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Market Response to Fiscal Stimulus**

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Saving Constraints, Debt, and the Credit Market Response to Fiscal Stimulus

Jorge Miranda-Pinto, Daniel Murphy, Kieran James Walsh, and Eric R. Young

We document that the interest rate response to fiscal stimulus (IRRF) is lower in countries with high inequality or high household debt. To interpret this evidence we develop a model in which households take on debt to maintain a consumption threshold (saving constraint). Now debt-burdened, these households use additional income to deleverage. In economies with more debt-burdened households, increases in government spending tighten credit conditions less (relax credit conditions more), leading to smaller increases (larger declines) in the interest rate. Our theoretical framework predicts that the negative relationship between the IRRF and debt only holds when credit is not restricted. It also predicts that the consumption response to fiscal stimulus is falling in debt and inequality (only during periods of relaxed credit). We perform a series of empirical tests and find support for these predictions. In doing so, we provide context to recent evidence on the debt-dependent effects of government spending by highlighting that the relationship between debt and fiscal effects varies with credit conditions.

Keywords: interest rates, fiscal stimulus, household debt, inequality.

JEL Codes: E62, E43, E21, D31, H31

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1 Introduction

The size and length of the Great Recession renewed attention on fiscal policy as a stabilization tool. The design of optimal fiscal policy depends on an understanding of transmission mechanisms. The interest rate response to fiscal stimulus, which we call the IRRF, is of central importance, as it controls the extent to which stimulus crowds out investment and therefore future output.

Despite the relevance of the interest rate channel, the literature has yet to offer clarity on how or why the interest rate responds to government spending. This lack of attention and clarity may be due to an apparent conflict between theory and empirical findings. While standard theory (of both neoclassical and New Keynesian underpinnings) predicts that interest rates rise in response to government spending, studies based on the US and UK tend to find a zero or negative effect on interest rates (e.g., [Barro \[1987\]](#) and, more recently, [Ramey \[2011\]](#) and [Fisher and Peters \[2010\]](#)). Related and also puzzling is the evidence that government spending tends to be associated with local currency depreciation rather than appreciation (e.g., [Ravn et al. \[2012\]](#), [Corsetti et al. \[2012b\]](#), and [Faccini et al. \[2016\]](#)).¹

In this paper we combine empirics and theory to argue that household heterogeneity, in the distribution of income and debt, is important for understanding the credit market response to fiscal stimulus. Much of the theoretical and empirical literature on the propagation of fiscal shocks has focused on the relevance of poor households with high marginal propensities to consume (MPCs) (e.g., [Eggertsson and Krugman \[2012\]](#), [Brinca et al. \[2016\]](#), and [Demyanyk et al. \[2019\]](#)). However, an emerging empirical literature has documented the prevalence of low-MPC behavior among poor indebted households (e.g., [Bunn et al. \[2018\]](#) and [Sahm et al. \[2015\]](#)).² We show that these households are critical for understanding the effects of fiscal stimulus on credit markets (and, relatedly, consumption), and that they can help explain prior evidence that government spending relaxes credit markets.

Our results indicate that inequality and debt are associated with smaller (or more negative) effects of government spending on interest rates and consumption, which is seemingly in contrast to recent empirical evidence based on the Great Recession ([Demyanyk et al. \[2019\]](#)). We reconcile our evidence with the [Demyanyk et al. \[2019\]](#) study by highlighting the role of credit conditions. In short, fiscal effects depend on debt, and this debt-dependence varies

¹The mechanism that would imply currency *appreciation* from government spending (vs. the depreciation seen in the data) is straightforward. Increased government spending crowds out private activity. The interest rate increases to clear the goods market, and higher rates attract foreign capital inflows, which appreciate the currency.

²See [Miranda-Pinto et al. \[2019\]](#) for a detailed review of the empirical evidence documenting the prevalence of poor households with low MPCs.

with credit conditions.

We begin by documenting a new pattern in the effect of government spending on credit markets across countries. Our cross-country evidence focuses on government bond yields instead of short-term interest rates to capture financial market conditions rather than the stance of monetary policy. We employ two approaches to identifying fiscal shocks. First, we follow [Blanchard and Perotti \[2002\]](#), who exploit relatively high-frequency data and legislative lags to construct government spending innovations that are plausibly exogenous to current economic conditions. We also use the approach proposed by [Auerbach and Gorodnichenko \[2013\]](#), which, unlike that of [Blanchard and Perotti \[2002\]](#), takes into account the anticipation of government spending plans by using surveys of professional forecasters from OECD databases.

We document that there is substantial heterogeneity in the IRRF across OECD countries, with approximately half of the countries experiencing a decline in government bond yields in response to an expansion of government consumption. Our baseline cross-country facts focus on the period before the global financial crisis (GFC) but the results are robust to using data post-GFC. Existing theory offers little guidance on the mechanisms that could account for these patterns. General equilibrium models are generally unable to explain negative IRRFs for longer-term nominal government bond yields, and no theory of which we are aware has been proposed to account for heterogeneity in the IRRF (except with respect to fiscal shocks *at* versus *away from* the zero lower bound).

To shed light on the mechanisms responsible for this variation, we regress the IRRFs on country-level characteristics. We document that country-level income inequality and household leverage are the strongest predictors of the IRRF. In particular, higher inequality and higher household debt are associated with a lower IRRF, both unconditionally and conditional on other potential country-level determinants of the IRRF. This result is surprising given that one might expect high inequality or leverage to imply the existence of many credit-constrained households with high marginal propensities to consume (see, for example, [Huggett \[1993\]](#), [Aiyagari \[1994\]](#), and [Brinca et al. \[2016\]](#)) that would, all else equal, push up the IRRF. The negative relationship between inequality or household debt and the IRRF suggests new theory is needed to understand the data.

To rationalize this evidence, we propose a theory that builds on the insights in [Chetty and Szeidl \[2007\]](#) and our companion paper, [Miranda-Pinto et al. \[2019\]](#). In [Miranda-Pinto et al. \[2019\]](#), we demonstrate that a dynamic heterogeneous-agent model featuring time-varying consumption thresholds can rationalize many aspects of the household-level joint dynamics of consumption and income.³ These consumption thresholds represent stochastic maintenance

³Specifically, [Miranda-Pinto et al. \[2019\]](#) present evidence that 1) household-level consumption is as volatile as household income on average, 2) household-level consumption is relatively uncorrelated with income, 3) a large fraction of low-wealth households exhibit marginal propensities to consume near zero

costs for aspects of current consumption that are determined by prior decisions and costly to adjust in the short term (“consumption commitments” -Chetty and Szeidl [2007]). For example, automobiles (committed consumption) may break down and require repairs. In a stationary equilibrium, the consumption of many low-wealth, low-income households is pushed up by these consumption thresholds (relative to consumption in the absence of the thresholds), rendering them *debt-burdened* or *saving-constrained*. These households use all additional income to delever rather than to increase consumption.

Here we embed consumption thresholds (saving constraints) in a two-period general equilibrium model to demonstrate that the existence of these high-debt, saving-constrained households can help rationalize our evidence on the relationship between the IRRF and inequality (debt). The model illustrates in a simple setting how saving constraints generate an inverse relationship between inequality (and debt) and the IRRF. In our model, a fraction of households are sufficiently poor that they hit the minimum consumption constraint in the first period (consistent with the prevalence of saving constraints among low-wealth households in Miranda-Pinto et al. [2019]). Higher inequality is associated with more poor households that must borrow to meet their consumption threshold in the first period (and hence more debt). Government spending redistributes income to poor, saving-constrained households with low MPCs.⁴ This redistribution to low-MPC households relaxes credit markets and puts downward pressure on the equilibrium interest rate, as government wages help poor workers delever. With higher inequality, more households are saving-constrained, household debt is higher, and government spending relaxes credit markets more (tightens them less).

The relative credit market relaxation in our theory is driven by low MPCs due to the prevalence of saving-constrained households. This credit market relaxation can manifest in a low interest rate response and/or a low consumption response to fiscal stimulus. We therefore test the prediction that consumption should (weakly) increase less after fiscal shocks in countries or counties with higher household debt. To test this prediction, we use cross-country data to study how the private consumption response to government spending shocks depends on households’ debt. The cross-country evidence supports this implication. We find that the four-quarter response of consumption to government spending shocks is smaller in countries with high inequality or high household debt. This result is consistent with prior evidence in Jappelli and Pagano [1989], who find that among a subsample of OECD countries, consumption is less responsive to income in countries with higher levels of consumer debt. We

(consistent with evidence in Bunn et al. [2018], Sahm et al. [2015] and Misra and Surico [2014]), and 4) lagged high expenditure is associated with low contemporaneous spending propensities.

⁴Specifically, in producing government goods, the government hires and pays wages to workers, composed of both high-debt (saving-constrained) low-income agents (for whom the consumption threshold is binding) and unconstrained rich agents. Taxes are proportional to income, so wages associated with government production redistribute resources to the low-wealth households with zero MPCs.

supplement this evidence using time-varying local projection methods for the US. We show that the IRRF and the consumption response to fiscal stimulus (CRF) are lower (negative) during times of high household debt.

Our evidence that the consumption response to government spending is *lower* in the presence of high household debt is somewhat surprising in light of recent evidence in [Demyanyk et al. \[2019\]](#) that consumer debt during the Great Recession was associated with higher consumption responses to fiscal stimulus. Our evidence can be reconciled with that in [Demyanyk et al. \[2019\]](#) by noting that their evidence is based on an episode in which credit conditions were very tight, while our evidence is based on a longer span of time with looser credit conditions. To emphasize the relevance of credit conditions, we present a simple extension to our theory in which credit is rationed. When credit is sufficiently tight, poor households become credit-constrained rather than saving-constrained (they cannot even meet their consumption threshold in the first period) and exhibit large MPCs. In that case, the consumption response to fiscal stimulus is increasing in inequality and debt, consistent with the evidence in [Demyanyk et al. \[2019\]](#) and with the theoretical predictions in [Eggertsson and Krugman \[2012\]](#). But under normal (looser) credit conditions, high-debt households are saving-constrained and exhibit low MPCs.

To empirically examine the role of the interaction between credit conditions and debt, we exploit the variation in credit conditions and debt from US data. We first focus on time-series variation in aggregate data and document that high consumer debt is associated with a lower IRRF and CRF, but not when credit conditions are tight.⁵ We then conduct a complementary analysis that exploits strong cross-sectional variation in government spending, debt, and consumption. In particular, we extend the analysis in [Demyanyk et al. \[2019\]](#) and examine the relationship between consumer debt and fiscal effects across regions (counties) in the US, both during a period of normal-to-loose credit conditions (prior to the Great Recession) and during a period of tight credit (the Great Recession). Consistent with our other evidence and our theory, we find that the consumption (auto registration) response to Department of Defense (DOD) spending is lower in high-debt counties *only during the period of loose credit*.⁶

Our empirical and theoretical results are related to a number of other strands of the literature. Recent empirical work documents the determinants of fiscal output multipliers in cross-country settings (e.g., [Brinca et al. \[2016\]](#), [Ilzetzki et al. \[2013\]](#), [Corsetti et al. \[2012a\]](#)). While we likewise examine cross-country determinants of the effects of fiscal shocks, our focus is on heterogeneity in interest rates (and consumption) rather than output, and we

⁵This result is consistent with the evidence in [Cho et al. \[2019\]](#) that MPCs among US households were higher during the Great Recession.

⁶Consistent with the prior literature (e.g., [Mian et al. \[2013\]](#) and [Demyanyk et al. \[2019\]](#)), we use auto registrations as a proxy for local consumption.

consider OECD countries exclusively.

Furthermore, our evidence of negative IRRFs in a number of countries potentially helps resolve the puzzling finding of previous papers that expansionary government spending shocks are not clearly associated with exchange rate appreciations (see, for example, Corsetti et al. [2012b]). The standard Mundell-Fleming model predicts that exchange rates should increase as domestic interest rates rise, attracting capital inflows. Evidence against exchange rate appreciation has been interpreted as a rejection of Mundell-Fleming (Ravn et al. [2012]). Our paper offers a potential reconciliation between the data and the Mundell-Fleming interest rate channel of exchange rate movements.

The remainder of the paper proceeds as follows. Section 2 documents the relationship between the IRRF and inequality and household debt. Section 3 presents a qualitative theory of debt-burdened households to rationalize our findings. Section 4 presents several empirical validation exercises, including cross-country results for the United States. Section 5 concludes.

2 The interest rate response to fiscal stimulus

To estimate country-level fiscal shocks and IRRFs, we collect quarterly data on real government consumption, real GDP, and nominal interest rates across countries. Obtaining reliable country-level estimates of fiscal shocks requires a sufficient time span of data. Therefore, we limit our focus to OECD countries, most of which provide quarterly data that span a period of over 20 years. The primary data source is the OECD. We supplement the OECD numbers with data from Haver Analytics whenever doing so extends the sample.⁷ A detailed description of the data used to estimate fiscal shocks is in our online data appendix.⁸

Our study focuses on government bond yields because they are the interest rate most widely available for our sample. An advantage of examining yields on longer-dated bonds is that they are not directly controlled by central banks but rather depend on credit conditions more generally. Our sample includes all OECD countries for which we observe government bond yields for at least 10 consecutive years prior to the end of our estimation period, 2007. The average maturity in our sample is around 8 years. Our baseline estimation period ends in 2007 in order to avoid structural breaks that may have been associated with the GFC and to focus on the transmission mechanism of government spending shocks outside crisis times. However, the results are robust to using longer times series that include post-GFC data. In Appendix A.1 we also examine data on shorter-term interest rates, which we refer

⁷The Haver Analytics data are in nominal terms. We put the nominal values in real terms by deflating by the country's GDP deflator. Government bond yields are kept as nominal due to the lack of data on inflation expectations.

⁸Online data appendix: https://drive.google.com/open?id=1r-MnOA0emMA-Hl_LxgUAiaYaYVvpaxnZ

to as policy rates. We use direct measures of central bank policy rates when available. For countries that do not have policy rate data, we use the short-term interest rate series in [Ilzetzi et al. \[2013\]](#). The policy rates for members of the European Monetary Union are equal to European Central Bank rates.

2.1 Identifying shocks to government consumption expenditures

We identify government spending shocks following the approach in [Blanchard and Perotti \[2002\]](#). The key identification assumption is that, within a quarter, government spending is predetermined with respect to other macro variables. Hence government spending responds contemporaneously to its own shock but not to other shocks in the economy. Based on the delay in the political process that typically justifies this restriction, much of the literature has adopted the Blanchard-Perotti approach (e.g., [Bachmann and Sims \[2012\]](#), [Auerbach and Gorodnichenko \[2012\]](#), [Rossi and Zubairy \[2011\]](#), and [Brinca et al. \[2016\]](#)).

Despite the widespread use of the Blanchard-Perotti approach and the plausibility of its identifying assumptions, there are potential limitations. If changes in government spending are anticipated, the Blanchard-Perotti approach will not capture the exogenous component of government spending ([Ramey \[2011\]](#)). To overcome this challenge, [Ramey \[2011\]](#) uses news about future defense spending to identify fiscal shocks. As [Ilzetzi et al. \[2013\]](#) point out, this approach is not viable when estimating fiscal shocks across countries. Data on news about military buildups on which the estimates are based are not available across countries, and even within the US there is little variation in the news measure in the post-war period. Therefore, we adopt the Blanchard-Perotti approach. We acknowledge the potential limitations of this approach but note that the estimated effects of stimulus on interest rates are relatively consistent across empirical specifications, at least for the US (see the discussion in [Murphy and Walsh \[2018\]](#)). As a robustness check, we also identify shocks using semi-annual data on forecast errors for government spending, as in [Auerbach and Gorodnichenko \[2013\]](#). We show in Appendix [A.2](#) that the main results of the paper also hold when we use the semi-annual government innovations from their work.

We identify fiscal shocks independently for each country in our sample. To do so, we estimate

$$A_0 X_t = \sum_{j=1}^4 A_j X_{t-j} + \varepsilon_t, \quad (1)$$

where $X_t = [G_t, Y_t, r_t]'$ consists of log real government final consumption expenditure G_t , log real GDP, and government bond yields r_t . $\varepsilon_t = [\nu_t, \varepsilon_{2,t}, \varepsilon_{3,t}]$ is a vector of structural shocks, and ν_t is the shock to government spending. The identifying assumption amounts to a zero restriction on the (1,2) and (1,3) elements of A_0 . We use four lags of our endogenous variables. Unlike [Blanchard and Perotti \[2002\]](#), we do not have quarterly data on tax revenue

for our sample.^{9,10}

We estimate impulse responses of interest rates to the fiscal shocks. For the purpose of our cross-country analysis, we summarize the information in the impulse responses by examining the average four-quarter impulse response to government consumption shocks. Let ρ_h be the horizon h impulse response of interest rates (in annualized percentage points). The country-level interest rate response to a one-standard-deviation shock to government consumption is computed as:

$$IRRF = \frac{1}{4} \sum_{h=0}^3 \rho_h. \quad (2)$$

Figure I depicts the substantial variation in the IRRF across countries. In half of the countries in the sample (14 countries), the response of interest rates to government consumption shocks is negative. In Switzerland a one-standard-deviation shock *increases* interest rates by 0.13 percentage points on average over four quarters. In the US, a one-standard-deviation shock to government expenditure *decreases* interest rates by 0.06 percentage points.

Next we examine the country-level determinants of the IRRF.

2.2 Determinants of the IRRF

Motivated by prior theoretical work (e.g., Eggertsson and Krugman [2012], and Brinca et al. [2016]), we examine whether household debt and inequality can account for the variation in the IRRF. Our measure of inequality is the ratio of the income of the richest 10 percent of the population to the income of the poorest 10 percent, which is provided by the OECD. For each country, we take the average since 2001, when those data are first available. Income inequality is very stable within countries and exhibits substantial cross-sectional dispersion. The average within-country standard deviation of inequality is 0.15, while the cross country standard deviation of our measure is 1.4. The US is the most unequal country of the sample with an average ratio of 6.2, while Denmark has a ratio of 2.8. For household debt, we use the household debt-to-income ratio from OECD Statistics. In particular, we collect for each country, the ratio of households' total liabilities (loans, primarily mortgage loans and consumer credit, and other accounts payable) to net disposable income. We then use, for each country, the sample average.¹¹ The household debt measure likewise exhibits stronger

⁹To explore how important is the omission of the tax revenue data, we check how the interest rate response to fiscal shocks in the VAR changes when tax revenue is included for the US. We find that the one-year interest rate response is practically unchanged when tax revenue is added to the VAR, consistent with the findings in Ilzetzki et al. [2013] with respect to the output multiplier.

¹⁰We follow Auerbach and Gorodnichenko [2012] and estimate the VAR with the variables in log levels to preserve the cointegration relations. The fiscal shocks backed out from the VAR are stationary.

¹¹Data for most countries begin in 1996. Data for Ireland, Poland, Slovenia, Spain, and Switzerland are available as of 2003. Korea has data only for the period 2011-2014.

cross-country variation than within-country variation. We report results that use the entire time series when constructing the country-specific measure, although results are similar when limiting the sample to pre-2008 data (and therefore dropping Korea, which only has post-2008 debt data).

Given that our estimated IRRF across countries is estimated with different degrees of precision, in our regression analysis we use weighted least squares (WLS). Our idea is to give less weight to observations that are estimated with less precision.¹²

$$\omega_i = \frac{1}{IRRF_i^{95} - IRRF_i^5}, \quad (3)$$

where $IRRF_i^{95}$ and $IRRF_i^5$ are the upper (95 percent) and lower (5 percent) bounds of the bootstrap confidence intervals of the IRRF of country i , respectively.

Figure II documents the unconditional relationship between the IRRF and inequality and household debt. The IRRF declines with inequality and debt, a surprising pattern given that inequality and indebtedness are often associated with credit constraints (see, for example, Brinca et al. [2016]) that would be expected to cause a higher IRRF.

It is possible that the inverse relationship between inequality and the IRRF is due to monetary policy that is more accommodative of fiscal shocks in unequal countries. We examine policy rate responses (Figure A.I in Appendix A.1) and find that the same relationship does not hold (policy rate responses are independent of inequality or debt), suggesting that government spending relaxes credit markets relatively more in unequal countries, beyond any response of monetary policy to government spending shocks. This is consistent with the evidence in Murphy and Walsh [2018] that monetary accommodation cannot fully account for the negative IRRF in the US.

To further isolate the role of inequality from central bank policy and other determinants, we regress the IRRF on measures of central bank independence and financial openness. We define a dummy variable for countries with an inflation targeting scheme prior to 2007 (see Carare and Stone [2003]). Our measure of financial openness, from Lane and Milesi-Ferretti [2007], is financial assets plus liabilities, over GDP. The motivation for including this control is that Mundell-Fleming predicts that countries that are more open to international financial markets have smaller or zero responses of interest rates to fiscal shocks. In Table I, we provide the relevant descriptive statistics of our dependent variable and control variables.

Table II shows the dependence of the IRRF on inequality (column 1) and debt (column 2), conditional on these other determinants. We normalize our covariates, except inflation tar-

¹²WLS provides efficiency gains over OLS and consistent standard errors if all of the error in our regression analysis is attributable to measurement error in the IRRF. If there are additional sources of error (as in the typical case), Lewis and Linzer [2005] show that if the additional error is small relative to the measurement error in the dependent variable, our WLS procedure is similar to feasible generalized least squares that explicitly accounts for both sources of error.

geting, by their sample standard deviation. We find that a one-standard-deviation increase in inequality is associated with a 2.7-basis-point decline in the IRRF, and a one-standard-deviation increase in the household debt-to-income ratio is associated with a 2.4-basis-point reduction in the IRRF.¹³

To summarize our results, the interest rate response to government purchases is heterogeneous across countries and is inversely related to inequality and household leverage. Below we propose a model in which high inequality and high debt are associated with a large fraction of low-income households with high propensities to save (low MPCs). Government consumption redistributes resources to these low-income households and relaxes credit markets.

3 Theory: Saving-constrained households, debt, and interest rates

Here we develop a framework in which the distribution of income (and therefore debt) is crucially important for the transmission of fiscal policy. To explain our baseline set of facts, we depart from prior theoretical work on the relationship between debt (or inequality) and fiscal effects (e.g., [Eggertsson and Krugman \[2012\]](#)) in that we abstract from credit constraints. We consider an alternative friction that arises from households’ need to cover unexpected expenses such as medical bills and automobile repairs. These expenses are costly to avoid. In our baseline model, households have enough access to credit to cover these consumption thresholds. Now debt-burdened, these households use additional income to delever. We then extend our model to study the role of credit constraints in shaping the interest rate response to fiscal stimulus.

[Miranda-Pinto et al. \[2019\]](#) document the importance of unexpected expenditures—or consumption threshold shocks—in matching key features of the microdata.¹⁴ Consumption thresholds build on the notion of “consumption commitments” in [Chetty and Szeidl \[2007\]](#) in that they represent stochastic maintenance costs for aspects of consumption that are costly to adjust in the short term. In [Miranda-Pinto et al. \[2019\]](#) we demonstrate that many low-

¹³Inverse relationships also hold when we control for the fraction of government foreign debt-to-GDP. The coefficient for foreign public debt-to-GDP is negative and consistent with the predictions in [Priftis and Zimic \[2018\]](#) and [Broner et al. \[2018\]](#). However, we only have 19 observations in this specification as there are no data for Belgium, Denmark, France, Germany, Japan, New Zealand, Norway, and Poland.

¹⁴[Miranda-Pinto et al. \[2019\]](#) lay out a theory of saving-constrained households and demonstrate that in a dynamic setting with incomplete markets, saving-constrained households exist in the stationary equilibrium (they do not fully precautionarily save to avoid the constraint in a calibrated model). The paper shows that the existence of saving-constrained households provides an explanation for puzzling aspects of the microdata. For example, household-level consumption is as volatile as income but relatively uncorrelated with income. Furthermore, many high-debt/low-wealth households save all additional income (e.g., [Sahm et al. \[2015\]](#) and [Misra and Surico \[2014\]](#)) and in Alaska lower-income households tend to have lower MPCs ([Kueng \[2018\]](#)).

income households that experience a high consumption threshold take on debt to cover the expense and use all additional income to delever. We refer to these households as *saving-constrained* because they borrow more (save less) than they would in the absence of the consumption threshold.

Here we introduce saving-constrained households in a general equilibrium setting. Our objective is to demonstrate in a clear and simple setting the interrelationships among debt, inequality, and the IRRF. Therefore, we abstract from the infinite-horizon environment in [Miranda-Pinto et al. \[2019\]](#) and instead consider a two-period setting in which households are subject to a consumption constraint in the first period. This constraint is a reduced-form way of modeling the stochastic consumption thresholds that cause low-income households to be saving constrained in [Miranda-Pinto et al. \[2019\]](#).

In the model, higher inequality is associated with more poor households that must borrow to meet their consumption threshold in the first period (and hence more debt). Government spending redistributes income to poor, saving-constrained households with low MPCs. This redistribution to low-MPC households relaxes credit markets and puts downward pressure on the equilibrium interest rate, as government wages help poor workers delever. With higher inequality, more households are saving-constrained, household debt is higher, and government spending relaxes credits market more (tightens them less).

To accommodate the possibility that interest rates can fall in response to government spending, we examine a setting that permits slack in labor markets.¹⁵ As discussed in [Murphy and Walsh \[2018\]](#), the existence of slack permits a non-positive interest rate response to government spending. In our model, government spending can cause a negative interest rate response in the presence of slack by redistributing income to low-income, saving-constrained households.

3.1 Model

Suppose there are two agent types, rich(r) and non-rich (p). The measure of non-rich agents is $\pi \in [1/2, 1)$, and the measure of rich agents is $1 - \pi$. As we will see, π will determine the level of inequality and gross debt in the economy. Each agent elastically supplies up to \bar{L} units of labor in each period, of which there are two: $t \in \{0, 1\}$.

In each period, there is a representative private firm that solves

$$\Pi = \max_{\ell} (A\ell^{\alpha} - w\ell),$$

where w is the wage, which is stuck, and $0 < \alpha < 1$. Given w , firm labor demand is $\ell^* = (w/(\alpha A))^{1/(\alpha-1)}$. We assume that (1) $\bar{L} > \ell^*$, (2) the firm randomly hires among the agents,

¹⁵The existence of slack in labor markets is consistent with the empirical evidence in [Auerbach et al. \[2019\]](#).

and (3) $A = (w/\alpha)^\alpha$ (a simplifying normalization). Therefore, firm and worker optimization implies that $\Pi + w\ell^* = A\ell^{*\alpha} = 1$, that $\ell^* = \alpha/w$, and that each agent's private-sector labor income is $w\ell^* = \alpha$, a fraction π of which goes to non-rich agents. Moreover, since $\ell^* < \bar{L}$ there is slack in the labor market in the sense that each agent is willing to supply more labor than the private sector is willing to hire at the stuck wage w .

In $t = 0$, the government also hires the agents (again, randomly across types). Specifically, the government demands $\tilde{G} = G/w < \bar{L} - \ell^*$ units of labor, which the agents are willing to supply since $\tilde{G} + \ell^* < \bar{L}$. The government uses the workers to produce government goods and effectively buys these goods from itself. For the purposes of national accounting, these public purchases are valued at their cost. So, $G = \tilde{G}w = \pi\tilde{G}w + (1 - \pi)\tilde{G}w$ is both the public wage paid to each agent and the value of government purchases in the national accounts. GDP or national income is, in the two periods,

$$\begin{aligned} Y_0 &= \Pi + w\ell^* + w\tilde{G} = A\ell^{*\alpha} + G = 1 + G \\ Y_1 &= \Pi + w\ell^* = A\ell^{*\alpha} = 1 \end{aligned} \tag{4}$$

We assume that the rich collectively own half of firm profits. Thus, the total private sector pre-tax income of the rich is $\Pi/2 + (1 - \pi)w\ell^*$, while the income of a rich individual is $y^r = \Pi/(2(1 - \pi)) + w\ell^*$. Similarly, the private sector pre-tax income of a non-rich individual is $y^p = \Pi/(2\pi) + w\ell^*$, so $(1 - \pi)y^r + \pi y^p = 1$. A useful feature of this setup is that a single parameter, π , governs inequality. As π varies between $1/2$ and 1 , total private income is fixed at $\Pi + w\ell^* = 1$. However, since the poorest 50 percent of agents are always non-rich, the total private pre-tax income of the richest 50 percent of agents is

$$\Pi + w\ell^* - \frac{1}{2} \left(\frac{\Pi}{2\pi} + w\ell^* \right),$$

which is monotonically increasing in π . Also, as $\pi \rightarrow 1$, half of firm profits are owned by an increasingly small fraction of agents. Furthermore, as $\pi \rightarrow 1$, more agents borrow to meet the consumption threshold (by assumption), leading to higher debt.¹⁶

In the first period, the agents and the government trade zero net supply bonds at gross interest rate R . The government pays for purchases with a flat proportional tax τ on private income in the second period. Since $(1 - \pi)y^r + \pi y^p = 1$, the government budget constraint is

$$RG = \tau. \tag{5}$$

¹⁶In the cross-country data, while inequality and debt are positively correlated, that correlation is not 1. However, our empirical results show that the source of this lower correlation has little to do with the IRRF, so we abstract from whatever may be driving it.

The problem of an arbitrary agent of type $i \in \{r, p\}$ is

$$\begin{aligned} & \max_{c_0, c_1} \{\log(c_0) + \log(c_1)\} \text{ subject to} \\ & (i) : c_0 + \frac{1}{R}c_1 = y^i + \frac{1}{R}y^i(1 - \tau) + G \\ & (ii) : c_0 \geq \underline{c}, \end{aligned} \tag{6}$$

where \underline{c} is the consumption threshold. Recall that $G = \tilde{G}w$ is wage income from government work, and y^i includes both private profits and wages. Since taxes are proportional to private income but government wages are uniform across agents, fiscal policy redistributes from rich to non-rich.

Under the above assumptions, *equilibrium with slack in the labor market* consists of an interest rate R , agent consumption, and taxes τ such that goods markets clear ($\pi(c_0^p, c_1^p) + (1 - \pi)(c_0^r, c_1^r) = (1, 1)$), consumption solves the agents' problems (6) given prices and taxes, and the government budget constraint (5) is satisfied ($RG = \tau$).¹⁷ We restrict attention to our case of interest in which equilibrium consumption satisfies $c_0^r > c_0^p = \underline{c}$ (the minimum consumption level binds for the non-rich only), in which rich households are savers and poor households are borrowers.¹⁸ In this *saving-constrained equilibrium*, optimal rich consumption, from combining the Euler equation and the budget constraint of the rich, is

$$c_0^r = \frac{1}{2}G + \frac{1}{2}y^r \left(1 + \frac{1}{R}(1 - \tau)\right),$$

which after plugging in the government budget constraint (5) becomes

$$c_0^r = \frac{1}{2}(1 - y^r)G + \frac{1}{2}y^r \left(1 + \frac{1}{R}\right). \tag{7}$$

Finally, imposing market clearing ($\pi c_0^p + (1 - \pi)c_0^r = 1$) and $y^r = \Pi / (2(1 - \pi)) + w\ell^*$, we get

$$\begin{aligned} \frac{1}{R} &= \frac{2(1 - \pi\underline{c})}{\frac{\Pi}{2} + w\ell^*(1 - \pi)} - \frac{1 - \left(\frac{\Pi}{2(1 - \pi)} + w\ell^*\right)}{\frac{\Pi}{2(1 - \pi)} + w\ell^*}G - 1 \\ &= \frac{2(1 - \pi\underline{c})}{(1 - \pi)y^r} - \frac{1 - y^r}{y^r}G - 1. \end{aligned} \tag{8}$$

It immediately follows that

$$\frac{\partial^2(1/R)}{\partial G \partial \pi} > 0,$$

implying the following proposition.

¹⁷The government goods market clears for free since, by assumption, the government consumes whatever it produces. The labor market doesn't clear since each agent is willing to supply \bar{L} , while at stuck wage w private and public firms only demand $\ell^* + \tilde{G} < \bar{L}$ units of labor from each agent.

¹⁸We discuss the existence of this form of equilibrium in Section 3.2 below.

Proposition 1 *In a saving-constrained equilibrium with slack in the labor market, the interest rate response to fiscal stimulus falls as inequality rises: $\frac{\partial^2 R}{\partial G \partial \pi} < 0$.*

Proposition 1 says that the impact of G on R is declining in inequality. Government spending redistributes from high MPC to low MPC households, which relaxes credit markets more when the economy is populated by a larger fraction of debt-burdened households. Note, however, that in this stripped-down model increasing government purchases actually unambiguously decreases the interest rate, contrary to standard intuition. This is because here government spending destroys no resources.¹⁹ However, it is trivial to include government waste by assuming that government consumption/production G requires an input γG of the consumption good, meaning the public budget constraint becomes $G(1 + \gamma)R = \tau$. In that case, the sign of $\partial R / \partial G$ may be positive or negative but $\partial^2 R / (\partial G \partial \pi) < 0$ still holds provided γ isn't too large. We explore this case in Section 3.2.

To summarize, a theory with saving constraints suggests that high inequality is associated with a weaker or even negative response of interest rates to government spending. The same is true with respect to debt: at $t = 0$ a non-rich agent is borrowing $\underline{c} - (y^p + G)$, which is increasing in π . This immediately implies that total private debt, $\pi(\underline{c} - (y^p + G))$, is also associated with inequality and a low IRRF.

The Consumption Response to Fiscal Stimulus: The credit market relaxation in response to government purchases manifests entirely in the interest rate response. Since private output is fixed (and under the assumption that the government does not purchase private-sector output, so is aggregate consumption), there is no quantity adjustment from credit market relaxation. In a more complicated setup with elastic private-sector output, however, the adjustment could occur through both prices (the interest rate) and quantities (consumption). In particular, if there were a *private-sector* multiplier from increasing G ,²⁰ equilibrium private consumption could increase from fiscal stimulus, and rising inequality could dampen the consumption response through the delevering of saving-constrained agents. In that case, equilibrium credit market relaxation could manifest both as a lower interest rate and as lower private consumption.

In our setting, aggregate desired consumption is $C = \pi c_0^p + (1 - \pi) c_0^r$. By Equation 7, it follows that aggregate desired consumption is (imposing the government budget constraint but not the market clearing interest rate)

$$C = \pi \underline{c} + (1 - \pi) \left[\frac{1}{2} (1 - y^r) G + \frac{1}{2} y^r \left(1 + \frac{1}{R} \right) \right],$$

¹⁹See [Murphy and Walsh \[2018\]](#) for a formal discussion of why excess capacity (or government spending that does not crowd out private resources) implies that interest rates do not rise in response to government spending.

²⁰In our setting above, the fiscal multiplier is 1, although this stimulus occurs entirely through government consumption/production (see Equation (4)). The *private-sector* multiplier is 0 since private-sector output is determined by firms' fixed labor demand.

and hence, since $y^r = \Pi / (2(1 - \pi)) + w\ell^*$,

$$\frac{\partial^2 C}{\partial G \partial \pi} < 0. \quad (9)$$

Therefore, an implication of the theory with saving-constrained households is that the partial equilibrium relationship between inequality (and debt) and the consumption response to fiscal stimulus (CRF) is negative. In our simple theoretical setting there is no general equilibrium relationship due to simplifying assumptions about the supply side of the economy, but in a setting with elastic private-sector output, we would predict the relationship to be negative. Below we confirm that in the data, the CRF is, if anything, inversely related to inequality and debt.

Existence: We have shown that the IRRF and partial equilibrium CRF are declining in both inequality and debt in a *saving-constrained equilibrium with slack in the labor market*, but we did not prove this equilibrium exists. However, it is straightforward to show that it does indeed exist when parameters satisfy the following:

$$\frac{\Pi}{4} \left(\frac{2\pi - 1}{\pi} \right) G + \frac{\Pi}{2\pi} + w\ell^* \leq \underline{c} < \min \left\{ 1, \frac{\Pi}{4} \left(\frac{2\pi - 1}{\pi} \right) G + \frac{3}{2} \frac{\Pi}{2\pi} + \frac{1 + \pi}{2\pi} w\ell^* \right\} \quad (10)$$

First consider the left inequality, which ensures that $c_0^p = \underline{c}$ (at the equilibrium interest rate (8)). Since $\Pi / (2\pi) + w\ell^* < 1$ for $\pi > 1/2$, there exists $\underline{c} \in (0, 1)$ satisfying this condition provided, for example, G is sufficiently small and $\pi > 1/2$. $\underline{c} \leq 1$ is necessary for existence since $c_0^r \geq c_0^p$ and the total private endowment is 1. The right inequality ensures that the expression for the equilibrium interest rate (8) is strictly positive. Since $3/2 > 1$ and $(1 + \pi) / (2\pi) \geq 1$, if we can find $\underline{c} \in (0, 1)$ satisfying the left inequality, we can find $\underline{c} \in (0, 1)$ satisfying the right as well. Note that if (10) holds, market clearing implies $c_0^r > \underline{c}$.

3.2 Numerical example with government waste

We now generalize the model to the case in which government production requires the consumption good (and hence crowds out the private sector) as well as labor. Suppose that one unit of government output requires an input of γ of the consumption good. The government budget constraint (5) becomes $RG(1 + \gamma) = \tau$, and the market clearing condition becomes $\pi (c_0^p, c_1^p) + (1 - \pi) (c_0^r, c_1^r) = (1 - \gamma G, 1)$. Figure III shows how the *saving-constrained equilibrium with slack in the labor market* changes as we vary inequality (π).²¹

The top panel plots the IRRF, the percentage point change in equilibrium R for an increase in G of .02 (2 percent of private output), against π . As in the empirical Figure II, there is an inverse relationship between inequality and the IRRF, and low (high) inequality

²¹As an illustrative numerical example, we set $\gamma = .053$, $\alpha = 2/3$, $w = .5$, $G = 0$, $\bar{L} = 5/3$, and $\underline{c} = .95$. With the Section 3.1 normalization $A = (w/\alpha)^\alpha$, we get $\ell^* = 4/3$, $A\ell^{*\alpha} = 1$, $\Pi = 1/3$, and $w\ell^* = 2/3$.

is associated with positive (negative) IRRFs. The middle panel shows that gross private debt, $\pi(\underline{c} - (y^p + G))$, increases with inequality as more agents become saving-constrained, and the bottom panel illustrates Equation 9's inverse relationship between inequality and the partial equilibrium CRF (defined as $100\Delta C/\Delta G$, holding R fixed). As in the case without government waste γ , both the IRRF and CRF decline as inequality and debt rise.²²

3.3 Credit constraints

Here we demonstrate the role of credit conditions for the effect of government spending in the presence of saving-constrained households. In the baseline scenario presented above, there are no borrowing constraints or debt limits. In this model extension we examine the role of tight credit conditions in the form of debt limits.

Consider a situation in which poor households (borrowers) are subject to a borrowing limit that precludes them from satisfying the minimum consumption level. In particular, suppose that the constraint $c_0 \geq \underline{c}$ is replaced with

$$R(y^i + G - c_0) \geq \underline{b},$$

which says that the agents can at $t = 0$ promise to pay at most $-\underline{b} \geq 0$ at $t = 1$. If this constraint binds only for the non-rich, we have

$$c_0^p = y^p + G - \frac{1}{R}\underline{b},$$

and then optimal consumption of the rich is

$$c_0^r = \frac{1}{2}(1 - y^r)G + \frac{1}{2}y^r\left(1 + \frac{1}{R}\right).$$

Imposing market clearing ($\pi c_0^p + (1 - \pi)c_0^r = 1$) and using $y^r = \Pi/(2(1 - \pi)) + w\ell^*$, we obtain

$$\frac{1}{R} = \frac{\pi y^p + \left[\pi + (1 - \pi)\frac{1}{2} - (1 - \pi)\frac{1}{2}y^r\right]G - 1 + (1 - \pi)\frac{1}{2}y^r}{\pi \underline{b} - (1 - \pi)\frac{1}{2}y^r},$$

implying

²²Note, however, that with sufficiently high γ it is possible for the IRRF to increase with inequality. This is because with $\gamma > 0$, rising inequality has two opposite effects on the IRRF. On one hand, more agents are saving-constrained, and their delevering relaxes credit markets. On the other hand, the interest rate adjusts to induce the rich to consume an amount sufficient to clear markets. With high γ , the second effect dominates, and high rates are needed to get the rich to forgo consumption at $t = 0$. In this case, as inequality rises, there are fewer rich agents, requiring a larger rate increase to clear markets.

$$\frac{\partial(1/R)}{\partial G} = \frac{\frac{\Pi}{2} + (1-\pi)w\ell^* - 1 - \pi}{2\pi(-\underline{b}) + (1-\pi)w\ell^* + \frac{\Pi}{2}}.$$

Reorganizing and using the fact that $\Pi + w\ell^* = 1$ and that $\pi \in [1/2, 1)$, we obtain

$$\begin{aligned} \frac{\partial(1/R)}{\partial G} &= \frac{-\frac{1}{2} + w\ell^*(\frac{1}{2} - \pi) - \pi}{2\pi(-\underline{b}) + (1-\pi)w\ell^* + \frac{\Pi}{2}} < 0 \\ &\implies \\ \frac{\partial R}{\partial G} &> 0. \end{aligned}$$

And, if credit conditions are tight ($-\underline{b}$ is small),

$$\begin{aligned} \frac{\partial^2(1/R)}{\partial G \partial \pi} &< 0 \\ &\implies \\ \frac{\partial^2 R}{\partial G \partial \pi} &> 0. \end{aligned}$$

Therefore, even in a world with minimum consumption thresholds, if credit conditions become sufficiently tight, non-rich households will become borrowing-constrained (rather than saving-constrained). And in that case, the interest rate rises in response to a G shock, and the effect is amplified by inequality. In other words, the sign of the dependence of the IRRF on inequality is determined by credit conditions: with loose credit, non-rich households face saving constraints, and the IRRF declines in inequality. The same is true with respect to debt. When poor households are borrowers and rich households are savers, total private debt is $\pi(c_0^p - (y^p + G))$, which is also associated with inequality and a high IRRF.

The same applies for aggregate consumption $C = \pi c_0^p + (1-\pi)c_0^r$. When the borrowing constraint is binding for the poor, aggregate consumption is

$$C = \pi\left(y^p + G - \frac{1}{R}\underline{b}\right) + (1-\pi)\left(\frac{1}{2}(1-y^r)G + \frac{1}{2}y^r\left(1 + \frac{1}{R}\right)\right),$$

implying

$$\begin{aligned}
\frac{\partial C}{\partial G} &= \pi + \frac{(1-\pi)}{2} \left(1 - w\ell^* - \frac{\Pi}{2(1-\pi)} \right) \\
&\implies \\
\frac{\partial C}{\partial G} &= \frac{\pi}{2} + \frac{w\ell^*}{2} \left(\frac{1}{2} + \pi \right) + \frac{1}{2} (1 - w\ell^*) > 0 \\
&\implies \\
\frac{\partial^2 C}{\partial G \partial \pi} &= \frac{1 + w\ell^*}{2} > 0.
\end{aligned}$$

Hence, with tight credit the partial equilibrium response of consumption to fiscal shocks is positive and increasing in inequality and debt.

4 Validating the model's implications

In this section, we examine the model's predictions that a) the consumption response to fiscal stimulus (CRF) is falling in inequality and debt, and b) the relationship between fiscal effects and debt depends on credit conditions. We begin by extending the cross-country analysis of Section 2 and document that the country-level CRF is falling in country's inequality and household debt. We then turn our focus to US data, which exhibit strong within-county variation in debt, to examine the relationship between debt and the CRF and IRRF. To investigate how credit conditions alter the relationship between fiscal effects and debt in the US, we conduct two complementary pieces of analysis. First, we examine time series variation in aggregate data and find that the CRF and IRRF are lower during periods of high debt on average, but not lower during periods of high debt associated with tight credit conditions. Second, we exploit variation across US counties as an alternative approach to testing the relationship between fiscal effects, debt, and credit conditions. Specifically, we run separate cross-sectional regressions to examine the debt-dependent effects of government spending during a period of loose credit (prior to the Great Recession) and during a period of tight credit (during the Great Recession).

4.1 The consumption response to fiscal stimulus and debt

Here we test the theory's prediction that the relationship between the correlates of savings constraints (inequality and debt) and the consumption response to fiscal stimulus is non-positive. As in Section 2, we identify fiscal shocks independently for each country in our sample. To do so, we estimate Equation 1, where $X_t = [G_t, Y_t, C_t]'$: X_t consists of log real government consumption G_t , log real GDP, and log real private consumption C_t . $\varepsilon_t = [\nu_t, \varepsilon_{2,t}, \varepsilon_{3,t}]$ is a vector of structural shocks, and v_t is the shock to government spending. We

follow the identification approach of Blanchard and Perotti [2002], as in Section 2.

We summarize the information in the impulse responses by examining the 4-quarter response to government consumption shocks. Let ρ_h^c be the horizon h impulse response of consumption. The country-level consumption response to a one-standard-deviation shock to government consumption is computed as:²³

$$CRF = \sum_{h=0}^3 \rho_h^c. \quad (11)$$

Note that our CRF can be interpreted as an elasticity. In particular, the CRF is the percentage change in consumption in response to a 1 percent increase in government spending. To correct for the uncertainty in measuring the CRF, we define ω_i^{CRF} as in Equation 3. The pattern in Figure IV is consistent with credit market relaxation in response to government purchases. There is a negative relationship between inequality (or household debt) and the four-quarter response of private consumption to government spending shocks. Table III also shows a negative relationship between the CRF and income inequality or household debt to income. This relationship is statistically significant for household debt only. A one-standard-deviation increase in household debt is associated with a CRF that is 0.0042 percentage points lower, which is equivalent to about half of a standard deviation in the CRF's distribution in Table I.²⁴

4.2 Time-varying effect of fiscal shocks in the US

The evidence from Section 4.1 is somewhat surprising in light of recent evidence that high consumer debt has been associated with larger consumption responses to fiscal stimulus (e.g., Demyanyk et al. [2019]). A possible explanation for these otherwise seemingly contradictory findings is that the relationship between fiscal effects and debt varies with credit conditions. In particular, under normal or loose credit conditions, households are able to borrow to reach their consumption thresholds and they have low MPCs (and hence a low consumption response to government spending, as in Section 3.1). Under tight credit conditions, many households are credit-constrained and exhibit high MPCs, as in Section 3.3. The evidence in Demyanyk et al. [2019] is suggestive of such a relationship. They document that during the Great Recession, when credit was tight, cities with high consumer leverage exhibited larger income multipliers and high-debt households exhibited stronger consumption responses to government spending. But prior to the Great Recession (when credit was loose), government spending income multipliers were, if anything, lower in cities with higher consumer leverage.

Here we explicitly examine the state-dependent relationship between fiscal effects and

²³Here we report the *cumulative* four-quarter response instead of the *average* four-quarter response.

²⁴The same results hold when we control for the fraction of government foreign debt to GDP.

debt by exploiting detailed data on consumption, consumer debt, and credit conditions in the United States. We employ two complementary approaches. We first use local projections to examine time-varying impulse responses using aggregate US data. We find that CRFs and IRRFs tend to be lower during periods of high debt, but not during periods of high debt and tight credit. We then extend the empirical design in [Demyanyk et al. \[2019\]](#) and examine the relationship between consumer debt and fiscal effects across regions (counties) in the US, both during a period of loose credit conditions (prior to the Great Recession) and during a period of tight credit (the Great Recession).

4.2.1 Time series analysis of the relationship between household debt and the effects of government spending

Here we examine the within-US relationship between debt and fiscal effects. As documented above, the US has high debt, high inequality, and low CRFs and IRRFs on average. But debt varies considerably over time, permitting an investigation of the within-country relationship between debt and fiscal effects. To do so, we follow [Auerbach and Gorodnichenko \[2012\]](#) and [Ramey and Zubairy \[2018\]](#) and use a time-varying version of the local projection method from [Jordà \[2005\]](#). Local projection methods are more amenable to estimating time-varying impulse responses than time-varying SVAR impulse response functions for several reasons. First, we can directly test our model’s prediction by focusing on the state of household debt (and credit conditions). Second, the estimation of impulse response functions in non-linear time-varying VAR models requires one to iterate forward on the estimated parameters for which one needs to make assumptions on how the economy transitions from state to state and on how the shocks affect the state. Local projection methods need no assumptions about the future evolution of the state of the economy and impulse response functions are the result of a series of simple regressions at different horizons.

We first examine how IRFs and CRFs vary with household debt in the US by estimating the following specification for each horizon h :

$$y_{t+h} = I_{t-1}[\alpha_A + \psi_{A,h}(L)x_{t-1} + \beta_{A,h}shock_t] + (1 - I_{t-1})[\alpha_B + \psi_{B,h}(L)x_{t-1} + \beta_{B,h}shock_t] + \epsilon_{t+h}, \quad (12)$$

where y_{t+h} is our variable of interest (interest rate or consumption) at $t+h$, I_{t-1} is an indicator variable that takes the value of 1 when the economy is in a *high-debt* state at $t-1$, and takes the value of 0 otherwise. x_{t-1} represents our set of controls (four lags of log real GDP, log real government spending, and the variable of interest itself), and $shock_t$ is the (log) government spending shock.²⁵ We identify government spending shocks using the

²⁵Similar results hold when we add a linear and a quadratic trend and when we use a different number

Blanchard and Perotti [2002] assumption that government spending is predetermined within a quarter.²⁶ The coefficient $\beta_{A,h}$ represents the response of variable y at time $t+h$ to the government spending shock at time t , in the state of the economy A .

Our estimation sample covers the period 1971Q1-2015Q4.²⁷ Our interest rate measure is the same as in Section 2, the US 10-Year government bond yield at constant maturity, which we collect from Haver Analytics (originally sourced from the IMF). Our data on real GDP, real private consumption, and real government consumption are the same as those used in Section 2. Finally, we construct our indicator variable I_{t-1} following Alpanda and Zubairy [2019]. The authors use the US household debt-to-GDP ratio to define periods in which household debt is above trend (*high-debt* state). Figure V depicts the US household debt-to-GDP ratio and its estimated trend. The high-debt state represents 48 percent of our sample period.²⁸

We report the estimated interest rate response to fiscal shocks in Figure VI. The results provide support for our model’s prediction: government spending tends to relax credit markets more (or tighten credit markets less) in high-debt states compared to low-debt states.²⁹

The results for consumption in Figure VII point in the same direction. In high-debt states, fiscal shocks tend to reduce private consumption in the first eight quarters, while in low-debt states fiscal shocks tend to increase private consumption on impact but have zero statistical effect afterward (except by a statistically significant decline in quarter eight). This evidence is consistent with our models’ prediction that high debt is associated with a large fraction of households with MPCs of zero. It is, however, inconsistent with the notion that high debt is associated with a large fraction of credit-constrained households with high MPCs. The model extension of Section 3.3 implies that, in the presence of tight credit, the inverse relationship between fiscal effects and debt breaks down. In the subsequent analysis we examine this prediction by isolating episodes of high debt and tight credit.

of lags of the control variables.

²⁶We do not use the Ramey [2011] military news shocks variable because it contains very little information for the periods after World War II and the Korean war. This is especially relevant in our case, as we need sufficient time variation in government spending shocks within different states after 1971.

²⁷In our estimations, we use the National Financial Conditions Index from the Chicago Fed to measure the stance of credit supply. This index is available only since 1971Q1. Therefore, to ensure that our different state-dependent results are comparable, we use the sample 1971Q1-2015Q4 throughout this section.

²⁸Alpanda and Zubairy [2019] estimate the trend in the household debt-to-GDP ratio using the HP filter with a high smoothing parameter ($\lambda = 10^4$). The periods of high-debt in Alpanda and Zubairy [2019] are 1956Q2–1968Q4, 1979Q1–1980Q4, 1985Q4–1992Q3, and 2003Q2–2011Q1. Our dates are slightly different due to the different sample; however, the same results hold if we use their dates.

²⁹Very similar results hold when we use the BAA bond rate instead.

4.3 Do credit conditions affect the relationship between household debt and fiscal shocks?

To study how credit conditions affect the relationship between household debt and the IRRF or CRF, we follow two complementary approaches. First, we extend the previous time series approach and define a *high-debt/tight-credit* state to estimate the IRRF and CRF in times of high-debt and tight-credit conditions. Second, we use US county-level data to study the consumption response to fiscal stimulus in high-debt counties in the years before the Great Recession (loose credit) and during the Great Recession (tight credit).

4.3.1 Time series approach

To measure the stance of US credit conditions, we use the Chicago Fed’s National Financial Conditions Index (NFCI). Positive values of the index represent periods in which credit conditions are tighter-than-average, while negative values represent times of looser-than-average credit conditions. Figure VIII depicts the household debt gap and it highlights the periods where high debt was also accompanied by periods of tight-credit. Some but not all of the high-debt periods are associated with tight credit: 43 percent of the periods associated with high debt (21 percent of the total sample) are also associated with tighter-than-average credit conditions.

We then estimate Equation (12) and define I_{t-1} based on the high-debt/tight-credit criteria. The results in Figure IX show that fiscal shocks have a zero four-quarter effect on interest rates in high-debt/tight-credit states. This result contrasts with the credit market relaxation in periods of high debt in Figure VI.

Figure X shows state-dependent consumption responses. The high-debt/tight-credit CRFs are positive and larger at horizons 3 to 7, but otherwise are similar to the alternative state CRFs. This result also contrasts with the negative consumption response to fiscal stimulus in Figure VII during periods of high debt. The relationship between debt and the CRF is therefore different when high debt is accompanied by tight credit. However, wide error bands prevent a more conclusive statement about the credit market effect of the relationship between consumption responses and debt. Therefore, we turn to regional data in the US to exploit the cross-sectional variation in debt during different periods marked by strong differences in credit conditions.

4.3.2 Cross-section approach

The analysis in Section 4.3.1 above relies on limited time series variation in consumption, debt, and government spending. Here we extend the analysis to exploit a much stronger source of variation based on cross-sectional differences in government spending, debt, and

consumption across counties in the US. In particular, we examine how the effect of defense spending on consumption (measured by auto registrations) varies with household leverage, both during a period of loose credit conditions (2002/03 to 2004/05) and during a period of tight credit conditions (2006/07 to 2008/09). Our empirical design builds on that in [Demyanyk et al. \[2019\]](#). They examine fiscal earnings multipliers across cities to document debt-dependent income multipliers. They then examine detailed data on household debt and consumption to examine whether households with higher debt during the Great Recession exhibited larger propensities to spend out of a shock to defense spending in their city. [Demyanyk et al. \[2019\]](#) examine debt-dependent city-level income multipliers both during the period before the Great Recession and during the Great Recession, and they find that fiscal multipliers were larger only during the Great Recession when credit conditions were tight.

We amend their empirical design in the following ways. First, since we are interested in consumption responses rather than earnings multipliers, we examine county-level responses to Department of Defense (DOD) spending. This provides more statistical power than city-level tests. It also helps limit the possibility that consumption responses could be attributed to other general equilibrium effects that are more likely to operate in larger economic geographies.³⁰ Second, we examine regional consumption responses rather than regional income multipliers. In other respects, the analysis is identical: we use the same source of variation in government spending (DoD contracts), the same measure of household leverage, the same cross-sectional covariates, and the same time windows for our analysis (changes between 2002/03 and 2004/05 for the period of loose credit and 2006/07 to 2008/09 for the period of tight credit).³¹

Our measure of consumption is auto registrations, which has been used as a proxy for broad measures of consumption in cross-sectional analyses of disaggregate levels of economic geography such as counties (e.g., [Demyanyk et al. \[2019\]](#) and [Mian et al. \[2013\]](#)). The data are provided by R. L. Polk. The sample for consumption growth exhibits some large outliers, reflecting either measurement error or large swings in auto registrations in smaller counties. Therefore we trim the auto consumption growth measure at the 1 percent and 99 percent levels. The government spending measure is based on the DoD spending measure from [Demyanyk et al. \[2019\]](#) (see also [Auerbach et al. \[2019\]](#)). Our measure of county-level debt to income is from [Mian and Sufi \[2015\]](#).

³⁰As discussed in [Auerbach et al. \[2019\]](#), GDP and earnings multipliers are increasing in the size of the local economy (e.g., city-level multipliers are larger than county-level multipliers). By focusing on county-level effects, we are more likely to isolate the direct effect of government spending on consumption from the effect of income multipliers on consumption.

³¹The city-level household leverage measure and covariates used in [Demyanyk et al. \[2019\]](#) are weighted averages of the county-level covariates from [Mian and Sufi \[2015\]](#). We use the direct county-level measures.

Our empirical specification is

$$\frac{C_i^{Post} - C_i^{Pre}}{C_i^{Pre}} = \alpha + \beta_0 \frac{G_i^{Post} - G_i^{Pre}}{Y_i^{Pre}} + \beta_1 \frac{G_i^{Post} - G_i^{Pre}}{Y_i^{Pre}} \cdot DTI^{Pre} + X_i + \epsilon_i,$$

where Y_i^j is income in county i in period $j \in PRE, POST$, C is auto registrations, DTI is household leverage, G is DOD spending, and X_i are county-specific covariates that include pre-period industry shares, percentage of white people in the local population, median household income, the percentage of owner-occupied housing units, the percentage of the population that has earned less than a high school diploma, the percentage of the population that has not earned more than a high school diploma, the unemployment rate, a dummy for urban areas, and the local poverty rate.

The coefficient of interest is β_1 , which is an estimate of the extent to which the consumption response to fiscal stimulus depends on household leverage. We instrument for the change in defense spending (and its interaction with leverage) using the Bartik-type instrument used in [Nakamura and Steinsson \[2014\]](#), [Demyanyk et al. \[2019\]](#), and [Auerbach et al. \[2019\]](#). Specifically, $\frac{G_i^{Post} - G_i^{Pre}}{Y_i^{Pre}}$ ($\% \Delta G$ for short) is instrumented with $(s_i \cdot \frac{G^{Post} - G^{Pre}}{Y_i^{Pre}})$, where G is aggregate government spending and s_i is the average share of county i in total government spending over the sample period. This IV approach addresses two potential concerns. First, as discussed in [Nakamura and Steinsson \[2014\]](#), it corrects for the possibility that defense spending may respond endogenously to local economic conditions. Second, the instrument captures the component of defense contracts that represents actual spending/production increases and strips out anticipated transitory cash transfers from the DOD to contractors (see [Auerbach et al. \[2019\]](#) for further details). We run separate specifications for the period of loose credit (pre=2002/03, post=2004/05) and the period of tight credit (pre=2006/07, post=2008/09).

Table [IV](#) shows that the response of auto purchases to local defense spending for the period 2002-2004 is indeed lower in counties with higher debt (column 2). On the other hand, and consistent with [Demyanyk et al. \[2019\]](#), the evidence for the period 2006-2008 suggests that the response of auto purchases to local defense spending is higher in counties with higher debt (column 4). The latter result lacks statistical significance, perhaps reflecting the fact that more granular data are needed to detect the positive relationship between consumption responses and debt (e.g., [Demyanyk et al. \[2019\]](#) exploit individual-level and zip-code-level measures of debt, which are not available to us). Overall, the results in Table [IV](#) support the idea that the relationship between household debt and fiscal stimulus depends on credit

conditions.³²

5 Conclusion

We present a new set of facts on the transmission of fiscal shocks. Government spending is associated with lower interest rate and consumption responses in the presence of higher debt or inequality. The debt-dependent relationship holds across countries, over time within the United States, and (for consumption) across regions in the United States during periods of normal-to-loose credit conditions. Furthermore, the interest rate response to government spending is negative in approximately half of OECD countries, a relationship that is difficult to reconcile with existing theory.

We offer a new theoretical framework to help explain the patterns in the data. In our model, high inequality is associated with high debt and a large share of low-income households that save additional income due to consumption thresholds. The model implies that under normal credit conditions, government spending increases (reduces) consumption and interest rates less (more) when there is more inequality and debt. If government spending does not crowd out private-sector employment, (e.g., there is slack), then interest rates can fall.

Our general equilibrium framework builds on the insights in our companion paper, [Miranda-Pinto et al. \[2019\]](#), which demonstrates that many low-income, low-MPC (saving-constrained) households can arise in a heterogeneous-agent model with precautionary motives and stochastic consumption thresholds. The infinite-horizon model in that paper helps explain otherwise puzzling features of the microdata, including the existence of many low-wealth, low-MPC households documented in the recent empirical literature. Here we extend the insights from that paper to demonstrate that general equilibrium implications can shed light on new and otherwise puzzling features of the macro data.

Our results may seem puzzling in light of recent theory and evidence that government spending stimulates consumption more during periods of high debt (e.g., [Eggertsson and Krugman \[2012\]](#) and [Demyanyk et al. \[2019\]](#)). We demonstrate that credit conditions are a crucial element of a comprehensive perspective on the relationship between debt and fiscal effects. When credit conditions are relatively loose, high debt is associated with more low-MPC households, which implies a lower consumption response. But when credit is tight, low-income households become credit-constrained and exhibit high MPCs and a stronger consumption response to fiscal stimulus.

³²Our results are consistent with the results in [Cho et al. \[2019\]](#) who document the time-varying MPC of U.S. households. Using PSID data, the authors show that even when the level of household debt reached historic levels between 2003-2007 (ranging from 0.82 to 0.97), it was not until 2009 (when debt to GDP peaked at 0.98) that households' MPC increased dramatically.

The mechanisms we highlight here are likely to have implications for the propagation and state-dependent effects of other macroeconomic shocks.

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Tables and Figures

Tables

Table I
Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
IRRF	28	0.01	0.09	-0.15	0.28
CRF	28	0.0017	0.0090	-0.0133	0.0273
Inequality	28	3.90	0.79	2.85	6.20
debt to income	28	123.23	61.18	32.96	275.92
Financial openness ratio	28	3.05	2.80	0.87	14.50
Inflation targeting dummy	28	0.46	0.51	0.00	1.00
Fraction of G external debt	19	26.83	16.37	4.37	70.11

Table II
IRRF and Country Characteristics

VARIABLES	(1) IRRF	(2) IRRF
Income ratio 90th/10th	-0.027*** (0.009)	
HH debt to income		-0.024* (0.013)
Financial Openness	0.007 (0.009)	0.023* (0.012)
Inflation Targeting	-0.050* (0.025)	-0.033 (0.025)
Observations	28	28
R-squared	0.264	0.202

Note: This table presents the WLS coefficients of regressing the estimated IRRF against income inequality (from OECD database), consumer leverage, financial openness (from [Lane and Milesi-Ferretti \[2007\]](#)), and an inflation targeting dummy (from [Carare and Stone \[2003\]](#)). The regression weights are ω_i (Equation 3). Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table III
CRF and Country Characteristics

VARIABLES	(1) CRF	(2) CRF
Income ratio 90th/10th	-0.0015 (0.002)	
HH debt to income		-0.0042** (0.002)
Financial Openness	-0.0017 (0.002)	0.0009 (0.002)
Inflation Targeting	-0.0022 (0.003)	-0.0001 (0.003)
Observations	28	28
R-squared	0.057	0.231

Note: This table presents the WLS coefficients of regressing the estimated CRF against inequality, consumer leverage, financial openness, and an inflation targeting dummy (Carare and Stone [2003]). The regression weights are ω_i^{CRF} . Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table IV
Consumption and Household Debt US counties

	Loose Credit		Tight Credit	
	2002/3-2004/5		2006/7-2008/9	
VARIABLES	(1) % ΔC	(2) % ΔC	(3) % ΔC	(4) % ΔC
% ΔG	1.66** (0.83)	7.34*** (1.99)	0.10 (0.21)	-0.54 (0.50)
DTI	0.10 (0.07)	0.15** (0.06)	-0.07*** (0.02)	-0.07*** (0.02)
% $\Delta G \cdot DTI$		-5.30*** (1.85)		0.48 (0.32)
County controls	Yes	Yes	Yes	Yes
Observations	2040	2040	1973	1973
First-stage F-stat	16.5	22.44	20.21	36.63

Note: All regressions control for county-level covariates: industry shares, the percentage of white people in the local population, median household income, median home values, the percentage of owner-occupied housing units, the percentage with less than a high school diploma, percentage with only a high school diploma, the unemployment rate, a dummy for urban areas, and the poverty rate at the respective geographic level. The change in DOD spending is normalized by county-level employment earnings in the early two-year part of the sample. Specifically, the change in DOD spending between 2002/03 (2006/07) and 2004/05 (2008/09) is normalized by average earnings in 2002 (2006) and 2003 (2007). Debt-to-income is measured in 2001 for the loose credit period and as of 2006 for the tight credit period. The sample for each period is trimmed at the 1% and 99% level of auto growth, as some very small counties exhibit large reported swings in auto registrations.

Figures

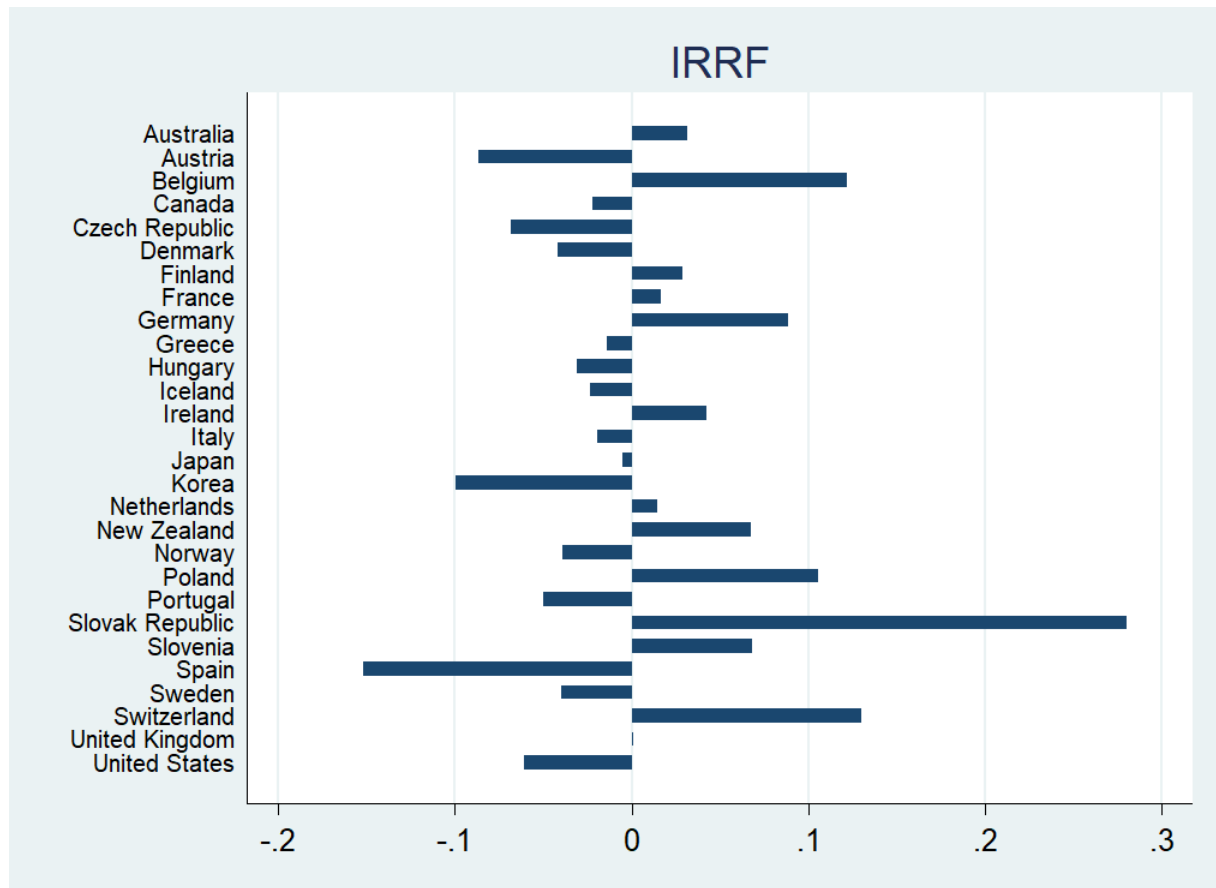


Figure I

For each country, the figure shows the IRRF (Equation 2) in percentage points estimated from the country-specific start date through 2007Q4.

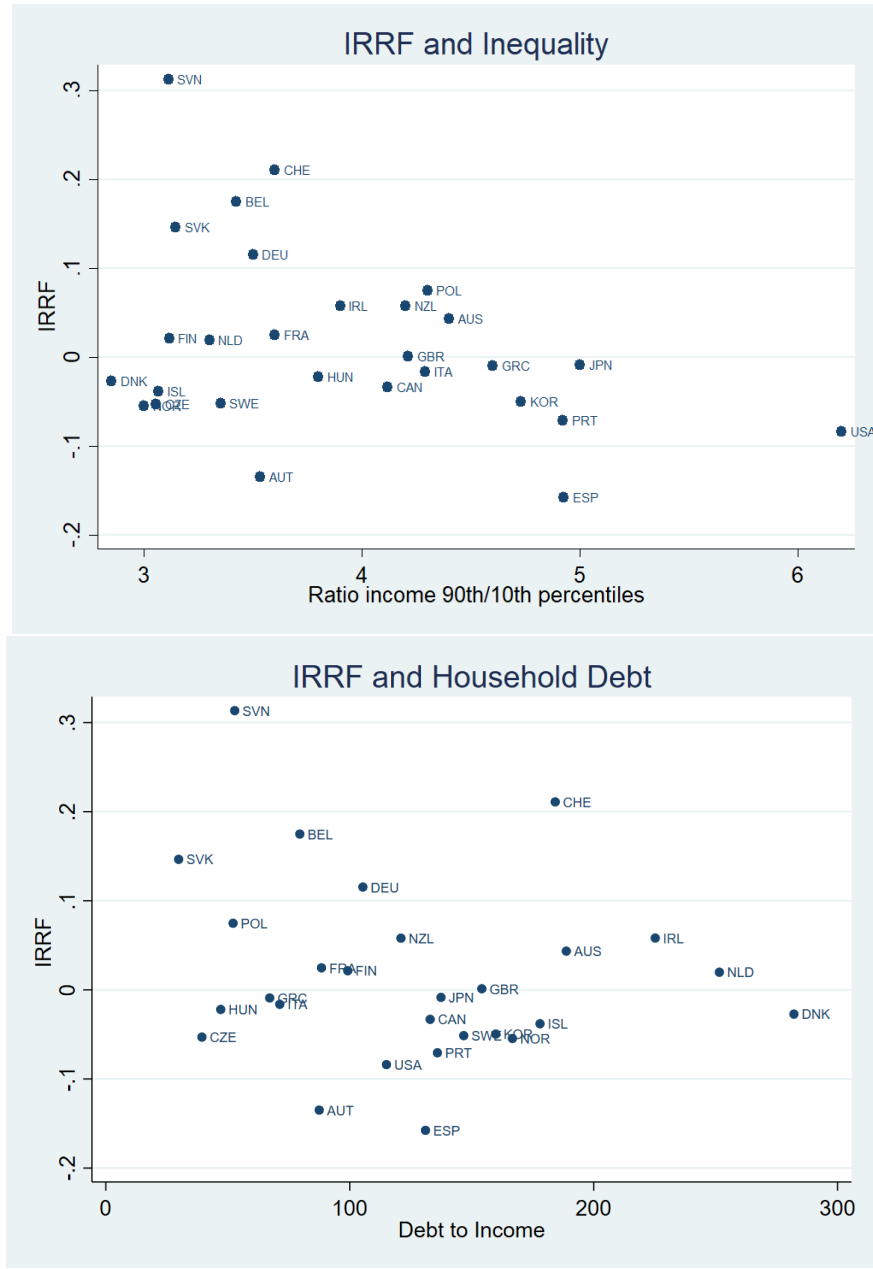


Figure II

The figure plots $\omega_i IRRF_i$ (see Equations 2 and 3) in percentage points (estimated from the country-specific start date through 2007Q4) against income inequality (from the OECD, averaged over 2001-2013) and household debt to income (from the OECD, averaged over 2010-2016).

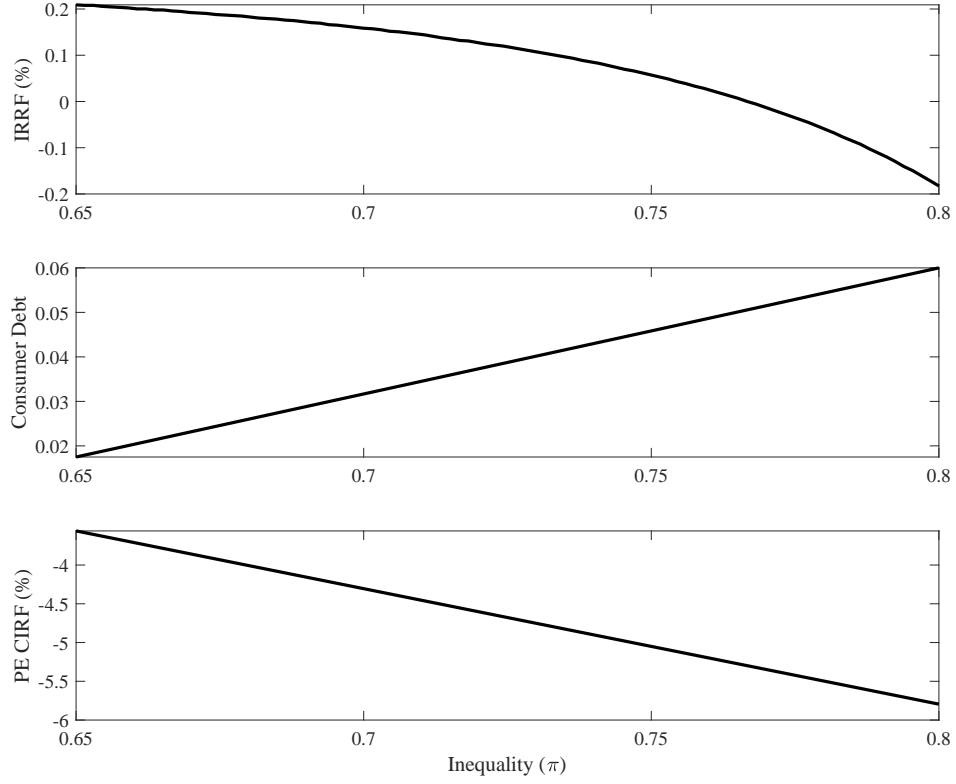


Figure III

The figure shows how the model's *saving-constrained equilibrium with slack in the labor market*, for the case with government waste $\gamma > 0$, changes as we vary inequality (π). The top panel plots the percentage point change in equilibrium R for an increase in G of .02, the middle panel shows gross private debt, and the bottom panel plots the partial equilibrium consumption response for an increase in G of .02 ($100\Delta C/\Delta G$).

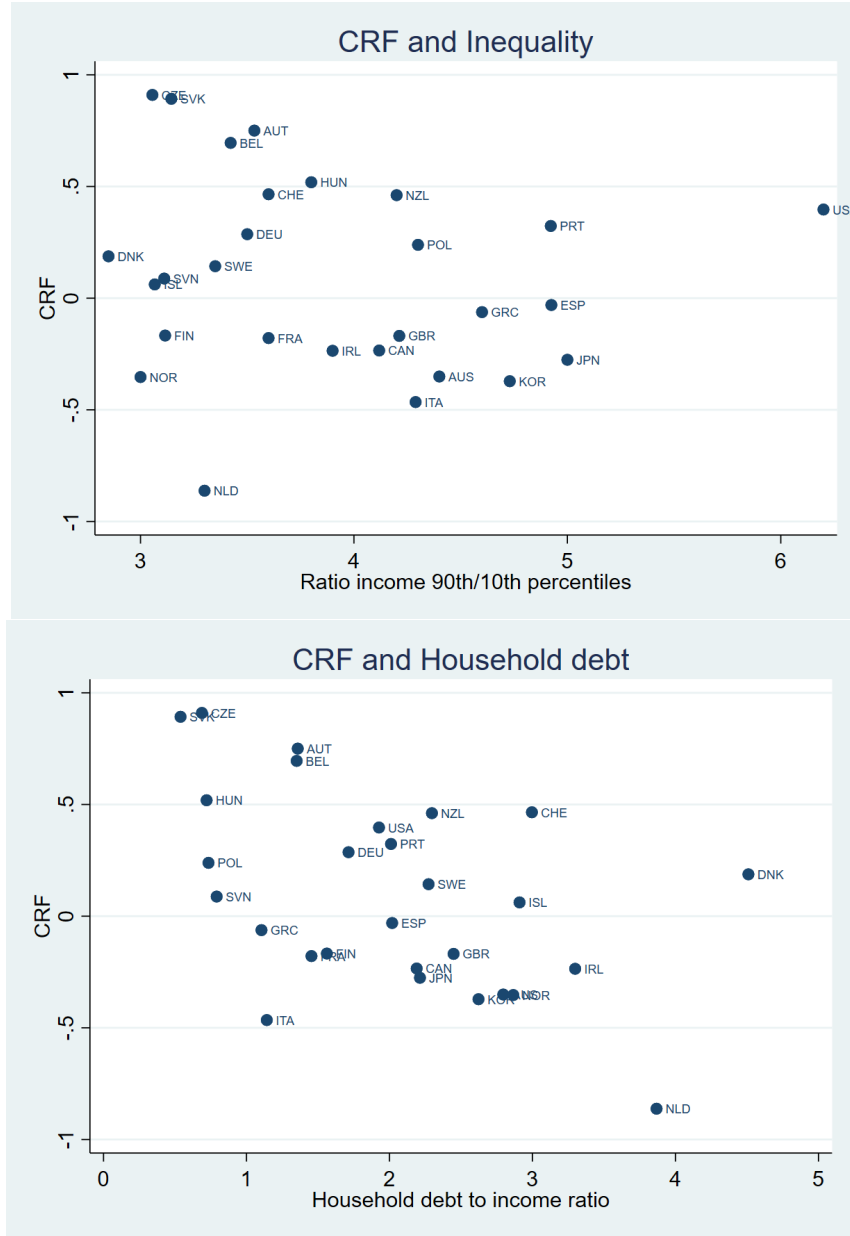


Figure IV

The figure plots $\omega_i^{CRF} CRF_i$ (Equation 11) (estimated from the country-specific start date through 2007Q4) against income inequality (from the OECD, averaged over 2001-2013) and household debt to income (from the OECD, averaged over 2010-2016).

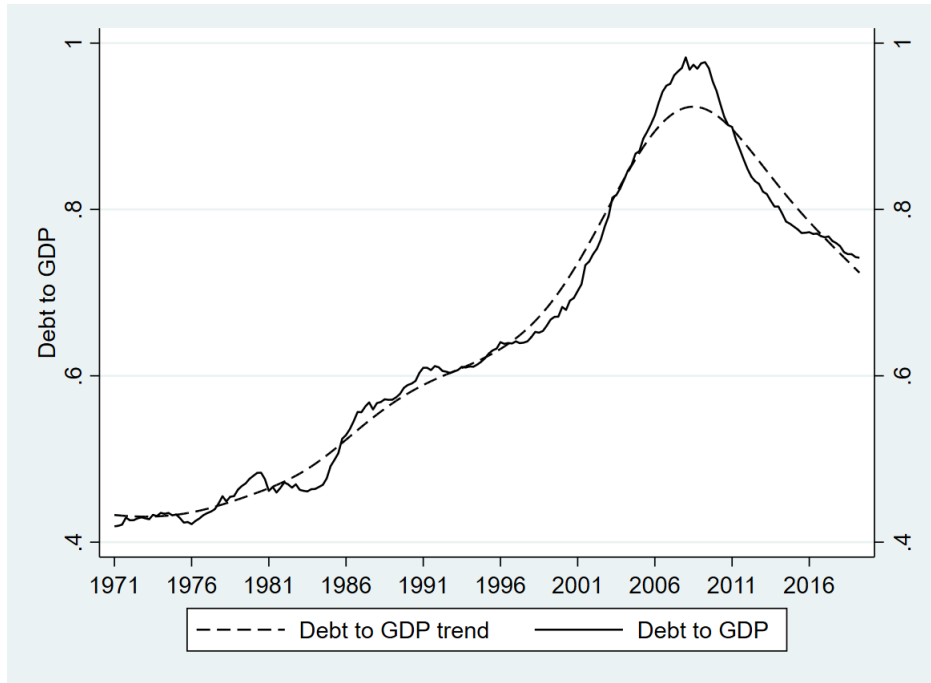


Figure V

The figure plots the U.S household debt-to-GDP ratio and its trend. The trend is estimated using the HP filter with a large smoothing parameter $\lambda = 10^4$.

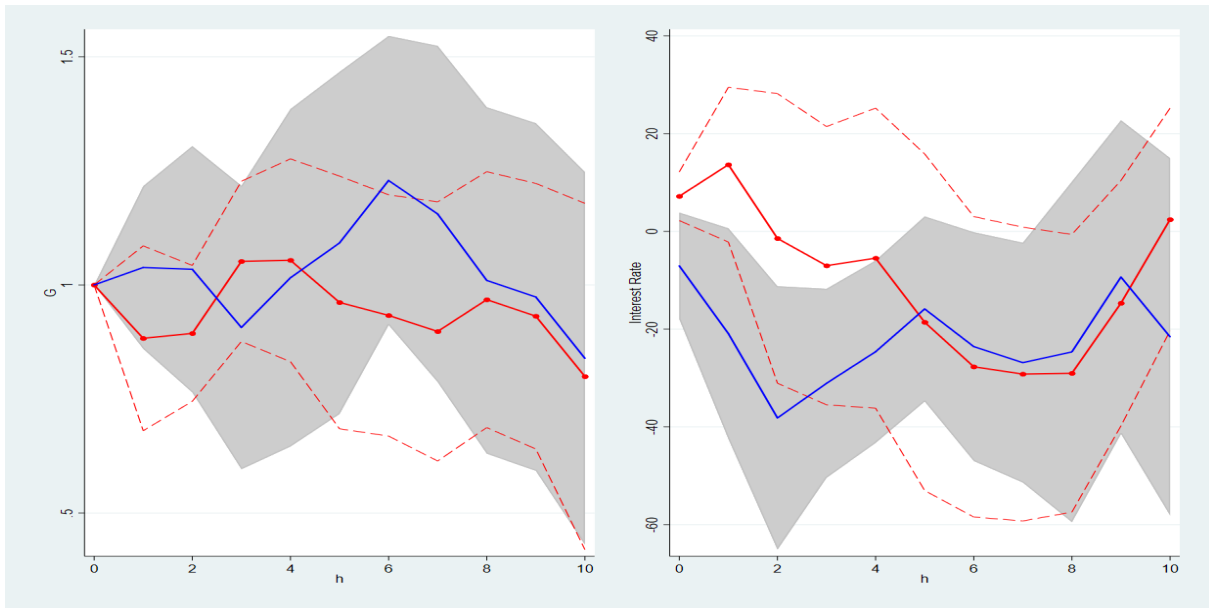


Figure VI

The figure plots the government spending response to fiscal shocks (left panel) and the IRRF (right panel) in low-debt states (red line) and high-debt states (blue line). We report the 90% confidence interval.

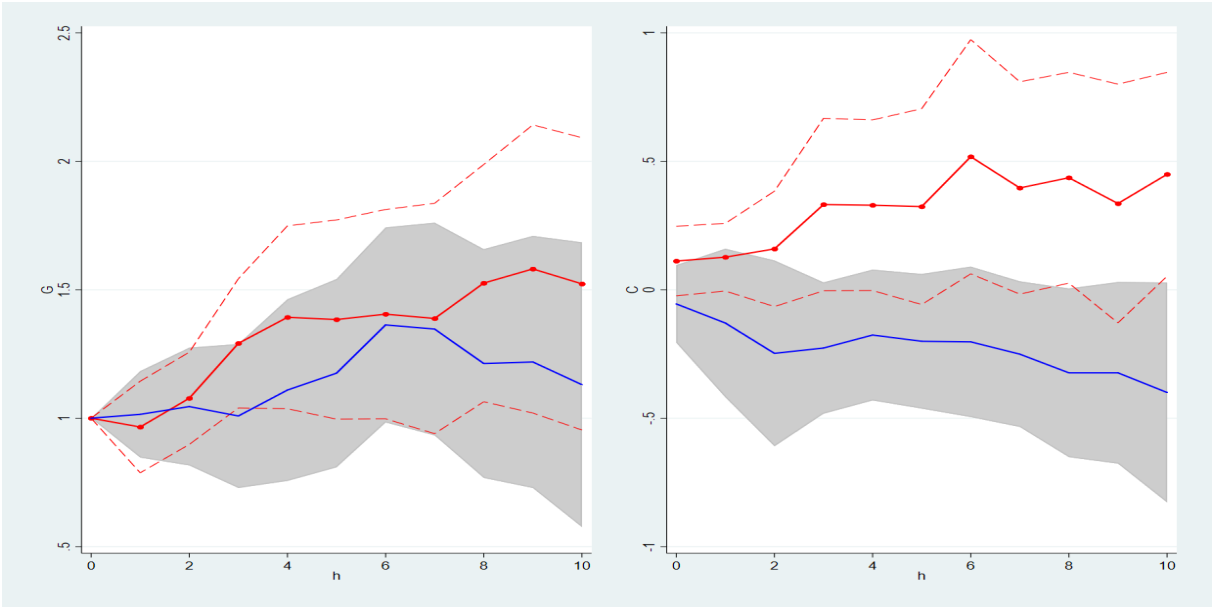


Figure VII

The figure plots the government spending response to fiscal shocks (left panel) and the CRF (right panel) in low-debt states (red line) and high-debt states (blue line). We report the 90% confidence interval.

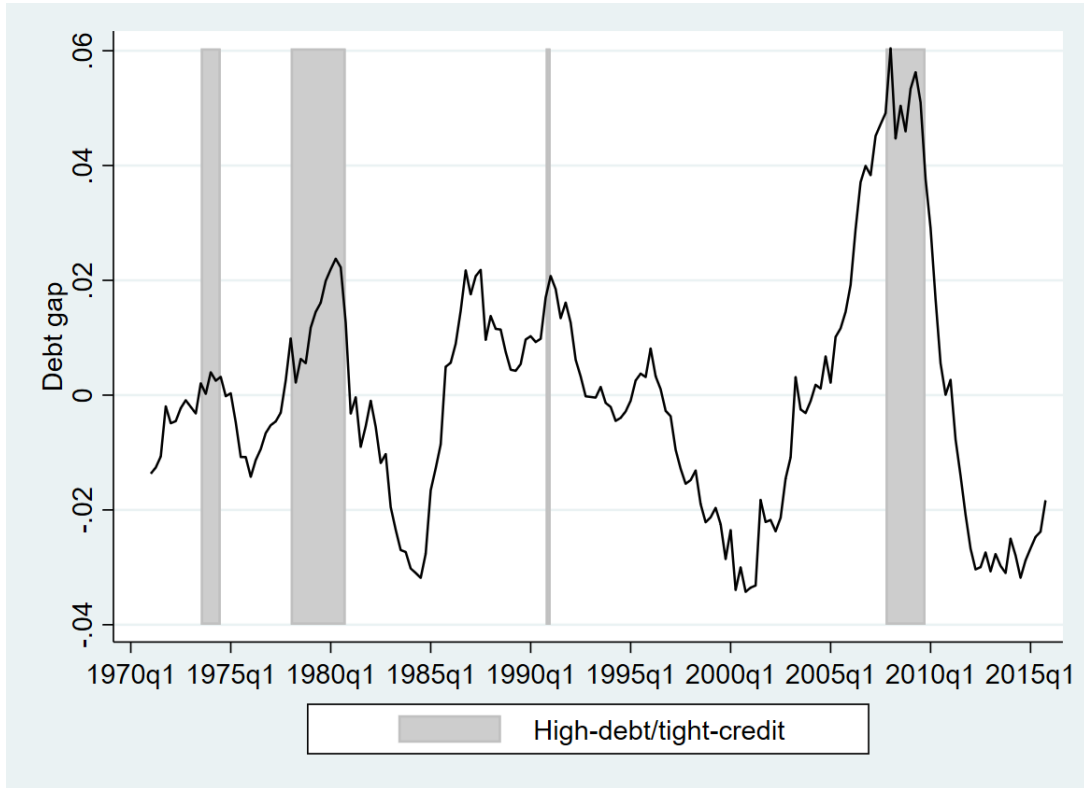


Figure VIII

The figure plots the US household debt-to-GDP gap (deviation from trend). Grey areas correspond to periods of high debt and tight credit. Tight credit periods are defined as periods in which the Chicago Fed's National Financial Conditions Index (NFCI) exceeded zero.

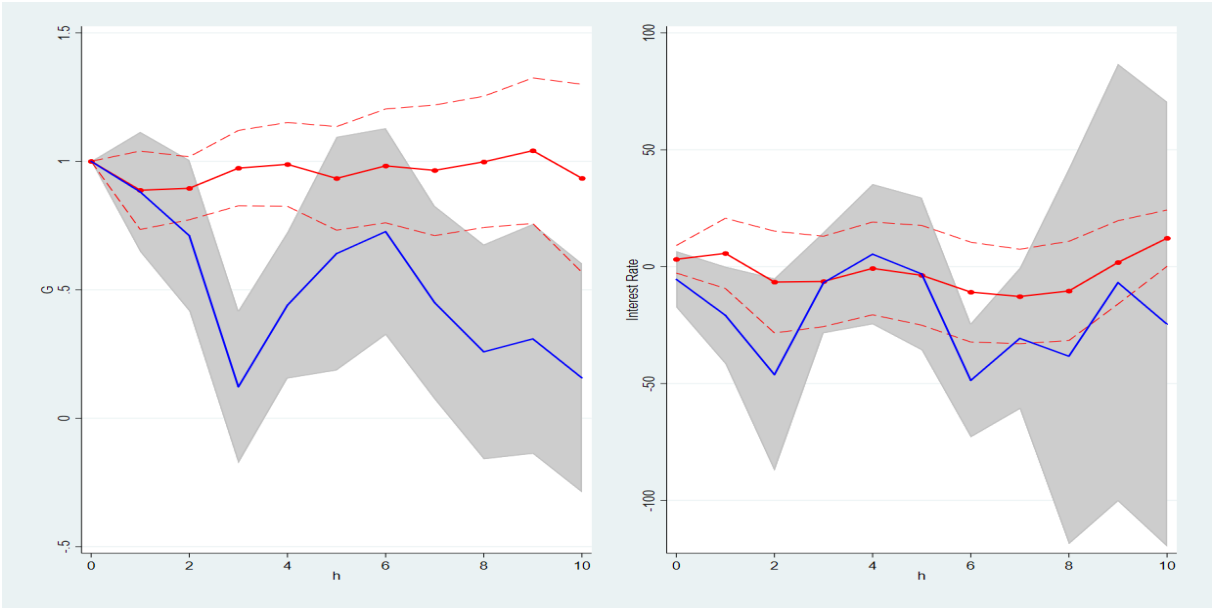


Figure IX

The figure plots the government spending response to fiscal shocks (left panel) and the IRRF (right panel) in the high-debt/tight-credit state (blue line) and in the low-debt-or-high-debt/loose-credit state (red line). We report the 90% confidence interval.

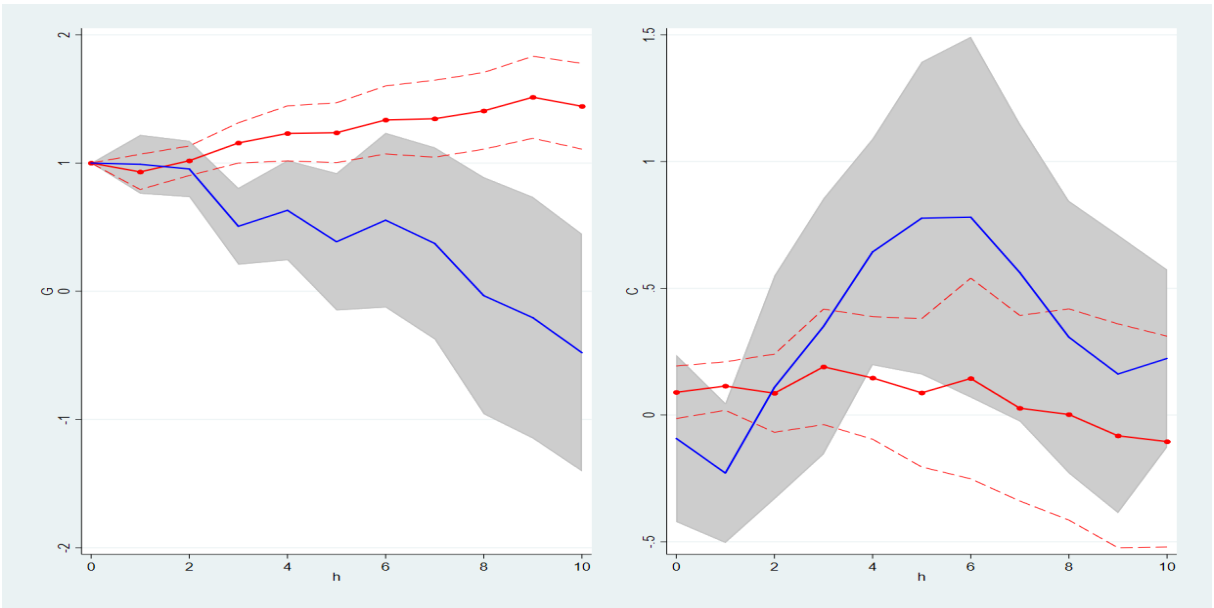


Figure X

The figure plots the government spending response to fiscal shocks (left panel) and the CRF (right panel) in the high-debt/tight-credit state (blue line) and in the low-debt-or-high-debt/loose-credit state (red line). We report the 90% confidence interval.

A Appendix

A.1 Policy rate response to fiscal shocks and inequality



Figure A.I

The figure plots ω^{policy} policy rate RF (estimated from the country-specific start date through 2007Q4) against income inequality (from the OECD, averaged over 2001-2013) and household debt to income (from the OECD, averaged over 2010-2016) .

A.2 Auerbach and Gorodnichenko [2013] shocks and local projection methods

In this section we use the government spending shocks estimated by Auerbach and Gorodnichenko [2013] to calculate the interest rate response to fiscal stimulus. The authors regress one-period-ahead percent forecast errors for government spending from the OECD’s “Outlook and Projections Database” in each country on that country’s lagged macroeconomic variables (output, government spending, exchange rate, inflation, investment, and imports). The authors also consider a set of country and period fixed effects. The residuals from this regression are innovations in government spending orthogonal to professional forecasts and lags of macroeconomic variables.³³

We take the estimated unanticipated government spending shocks from Auerbach and Gorodnichenko [2013] (for the pre-GFC period) and use linear projection methods to measure the effect on government bond yields. The data are semi-annual. Therefore, to compare with our four-quarter IRRF from Section 2, we regress the semi-annual government bond yield against the contemporaneous innovation to government spending and its one semester lag. In particular, for each country, we regress

$$r_{t+h} = \beta_0 + \beta_h \hat{G}_t^{shock} + \mu_{t+h}, \quad (13)$$

where r_{t+h} is the country’s government bond yield at semester $t+h$, \hat{G}_t^{shock} is the Auerbach and Gorodnichenko [2013] semi-annual shock to government spending in semester t , and μ_{t+h} is the error term. We convert our quarterly data on government bond yields to the semi-annual frequency by averaging each semester’s quarters. The average four-quarter (two-semester) interest rate response to fiscal stimulus is $IRRF = \frac{1}{2}(\hat{\beta}_1 + \hat{\beta}_2)$. We use the OLS standard deviation of β_1 and β_2 to adjust for the uncertainty in the estimates (ω).

Figure A.II reports the estimated IRRFs using this approach. There are 15 countries with a negative IRRF. Here the US displays a positive IRRF. The key difference with respect to the IRRF for the US obtained using the approach in Blanchard and Perotti [2002] is that in this case we have a significantly smaller amount of observations. Indeed, we only have government spending shocks identified semi-annually since 1986 semester 1, while in the Blanchard and Perotti [2002] approach we have quarterly data since 1957Q1. Greece is another country with significant differences across methods. Greece displays the most negative IRRF using the local projection method, while it has an almost zero IRRF using the Blanchard and Perotti [2002] approach. These results are also a consequence of the small sample size. With the local projection method we have Greece’s shocks from 1997 semester 1 until 2003 semester 2, while for the Blanchard and Perotti [2002] approach we have quarterly

³³Note that the government spending series in Auerbach and Gorodnichenko [2013] is the sum of real public consumption expenditure and real government gross capital formation.

data for the period 1992-2007. Greece and the US are indeed the top and bottom IRRFs.

In Figure A.III, we show that the inverse relationship between the IRRF and inequality (or household debt to income ratio) still holds when we use local projection methods and semi-annual government innovations from Auerbach and Gorodnichenko [2013].

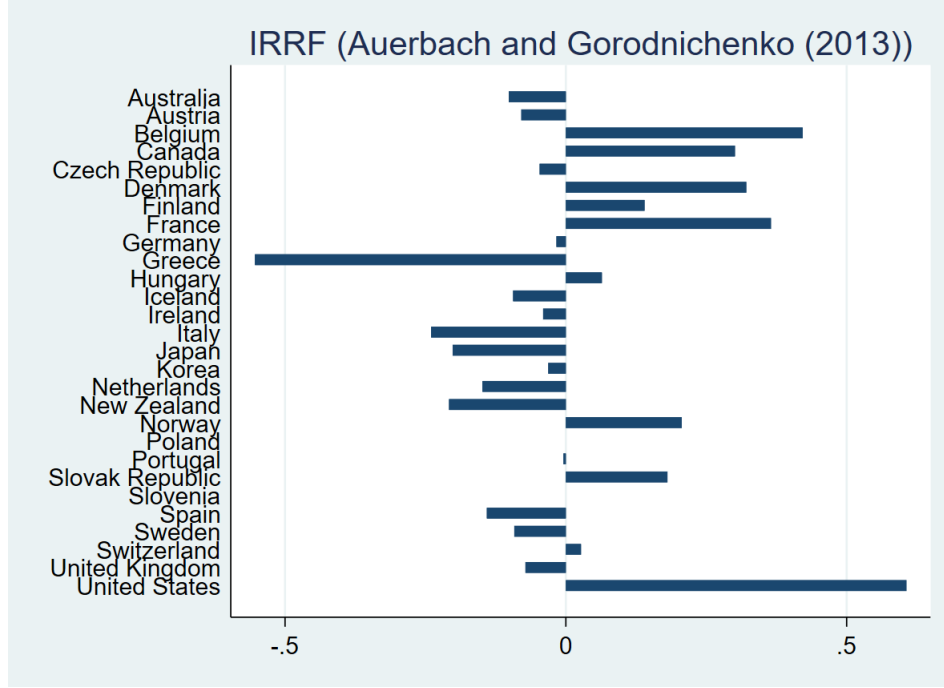


Figure A.II

For each country, the figure shows the variance adjusted IRRF in percentage points estimated from the shocks of Auerbach and Gorodnichenko [2013].

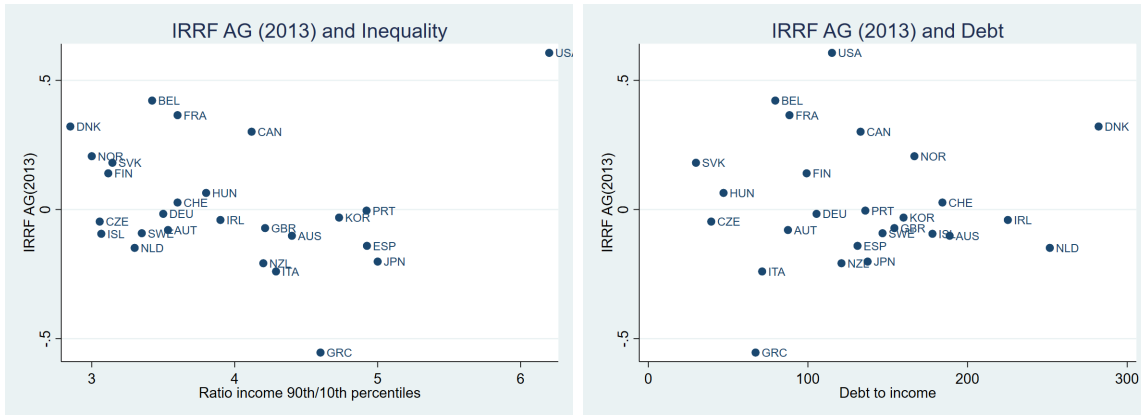


Figure A.III

The figure plots $\frac{1}{w}IRRF$ in percentage points estimated from the shocks of Auerbach and Gorodnichenko [2013] against income inequality (from the OECD, averaged over 2001-2013) and household debt to income ratio (from the OECD, averaged over 2010-2016).