsilon_{it+h}^{1S} \tag{1}$$

$$\sum_{l=0}^{h} \tilde{y}_{it+l} = \beta_h^{2S} \left(\widehat{\sum_{l=0}^{h} \tilde{g}_{it+l}} \right) + \gamma_h^{2S}(L) ctr_{it-1} + \alpha_{ih}^{2S} + \delta_{th}^{2S} + \varepsilon_{it+h}^{2S} \tag{2}$$

for $h = 0, \ldots, H$.

Equation (1) represents the first stage regression, where the cumulative path of government spending per capita $\sum_{l=0}^{h} \tilde{g}_{it+l}$ in a U.S. state i between t and $t+h$ is regressed on government spending per capita at time t, $\tilde{g}_{it}$, a set of control variables ctr_{it-1}, state-specific effects α_{ih} and time-specific effects δ_{th}. In the second stage (2), the regression of the cumulative path of gross domestic product per capita $\sum_{l=0}^{h} \tilde{y}_{it+l}$ on the instrumented cumulative path of government spending provides an estimate of the cumulative multiplier β_h^{2S} and its statistical uncertainty. In both equations, ε_{it+h}^{1S} and ε_{it+h}^{2S} capture the residual variation.

The quarterly frequency of our state-level dataset allows us to apply the popular Blanchard and Perotti (2002) identification method, which exploits the timing assumption that, due to the presence of political and institutional delays, the amount of government expenditures made in a state i in a quarter t depends on a set of *predetermined* variables ctr_{it-1}. The inclusion of ctr_{it-1} among the regressors isolates the autonomous component in $\tilde{g}_{it}$. Our set of predetermined variables includes four lags of state-level government production and GDP. Put differently, we assume that government production in an individual state does not react on impact to innovations in state GDP.[5] Furthermore, fixed effects allow to control for state-specific characteristics that are constant over time, while time effects control for aggregate shocks and common policies such as changes in monetary policy, aggregate taxes and national government spending. The use of time effects implies that we estimate "relative" state multipliers, which should be interpreted as the effects of an increase in government expenditures in one state relative to another on relative output (Nakamura and Steinsson 2014). Relative multipliers are thus conceptually different from aggregate multipliers.[6]

Following Hall (2009), we express the variables in the model as follows:

$$\tilde{v}_{it+l} = \frac{\Delta_{l+1} v_{it+l}}{y_{it-1}}$$

where v_{it} is a generic income variable in real per-capita terms. This specification guarantees that government spending and GDP are in the same units, which allows to interpret β_h^{2S} as a multiplier (i.e. not as an elasticity). The use of an ex-ante transformation does not only provide a direct estimate of the multiplier, but it also minimizes the potential bias associated with the alternative ex-post conversion of the estimated elasticity in a multiplier. As noted in Ramey and Zubairy (2016), ex-post transformations are only sensible when the level of government spending as a share of gross domestic product (G/Y) is fairly constant in the sample. Similarly to the case of time-series models using historical data, which have to deal with a massive increase in the share of government spending around WWII, panel

[5] A drawback of the Blanchard and Perotti (2002) identification method is that these shocks may be predictable and hence not fully unanticipated. Ramey (2011a) has shown that this is the case for the U.S. at the aggregate (national) level. Several studies have, however, shown that accounting for the predictability at the aggregate level does not significantly affect the results (e.g. Mertens and Ravn 2010). It is not possible to check this at the level of all individual states given lacking data, but if anticipation does not change the aggregate multiplier significantly, it is probably also not a major problem for the estimation of state multipliers.

[6] When we omit the time effects from the estimations (and include four lags of aggregate government spending and GDP as control variables), we obtain quite similar multipliers. This stands in sharp contrast to Dupor and Guerrero (2016), who find multipliers that are considerably larger without time effects.

models using disaggregate U.S. data have to deal with the fact that the share might be highly different across states. In our sample, the spending shares range between 9% and 37%, with a cross-sectional average of 14%. The use of an ex-ante transformation hence provides a direct and accurate way to retrieve the size of the multiplier.

We estimate the model in equations (1)-(2) using the fixed effects estimator. The standard errors in both equations are based on the Driscoll and Kraay (1998) correction, which takes into account the potential residual correlation across U.S. states, as well as serial correlation and heteroskedasticity among the residuals over time. The standard errors in equation (2) are further adjusted in order to take into account the uncertainty related to the first stage regression (1). To allow for a comparison of the estimates across horizons h, we hold the sample constant (i.e. by using the sample for the longest horizon, $H = 8$), leaving us with a balanced macro panel consisting of 1581 observations.

2.3 Estimation results

The benchmark results are shown in Figure 2. The green solid line represents the size of the cumulative relative multiplier β_h^{2S} over a horizon of eight quarters, while the dark and light shadings are the 68 and 90 percent Driscoll-Kraay adjusted confidence bands, respectively. Overall, the multipliers are estimated with good precision. Although it is difficult to compare our quarterly cumulative spending multipliers with other studies, a first interesting observation is that state relative multipliers during the decade surrounding the Great Recession were on average quite similar to those reported in the literature for the decades before the financial crisis. We obtain an "average" relative multiplier of 1.6 during the first year and 1.2 during the first two years. As a benchmark, Nakamura and Steinsson (2014) regress two-year changes in output on two-year changes in spending and find relative multipliers that range between 1.3 and 1.9 for the period 1966-2006 depending on the model specification. Serrato and Wingender (2016) report values in the range of 1.7 and 2.2 based on an analysis of U.S. counties on four-years intervals during the 80s, 90s and 2000s, while Shoag (2013) presents an estimate of 1.4 for the fiscal multiplier in U.S. states for the period 2008-2009.

In contrast to these (and related) studies using regional annual or lower frequency data, the quarterly frequency of our data series allows to shed light on the within-year dynamics of the cumulative multiplier. These dynamics appear to be sizable in our sample. The impact multiplier is 1.9. This implies that there is a 0.9 dollar increase (decrease) in relative private

sector production for every dollar increase (decrease) in relative government value added. However, the size of the cumulative multiplier gradually declines at longer horizons. After four quarters, relative multipliers even become less than 1.0, in order to stabilize around 0.7 after about two years. This decline is measured with precision and indicates that the medium-run effectiveness of fiscal policy to smooth asymmetric evolutions in states' business cycles is moderate. These dynamics suggest that the use of quarterly data is not only useful for the identification of regional fiscal policy shocks, but also provides relevant information for policymakers and the construction of models to study fiscal policy. The important within-year dynamics that result from our estimations imply, for example, that the typical use of lower frequency (i.e. annual or biannual) data can misrepresent the effectiveness of fiscal policy at very short horizons, hence providing misleading policy recommendations. Multipliers that quickly decrease in value over subsequent quarters may be related to the persistence of the fiscal shocks, the type of fiscal policy instrument (Batini et al. 2014) or reflect time-varying factors such as accelerator effects in recessions (Canzoneri et al. 2016). A detailed analysis of the reasons is out of the scope of this paper.

3 Heterogeneous relative multipliers

Fiscal multipliers that are estimated in empirical studies measure the effectiveness of an average government spending shock within the sample period. However, the actual size of the multiplier in a specific state at a particular point in time may significantly differ from the general tendency. Specifically, multipliers are not structural characteristics of the macroeconomy, and their size can differ over time but also across states. From a policy perspective, in the presence of multipliers that change depending on underlying conditions of the economy, linear estimates as the ones shown in Figure 2 may provide a misguided source of information. In this section, we assess the relevance of some key possible determinants of relative fiscal multipliers across states.

3.1 Determinants of relative multipliers

Blanchard and Leigh (2013) have argued that the failure to recognize an upward change in the magnitude of fiscal multipliers during the Great Recession and its aftermath has significantly contributed to the growth forecast errors made by policy institutions. Inspired by these considerations, the literature has shown an increasing interest in the analysis of how the

effectiveness of fiscal policy may change under certain economic and financial conditions. The amount of private debt accumulation prior to the start of the Great Recession and the impact of leverage on the recession have directed researchers towards exploring the role played by the business cycle and the degree of private indebtedness in affecting the transmission of fiscal policy. We examine whether both conditions, as well as their interaction, matter for relative multipliers across states.[7]

Business cycle The influence of the business cycle on fiscal multipliers reflects the Keynesian argument that government spending is more effective during periods of economic slack. From a theoretical perspective, Michaillat (2014) obtains countercyclical multipliers based on a model where the presence of search-and-matching features in the labor market leads to less crowding-out of private sector resources in recessions. Canzoneri et al. (2016) retrieve stronger multipliers of public spending in recessions as a result of countercyclical financial frictions and credit constraints in a macro model with costly financial intermediation, which results in a stronger financial accelerator in recessions. The strength of the financial accelerator and the magnitude of the government spending multiplier depends on the spread between borrowing and lending at the moment of the fiscal impulse, i.e. the intensity of financial frictions. Hence, this mechanism might have been particularly important in the financial crisis.

There are already several empirical studies that have focused on the effects of fiscal policy during recessions or periods of slack. The results are mixed. Auerbach and Gorodnichenko (2012) find that aggregate U.S. multipliers are larger during recessions than in expansions. Caggiano et al. (2015) find that this is only the case in deep recessions, while Owyang et al. (2013) and Ramey and Zubairy (2016) find no influence of the business cycle on government spending multipliers. At the regional level, Nakamura and Steinsson (2014), Brückner and Tuladhar (2013) and Serrato and Wingender (2016) all document a larger multiplier during periods of economic slack.

The left panel of Figure 3 shows the incidence of state-level recessions in our sample. It shows the percentage of U.S. states experiencing a recession at each quarter of the sample

[7]Other popular determinants of fiscal multipliers that have been documented in the literature are the stance of monetary policy (Christiano et al. 2011) or the level of government debt (Perotti 1999). Both features can, however, not explain the magnitude of relative fiscal multipliers. One of the advantages of disaggregate data is hence that these features can also not distort the estimations and the role of the other determinants.

period, where recessions are defined as a negative state-level real GDP growth for at least two consecutive quarters. For example, 80% of the states were experiencing a downturn during the Great Recession between 2008Q1-2009Q2, while the remaining 20% were not. Also outside this period, several states experienced a prolonged decline in real GDP. For example, in the second half of 2012, nearly 60% of the states suffered a drop in activity of at least two consecutive quarters. These differences could result in heterogeneous multipliers.

In the empirical analysis, we will make a distinction between recessions and deep recessions, where the latter are defined as periods in which the drop of real GDP was greater than the sample average decline for at least two quarters.[8] The deep recessions are also shown in the left panel of Figure 3 (red bars), and account for approximately one-third of all recessions. This simple split-up allows us to examine the influence of the intensity of a recession on state government spending multipliers. This can be motivated by the findings of Caggiano et al. (2015) at the aggregate level. In addition, the intensity of financial frictions and financial accelerator mechanism described in Canzoneri et al. (2016) are likely much stronger in severe recessions.

Household debt Besides the role of the business cycle, theoretical studies have more recently advanced the idea that also private indebtedness is important for the size of government spending multipliers. Specifically, debtors tend to have a larger marginal propensity to consume out of current income relative to lenders, which implies that they will increase (decrease) their consumption much more to changes in income than others. This, in turn, results in higher multipliers. Such a mechanism has been formally demonstrated by Eggertsson and Krugman (2012) and Andrés et al. (2015) by assuming that debtors face binding borrowing constraints. In Kaplan et al. (2014) and Kaplan and Violante (2014), instead, debtors who own large illiquid assets (e.g. houses) may display so-called hand-to-mouth behavior independently from the presence of borrowing constraints. A common implication of these models is that fiscal policy during the last decade might have been much more effective in states with high debt burdens.

There are also a number of empirical studies that find a positive impact of household

[8] As an alternative business cycle indicator, we have also explored whether relative spending multipliers depended on unemployment. In contrast to Nakamura and Steinsson (2014), we find little impact of the state's unemployment rates on the multiplier within our sample period. A possible explanation is that unemployment rates were not an accurate measure of slack during this period because many employees left the labor market when they lost their job. In addition, unemployment was relatively high during the whole sample period, which makes it difficult to differentiate periods of high and low slack.

debt on the size of fiscal multipliers. Bernardini and Peersman (2015) find the aggregate government spending multiplier in the U.S. over the past century to be higher in periods of private debt overhang relative to periods where debt is below its trend. Klein (2016) confirms this finding for a panel of OECD countries and the consequences of austerity measures. Finally, Demyanyk et al. (2016) use cross-sectional data of U.S. metropolitan and micropolitan areas, and find that output is relatively more affected by government spending in areas with more consumer debt.

The amount of household debt may hence also result in heterogeneous multipliers across states. Private indebtedness has indeed been very different across states. This is illustrated in the right panel of Figure 3, which summarizes the variation of household debt across states in our sample period. The information is based on the second recently released data source that we use in this paper, i.e. the Consumer Credit Panel of the FRBNY. The data are annual. Household indebtedness is measured as the outstanding value of household mortgage debt in a U.S. state divided by personal income.[9] The cross-sectional average captures the hump-shape dynamics in the debt-to-income ratio, which went from 60% in 2005 to nearly 68% at the peak, and subsequently dropped to 50% at the end of the sample. Besides important time-variation in the average, the figure documents considerable cross-sectional variation. At the peak of the debt cycle, there are states with debt ratios close to 40%, as well as states with household debt levels greater than 100%. The sizable variation in the household debt-to-income ratio enables us to analyze the existence of an association between the size of state multipliers and the degree of household indebtedness in the economy.

Interaction of household indebtedness and the business cycle The bulk of the empirical literature on time-varying multipliers focuses on a single economic condition as a possible driver. However, it can be argued that the influence of household debt and the stance of the business cycle on multipliers are intertwined, in particular for the decade under analysis. Specifically, households' borrowing constraints are typically more relevant during recessionary periods due to varying attitudes towards leverage and financial accelerator effects depending on the level of economic activity (Bernanke and Gertler 1989; Peersman and Smets 2005). Furthermore, Eggertsson and Krugman (2012) show that the amount of private debt augments the multiplier at times when households are forced into rapid deleveraging. Such

[9]Mortgage debt provides a better link to economic theory than total household debt (which also includes credit card debt, auto loans and student debt). Notice, however, that mortgage debt accounts by far for the largest share of total household debt. In addition, our results are robust to the use of total household debt.

deleveraging was exactly what was happening and a key source of the (deep) recessions in many states in the sample period (Mian and Sufi 2010). On the other hand, Kaplan and Violante (2014) find that a severe recession leads to a reduction of hand-to-mouth behavior by wealthy households, which in turn leads to a smaller aggregate consumption reaction following a fiscal spending shock. By focusing on both the level of household debt, the stance of the business cycle and their interaction, we can assess the possible mutual influence of these factors on the size of the multiplier.

3.2 Empirical specification

To investigate the joint role played by recessions and household debt in affecting the size of state government spending multipliers, we allow the model in equations (1)-(2) to linearly depend on the presence of a (deep) recession r_{it-1}, the level of household debt d_{it-1} and their interaction at the moment of the fiscal impulse.[10] The model becomes:

$$\begin{aligned}\sum_{l=0}^{h}\tilde{g}_{it+l} = &\left[\beta_h^{1S,(1-r)} + \beta_h^{1S,(1-r)d} d_{it-1}\right](1 - r_{it-1})\,\tilde{g}_{it} + \\ &+ \left[\beta_h^{1S,r} + \beta_h^{1S,rd} d_{it-1}\right] r_{it-1}\tilde{g}_{it} \\ &+ \left[\gamma_h^{1S,(1-r)}(L) + \gamma_h^{1S,(1-r)d}(L) d_{it-1}\right](1 - r_{it-1})\,ctr_{it-1} \\ &+ \left[\gamma_h^{1S,r}(L) + \gamma_h^{1S,rd}(L) d_{it-1}\right] r_{it-1} ctr_{it-1} + \alpha_{ih} + \delta_{th} + \varepsilon_{it+h}^{1S}, \end{aligned} \tag{3}$$

$$\begin{aligned}\sum_{l=0}^{h}\tilde{y}_{it+l} = &\left[\beta_h^{2S,(1-r)} + \beta_h^{2S,(1-r)d} d_{it-1}\right](1 - r_{it-1})\left(\widehat{\sum_{l=0}^{h}\tilde{g}_{it+l}}\right) + \\ &+ \left[\beta_h^{2S,r} + \beta_h^{2S,rd} d_{it-1}\right] r_{it-1}\left(\widehat{\sum_{l=0}^{h}\tilde{g}_{it+l}}\right) \\ &+ \left[\gamma_h^{2S,(1-r)}(L) + \gamma_h^{2S,(1-r)d}(L) d_{it-1}\right](1 - r_{it-1})\,ctr_{it-1} \\ &+ \left[\gamma_h^{2S,r}(L) + \gamma_h^{2S,rd}(L) d_{it-1}\right] r_{it-1} ctr_{it-1} + \alpha_{ih} + \delta_{th} + \varepsilon_{it+h}^{2S}, \end{aligned} \tag{4}$$

[10] The use of one-period lagged variables that could affect multipliers guarantees that they are not endogenously affected by the shock. Since household debt series are annual, this implies that we systematically include the debt ratio of the last quarter of the previous year. We also add the variables r_{it-1}, d_{it-1} and their interaction to the control variables, which is standard in multiple regression models with interaction terms.

where $\beta_h^{2S,(1-r)}$ and $\beta_h^{2S,r}$ measure the average multipliers outside and inside recessions, and $\beta_h^{2S,(1-r)d}$ and $\beta_h^{2S,rd}$ are the additional effects associated with a one-standard deviation difference in household debt inside and outside recessions.[11]

3.3 Results

Figure 4 shows the influence of recessions and household indebtedness on cumulative relative government spending multipliers. The top panel depicts the specification related to standard recessions versus expansions, while the bottom panel restricts the analysis to the case of deep recessions versus expansions and mild(er) recessions. In each graph, the blue line represents the point estimate, whereas the bands show the 68% and the 90% confidence intervals based on Driscoll-Kraay standard errors.

The results reveal considerable heterogeneity of government spending multipliers within the sample period. In line with the baseline results discussed in section 2.3, relative multipliers are around 2 on impact in normal times, and quickly decline at longer horizons. We even find multipliers that are not significantly different from zero after two years. The magnitude and dynamics of multipliers in (deep) recessions are, however, very different. In recessions, impact multipliers are also around 2, but in contrast to normal times, multipliers remain at this high level over the whole two-year horizon (1.6 after eight quarters) and significantly larger than multipliers in normal times in the long run. A possible explanation of more persistent output effects of fiscal policy shocks initiated during recessions may be hysteresis effects (Delong and Summers 2012). On the other hand, we find substantial higher multipliers in deep recessions, a finding that is in line with the aggregate results of Caggiano et al. (2015). More precisely, state relative government spending multipliers in severe recessions turn out to be above 3 on impact, and again remain at such a high level at longer horizons. The business cycle is hence an important determinant of relative multipliers.

The second row in each panel provides a measure of the strength of the association between the degree of household indebtedness and the size of state multipliers outside and inside (deep) recession periods. Outside (deep) recessions, we find a modest, though statistically significant, positive effect of household debt on the multiplier. When the household debt-to-income ratio

[11] The average multipliers are obtained by centering $d_{it-1}\,(1 - r_{it-1})$ and $d_{it-1}r_{it-1}$ respectively outside and inside recessions. For a convenient interpretation of the results, we normalize household debt by the standard deviation of the the household mortgage debt distribution over the sample period, which is approximately 18.5%.

in an individual state is one standard deviation higher than the sample mean, the multiplier turns out to be roughly 0.3 larger. This finding is consistent with the aggregate evidence of Bernardini and Peersman (2015). Interestingly, household indebtedness becomes a significant more important driver of multipliers in recessions, which tends to increase with the intensity of the recession. In particular, when household debt is one standard deviation higher than the sample mean, the state's multipliers increase by approximately 0.5 in recessions and even 1.7 in deep recessions. In other words, the results suggest that in recessionary periods, not only the average size of the multiplier tends to increase, but also its dependence on the degree of household indebtedness. This finding is consistent with, for example, tighter borrowing constraints and more financial frictions in recessions as discussed in Eggertsson and Krugman (2012) and Canzoneri et al. (2016).

Heterogeneity of multipliers in practice The above results imply that average (linear) relative government spending multipliers are not very useful for policymakers and forecasters in real time. To illustrate the economic relevance of the underlying drivers for fiscal policy in practice, the top panel of Figure 5 shows a map with the implied two-year cumulative multipliers of all U.S. states in 2009Q1. The latter is the moment when the ARRA in response to the crisis was signed into law. The aim of the program was to increase investment in e.g. infrastructure, transportation, education and health care services in order to promote economic recovery and support those most affected by the recession. The program was funded by the federal government in order to avoid reductions in essential services and counterproductive state and local tax increases. Interestingly, the expenditures were not uniformly distributed across states. The effectiveness hence heavily depended on the size of local multipliers when the program was implemented. The implied multipliers in Figure 5 are calculated based on the results of section 3 and the actual economic conditions of the states when the program was decided. As can be observed in the figure, the implied multipliers were substantially different across states. For example, we obtain relative multipliers above 4 for Florida, Arizona and Minnesota, while implied multipliers were nearly positive and clearly below 1 for New York and Texas. Put differently, the effectiveness of the ARRA was likely very diverse across states.

Also the bottom panels of Figure 5 demonstrate the importance of the underlying economic conditions in practice. The left panel depicts the implied cumulative relative multipliers at one point in time, 2013Q1, for Oregon, Maine and Oklahoma, respectively. The three states are characterized by different levels of household debt-to-income ratios

during that period. Oregon displayed a debt level that was highly above average, Maine's debt ratio was close to the average and Oklahoma's was well below average. Oregon and Maine also experienced a deep recession in the preceding quarters which was not the case for Oklahoma. These varying state-level characteristics lead to highly different values and dynamics of the implied multipliers. In particular, the implied multiplier was consistently above 4 at all horizons for Oregon. In Maine, the implied multipliers were around 3 at all horizons. For Oklahoma, we obtain implied multipliers that were around 2 on impact, and nearly 0 after one year and beyond. On the other hand, the right panel shows the implied multipliers for one state, New Mexico, at three different moments within the sample period. We obtain peak values of almost 4 in 2009Q3, while implied peak multipliers were around 3 and below 2 in 2013Q1 and 2006Q4, respectively, where the implied multiplier quickly levels off for 2006Q4. 2009Q3 and 2013Q1 correspond with quarters that are preceded by a deep recession where household debt-to-income is lower in the latest period due to deleveraging. Overall, these calculations suggest that the stance of the business cycle, the amount of private debt and the interaction of both conditions should be taken into account to assess the consequences of fiscal policies on individual states.

4 Aggregate effects of spending redistributions

Local multipliers are key indicators to understand if and to what extent fiscal policy is effective at stabilizing regional business cycles or smoothing asymmetric shocks. Differently from aggregate multipliers, however, they are not necessarily informative about the ability of fiscal policy to affect the economy as a whole. To understand why, notice that relative multipliers measure the impact of a shift in relative government spending on relative economic activity of a state, holding national effects constant. The fact that fiscal policy has an effect on relative output does not necessarily imply that it also has an influence on aggregate output. Specifically, a rise of output in one state and a corresponding decline of output in another state could have a strong impact on relative GDP, while aggregate GDP remains constant. As a result, economic studies focusing on aggregate economic stabilization typically do not attach much importance to local multipliers. However, it should be noted that under the presence of heterogeneous effects of fiscal policy across states and over time, local multipliers can also provide a valuable source of information for "aggregate policy-making". As argued by Ramey (2011b), heterogeneity implies that targeted redistributions of government spending across states might generate sizable aggregate effects on economic activity. More precisely,

the results of this paper suggest that, keeping aggregate government spending constant, a mere redistribution of spending towards states in a (deep) recession or characterized by a high debt burden in the household sector, should stimulate aggregate GDP.

In this section, we test this conjecture more directly. To do this, we first construct a simple indicator that reflects redistribution of government spending from states with potential low multipliers to states that have likely large multipliers inspired by the results of section 3:

$$I_t = \Delta G_t^{hm} - \Delta G_t \tag{5}$$

where ΔG_t^{hm} and ΔG_t are government spending growth in potential high-multiplier (hm) states and aggregate (national) growth in government spending in quarter t, respectively. Potential high multiplier states are those states that are in a (deep) recession at $t-1$.[12] An indicator I_t that is larger than one hence implies that there is extra redistribution of government spending of potential low multiplier states to high multiplier states relative to the level of government spending in the previous quarter, and vice versa when the indicator is less than one. To check the robustness, we construct a similar indicator for redistribution towards states that have high household debt ratios. The latter are simply the top one-third of the states according to the average debt-to-GDP ratio over the whole sample.

In the next step, we embed this indicator in a simple VAR model for the aggregate U.S. economy. Specifically, we estimate a three-variable VAR containing aggregate government spending (value added) per capita, the redistribution indicator and aggregate real GDP per capita. The VAR is estimated over the sample period 2005Q1-2015Q4 with four lags. Notice that the sample period is relatively short. The results should therefore be interpreted with caution, but should nevertheless provide useful insights on the macroeconomic effects of fiscal redistribution across states. Within this VAR model, we identify innovations to the index that are orthogonal to changes in aggregate government spending, and estimate the macro consequences. In line with the standard Blanchard and Perotti (2002) approach, we assume that the composition of government spending across state does not react within the quarter to shocks to economic activity. This corresponds to a Cholesky decomposition with the variables ordered as described above.

The results of the estimations are reported in Figure 6. The panels show the impulse responses to a one standard deviation innovation to the redistribution index, together with 68% and 90% confidence bands. The rows of the figure show the results for redistribution

[12] To obtain ΔG_t^{hm}, we weight the individual state growth rates by their share in total government spending.

towards states that are in a recession, deep recession or have high household debt, respectively. For all three indicators, we find a significant impact of redistribution across states on aggregate economic activity. The effects are economically meaningful. Specifically, a one-standard-deviation increase in the redistribution index towards states in a recession augments aggregate GDP by approximately 0.4% after two quarters. In line with our results on relative multipliers, redistribution is even more effective in stimulating aggregate economic activity when it is targeted to states in a deep recession, i.e. a rise in real GDP by 0.5%. Finally, an average change in the composition of government spending growth to states with high household debt levels raises U.S. GDP by 0.4% at the peak. Overall, these estimates confirm that a regional redistribution of government expenditures across states is able to influence aggregate economic activity.

5 Conclusions

Relative government spending multipliers are a key ingredient for policymakers who want to stabilize asymmetric shocks and divergent business cycles within a currency union. In this study, we have used a novel quarterly dataset of U.S. states to estimate the dynamics of state relative government spending multipliers and their drivers over the period 2005Q1-2015Q4. The availability of quarterly data by state, along with a sizable cross-section dimension and variation in the data, allows for a detailed analysis of relative fiscal multipliers and their dependence on economic conditions in the period surrounding the Great Recession. We find that average relative cumulative multipliers were large on impact, i.e. almost 2, but swiftly declined to less than 1 after one year.

In the next step, we have examined whether relative spending multipliers depended on some crucial underlying economic conditions of the states. We find that relative multipliers were considerably larger and more persistent in severe recessions. In addition, multipliers increase by the state's amount of private debt. The latter effect on multipliers is even more the case in recessionary periods. The influence of these drivers on relative multipliers is economically important, and should be taken into account by policymakers in practice. For example, we show that implied cumulative multipliers at the moment when the ARRA program was signed into law, ranged between 0 and more than 4 across individual states. Similarly, we show that relative multipliers for the same state at different moments in time could also have varied between 0 and 4 depending on the underlying conditions at the moment of the fiscal impulse.

A lesson that we could also learn from the estimations is that mere targeted redistributions of government spending across states may also stimulate aggregate U.S. economic activity. This can be done by redistributing government expenditures from states with low relative multipliers to states with large multipliers. By constructing a simple redistribution index, we provide evidence that implicit redistribution of government spending within the sample period had sizable aggregate effects. This finding is a promising avenue for a more detailed analysis in future research.

Data appendix

GDP by State and Industry *(Bureau of Economic Analysis)*
The original series are quarterly, are expressed in millions of dollars, and are seasonally adjusted at annual rates. State-level GDP is "All industry total", while state-level government spending is "Government". We compute State-level GDP deflators by dividing nominal GDP by real GDP.

Personal income by State *(Bureau of Economic Analysis)*
The original series are quarterly, are expressed in thousands of dollars, and are seasonally adjusted at annual rates.

Population by State *(Census Bureau)*
The original series are annual and are expressed in units. We construct State-level quarterly series by replacing the annual figure in each quarter of the year.

Household debt by State *(Federal Reserve Bank of New York)*
The original series report the stock of household mortgage debt in the last quarter the year (Q4), and are expressed in dollars. We compute State-level debt-to-income ratios by dividing the original series by disposable income. In order to work with quarterly series, we set the first three quarters of a specific year equal to the last quarter of the previous year (e.g. we set the 2007Q1–2007Q3 figures equal to the 2006Q4 figure). Our results are robust to the (less conservative) use of a linear interpolation.

References

Albuquerque, Bruno, 2017. "One Size Fits All? Monetary Policy and Asymmetric Household Debt Cycles in US States," *Ghent University Manuscript.*

Andrés, Javier, José E. Boscá, and Javier Ferri, 2015. "Household Debt and Fiscal Multipliers," *Economica* 82(s1), 1048-1081.

Auerbach, Alan. J. and Yuriy Gorodnichenko, 2012. "Measuring the Output Responses to Fiscal Policy," *American Economic Journal: Economic Policy* 4(2), 1-27.

Bartik, Timothy J., 1991. "Who Benefits from State and Local Economic Development Policies?," W.E. Upjohn Institute for Employment Research.

Batini, Nicoletta, Luc Eyraud, Lorenzo Forni, and Anke Weber, 2014. "Fiscal Multipliers: Size, Determinants, and Use in Macroeconomic Projections," *IMF Technical Notes and Manuals* 14/04.

Bernanke, Ben and Mark Gertler, 1989. "Agency Costs, Net Worth, and Business Fluctuations," *American Economic Review* 79(1), 14-31.

Bernardini, Marco and Gert Peersman, 2015. "Private Debt Overhang and the Government Spending Multiplier: Evidence for the United States," *CESifo Working Paper* 5284.

Blanchard, Olivier J. and Daniel Leigh, 2013. "Growth Forecast Errors and Fiscal Multipliers," *American Economic Review: Papers and Proceedings* 103(3), 117-120.

Blanchard, Olivier J. and Roberto Perotti, 2002. "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output," *The Quarterly Journal of Economics* 117(4), 1329-1368.

Brückner, Markus and Anita Tuladhar, 2013. "Local Government Spending Multipliers and Financial Distress: Evidence from Japanese Prefectures," *Economic Journal* 124(581), 1279-1316.

Caggiano, Giovanni, Efrem Castelnuovo, Valentina Colombo, and Gabriela Nodari, 2015. "Estimating Fiscal Multipliers: News From a Non-linear World," *Economic Journal* 125(584), 746-776.

Canzoneri, Matthew, Fabrice Collard, Harris Dellas, and Behzad Diba, 2016. "Fiscal Multipliers in Recessions," *Economic Journal* 126(590), 75-108.

Chodorow-Reich, Gabriel, Laura Feiveson, Zachary Liscow, and William Gui Woolston, 2012. "Does State Fiscal Relief during Recessions Increase Employment? Evidence from the American Recovery and Reinvestment Act," *American Economic Journal: Economic Policy* 4(3), 118-145.

Christiano, Lawrence, Martin Eichenbaum, and Sergio Rebelo, 2011. "When Is the Government Spending Multiplier Large?," *Journal of Political Economy* 119(1), 78-121.

Cochrane, John H., 2012. "Manna from Heaven: The Harvard Stimulus Debates," *The Grumpy Economist*, Web blog post March 4.

Delong, J. Bradford and Lawrence H. Summers, 2012. "Fiscal Policy in a Depressed Economy," *Brookings Papers on Economic Activity* 43(1), 233-297.

Demyanyk, Yuliya, Elena Loutskina, and Daniel Murphy, 2016. "Fiscal Stimulus and Consumer Debt," *Federal Reserve Bank of Cleveland Working Paper* 16-20.

Driscoll, John C. and Aart C. Kraay, 1998. "Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data," *Review of Economics and Statistics* 80(4), 549-560.

Dupor, Bill and Rodrigo Guerrero, 2016. "Local and Aggregate Fiscal Policy Multipliers," *Federal Reserve Bank of St. Louis Working Paper* 2016-4.

Eggertsson, Gauti B. and Paul Krugman, 2012. "Debt, Deleveraging, and the Liquidity Trap: a Fisher-Minsky-Koo Approach," *The Quarterly Journal of Economics* 127(3), 1469-1513.

Hall, Robert E., 2009. "By How Much Does GDP Rise If the Government Buys More Output?," *Brookings Papers on Economic Activity* 40(2), 183-249.

Jordà, Òscar, 2005. "Estimation and Inference of Impulse Responses by Local Projections," *American Economic Review* 95(1), 161-182.

Kaplan, Greg and Giovanni L. Violante, 2014. "A Model of the Consumption Response to Fiscal Stimulus Payments," *Econometrica* 82(4), 1199-1239.

Kaplan, Greg, Giovanni L. Violante, and Justin Weidner, 2014. "The Wealthy Hand-to-Mouth," *Brookings Papers on Economic Activity* 45(1), 77-153.

Klein, Mathias, 2016. "Austerity and Private Debt," *Journal of Money, Credit and Banking*, forthcoming.

Mertens, Karel and Morten O. Ravn, 2010. "Measuring the Impact of Fiscal Policy in the Face of Anticipation: A Structural VAR Approach," *Economic Journal*, 120(544), 393-413.

Mian, Atif and Amir Sufi, 2010. "Household Leverage and the Recession of 2007-09," *IMF Economic Review* 58(1), 74-117.

Michaillat, Pascal, 2014. "A Theory of Countercyclical Government Multiplier," *American Economic Journal: Macroeconomics* 6(1), 190-217.

Nakamura, Emi and Jón Steinsson, 2014. "Fiscal Stimulus in a Monetary Union: Evidence from US Regions," *American Economic Review* 104(3), 753-792.

Owyang, Michael T., Valerie A. Ramey, and Sarah Zubairy, 2013. "Are Government Spending Multipliers Greater during Periods of Slack? Evidence from Twentieth-Century Historical Data," *American Economic Review: Papers and Proceedings* 103(3), 129-134.

Peersman, Gert and Frank Smets, 2005. "The Industry Effects of Monetary Policy in the Euro Area," *Economic Journal* 115(503), 319-342.

Perotti, Roberto, 1999. "Fiscal Policy in Good Times and Bad," *Quarterly Journal of Economics* 114(4), 1399-1436.

Ramey, Valerie A., 2011a. "Identifying Government Spending Shocks: It's All in the Timing," *Quarterly Journal of Economics* 126(1), 1-50.

Ramey, Valerie A., 2011b. "Can Government Purchases Stimulate the Economy?," *Journal of Economic Literature* 49(3), 673-685.

Ramey, Valerie A., 2013. "Government Spending and Private Activity," in A. Alesina and F. Giavazzi (eds) *Fiscal Policy After the Financial Crisis*, University of Chicago Press, Chicago, IL, pp. 19-55.

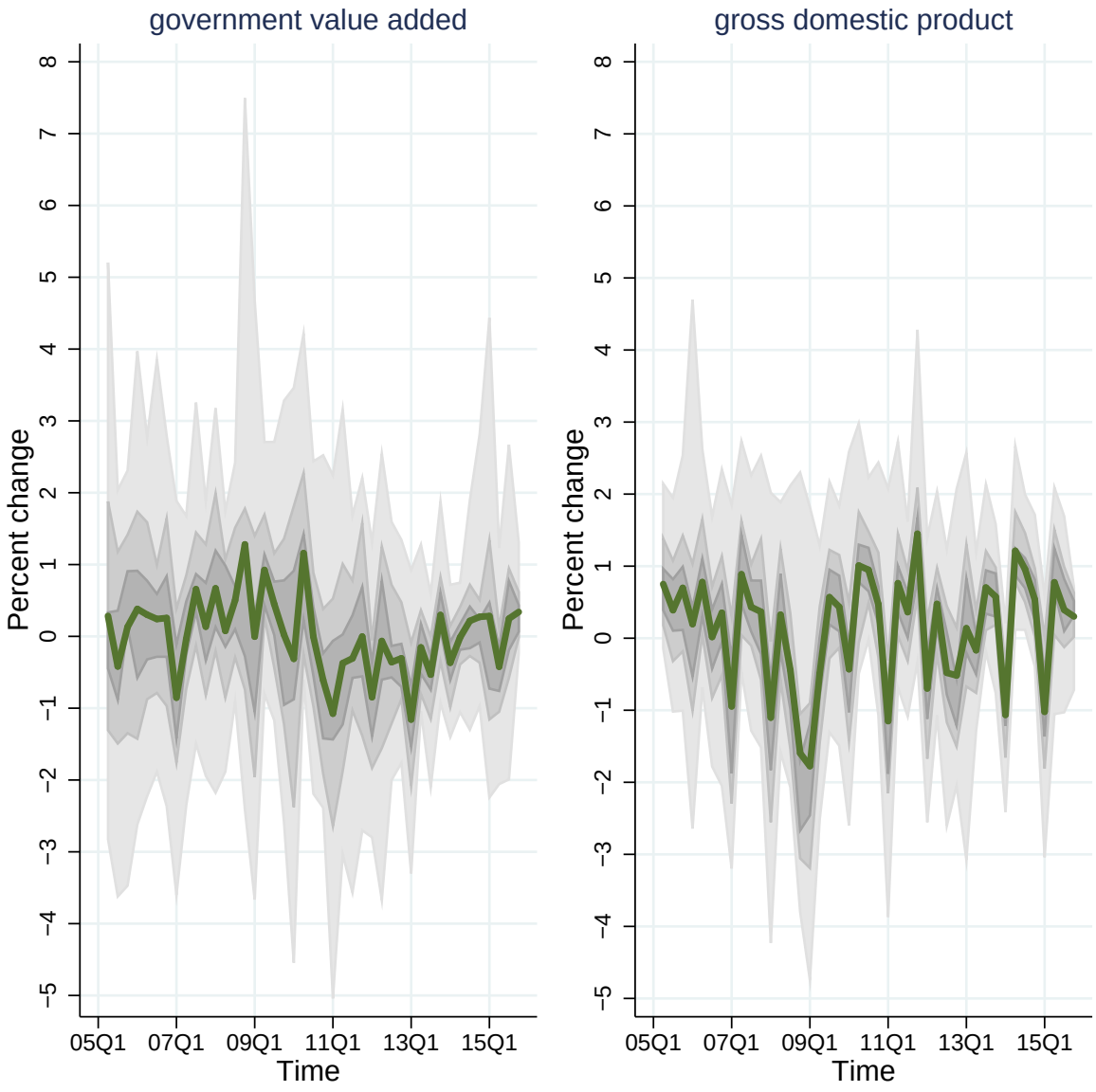
Ramey, Valerie A., 2016. "Macroeconomic Shocks and Their Propagation," in J.B. Taylor and H. Uhlig (eds) *Handbook of Macroeconomics*, vol. 2, Elsevier, Amsterdam, Netherlands, 71-162.

Ramey, Valerie A. and Sarah Zubairy, 2016. "Government Spending Multipliers in Good Times and in Bad: Evidence from U.S. Historical Data," *Journal of Political Economy*, forthcoming.

Serrato, Juan Carlos Suárez, and Philippe Wingender, 2016. "Estimating Local Fiscal Multipliers," *NBER Working Paper* 22425.

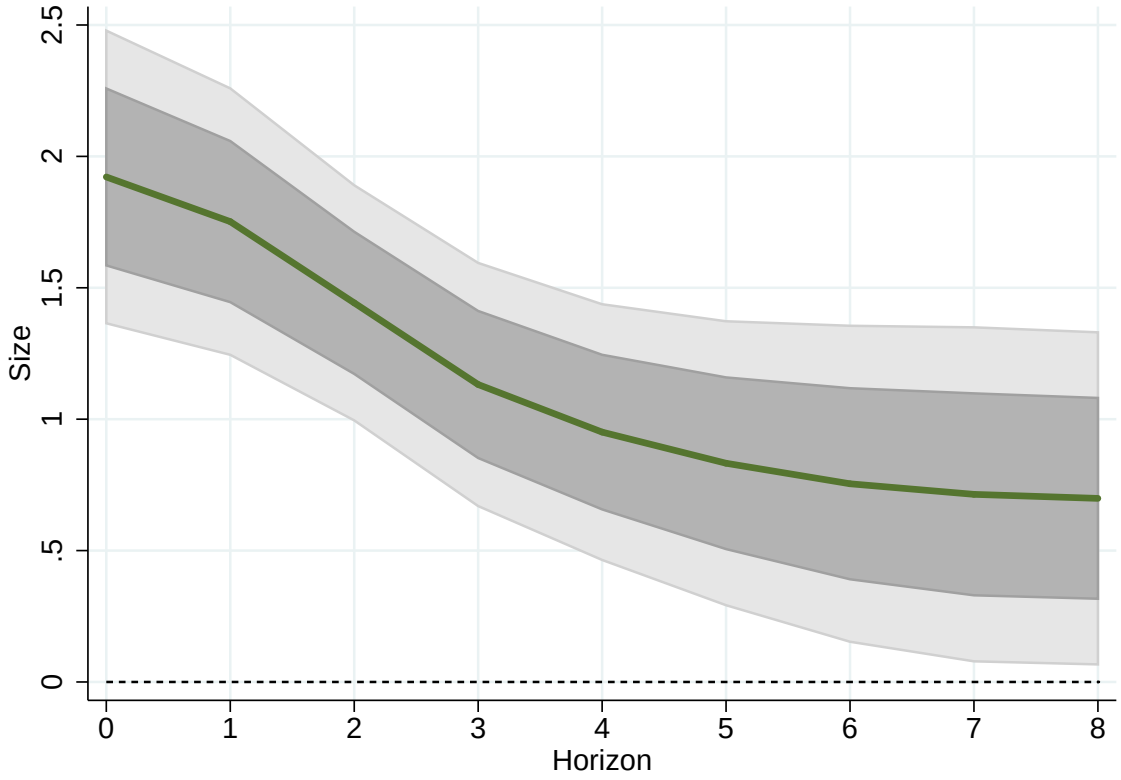
Shoag, Daniel, 2013. "Using State Pension Shocks to Estimate Fiscal Multipliers since the Great Recession," *American Economic Review: Papers and Proceedings* 103(3), 121-124.

Figure 1. Cross-state variation of government value added and GDP over time



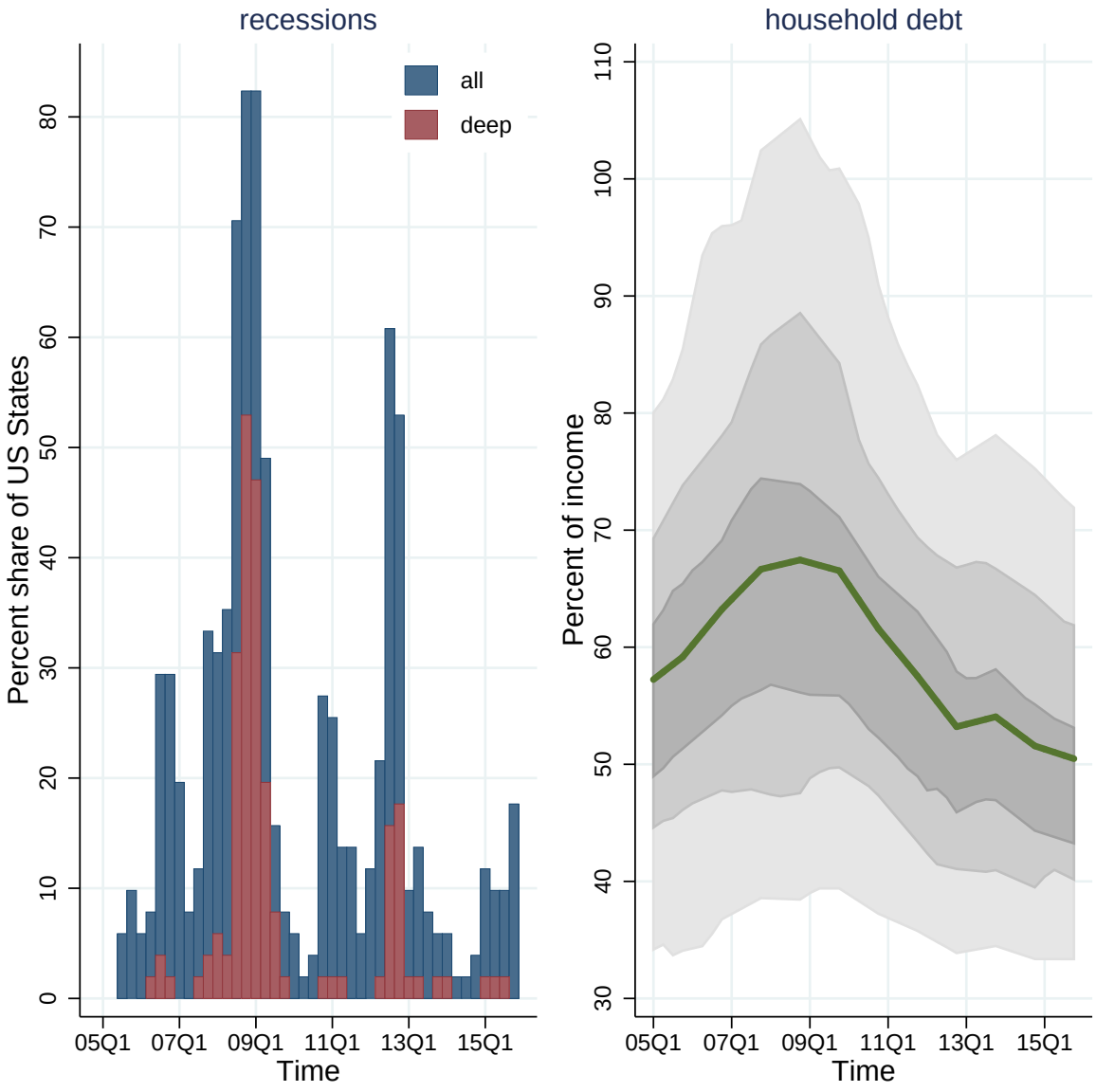
Note. The green lines show the cross-state averages of the quarterly growth rates of government value added and gross domestic product over time. Both variables are expressed in real per capita terms. The bands show different percentile intervals: 35th-65th (30%), 20th-80th (60%), 5th-95th (90%).

Figure 2. Average cumulative relative government spending multipliers



Note. The green line depicts the cumulative relative fiscal multiplier over a two-year horizon, i.e. the estimated parameter β_h^{2S} in (2) for $h = 0, \ldots, 8$. Bands are 68% (dark) and 90% (light) confidence intervals.

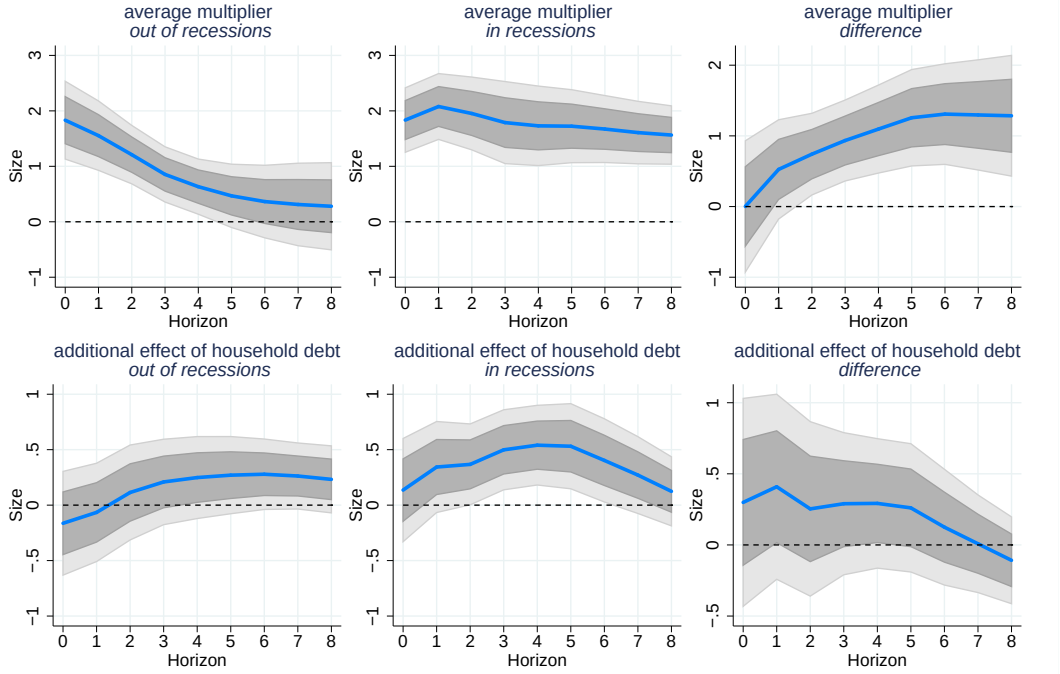
Figure 3. Cross-state variation of economic conditions over time



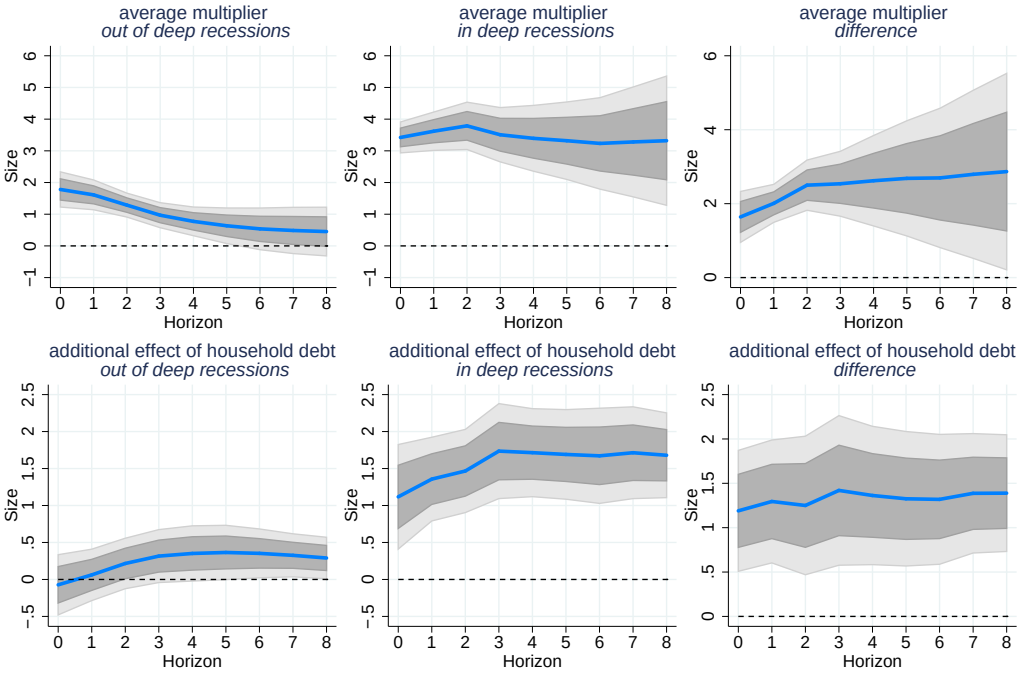
Note. The bar graph depicts the percentage of US states in recession (deep recession) in each quarter of our sample. The green line shows the cross-state average of household debt over time. The bands show different percentile intervals: 35th-65th (30%), 20th-80th (60%), 5th-95th (90%).

Figure 4. Effects of recessions and household debt on relative multipliers

(a) *Recessions*

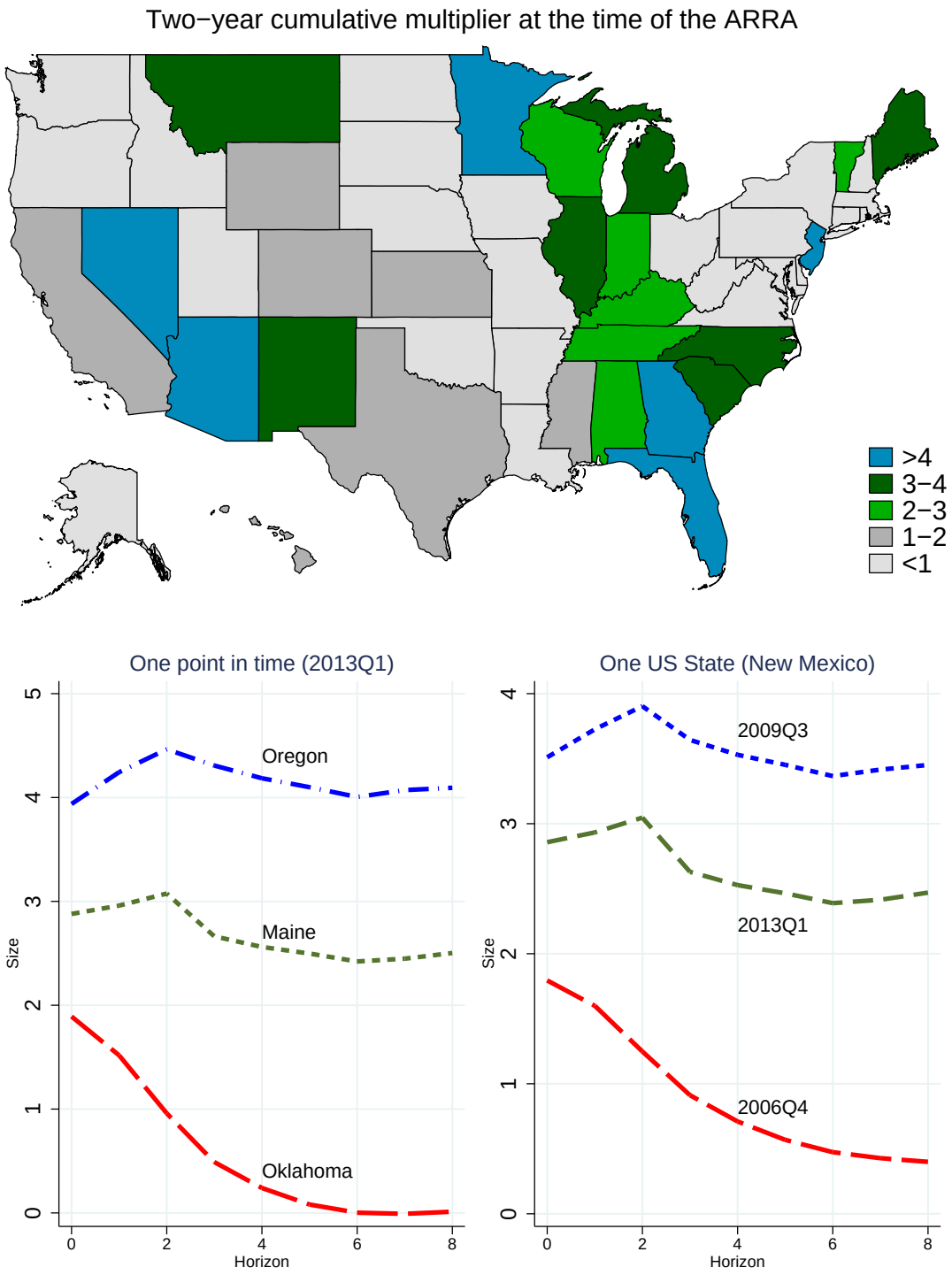


(b) *Deep recessions*



Note. Bands are 68% (dark) and 90% (light) confidence intervals. The additional effect of debt is normalized to one-standard deviation (approximately 18.5%).

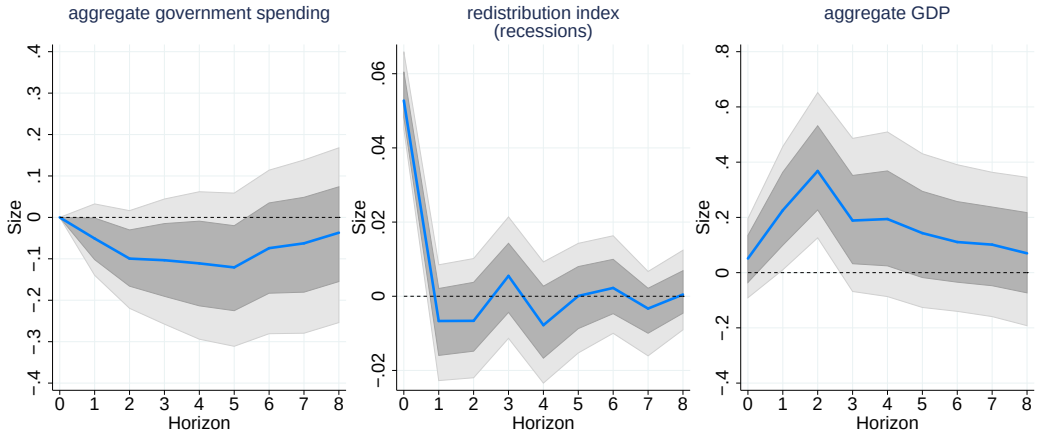
Figure 5. Implied relative multipliers using actual data



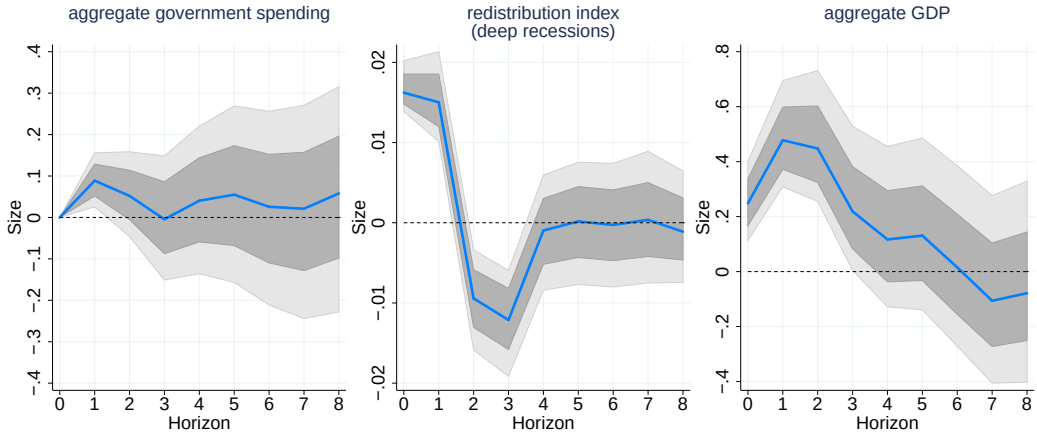
Note. Each multiplier depends on the amount of household debt and the presence or not of a deep recession at the moment of the fiscal impulse.

Figure 6. Aggregate effects of redistribution shocks

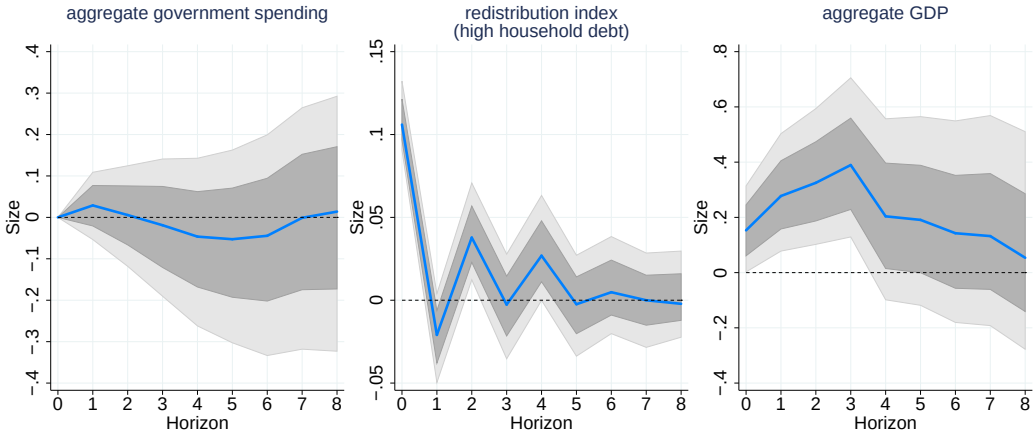
(a) *Redistribution of spending to US states in recessions*



(b) *Redistribution of spending to US states in deep recessions*



(c) *Redistribution of spending to US states with high household debt*



Note. Bands are 68% (dark) and 90% (light) confidence intervals. The redistribution shock is normalized to one-standard deviation.