Private Debt Overhang and the Government Spending Multiplier: Evidence for the United States*

Marco Bernardini
Ghent University

Gert Peersman
Ghent University

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Abstract

Using state-dependent local projection methods and historical U.S. data, we find that government spending multipliers are considerably larger in periods of private debt overhang. In particular, we find significant crowding-out of personal consumption and investment in low private debt states, resulting in multipliers that are below one. Conversely, in periods of private debt overhang, there is a strong crowding-in effect, while multipliers are much larger than one. These results are robust for the type of government spending shocks, and when we control for the business cycle, financial crises, deleveraging periods, government debt overhang and the presence of the zero lower bound on the nominal interest rate. Our findings imply that spending multipliers were likely much larger than average during the Great Recession.

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1 Introduction

The Great Recession and the European sovereign debt crisis have reignited the academic and political debate on the role of fiscal stimulus packages for business cycle stabilization, as well as the macroeconomic consequences of austerity policies. Whereas the debate previously focused mainly on the average size of the so-called government spending multiplier, i.e. the dollar change in output to an exogenous dollar increase or decrease in government purchases, the current debate centers more on the question whether government spending multipliers differ according to the state of the economy. In particular, government spending multipliers are not structural constants, and may depend on a number of conditions that vary across countries and time (Hall 2009).

From a theoretical perspective, multipliers depend for instance on monetary policy and the amount of slack in the economy. Eggertsson (2011), Eggertsson and Woodford (2003) and Christiano *et* al. (2011) show that a deficit-financed increase in government purchases has a much stronger impact on economic activity when the nominal interest rate hits the zero lower bound. Michaillat (2014) demonstrates that the effect of government policies may be stronger in recessions, even when the zero lower bound does not bind. The empirical support for both hypotheses is, however, mixed. For example, Auerbach and Gorodnichenko (2012, 2013) find innovations to government purchases to be much more effective in recessions than expansions, but this finding cannot be confirmed by Owyang *et* al. (2013) and Ramey and Zubairy (2014) for military spending news shocks over a longer sample period. The latter study also finds no robust evidence that multipliers are greater when interest rates are near the zero lower bound. Accordingly, Ramey and Zubairy conclude that *"[...] contrary to recent conjecture, government spending multipliers were not necessarily higher than average during the Great Recession."*

In this paper, we approach the state-dependence of government spending multipliers in another way, i.e. we examine whether aggregate spending multipliers in the United States (U.S.) have historically been greater in periods of private debt overhang. This hypothesis is supported by several recent theoretical studies. In particular, Eggertsson and Krugman (2012), Kaplan and Violante (2014), and Andrés *et* al. (2015) show that spending multipliers increase with the amount of debt-constrained agents in the economy, which in turn depends on the level of indebteness and interest payments relative to earnings. These agents face binding liquidity constraints to consume because they are already borrowing as much as they can or want. Accordingly, they also can or do not maximize their intertemporal objective function and spend every period their disposable income.[1] Intuitively, in the standard Neoclassical and New-Keynesian model, deficit-financed increases in government purchases generate a negative wealth effect that induces a reduction in consumption of intertemporal maximizing agents. This crowding-out effect of government spending vanishes for agents that are liquidity-constrained, resulting in traditional Keynesian-type multipliers in which consumption is based on disposable income rather than permanent income. Combined with sticky prices, this results in a higher average marginal propensity to consume and hence a greater multiplier.

It is surprising that the role of private debt has so far been ignored in the empirical literature on state dependent fiscal multipliers, while private debt overhang may indeed have augmented multipliers in the Great Recession. Specifically, it is widely believed that a rapid increase in household debt between 2000 and 2008 sets the stage for the Great Recession, and that tightening household liquidity constraints have been essential for understanding the macroeconomic consequences of the crisis (e.g. Hall 2011). For example, Mian and Sufi (2011) find that differences in the debt overhang of households before the crisis can explain the post-crisis recovery at the county level within the U.S., while Jordà *et* al. (2013) show that more credit-intensive asset prices bubbles tend to be followed by deeper recessions and slower recoveries for a panel of 14 advanced countries between 1870 and 2008. In a recent study, Cloyne and Surico (2016) find for the United Kingdom that individual households with mortgage debt increase their consumption after a decline in income taxes, while outright homeowners hardly adjust their expenditures. It is an open question whether private debt also matters for the aggregate effects of fiscal policy in the U.S., in particular the evolution of government spending multipliers over time.

In the spirit of Auerbach and Gorodnichenko (2013), Owyang *et* al. (2013) and Ramey and Zubairy (2014), we estimate state-dependent government purchases multipliers for the U.S. using Jordà's (2005) local projection method, and allow the state of the economy to vary according to the presence of debt overhang in the private sector. High and low private debt states are identified as periods when private debt-to-GDP ratios were respectively above and below trend. We use historical U.S. data from Gordon and Krenn (2010) and Carter *et* al. (2006) to have sufficient episodes of substantial variation in government spending and private debt states, i.e. the sample period is 1919Q1-2013Q4. For example, the fluctuations

[1] The "debt-constrained agent" is a much broader concept than the "borrowing-constrained agent" adopted in Perotti (1999) or Galí *et* al. (2007). The latter are households and firms that have no access to financial markets and systematically consume their disposable income. However, even wealthy households may be debt-constrained and periodically spend their disposable income, e.g. because they got into debt to finance the purchase of large illiquid assets such as housing.

in government purchases and private debt during the Great Depression and World War II were huge, providing a rich source of information to analyze the role of debt overhang as a driver of the spending multiplier. We examine the effects of two very different types of government spending shocks that have been proposed in the literature. In particular, we consider exogenous changes in government purchases in the spirit of Blanchard and Perotti (2002) and Ramey's (2011) narratively identified defense news shocks.

We find that government spending multipliers are considerably larger in periods of private debt overhang. The results reveal a crowding-out effect on real personal consumption and investment in low private debt states, resulting in cumulative multipliers that are below one, i.e. ranging between 0.8 and 0.9 in the medium to long run. Conversely, in high private debt states, both consumption and investment increase in response to an expansionary government spending shock, whereas multipliers turn out to be much larger than one. In the long run (after 3 years), we find cumulative multipliers around 1.5 in periods of private debt overhang. Furthermore, in the identified episodes of ample private debt over the past century, more (less) government purchases have on average reduced (increased) the government debt-to-GDP ratio.

The results are robust for alternative specifications of the model, definition of debt overhang, shorter (post-war) sample periods, and the type of government spending shocks. Moreover, the results prove to be robust when we control for alternative state variables that could influence the multiplier. Specifically, we still find much higher multipliers when we control for periods of banking crises, stock market crashes, deleveraging, recessions (slack), the presence of the zero lower bound on the interest rate, as well as government debt overhang.

These stylized facts have some important (policy) implications. First, the amount of private debt in the economy seems to be an important indicator for the repercussions of fiscal consolidations and stimulus packages. In low private debt periods, increases in government purchases may not be effective in stimulating private sector activity, while the consequences of fiscal consolidations are probably not very harmful. In contrast, at times of debt overhang in the private sector, deficit-financed government spending is probably able to support the economy. In other words, as argued by Eggertsson and Krugman (2012), more public debt can be a solution to a problem caused by too much private debt. A fiscal expansion could sustain output and employment while private balance sheets are repaired, and the government can successfully pay down its own debt after the high private debt period has come to an end. Second, given the excessive private debt levels at the onset of the Great Recession, our findings align with the post-crisis perception that government spending multipliers were much larger than in normal times. Finally, theoretical macroeconomic models that analyze fiscal policy issues should take into account debt overhang in the private sector to properly capture the interaction with the real economy. More generally, private debt seems to matter for macroeconomic fluctuations.

The rest of the paper is organized as follows. In the next section, we describe the state-dependent local projection methodology. The measurement of private debt states and different types of government spending shocks that we consider in the empirical analysis are discussed in section 3. The benchmark estimation results are reported in section 4, the impact on some other relevant variables in section 5, while section 6 addresses some extensions of the model to control for the influence of a set of financial, business cycle and policy states. Finally, section 7 concludes.

2 Methodology

To investigate government spending multipliers depending on the state of the economy, we follow Auerbach and Gorodnichenko (2013), Owyang *et* al. (2013) and Ramey and Zubairy (2014), and estimate state-dependent impulse responses to exogenous innovations in government purchases using Jordà's (2005) local projections. This method has become very popular to estimate fiscal multipliers. The advantages compared to vector autoregressions (VARs) are that it is more robust to misspecification because it does not impose implicit dynamic restrictions on the shape of the impulse responses, while also a more parsimonious specification can be used since not all variables are required to be included in all equations. Moreover, it can easily accommodate state dependence and avoids a potential bias when elasticities are converted to multipliers.[2]

For each variable, and each horizon, we estimate the following linear regression model:

$$\begin{aligned} z_{t+h} =& I_{t-1}\left[\alpha_{A,h} + \psi_{A,h}\left(L\right)ctr_{t-1} + \beta_{A,h}shock_t\right] + \\ & \left(1 - I_{t-1}\right)\left[\alpha_{B,h} + \psi_{B,h}\left(L\right)ctr_{t-1} + \beta_{B,h}shock_t\right] + \\ & \delta_1 t + \delta_2 t^2 + \varepsilon_{t+h} \end{aligned} \tag{1}$$

where z is the variable of interest at horizon h, I_{t-1} is a dummy variable that indicates the state $\{A, B\}$ of the economy in the period immediately prior to the government spending

[2]Notice that this method also has some disadvantages to calculate impulse responses, in particular a more erratic pattern at longer horizons because of a loss of efficiency. For a discussion, we refer to Ramey and Zubairy (2014).

shock *shock*, *ctr* is a vector of control variables, L represents the lag operator, and t and t^2 are linear and quadratic time trends.[3] The collection of the $\beta_{A,h}$ and $\beta_{B,h}$ coefficients provide directly the state-dependent responses of variable z at time $t+h$ to the shock at time t.

For the definition of the government spending shocks and the state of the economy, we refer to the next section. The variables z that we consider in the main estimations are real per capita GDP, personal consumption expenditures, fixed investment and government purchases.[4] From 1947Q1 onwards, we use the National Income and Product Accounts (NIPA) tables from the Bureau of Economic Analysis. Before this period, i.e. 1919Q1-1946Q4, we use the Gordon and Krenn (2010) historical quarterly dataset. Following Hall (2009) and Barro and Redlick (2011), we convert each variable prior to the estimations as follows:

$$z_{t+h} = \frac{Z_{t+h} - Z_{t-1}}{Y_{t-1}} \tag{2}$$

Z_t are respectively GDP and its components, while the responses are scaled by lagged GDP, i.e. Y_{t-1}. All coefficients are hence in the same unit, which is needed for the construction of the multipliers. The control variables *ctr* are GDP, government purchases, personal consumption, investment, nominal interest rate, average marginal tax rate, private and public debt-to-GDP ratios, whereas $L = 4$ in all the estimations.[5]

3 Measuring private debt states and government spending shocks

To analyze whether government spending multipliers depend on the presence of private debt overhang in the economy, we need to identify high and low private debt states. Furthermore, for the estimation of fiscal multipliers, it is crucial to identify exogenous and unanticipated

[3]A one-period-lagged indicator is used to avoid the potential simultaneity between the economic effect of the shock and the probability of being in a particular state.

[4]Similar to Perotti (2008), we consider personal consumption expenditures related to non-durable goods and services and fixed investments. Durable goods and changes in private inventories are excluded. For more details on the construction of all data used in this paper, we refer to the data appendix.

[5]In line with Barro and Redlick (2011), the control variables are transformed in first differences, and those expressed in dollars also scaled by lagged GDP. The conclusions reported in this paper are, however, not affected when we use dependent and control variables in levels. Following Ramey and Zubairy (2014), we also include lagged values of the defense news shocks to control for serial correlation. As will become clear in the next section, since the set of control variables already contains lagged government spending, this is not necessary for the Blanchard-Perotti shocks.

innovations to government purchases. In this section, we describe how we disentangle both states of the economy and how we derive autonomous shifts in government purchases.

3.1 Private debt states

The identification of episodes of private debt overhang is not trivial. It essentially requires two choices: the selection of an indicator that is available for the whole sample period, and a threshold criterion to disentangle high and low private debt periods. For the benchmark estimations, we use the domestic nonfinancial private debt-to-GDP ratio as the debt indicator, i.e. domestic debt net of government and financial sector debt divided by national income. A similar indicator is used by Schularick and Taylor (2012) to identify (bank) credit booms. The advantage of using a debt-to-GDP ratio is that we control for inflation, population and economic activity. The quarterly series is constructed by splicing the most recent Fed flow of funds data to the historical records provided in Carter *et* al. (2006).[6] To disentangle high and low private debt states, we define the former as the periods when there was a positive deviation of the debt-to-GDP ratio from a very smooth Hodrick–Prescott trend (i.e. $\lambda = 10^6$) for at least two consecutive quarters.[7] The debt-to-GDP ratio, the smooth trend and the resulting dummy (state) variable are shown in Figure 1. This procedure identifies four periods of private debt overhang: 1927Q3-1940Q3, 1957Q2-1975Q3, 1985Q3-1992Q1 and 2001Q3-2010Q3. Overall, the U.S. economy has been about half of the time in each state, which is convenient for an accurate estimation of the parameters.

A couple of remarks and robustness checks about the state variable are worth mentioning. First, the debt states are defined as episodes when the level of debt has been above or below its trend, i.e. in the benchmark estimations we do not distinguish between periods of rising (detrended) private debt and deleveraging. In section 6, we will analyze in more detail whether there are also differences between episodes of rising and falling debt-to-GDP ratios.

Second, the identified periods of private debt overhang correspond very well with alternative direct measures of household indebtedness that are only available over a shorter sample period. More specifically, panel (a) of Figure 2 shows the deviation from trend of the benchmark domestic nonfinancial private debt-to-GDP ratio, as well as two direct measures of household debt burden provided by the Federal Reserve Board, which are available from

[6] In the appendix, we provide the data transformations and the official sources.

[7] This criterion is in line with the literature on credit cycles, which had a deep influence on the Third Basel Accord (Basel III). Indeed, its implementation involves the use of a similar credit gap indicator (see Basel Committee on Banking Supervision 2010).

1980 onwards. The latter are shown in percentage points deviations from their (constant) median. The Debt Service Ratio (DSR) takes into account mortgage and consumer debt, while the Financial Obligations Ratio (FOR) is a more comprehensive measure that also includes additional forms of debt payment.[8] In essence, these measures are debt-to-income ratios, adjusted for the average interest rate and remaining maturity on outstanding debt. Intuitively, a decrease in the average interest rate on loans or an increase in the average remaining maturity tend to alleviate the debt burden. Notice that such factors are related to the entire stock of outstanding debt and, thus, evolve very smoothly over time. For example, a change in the interest rate on new loans has only a marginal impact on the average interest payments on the outstanding debt stock. Furthermore, a likely driver of the average maturity of outstanding debt is financial innovation or financial progress, which can be seen as a long-term phenomenon. These considerations signify that "debt overhang" is a relative concept, because it tends to vary over time at low frequency, which requires detrending using very smooth filters. It is hence not surprising that direct measures of debt burden unveil very similar episodes of private debt overhang as our benchmark (detrended) debt measure.

Third, the identification of episodes of private debt overhang is hardly affected by the detrending method. Specifically, panel (b) of Figure 2 shows the evolution of detrended private debt over time when we apply respectively an extreme smooth HP-filter ($\lambda = 10^7$), and a band of simple long-term moving averages to gauge the trend. For the latter, we use a window ranging between 15-20 years in order to capture the low frequency which characterizes financial cycles (Borio 2014). Accordingly, private debt overhang episodes can be seen as periods when the private debt-to-GDP ratio was above its slowly-changing mean. The figure reveals that the deviation from trend is larger for the extreme smooth HP filter, and smaller for the band of moving averages in the first part of the sample period, while the differences between the series are negligible from the 1970s onwards. However, despite the differences in the deviations from trend at the beginning of the sample, the identified periods of private debt overhang are remarkably consistent throughout the sample.

Fourth, the identified periods of private debt overhang are also nearly identical when we use alternative private debt measures. This is illustrated in panel (c) of Figure 2, which shows the deviations from trend of the benchmark domestic nonfinancial private debt measure, total private debt-to-GDP (including financial sector debt) and household debt-to-GDP ratio. The latter is, for instance, used by Krugman (2013) as a proxy for the debt burden of U.S. households. The same HP-filter ($\lambda = 10^6$) has been applied to all three debt measures. As

[8]These are "rent payments on tenant-occupied property, auto lease payments, homeowners' insurance, and property tax payments." See the website of the Federal Reserve Board for additional information.

can be seen in the figure, the deviation of total private debt-to-GDP from trend is almost indistinguishable from the benchmark measure. Also the deviation of household debt-to-GDP from trend has been very similar over time. A notably difference was a somewhat larger positive deviation from trend during the mid-1950s and the 1960s, which confirms that this was indeed an episode of high private debt.[9]

In sum, since we use a discrete (dummy) indicator to identify private debt states, all debt measures or detrending methods more or less identify the same periods as high-debt and low-debt states, which makes us confident that we are capturing a general evolution that does not strongly depend on the selection of the debt indicator. In the online appendix of the paper, we also show the estimation results based on the alternative debt measures reported in panels (b) and (c) of Figure 2. The conclusions reported in the paper prove indeed to be robust for the selection of the debt indicator to identify periods of private debt overhang.

3.2 Government spending shocks

There is also not a unique way to identify exogenous changes in government purchases. Numerous studies have been conducted to isolate such components in government spending, and none of them are immune to identification problems. In this paper, we do not take a stance on the best way to identify shocks to government purchases, and therefore consider the two most popular approaches that have been used in the literature.

Blanchard-Perotti shocks Since the seminal paper of Blanchard and Perotti (2002), several studies have used VAR models to identify government spending shocks. The key identifying assumption that is usually made in this literature is that it typically takes longer than a quarter for government purchases to respond to changes in the economy, due to the presence of decision lags and the absence of automatic stabilizers affecting government purchases. In other words, government purchases follow a backward-looking policy rule of the type:

$$g_t = \psi(L)\, ctr_{t-1} + shock_t \tag{3}$$

where government purchases of goods and services depend on a set of lagged variables (ctr_{t-1}) and an orthogonal $shock_t$ capturing autonomous shifts in government spending. As pointed-out by Born *et* al. (2015), it is easy to implement the identification assumption of Blanchard

[9]This episode is also consistent with Mishkin (1977), whom argues that the severity of the 1973-1975 recession was primarily caused by household deleveraging.

and Perotti (2002) in a local projection framework. In particular, by substituting equation (3) in equation (1), we obtain the following expression:

$$\begin{aligned} z_{t+h} = & I_{t-1}\left[\alpha_{A,h} + \tilde{\psi}_{A,h}(L)\, ctr_{t-1} + \beta_{A,h} g_t\right] + \\ & (1 - I_{t-1})\left[\alpha_{B,h} + \tilde{\psi}_{B,h}(L)\, ctr_{t-1} + \beta_{B,h} g_t\right] + \\ & \delta_1 t + \delta_2 t^2 + \varepsilon_{t+h} \end{aligned} \tag{4}$$

where $\tilde{\psi}_{A,h} = \psi_{A,h}(L) - \beta_{A,h}\psi(L)$ and $\tilde{\psi}_{B,h} = \psi_{B,h}(L) - \beta_{B,h}\psi(L)$.

Equation (4) shows that the Blanchard and Perotti (2002) identification assumption implies that $shock_t$, henceforth BP shocks, can be instrumented by government spending g_t when the set of control variables ctr_t used in the local projection (1) contains the lagged variables of the policy rule (3).

Ramey's Defense News A drawback of the BP shocks is that there is evidence that these shocks are predictable, and hence not fully unanticipated.[10] For this reason, we also consider an alternative measure of exogenous innovations to government purchases. More precisely, we use Ramey's (2011) narrative defense news variable (henceforth DN) reflecting changes in the expected present value of government spending that are linked to political and military events, a series which has been updated and extended by Owyang *et* al. (2013) and Ramey and Zubairy (2014). The variable has been constructed using *Business Week* and several other newspaper sources. These changes are likely to be independent of the state of the economy, and can be considered as exogenous shocks to government spending. Differently from the BP shocks, this measure tackles the fiscal foresight problem by directly focusing on news instead of observable changes in government spending.

A first drawback of the DN shocks is that it cannot be excluded that the political and military events could have had an impact on the economy beyond the changes in government purchases, and that other fiscal shocks might have occurred at the same time, distorting the estimation results. Second, Perotti (2013) shows that the estimated average multipliers based on the DN shocks are sensitive to the presence of some extreme military events in the sample period, and that multipliers differ between defense and nondefense government spending on goods and services. Finally, the limited amount of news in the sample (around 25% of the observations t) could distort the estimation of state-dependent effects. It is thus useful to

[10] Ramey (2011) finds that professional forecasts and her narrative measure Granger-cause the VAR shocks. However, Mertens and Ravn (2010) and Perotti (2014) show that the predictability of the VAR innovations does not significantly affect the results.

consider both alternative measures of government spending shocks to assess the robustness of the results before drawing conclusions.

4 Are government spending multipliers greater in periods of private debt overhang?

The benchmark state-dependent results are presented in Figure 3, 4 and Table 1. The panels of Figure 3 show the estimated responses of real government spending, GDP, personal consumption and investment in both states for the first twelve quarters after respectively the BP and DN shocks, together with 90 percent confidence bands that are based on Newey-West standard errors. These responses, however, do not take into account the amount of government purchases generated by the shock. In order to properly compare the effects of government spending shocks across states and shock definitions, Figure 4 therefore shows the state-dependent cumulative spending multipliers, which measure the cumulative change of the variables per dollar of government purchases, from the time of the impulse to the reported horizon. These are calculated as $\frac{\sum_{h=0}^{H} \beta_{S,h}^{Z}}{\sum_{h=0}^{H} \beta_{S,h}^{G}}$, where H is the horizon of the cumulative multiplier. $\beta_{S,h}^{G}$ and $\beta_{S,h}^{Z}$ are the effects of the shock on respectively government spending and variable Z (GDP, consumption and investment) in state $S = \{A, B\}$ at horizon h. The cumulative output multipliers on impact and in the fourth, eighth and twelfth quarter are also reported in Table 1, as well as the estimated differences across states. Finally, because the estimations can be interpreted as an instrumental variable regression, Figure 4 also shows the state-dependent F-statistics to assess whether the shock is a good instrument for government spending in each state.[11]

As can be seen in Figure 3, there is a significant increase of government spending and output after both shocks in both states, but the pattern is different. After a BP shock, government purchases and output increase immediately, while both variables respond much more sluggishly to a DN shock, in particular government purchases. This can be explained by the different nature of the shocks. Specifically, BP shocks capture instantaneous shifts in government spending, while DN shocks portray news about future changes in spending. This is also reflected in the magnitudes of the short-run multipliers, i.e. cumulative multipliers are much larger for DN shocks than BP shocks in the very short run. Intuitively, unexpected

[11]State-dependent F-stats are computed as the square of the t-static $\frac{\beta_{S,h}^{G}}{\text{s.e.}\left(\beta_{S,h}^{G}\right)}$, where $\beta_{S,h}^{G}$ is the effect of the shock on government spending G at horizon h in state $S = \{A, B\}$. Following the IV-literature, we use a threshold value of 10 to gauge the relevance of the instruments.

news about future public purchases can induce an anticipated reaction of the private sector, leading to (extreme) large short-run cumulative multipliers.[12] In line with the delayed actual rise of government spending, the F-statistics for the DN shocks are very low in the short run and only become apparent at longer horizons. Accordingly, as also argued by Ramey and Zubairy (2014), DN multipliers are not informative and cannot be interpreted at short horizons.

Despite the different nature and dynamic pattern of both spending shocks, the magnitudes of the cumulative multipliers are, however, remarkably similar at longer horizons. More importantly, for both the BP and DN shocks, the government spending multipliers turn out to be considerably larger in high private debt periods. For both shocks, we find output multipliers that are positive, but smaller than one in low private debt states. The point estimates of the output multipliers range between 0.8-0.9 in the medium to long run for both shocks. In contrast, the estimated multipliers in periods of debt overhang are significantly greater than one, and even reach values of 1.9 for BP shocks and 4.7 for DN shocks. The long-run multipliers (after 12 quarters) for BP and DN shocks are respectively 1.5 and 1.4. The difference between both states is economically meaningful, and statistically significant.[13]

A closer inspection of the responses of personal consumption and investment in Figures 3 and 4, reveals a key reason for the different multipliers in both states. In particular, in periods when private debt is below its long-term trend, personal consumption hardly reacts and investment declines for both shocks. In other words, we find evidence of crowding-out of private domestic demand, which is consistent with intertemporal optimizing households in Neoclassical and several New-Keynesian models. However, exactly the opposite is the case in periods of private debt overhang. We systematically find a rise of personal consumption and investment after an expansionary government spending shock, a result that is more in line with traditional Keynesian reasoning. In sum, the amount of private debt in the economy seems to be a crucial indicator for the repercussions of fiscal stimulus and consolidation programs.

As already mentioned in section 3, and shown in the online appendix of the paper, the results are overall robust when we use alternative debt indicators to determine the state

[12]Remember that the cumulative multiplier is a ratio between the cumulative change in a generic income variable (e.g. GDP) and the cumulative change in government purchases. If the denominator is approximately zero, the cumulative multiplier tends to a very large value.

[13]Some studies only report the impact multipliers of innovations to government spending (as explained above, the impact multiplier is not informative for the DN shock). For the BP shocks, we find impact multipliers of 1.41 and 1.02 in respectively the high and low private debt state. The former is significantly different from one, the latter not. The difference between the impact multipliers (0.39) is statistically significant.

variable. We further check the robustness of the results for the sample period. A first reason is that most studies typically report fiscal multipliers for the post-WWII or post-Korean war sample periods. Notice, however, that sample periods excluding such extraordinary events are characterized by a very small amount of variation in the key variables, which limits the ability to measure multipliers. This is even more the case in a nonlinear setting.[14] A second reason for this sensitivity check, is that our extended dataset combines two sources of data (Gordon and Krenn database before, and NIPA Tables after 1947Q1). The results for the BP shocks for both sample periods are summarized in Figure 5 and Table 2, and confirm the conclusions obtained for the whole sample period.[15] Specifically, the estimated multipliers are significantly higher in periods of ample private debt, while the effects are more subdued in low private debt states. Overall, despite the difficulty of identifying state-dependent effects with very limited variation, our key result that government spending multipliers are greater in periods of private debt overhang remains when we remove the most informative part of the sample period.

5 Effects on interest rate, tax rate and debt ratios

Although our approach cannot determine the exact reason for the different behavior in both states, an issue which is out of the scope of this paper, we have also estimated the state-dependent effects of government spending shocks on some other variables to learn more about the macroeconomic dynamics. The results of this exercise are shown in Figure 6. More precisely, the panels in the figure present the effects of the shocks on respectively the nominal interest rate, the average marginal tax rate, as well as the private and government debt-to-GDP ratios.[16]

A number of interesting observations can be made. First, the nominal interest rate response is negligible and almost never significant. In the low private debt state, there is

[14]As argued in Hall (2009), *"there is little hope of learning much about the multipliers from any data after the mid-1950s"*. [...] All the existing evidence, *"is limited in its ability to measure multipliers for the period from 1948 onward by the lack of variation in government purchases, especially in its most exogenous component, military purchases"*.

[15]As discussed in Ramey (2011), the DN variable should not be used in post-war samples because it contains very little information. For this reason, the full set of results related to the effects of DN shocks in the post-war samples are only reported in the online appendix. The F-statistics indeed confirm the lack of information for this period.

[16]The only difference with the benchmark model is that the additional dependent variables are not scaled by lagged GDP since they are expressed in percentages.

even a mild decline following an expansionary spending shock. A passive or accommodative monetary policy reaction is typically also found in other empirical studies (e.g. Ramey 2011; Perotti 2014). This suggests that the presence of the zero lower bound on the nominal interest rate, i.e. the inability of the central bank to change the interest rate in response to fiscal policy, is by itself not a unique situation. Also in other periods, the interest rate seems to have remained constant after spending shocks.

Second, as pointed out by Baxter and King (1993), the way how the increases in government spending are financed might matter for the macroeconomic consequences. Multipliers are expected to be lower when spending is financed by distortionary taxes, rather than deficits. The estimated state-dependent responses of the marginal tax rate, however, suggest that the different estimated multipliers in high and low private debt states are not driven by the way spending is financed. In particular, the response of the marginal tax rate is not significantly different in both states for the BP government purchases shocks. For the DN shocks, taking into account the pattern of government spending, the tax rate increases even relatively more in the high private debt state.

Third, the effects of the government spending shocks on private and government debt ratios provide some useful insights on the effectiveness of fiscal consolidations and the macroeconomic dynamics in both states. For both shocks, we observe a decline in the private debt-to-GDP ratio after expansionary spending shocks. For the DN shocks, this is permanent. For the BP shocks, the decline is temporary. More importantly, the reduction in private debt ratios is for both shocks much larger in high private debt states. This finding is by itself not a surprise, given the greater multiplier, but the stronger decline in the private debt ratio could also serve as an amplifier of the government purchases shocks. Specifically, expansionary government spending shocks improve the balance sheets of households and firms more in high private debt states, making several of them less debt-constrained, which could in turn stimulate consumption and investment, further reducing the debt burden, etc. The opposite is obviously the case for a restrictive fiscal policy shock. This is exactly the debt deflation (inflation) amplification described in Fisher (1933) and Eggertsson and Krugman (2012). Such a mechanism, which could amplify the differences across private debt states, is also consistent with Mian and Sufi (2014), who observe that the marginal propensity to consume out of wealth is much higher for highly-leveraged households.

The results also reveal that government debt consolidations via a reduction in expenditures were not effective in reducing government debt in periods of debt overhang in the private sector. In contrast, fiscal expansions have on average reduced government debt in high private debt states. As shown in Figure 6, expansionary (restrictive) shocks to government purchases tend to be followed by a decline (rise) in the government debt-to-GDP ratio in high private debt states, whereas the opposite is true in low private debt states. Put differently, the permanent income of (intertemporal maximizing) Ricardian agents does not decrease after an expansionary fiscal policy shock in high private debt states. Since government debt does not increase, there is also no rise in future tax liabilities created by the government purchases. Hence, Ricardian agents probably do not cut consumption in high private debt states. In contrast, they might even increase consumption, further reinforcing the government spending shock. In sum, the stronger effect on private debt in high private debt states, as well as the favorable effect of a positive spending shock on government debt, could have acted as an accelerator mechanism for government purchases.

6 The role of other prominent state variables

So far, following the state-dependent local projections and regime-switching VAR literature, we have allowed the economy to switch between two alternative states, defined as periods of respectively high and low private debt-to-GDP ratios. In this section, we relax this assumption by estimating "augmented" state-dependent local projection models. By doing this, we are able to assess whether our results still hold when we control for other potential states of the economy that could have had an influence on the government spending multiplier. For example, there could have been an overlap of high private debt states with recessions or periods when the nominal interest rate reached the zero lower bound. There exists a literature which argues that these features also augment the multiplier. We first describe the augmented state-dependent local projection model that we use, and then discuss the estimation results when we control for a set of financial, business cycle, and policy states.

6.1 Augmented state-dependent local projection model

For each variable, and each horizon, we estimate the following linear regression model:

$$\begin{aligned} z_{t+h} = &\alpha_{A,h} + \psi_{A,h}(L)\, y_{t-1} + \beta_{A,h} shock_t + \\ &I_{B,t-1}\left[\alpha_{B,h} + \psi_{B,h}(L)\, y_{t-1} + \beta_{B,h} shock_t\right] + \\ &I_{C,t-1}\left[\alpha_{C,h} + \psi_{C,h}(L)\, y_{t-1} + \beta_{C,h} shock_t\right] + \\ &\delta_1 t + \delta_2 t^2 + \varepsilon_{t+h} \end{aligned} \tag{5}$$

where the notations are essentially the same as in the benchmark model. However, $I_{B,t-1}$ is now a dummy variable for being in a high private debt state, whereas $I_{C,t-1}$ is an indicator for an additional (control) state variable (e.g. recession periods). Notice that the state-dependent responses (controlling for the other state variable) are respectively the sum of the coefficients $\beta_{A,h}+\beta_{B,h}$ and $\beta_{A,h}+\beta_{C,h}$, while $\beta_{A,h}$ represents the responses outside both states (e.g. low private debt non-recession periods). We arbitrarily label the latter as the "neutral" state of the economy. The additional effect on the neutral output cumulative multiplier is computed as $\frac{\sum_{h=0}^{H}\beta_{A,h}^{Y}+\beta_{S,h}^{Y}}{\sum_{h=0}^{H}\beta_{A,h}^{G}+\beta_{S,h}^{G}} - \frac{\sum_{h=0}^{H}\beta_{A,h}^{Y}}{\sum_{h=0}^{H}\beta_{A,h}^{G}}$, where $S=\{B,C\}$. Before discussing the additional states and the related results, a note of caution is needed. Since DN shocks occurred only 25% of the time in the sample period, the lack of non-zero observations could result in imprecise estimates of the state-dependent effects when two state variables are considered simultaneously. In contrast to the BP shocks, the estimates for DN shocks are therefore not always very accurate, and the related results should be interpreted carefully.

6.2 Controlling for alternative financial states

Many theoretical papers refer to financial factors as a class of potential drivers of the fiscal multiplier. Terms as liquidity constraints, deleveraging and debt overhang are often used to indicate periods where consumption and investment could behave differently from what is predicted by intertemporal optimization. Although these concepts are sometimes used as synonymous, they define different situations. *Liquidity constraints* are frictions in the credit market that prevent agents to fully maximize their intertemporal objective functions, i.e. to achieve a target level of consumption and investment based on personal preferences and expected profits. *Deleveraging* is a situation where some borrowers, for some unspecified reason (a decrease in the borrowing limit as well as a change in debt preferences), actively try to decrease their outstanding debt through a cut in personal expenditures. Since the cut is not motivated by a change in spending preferences, the borrower could find himself liquidity(debt)-constrained. Finally *debt overhang* is a situation where households and firms have accumulated a high level of debt. This tends to increase the debt burden and, at the same time, could make it more difficult to get new loans to refinance existing debt. In other words, these are periods were the intensive/extensive margin of debt-constrained borrowers could be higher than normal. In this subsection, we check if our benchmark state variable is still meaningful when we control for indicators that proxy similar or alternative financial states.

In a cross-country panel analysis, Corsetti *et* al. (2012) find larger multipliers in the banking crises periods identified by Reinhart and Rogoff (2011). The underlying assumption is that borrowing constraints for the private sector are prevailing during such periods. Interestingly, panel (a) of Figure 6 shows that the episodes of banking crises identified for the U.S. always happened during periods of high private debt.[17] As a first check, we therefore estimate equation (5) with the banking crises periods as an additional state variable. The results for the cumulative output multipliers on impact and in the fourth, eighth and twelfth quarter are shown in Table 3, while all impulse responses functions can be found in the online appendix. The results confirm that multipliers are significantly higher in periods of private debt overhang for both shocks, even when we control for banking crises. For banking crises periods, the estimations based on BP shocks show a short-run positive and significant additional effect (in line with Corsetti *et* al. 2012, who use a similar identification strategy), while DN shocks generate erratic and inconclusive effects.

As a second check, we control for stock market crashes to proxy periods of declining net worth of the private sector. Again, we rely on Reinhart and Rogoff (2011) to identify such periods. As shown in panel (b) of Figure 7, in contrast to banking crises, stock market crashes also occurred in periods that we have classified as low private debt states. The estimation results in Table 3 reveal that, for both type of shocks, spending multipliers are still much larger in high private debt periods. On the other hand, somewhat surprising, we find evidence of lower multipliers during stock market crashes, independently of the shock that we use.

As a final check, we control for deleveraging periods. Eggertsson and Krugman (2012) show that spending multipliers increase when many agents are forced into deleveraging. Although it is the *attempt* to decrease debt that theoretically matters, several studies identify deleveraging periods as episodes when debt-to-GDP ratios decline.[18] Therefore, we define deleveraging as the peak-to-trough phase of the benchmark (detrended) debt-to-GDP ratio. Panel (c) of Figure 7 manifests that this definition captures the second part of a debt overhang episode and the initial part of the subsequent low private debt episode. Table 3 shows that spending multipliers are still significantly higher in periods of private debt overhang for BP shocks, while multipliers seems to be slightly lower in deleveraging periods. We do not find different multipliers in both states for DN shocks, but these estimates are very erratic and not informative. See the online appendix for a graphical representation to illustrate

[17]Since Reinhart and Rogoff (2011) identify banking crises at an annual frequency, we assume this applies to all individual quarters of the year.

[18]In general equilibrium, the attempt to decrease the debt position through a cut in consumption, could raise the debt-to-GDP ratio, due to a fall in GDP this might induce. For an empirical use of the term deleveraging, see for example Justiniano *et* al. (2015).

this. Overall, the augmented state-dependent local projections confirm the benchmark finding that multipliers are greater in periods of private debt overhang, even when we control for alternative financial states.

6.3 Controlling for the business cycle

Michaillat (2014) shows that the effects of government policies may be stronger in recession periods, because there is less crowding out of a rise in public employment on private employment when labor supply is convex. More generally, despite the lack of sound theoretical foundations, a popular Keynesian idea is that increases in government purchases might be more effective in recessions since more idle resources should be available for production. The empirical evidence is, however, mixed. Although some studies find the existence of a countercyclical multiplier (Auerbach and Gorodnichenko 2012 and 2013; Baum *et* al. 2012), Owyang *et* al. (2013) and Ramey and Zubairy (2014) do not confirm significant higher spending multipliers in recessions. The latter studies use the same local projections method, and a similar sample period as we do.[19]

To assess whether our results are not spuriously driven by an overlap of periods of slack with the high-debt state, we control for the business cycle. We use three different indicators. First, we augment the model with *unemployment slack* states. Following Ramey and Zubairy (2014), we define this state as periods when the unemployment rate was above the threshold level of 6.5%. This proxy tries to directly capture periods when a large fraction of resources were not employed. Second, we use the continuous recession indicator (*AG recessions*) constructed in Auerbach and Gorodnichenko (2012), which is based on a 7-quarter moving average of output growth rate. This variable tries to capture smooth changes in the cycle without focusing on discrete events. Finally, we use the *NBER recessions* periods. All three state variables are shown in Figure 7.

As can be seen in Table 3, the results confirm that multipliers are considerably higher in periods of debt overhang, irrespective of the state and measure of the business cycle. We find a significant rise in the cumulative multiplier at all horizons for the BP shocks, and at medium to long-run horizons for the DN shocks. On the other hand, the sign and significance of the impact of the business cycle on the multiplier is mixed. In particular, the estimated additional effect during periods of unemployment slack is negative for both shock, albeit

[19] We also do not find evidence of greater multipliers when we estimate a two-state local projection model where the state variable is a business cycle indicator. Caggiano *et* al. (2015) report significant differences only when they consider deep recessions and strong booms.

statistically not significant for DN shocks. For the AG recession indicator, we find a positive effect of BP shocks that vanishes beyond the impact multiplier, becoming even significantly negative at the 3^{rd} year horizon. For DN shocks, we find a negative and significant additional effect. Finally, during NBER recessions, we find a positive effect on the multiplier for BP shocks, which is only confirmed at the 3^{rd} year horizon by the DN shocks. Overall, in contrast to the role of private debt, it is not possible to draw robust conclusions on the influence of the business cycle on government spending multipliers.

6.4 Controlling for monetary and fiscal policy conditions

The final set of control variables that we consider are related to monetary and fiscal policy. Specifically, several theoretical studies conclude that the multiplier is larger in periods when there is a *binding zero lower bound on nominal interest rates* (Eggertsson and Woodford 2003; Christiano *et* al. 2011). The mechanism can be described as follows. An increase (decrease) in government spending leads to a rise (fall) in inflation expectations. When the nominal interest rate is held constant, this results in a fall (rise) of the real interest rate, spurring (repressing) the economy. Christiano *et* al. (2011) show that the multiplier can be much larger than one when the nominal interest rate does not respond to an increase in government purchases. Notice that also the estimated responses of the nominal interest rate in both states turn out to be quite modest (see section 5). However, Carrillo and Poilly (2013) show that the government spending multiplier rises in a liquidity trap, beyond the impact on the interest rate.

In order to control for zero lower bound or extremely accommodative monetary policy episodes, we use the dummy variable of Ramey and Zubairy (2014), who identify two such periods, i.e. 1932Q2-1951Q1 and 2008Q4-2013Q4. As can be seen in Figure 7, there has indeed been an overlap with periods of private debt overhang, in particular in the 1930s. The results reported in Table 3 demonstrate that multipliers are considerably larger in periods of private debt overhang, even if we control for the presence of the zero lower bound. For the zero lower bound periods, in contrast, we do not find robust evidence of significant different multipliers.

As a final check, we control for *government debt overhang*. Perotti (1999) shows that the multiplier is a negative function of the initial government debt level. The higher the debt owned by the government, the higher the expected future tax rate when tax distortions are convex, resulting in a stronger negative wealth effect on private consumption. For a panel of 19 OECD-countries, Perotti (1999) finds evidence that government expenditure shocks have a large positive effect on private consumption when government debt is low, whereas this effect vanishes when debt-to-GDP levels are high. Giavazzi and Pagano (1990) provide international evidence of expansionary fiscal consolidations at exceptionally high public debt-to-GDP levels. We are not aware of empirical studies that have examined the impact of government debt on spending multipliers in the United States.

To define periods of government debt overhang, we use the same method as described in section 3 for private debt, i.e. periods of government debt overhang are identified as the periods when there was a positive deviation of the government debt-to-GDP ratio from a smooth HP trend. The result of this exercise is shown in panel (h) of Figure 7. Also in this case, we can confirm our main finding that there is evidence of an additional positive and significant effect on the output spending multiplier during periods of high private debt. For government debt, we do not find an unambiguous influence on the multiplier.

7 Conclusions

In this paper, we have used state-dependent local projection methods and historical U.S. data to examine whether government spending multipliers have been different in periods of private debt overhang. The latter are identified as periods when the private nonfinancial debt-to-GDP ratio was above its long-term trend. We have compared the effects of respectively innovations to government purchases à la Blanchard-Perotti and Ramey's narrative defense news shocks.

We find that government spending multipliers were considerably larger in periods of private debt overhang. Specifically, in periods when the debt-to-GDP ratio was below its trend, the estimated spending multipliers turn out to be below one, which is the consequence of a mild crowding-out effect of government purchases on personal consumption and investment. These effects are in line with Neoclassical and some New-Keynesian models. The picture, however, totally changes in periods of ample private debt. The estimated multipliers in high private debt states are significantly greater than one. This is the result of a strong crowding-in effect on personal consumption and investment activities, a feature which is more in line with traditional Keynesian models. Moreover, we find that the government debt-to-GDP ratio decreases after an expansionary shock to government purchases in high private debt states, while there is a stronger decline of the private debt-to-GDP ratio. Both features could act as an amplifier of fiscal policy measures in periods of private debt overhang.

These results are new stylized facts, and deserve additional research. For example, it is not clear what the exact reason is for the different behavior of the private sector in periods of debt overhang. Can it be explained by an increase in the extensive and/or intensive margin of debt-constrained borrowers, as in the models of Eggertsson and Krugman (2012) and Andrés *et* al. (2015)? Is it driven by a much higher marginal propensity to consume of highly-leveraged households, a feature that has been documented by Mian and Sufi (2014)? Or are there alternative explanations? These are all issues that could be explored in future research. Another relevant extension of our analysis is the question whether also tax multipliers are different across private debt states.

Our findings also have some relevant policy implications. In particular, the state of private debt seems to be an important indicator for the consequences of fiscal consolidations and stimulus programs. In periods of debt overhang in the private sector, it is probably not a good idea to conduct austerity policies, because it could have dramatic effects on economic activity. In contrast, deficit-financed government purchases policies could significantly stimulate and stabilize the economy in periods when households are constrained by their debt. On the other hand, once private debt levels are again below trend, the timing is perfect to conduct fiscal consolidations, having minor negative consequences for economic activity.

A Data

Below we list the data used in the empirical analysis. For each variable, we report the sample period, the formula (using official IDs), the aggregation method and the source.

Variable	Sample	Formula & official IDs	Aggr.	Source
Real government spending	1919Q1-1946Q4	G	GR	GK10
	1947Q1-2013Q4	GCE/GDPCTPI		FRED
Real GDP	1919Q1-1946Q4	Y	GR	GK10
	1947Q1-2013Q4	GDP/GDPCTPI		FRED
Real consumption	1919Q1-1946Q4	CND+CS	GR	GK10
	1947Q1-2013Q4	(PCND+PCESV)/GDPCTPI		FRED
Real investment	1919Q1-1946Q4	IPDE+IRES+INRES	GR	GK10
	1947Q1-2013Q4	(PRFI+PNFI)/GDPCTPI		FRED
Population	1919Q1-1951Q4	pop	GR	ORZ13
	1952Q1-2013Q4	POP		FRED
Nominal interest rate	1919Q1-1946Q4	R	ST	GK10
	1947Q1-1955Q4	M13009USM156NNBR	ST	FRED
	1956Q1-2013Q4	FF		FRED
Average marginal tax rate	1919Q1-1949Q4	*Federal individual income tax*	ST	BR11
	1950Q1-2013Q4	*All tax units (series 1)*		M13
Private debt-to-GDP	1919Q1-1951Q4	*(Cj875-Cj887)/Ca10*	GR	HSUS
	1952Q1-2013Q4	(TODNS-SLGSDODNS-FGSDODNS)/GDP		FRED
Public debt-to-GDP	1919Q1-1951Q4	*Cj871/Ca10*	GR	HSUS
	1952Q1-2013Q4	(SLGSDODNS+FGSDODNS)/GDP		FRED
Total private debt-to-GDP	1919Q1-1951Q4	*Cj875/Ca10*	GR	HSUS
	1952Q1-2013Q4	(TODNS-SLGSDODNS-FGSDODNS+DODFS)/GDP		FRED
Household debt-to-GDP	1919Q1-1951Q4	*Cj879 /Ca10*	GR	HSUS
	1952Q1-2013Q4	CMDEBT/GDP		FRED
Unemployment rate	1919Q1-1947Q4	unemp	ST	ORZ13
	1948Q1-2013Q4	UNRATE		FRED
NBER recessions	1919Q1-2013Q4	USRECQ	—	FRED
Banking crises	1919Q1-2013Q4	*Banking crises (7)*	—	RR11
Stock market crashes	1919Q1-2013Q4	*Stock market crashes (4)*	—	RR11

Data related to different sources are merged either using the growth rate (GR) or simply by stacking (ST) them one on top of the other. The sources are Federal Reserve Economic Data (FRED), Carter *et* al. 2006 (HSUS), Gordon and Krenn 2010 (GK10), Barro and Redlick 2011 (BR11), Mertens 2013 (M13), Owyang *et* al. 2013 (ORZ13) and Reinhart and Rogoff 2011 (RR11). The formulas in italics indicate annual series.[20]

[20]Concerning the debt-to-GDP ratios, we transform the series in quarterly frequency using the cubic spline interpolation. Concerning the average marginal tax rate, the banking crises and stock market crashes episodes, annual figures are repeated for each quarter in the year.

B Error bands for cumulative multipliers

Local projections directly provide point estimates and confidence bands of impulse responses. In order to compute the error bands of the cumulative multipliers, we employ the following Monte Carlo simulation:

1. Estimation of the local projections
   Estimate the local projections related to government purchases (G) and an income variable (Z), i.e. for each couple of dependent variables $k = \{G, Z\}$ and for each horizon $h = [0, H]$, estimate the model and store the $m \times 1$ vector of parameters $\hat{\beta}_h^k$ and its $m \times m$ Newey-West variance-covariance matrix $\hat{V}_h^k$.

2. Generation of the draws from the aggregate multivariate normal
   Draw 1000 times from the following distribution

   $$\beta \sim \mathcal{N}\left[\beta_M, \beta_V\right]$$

   where the mean and the variance are constructed as follow:

   $$\beta_M = \begin{bmatrix} \hat{\beta}_0^Y \\ \hat{\beta}_0^G \\ \vdots \\ \hat{\beta}_H^Y \\ \beta_H^G \end{bmatrix} \qquad \beta_V = \begin{bmatrix} \hat{V}_0^Y & 0_{m\times m} & \cdots & 0_{m\times m} & 0_{m\times m} \\ 0_{m\times m} & \hat{V}_0^G & \cdots & 0_{m\times m} & 0_{m\times m} \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0_{m\times m} & 0_{m\times m} & \cdots & \hat{V}_H^Y & 0_{m\times m} \\ 0_{m\times m} & 0_{m\times m} & \cdots & 0_{m\times m} & \hat{V}_H^G \end{bmatrix}$$

   For each draw, calculate the objects of interest (e.g. the state dependent fiscal multiplier).

3. Construction of the error bands
   For each object of interest, sort the draws and select the percentiles $\left\{\frac{\alpha}{2}, \frac{1-\alpha}{2}\right\}$, where α is the selected significance level (e.g. $\alpha = 10\%$).

In the paper, the output of the Monte Carlo simulation has been exclusively used to compute the confidence bands of the derived statistics (e.g. the state-dependent cumulative multipliers). However, we have checked the precision of this method by comparing simulated and asymptotic impulse responses: error bands and point estimates always coincide.

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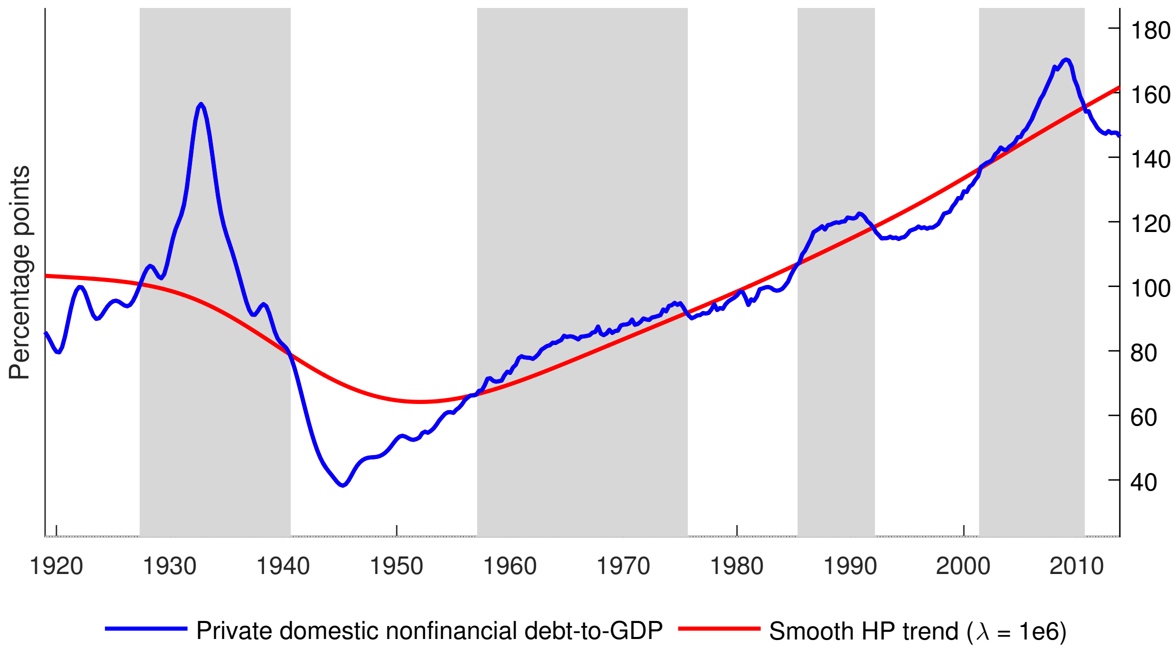
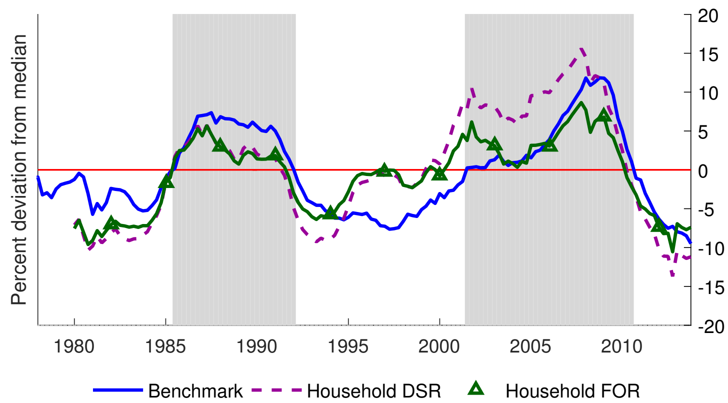
Figure 1. Benchmark periods of private debt overhang



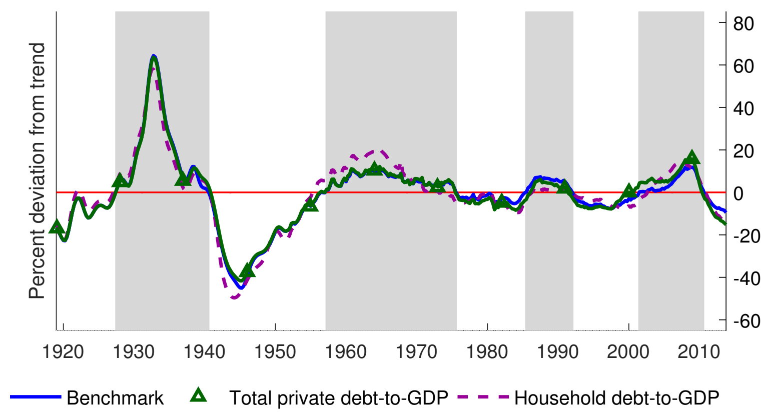
Note. The figure shows the U.S. private domestic nonfinancial debt-to-GDP ratio together with its smooth trend (obtained running an HP filter with a smoothing parameter equal to 1e6) from 1919Q1 to 2013Q4. Gray bars are the identified periods of high private debt.

Figure 2. Alternative measures of private debt overhang

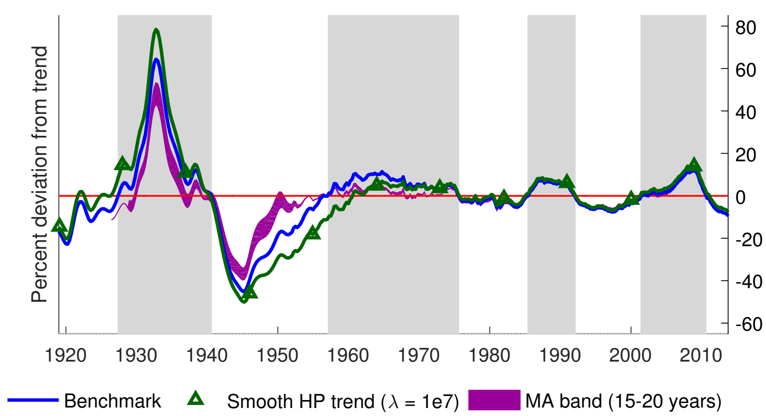
(a) Benchmark versus Debt Service Ratios



(b) Benchmark versus alternative trends



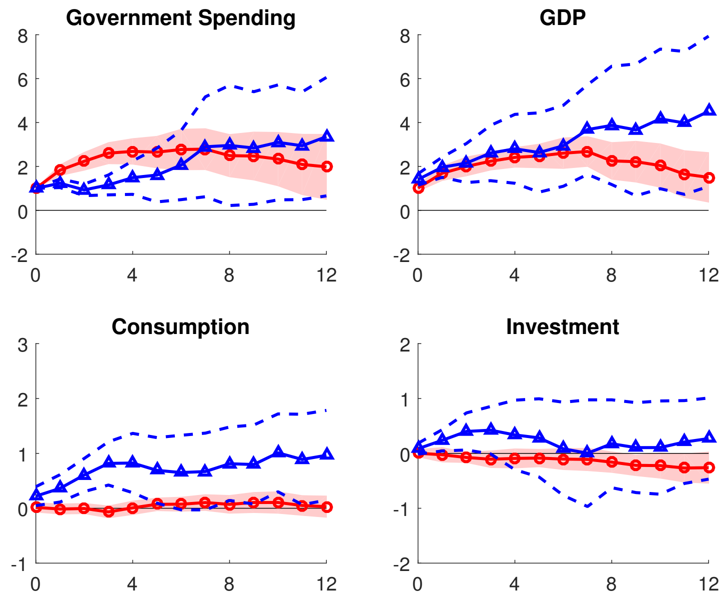
(c) Benchmark versus alternative variables



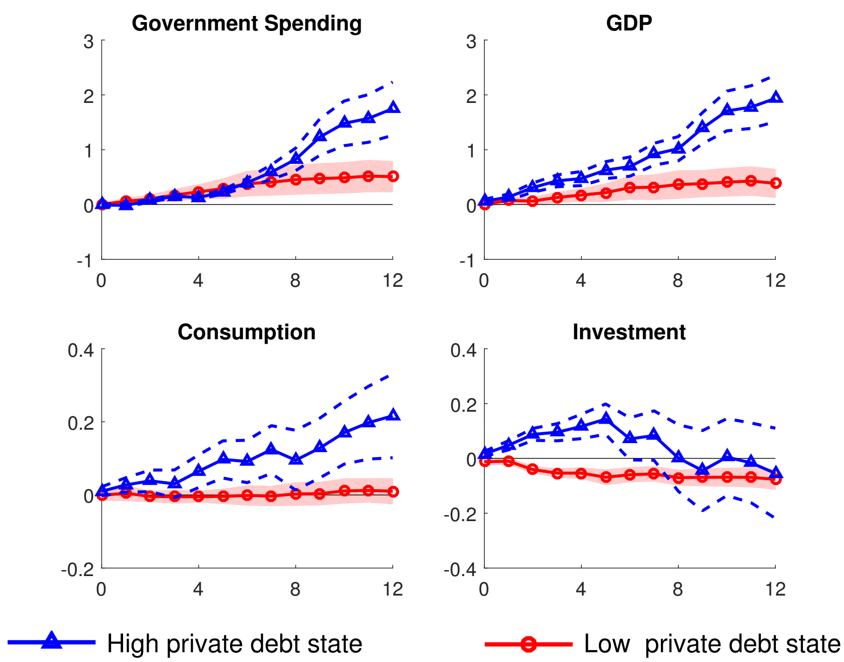
Note. Gray bars are the identified periods of high private debt. Panel (a) compares the benchmark deviation with measures of househould debt service and financial obligations ratios from the Federal Reserve Board (percent deviation from median). The other panels compare the benchmark percent deviation from trend with alternative measures obtained using different trends (b) and reference variables (c).

Figure 3. Effects of spending shocks in high and low private debt states

(a) BP shocks



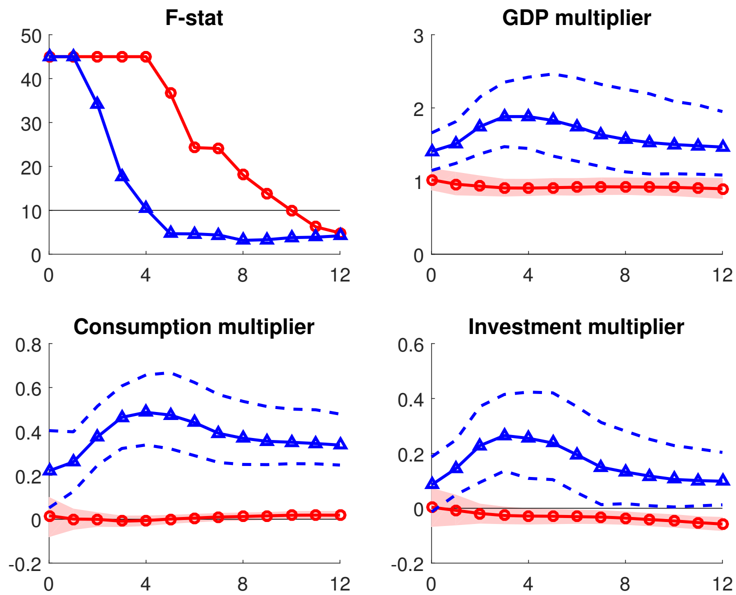
(b) DN shocks



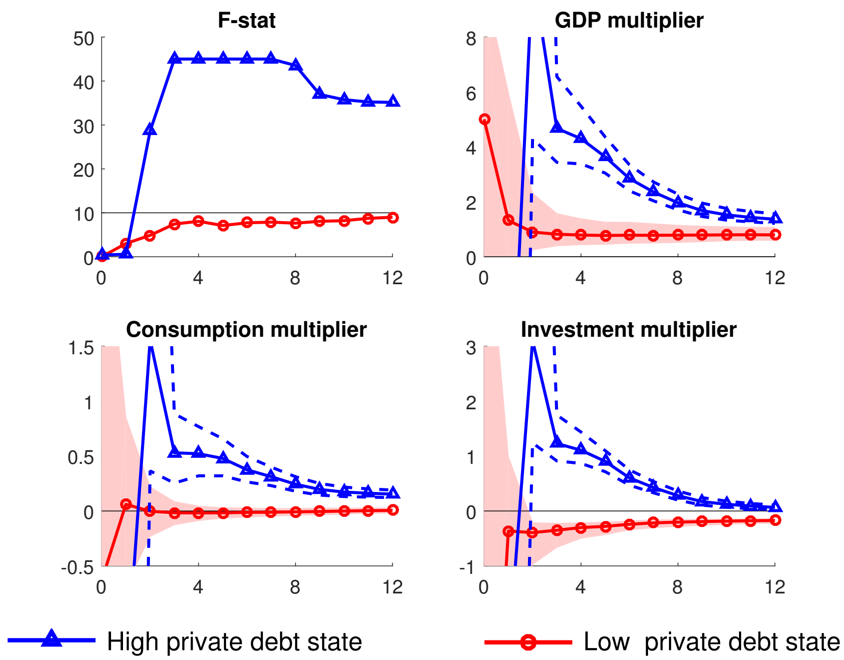
Note. Panel a) shows, respectively, the effects of Blanchard-Perotti shocks (BP) and Ramey's Defense News (DN). The horizontal axes measure the analyzed horizon (expressed in quarters after the shock) and the vertical axes measure the $ change. The bands show the 90% confidence interval.

Figure 4. Cumulative multipliers in high and low private debt states

(a) BP shocks



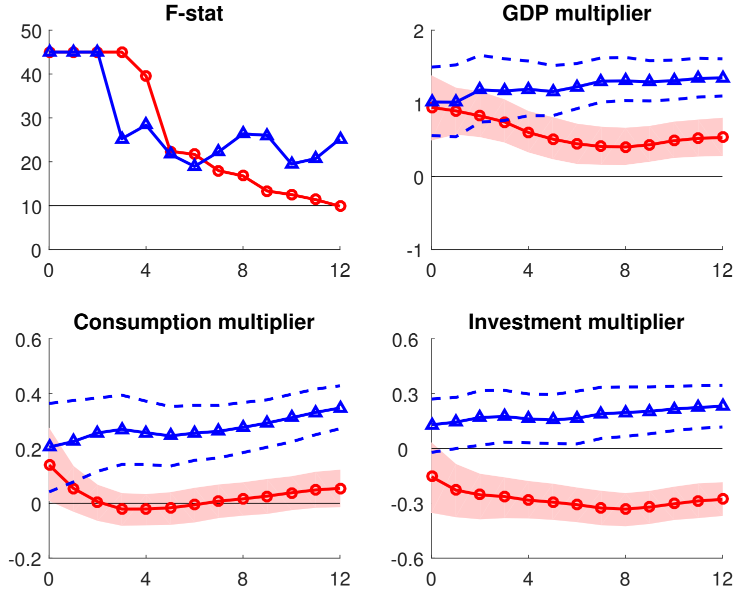
(b) DN shocks



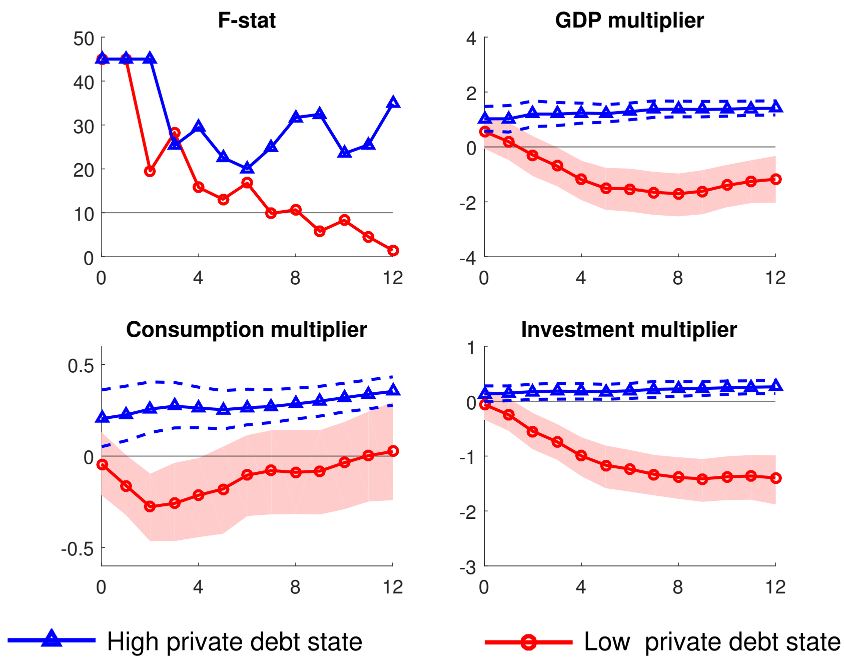
Note. Panels show the F-stats (capped at 45) and the cumulative multipliers for Blanchard-Perotti shocks (BP) and Ramey's Defense News (DN). The horizontal axes measure the analyzed horizon (expressed in quarters after the shock). Cumulative multipliers are calculated as $\frac{\sum_{h=0}^{H} \beta_{S,h}^{Z}}{\sum_{h=0}^{H} \beta_{S,h}^{G}}$, where $\beta_{S,h}^{Z}$ and $\beta_{S,h}^{G}$ are the effects of a government spending shock on an income variable Z and government spending G, in the state $S = \{A, B\}$ at horizon h. The bands show the 90% confidence interval (see appendix for details).

Figure 5. Cumulative spending multipliers in post-wars samples

(a) BP shocks: Post-WWII

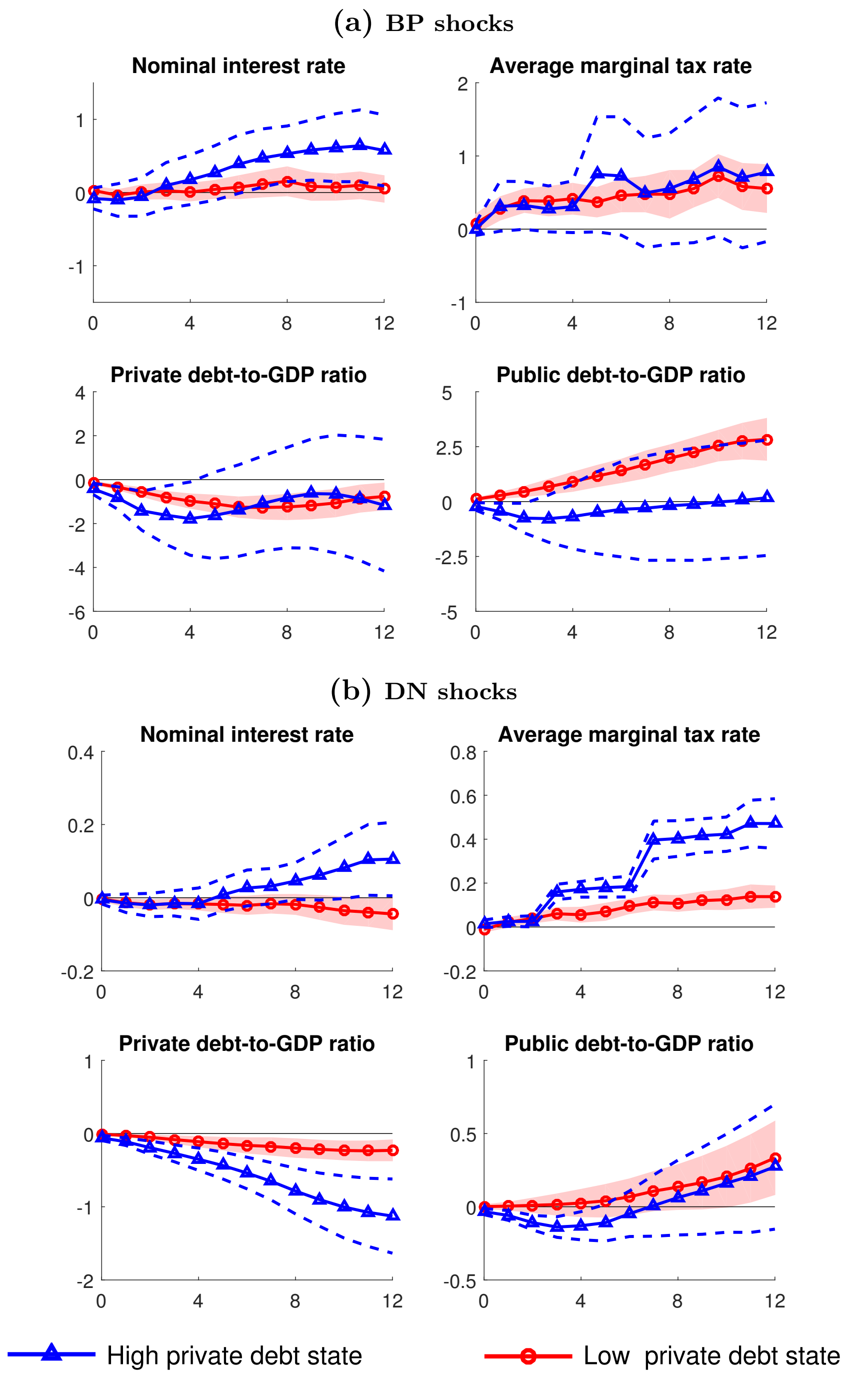


(b) BP shocks: Post-Korean war



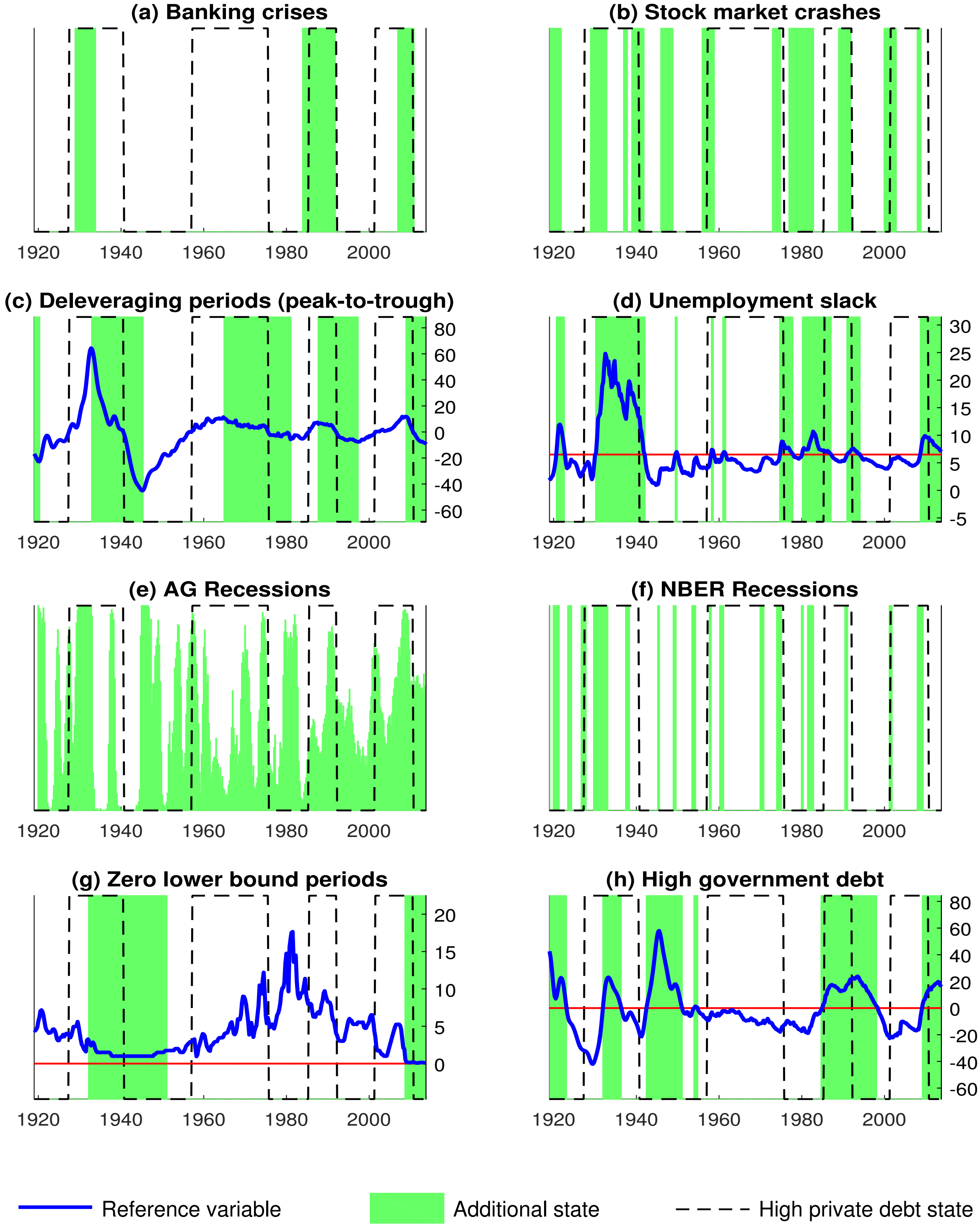
Note. Panels show the F-stats (capped at 45) and the cumulative multipliers for Blanchard-Perotti shocks (BP) and Ramey's Defense News (DN). The horizontal axes measure the analyzed horizon (expressed in quarters after the shock). Cumulative multipliers are calculated as $\frac{\sum_{h=0}^{H}\beta_{S,h}^{Z}}{\sum_{h=0}^{H}\beta_{S,h}^{G}}$, where $\beta_{S,h}^{Z}$ and $\beta_{S,h}^{G}$ are the effects of a government spending shock on an income variable Z and government spending G, in the state $S=\{A,B\}$ at horizon h. The bands show the 90% confidence interval (see appendix for details).

Figure 6. Effects on interest rate, tax rate and debt ratios



Note. Panel a) shows, respectively, the effects of Blanchard-Perotti shocks (BP) and Ramey's Defense News (DN). The horizontal axes measure the analyzed horizon (expressed in quarters after the shock) and the vertical axes measure the % change. The bands show the 90% confidence interval.

Figure 7. Additional state variables



Note. Additional states analyzed in the augmented state-dependent local projection models. Each figure compares the additional state (green bars) with the high private debt state (dotted lines). When available, we show the reference variable used to define the additional state (blue lines).

Table 1. GDP cumulative multipliers in high and low private debt states

(a) **BP shocks**

	Impact	**Q4**	**Q8**	**Q12**
High private debt	1.41	1.88	1.63	1.48
	[1.14 1.66]	[1.47 2.35]	[1.20 2.32]	[1.09 2.04]
Low private debt	1.02	0.91	0.92	0.90
	[0.88 1.17]	[0.79 1.03]	[0.82 1.04]	[0.78 1.04]
Difference	0.39	0.98	0.71	0.58
	[0.06 0.68]	[0.54 1.45]	[0.25 1.42]	[0.16 1.17]

(b) **DN shocks**

	Impact	**Q4**	**Q8**	**Q12**
High private debt	-6.06	4.68	2.35	1.43
	[-25.42 19.22]	[3.44 6.56]	[2.03 2.72]	[1.27 1.65]
Low private debt	5.01	0.82	0.78	0.80
	[-7.49 10.00]	[0.40 1.58]	[0.50 1.20]	[0.60 1.07]
Difference	-11.07	3.85	1.57	0.63
	[-37.21 24.73]	[2.40 5.76]	[1.10 2.02]	[0.32 0.92]

Note. The table reports the GDP cumulative spending multipliers in high and low private debt states at different horizons: impact, 4 quarters, 8 quarters and 12 quarters after the shock. Cumulative multipliers are calculated as $\frac{\sum_{h=0}^{H} \beta_{S,h}^{Z}}{\sum_{h=0}^{H} \beta_{S,h}^{G}}$, where $\beta_{S,h}^{Z}$ and $\beta_{S,h}^{G}$ are the effects of a government spending shock on an income variable Z and government spending G, in the state $S = \{A, B\}$ at horizon h. The confidence interval represents the 5th and 95th percentiles (see appendix for details).

Table 2. GDP cumulative spending multipliers in post-wars samples

(a) BP shocks: Post-WWII

	Impact	**Q4**	**Q8**	**Q12**
High private debt	1.02	1.17	1.30	1.34
	[0.56 1.49]	[0.77 1.61]	[1.02 1.62]	[1.09 1.62]
Low private debt	0.94	0.75	0.41	0.52
	[0.50 1.38]	[0.47 1.05]	[0.16 0.67]	[0.28 0.77]
Difference	0.07	0.42	0.89	0.82
	[-0.56 0.76]	[-0.08 0.95]	[0.51 1.29]	[0.46 1.18]

(b) BP shocks: Post-Korean war

	Impact	**Q4**	**Q8**	**Q12**
High private debt	1.02	1.20	1.37	1.40
	[0.58 1.47]	[0.78 1.62]	[1.08 1.68]	[1.15 1.67]
Low private debt	0.56	-0.70	-1.65	-1.26
	[-0.04 1.13]	[-1.42 -0.03]	[-2.46 -0.92]	[-2.03 -0.50]
Difference	0.46	1.90	3.02	2.66
	[-0.25 1.22]	[1.10 2.73]	[2.21 3.90]	[1.85 3.50]

Note. The table reports the GDP cumulative spending multipliers in high and low private debt states at different horizons: impact, 4 quarters, 8 quarters and 12 quarters after the shock. Cumulative multipliers are calculated as $\frac{\sum_{h=0}^{H} \beta_{S,h}^{Z}}{\sum_{h=0}^{H} \beta_{S,h}^{G}}$, where $\beta_{S,h}^{Z}$ and $\beta_{S,h}^{G}$ are the effects of a government spending shock on an income variable Z and government spending G, in the state $S = \{A, B\}$ at horizon h. The confidence interval represents the 5th and 95th percentiles (see appendix for details).

Table 3. Augmented state-dependent local projections: additional effects

(a) BP shocks

Controlling for alternative financial states

	Impact	**Q4**	**Q8**	**Q12**
High private debt	0.20	0.58***	0.35**	0.36*
Banking crises	0.60**	0.86***	0.59	0.82
High private debt	0.28*	1.12***	1.44***	1.36***
Stock market crashes	-0.18	-0.34***	-0.38***	-0.40***
High private debt	0.25*	1.12***	1.26***	1.47***
Deleveraging periods	-0.27***	-0.10	-0.14*	-0.17*

Controlling for the business cycle

	Impact	**Q4**	**Q8**	**Q12**
High private debt	0.59***	1.13***	1.43***	2.18*
Unemployment slack	-0.48***	-0.26**	-0.23**	-0.21**
High private debt	0.46***	0.92***	0.74***	0.76***
AG recessions	0.23*	0.00	-0.07	-0.18*
High private debt	0.45***	0.90***	0.70***	0.55***
NBER recessions	0.03	0.07	0.29**	0.49***

Controlling for monetary and fiscal policy conditions

	Impact	**Q4**	**Q8**	**Q12**
High private debt	0.40***	1.12***	0.97***	0.93***
Zero lower bound	0.15	0.12	-0.06	-1.07*
High private debt	0.45***	0.86***	0.51***	0.36***
High government debt	0.26**	0.09	0.10	-0.01

Note. Additional effects on the neutral output cumulative multiplier during periods of high private debt and an alternative state. Additional effects are calculated as $\frac{\sum_{h=0}^{H}\beta^{Y}_{A,h}+\beta^{Y}_{B,h}}{\sum_{h=0}^{H}\beta^{G}_{A,h}+\beta^{G}_{B,h}} - \frac{\sum_{h=0}^{H}\beta^{Y}_{A,h}}{\sum_{h=0}^{H}\beta^{G}_{A,h}}$ and $\frac{\sum_{h=0}^{H}\beta^{Y}_{A,h}+\beta^{Y}_{C,h}}{\sum_{h=0}^{H}\beta^{G}_{A,h}+\beta^{G}_{C,h}} - \frac{\sum_{h=0}^{H}\beta^{Y}_{A,h}}{\sum_{h=0}^{H}\beta^{G}_{A,h}}$, where $\beta^{Y}_{S,h}$ and $\beta^{G}_{S,h}$ are the effects of a government spending shock on GDP Y and government spending G, in the state $S = \{A, B, C\}$ at horizon h. The asterisks indicate the percentage of simulated draws which have the same sign of the point estimate: $*(> 90\%)$, $**(> 95\%)$, $***(> 99\%)$.

Table 3. Augmented state-dependent local projections: additional effects

(b) **DN shocks**

Controlling for alternative financial states

	Impact	Q4	Q8	Q12
High private debt	-7.67	3.67***	1.00***	0.27**
Banking crises	-91.38	-1.07	-9.69	1.18***
High private debt	3.13	4.43**	4.87***	1.26***
Stock market crashes	-0.43	-1.40***	-0.68***	-0.64***
High private debt	-0.67	-2.69*	-8.26	11.31
Deleveraging periods	0.62	-0.56	-5.92	10.15

Controlling for the business cycle

	Impact	Q4	Q8	Q12
High private debt	15.82	3.52*	35.10	1.80***
Unemployment slack	5.20	-0.64	-0.23	-0.11
High private debt	-42.01	-15.10	0.88***	0.18
AG recessions	-41.51	-1.00***	-1.19***	3.02
High private debt	-13.77	4.42***	1.50***	0.57***
NBER recessions	-3.62	-0.29	0.08	0.44*

Controlling for monetary and fiscal policy conditions

	Impact	Q4	Q8	Q12
High private debt	2.56	0.93***	0.92***	0.37
Zero lower bound	-1.20	0.73*	0.61*	-0.06
High private debt	-5.32	3.57***	1.51***	0.63***
High government debt	0.00	-0.90	-0.72	-1.03*

Note. Additional effects on the neutral output cumulative multiplier during periods of high private debt and an alternative state. Additional effects are calculated as $\frac{\sum_{h=0}^{H}\beta^{Y}_{A,h}+\beta^{Y}_{B,h}}{\sum_{h=0}^{H}\beta^{G}_{A,h}+\beta^{G}_{B,h}} - \frac{\sum_{h=0}^{H}\beta^{Y}_{A,h}}{\sum_{h=0}^{H}\beta^{G}_{A,h}}$ and $\frac{\sum_{h=0}^{H}\beta^{Y}_{A,h}+\beta^{Y}_{C,h}}{\sum_{h=0}^{H}\beta^{G}_{A,h}+\beta^{G}_{C,h}} - \frac{\sum_{h=0}^{H}\beta^{Y}_{A,h}}{\sum_{h=0}^{H}\beta^{G}_{A,h}}$, where $\beta^{Y}_{S,h}$ and $\beta^{G}_{S,h}$ are the effects of a government spending shock on GDP Y and government spending G, in the state $S = \{A, B, C\}$ at horizon h. The asterisks indicate the percentage of simulated draws which have the same sign of the point estimate: $*(> 90\%)$, $**(> 95\%)$, $***(> 99\%)$.