Austerity, Inequality, and Private Debt Overhang*

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Abstract

Using panel data of 17 OECD countries for 1980-2011, we find that the distributional consequences of fiscal consolidations depend significantly on the level of private indebtedness. Austerity leads to a strong and persistent increase in income inequality during periods of private debt overhang. In contrast, there are no discernible distributional effects when private debt is low. This result is robust to alternative identifications of fiscal consolidations, to different ways of defining periods of private debt overhang, and to controlling for the state of the business cycle. We explore different channels through which our findings can be rationalized.

Keywords: austerity, fiscal policy, inequality, private debt, local projections

JEL classifications: E62, E64, D63

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1 Introduction

In the aftermath of the Global Financial Crisis, many governments implemented large-scale austerity programs in order to reduce budget deficits. There is widespread concern that the rush towards austerity threatens not only economic stability, but also social equity. At the same time, it is widely recognized that private debt shapes macroeconomic fragility and crisis risk.[1] Against this background, we conduct an empirical investigation of how fiscal consolidations impact income inequality and thereby allow the distributional effects of austerity to vary depending on the level of private indebtedness.

We show that the level of private debt determines whether or not austerity affects income inequality. Austerity leads to a severe and significant increase in income inequality when firms and households are highly indebted. In contrast, fiscal consolidations are associated with no discernible distributional consequences when private debt is low. Importantly, the distributional consequences of austerity are mainly determined by the presence of private debt overhang[2], whereas the state of the business cycle only plays a minor role. Our results help inform policy discussions about when time is right for austerity.

Studying how policy changes affect the distribution of income across households is important for several key reasons. First, the distributional consequences affect the welfare assessment of the policy measure and determine public support for it. Second, the aggregate effects of policy interventions cannot be fully understood without consideration of distributional dynamics. For example, if a policy intervention redistributes income to households with an above-average marginal marginal propensity to consume, the redistribution itself offers a channel through which policy affects macroeconomic aggregates.

[1] See, e.g., Mian, Rao, and Sufi (2013) and Schularick and Taylor (2012).

[2] Throughout the paper, private debt overhang describes periods in which the ratio of private debt to GDP is above trend.

Consequently, a new stream of literature jointly analyzes the aggregate and the distributional consequences of policy shocks in New Keynesian heterogeneous agent models.[3] Our empirical findings provide conditional inequality responses that can be used as a target to differentiate between competing classes of heterogeneous agent models. Third, income inequality is linked to economic performance, political polarization, and financial market instability.[4]

Focusing on how private indebtedness influences the distributional consequences of austerity is motivated by the literature showing that private debt is of crucial importance for the propagation and amplification of shocks and policy interventions; see, e.g., Mian, Rao, and Sufi (2013), Schularick and Taylor (2012), and Giroud and Mueller (2016). Analyzing the interplay between private debt and fiscal policy, Eggertsson and Krugman (2012) and Andrés, Boscá, and Ferri (2015) show, using theoretical models, that the aggregate effects of government spending expansions are amplified by the level of private indebtedness.[5] Bernardini and Peersman (2015) and Klein (2017) provide empirical support for a positive relationship between the effectiveness of fiscal policy and private indebtedness. While all of these studies investigate how the aggregate effects of fiscal policy are affected by private indebtedness, to the best of our knowledge, this is the first paper studying the potentially important role of private debt in shaping the distributional consequences of fiscal policy interventions.

[3]See, e.g., Gornemann, Kuester, and Nakajima (2016), Auclert (2016), and Kaplan, Moll, and Violante (2016).

[4]While some papers find evidence that rising income inequality has negative consequences for economic growth (see, e.g., Alesina and Rodrik 1994 and Persson and Tabellini 1994), there is competing evidence of beneficial effects (see, e.g., Barro 2000 and Li and Zou 1998). Moreover, there is evidence that inequality may have adverse consequences for socio-political stability, see, e.g., Alesina and Perotti (1996). Finally, some studies link rising income inequality to financial market instability and the likelihood of financial crisis, see, e.g., Kumhof, Rancière, and Winant (2015) or Kirschenmann, Malinen, and Nyberg (2016).

[5]The rationale behind this lies in the presence of debt-constrained borrowers who have a higher marginal propensity to consume relative to non-constrained lenders. If the share of constrained households is sufficiently large, which corresponds to a high level of private indebtedness, Keynesian-multiplier effects emerge.

To investigate the effects of fiscal consolidations depending on the level of private indebtedness, we estimate state-dependent impulse responses of income inequality to exogenous changes in the government budget deficit using local projections, as suggested by Jordà (2005). Income inequality is measured by the Gini coefficient. The estimated responses are allowed to vary according to the state of the private debt cycle, defined as fluctuations in the ratio of private debt to GDP around its long-run trend.[6] High-debt states and low-debt states are identified as periods when the ratio of private debt to GDP was above or below trend, respectively. Identification of fiscal consolidation is achieved by using the narrative measure proposed by Devries, Guajardo, Leigh, and Pescatori (2011), available for 1980-2009, which we extend to include 2010 and 2011. The baseline dataset of our analysis covers a panel of 17 OECD countries from 1980 through 2011.

We find strong and statistically significant differences in the distributional consequences of austerity across debt states. A 1% of GDP reduction in the primary deficit translates into a rise in income inequality of around 2 Gini points in high private debt states. In contrast, when private debt is low, the inequality effects of fiscal consolidations are found to be small and statistically indistinguishable from zero. Thus, an estimation approach that abstracts from debt-dependence may well lead to wrong policy conclusions.

We conduct various robustness checks that confirm our findings. In particular, we take into account possible anticipation effects due to fiscal foresight, we consider alternative ways of defining periods of private debt overhang, and we restrict our sample to the period before the Global Financial Crisis. Moreover, we rule out that our results are driven by the state of the business cycle. Inequality significantly increases in periods of private debt overhang, irrespective of whether the economy is experiencing a boom or a slump.

[6]Throughout the paper, we use the terms "private debt cycle" and "credit cycle" interchangeably.

Likewise, in booms and slumps, austerity has no discernible distributional consequences when private debt is low.

We explore three channels through which debt-dependent distributional consequences of fiscal consolidations can be rationalized: the earnings heterogeneity channel, the income composition channel, and the savings redistribution channel. First, fiscal consolidations lead to a significant decline in aggregate employment in high private debt states, while it reacts only marginally when private debt is low.[7] As employment losses fall disproportionately upon low income groups, labor earnings at the bottom of the distribution may be disproportionately affected (this is the earnings heterogeneity channel). Taken together, this can explain why income inequality rises during periods of private debt overhang. Second, we demonstrate that the share of income accruing to capital increases significantly in periods of private debt overhang, whereas it stays almost constant when private debt is low. For poorer households labor earnings represent the primary source of income, while richer households rely relatively more on capital income. The relative increase in capital income then tends to increase income inequality, even more so during periods of private debt overhang (income composition channel). Third, we find that the real interest rate increases if fiscal consolidations are implemented when private debt is high, while it barely responds when private debt is low. An unexpected increase in interest rates hurts borrowers and benefits savers. To the extent that borrowers are generally at the lower end of the income distribution, this tends to generate a more unequal income distribution (savings redistribution channel).

Our paper is related to the literature that explores the distributional effects of monetary policy and fiscal policy, in general (see, e.g, Coibion, Gorodnichenko, Kueng, and

[7]This result mirrors the findings of Klein (2017) who shows, using data on only a subset of countries considered in this study, that the level of private indebtedness amplifies the adverse consequences of fiscal consolidations on aggregate economic activity.

Silvia 2012, Anderson, Inoue, and Rossi 2016, and Mumtaz and Theophilopoulou 2016), and fiscal consolidations, in particular (see, e.g., Agnello and Sousa 2014 and Ball, Furceri, Leigh, and Loungani 2013). However, none of these studies allows the effects to differ according to the state of the credit cycle. This is surprising given the aforementioned evidence suggesting that credit plays an important role in shaping economic fluctuations and the effects of policy interventions. In fact, we demonstrate that the inequality effects of fiscal policy vary considerably depending on the state of the credit cycle.

The remainder of the paper is organized as follows. Section 2 describes the data and the empirical strategy. Section 3 presents the main results and conducts various robustness checks. Section 4 explores mechanisms through which our results can be rationalized. The final section concludes.

2 Econometric Method and Data

We estimate state-dependent impulse responses to fiscal consolidations using local projections as proposed by Jordà (2005). This method is becoming an increasingly popular tool to estimate non-linear effects of policy interventions (see, for example, Auerbach and Gorodnichenko 2013, Ramey and Zubairy 2014 and Owyang, Ramey, and Zubairy 2013). The main advantages compared to VARs are that local projections are more robust to model misspecifications and the implicit dynamic restrictions involved in VARs are not imposed. Moreover, local projections offer a very convenient way to account for state dependence.[8]

[8]Note that the Jordà method does not uniformly dominate the standard VAR approach for calculating impulse responses. In particular, because it does not impose any restrictions that link the impulse responses across different horizons, the estimates are often erratic because of the loss of efficiency. Moreover, it sometimes displays oscillations at longer horizons. For a more detailed discussion, we refer to Ramey and Zubairy (2014).

For each horizon $k = 0, \ldots, 4$, we estimate the following regression model:

$$Y_{i,t+k} - Y_{i,t-1} = I_{i,t-1} \left[\beta_{H,k} D_{i,t} + \psi_{H,k} X_{i,t-1}\right] + (1 - I_{i,t-1}) \left[\beta_{L,k} D_{i,t} + \psi_{L,k} X_{i,t-1}\right] + \alpha_{i,k} + \eta_{t,k} + \epsilon_{i,t+k}\,, \quad (1)$$

where $Y_{i,t+k} - Y_{i,t-1}$ is the change in income inequality at horizon k, $D_{i,t}$ is a fiscal consolidation shock, $\alpha_{i,k}$ are country fixed effects, $\eta_{t,k}$ capture time fixed effects, and $X_{i,t-1}$ is a vector of control variables. The dummy variable $I_{i,t-1}$ captures the state $\{H, L\}$ of private indebtedness prior to the shock, where $I_{i,t-1} = 1$ if private debt is high. We include a one-period lag of $I_{i,t}$ in the regressions to minimize contemporaneous correlations between fiscal shocks and the state of the economy. Given our specification, $\beta_{H,k}$ provides the response of $Y_{i,t+k} - Y_{i,t-1}$ to the consolidation shock at time t in high private debt states, whereas $\beta_{L,k}$ provides the response in low private debt states. Note that the impulse responses incorporate the average transition of the economy from one state to another. In other words, if the fiscal consolidation shock affects the state of the debt cycle, this effect will be absorbed into the estimated coefficients $\beta_{H,k}$ and $\beta_{L,k}$.

We use annual data of 17 OECD countries for 1980-2011. The beginning and the end of the sample are restricted by the availability of inequality data for some countries. We measure income inequality using Gini indices of market income (pre-tax, pre-transfer) and net income (post-tax, post-transfer) from the Standardized World Income Inequality Database (SWIID).[9] The SWIID incorporates data from various international and national sources in order to increase comparability of available inequality data (for more details, see Jenkins 2015). Our vector of control variables $X_{i,t-1}$ includes real GDP growth and the change in the respective Gini coefficient.

[9] A detailed description of the data and the data sources can be found in the Appendix.

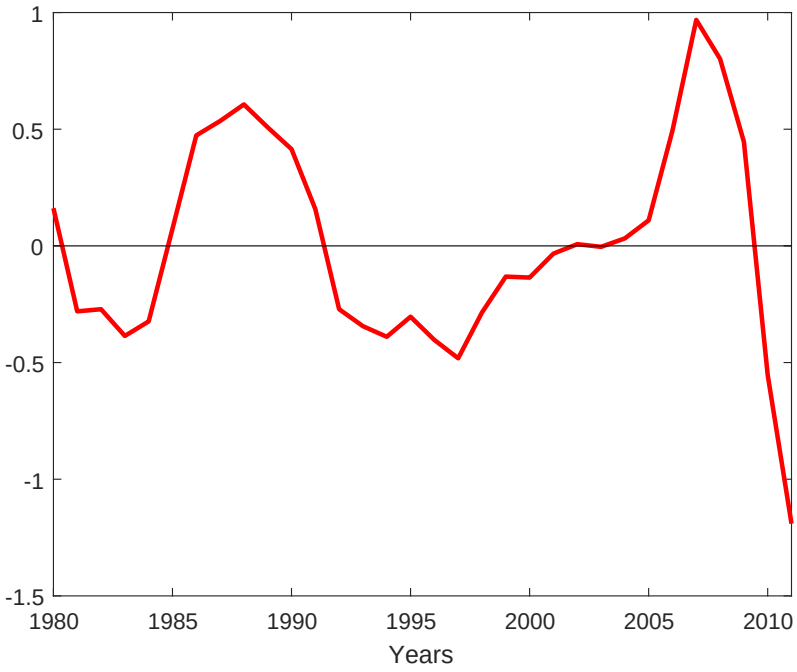
To measure fiscal consolidations, we use the narrative series proposed by Devries, Guajardo, Leigh, and Pescatori (2011), available for 1980-2009, which we extend through 2011. The series contains only those changes in the primary balance to GDP ratio that are motivated by a desire to reduce the budget deficit. The identified fiscal actions represent a response to past decisions and past economic conditions rather than to current and prospective conditions. Therefore, there should be no systematic correlation between the identified fiscal actions and other developments that affect economic activity in the short term. As a result, these fiscal actions are valid for estimating the short-term effects of fiscal consolidation on economic activity. In extending the narrative consolidation measure, we follow Dell' Erba, Mattina, and Roitman (2015) by using the following two OECD reports: *Restoring Public Finances, 2011* and *Restoring Public Finances, 2012 Update*. These reports outline the economic situation, fiscal consolidation strategy, and major consolidation measures for each OECD member country. The country notes in each report lay out each government's rationale for pursuing fiscal adjustment and are used to identify consolidation periods that were motivated by a desire for deficit reduction.

As indicator for private indebtedness, we use the ratio of private debt to GDP. A similar indicator is used by Schularick and Taylor (2012), and Jordà, Schularick, and Taylor (2013) to study the role of credit in shaping the business cycle. Private debt data are taken from the Bank for International Settlements's database on credit to the non-financial sector. To differentiate between high-debt and low-debt states, we filter the debt-to-GDP ratio by country-specific HP trends with smoothing parameter $\lambda = 100$, which corresponds to the usual value used for annual observations in the business cycle literature (Hodrick and Prescott 1997). This choice is justified by evidence found studying the characteristics of the credit cycle. Using a private credit series covering several advanced economies for

over 150 years, Jordà, Schularick, and Taylor (2016) find that the average duration of a credit cycle is similar to the average duration of a traditional business cycle. However, in a later exercise, we show that our results are robust when using a smoother HP-trend.

We define high private debt states as periods with positive deviations of debt-to-GDP ratios from trend. Periods in which the private debt-to-GDP ratios are below trend indicate low private debt states. As we calculate country-specific debt-to-GDP trends, the indicator variable varies across time for each country within our panel dataset. Our procedure implies that out of the 544 periods included in the sample, 279 or 51% are detected as low private debt periods, while the remaining 265 episodes or 49% indicate periods of private debt overhang. For the sake of illustration, Figure 1 shows the U.S. detrended private debt series as an example. The U.S. economy experienced two periods of private debt overhang, from the mid 1980s to the beginning of the 1990s and from the beginning of the 2000s to the end of the decade. The severe private de-leveraging process that followed the Global Financial crises lead to a massive reduction in outstanding private debt. Based on the narrative identification approach, the two largest U.S. consolidation packages were implemented in 1988 and 1994, respectively. The 1988 measure amounted to 0.85 percent of GDP and the 1994 consolidation amounted to 0.90 percent of GDP. While the first measure was implemented during a period of private debt overhang, the second consolidation occurred in an environment when private debt was below trend. Overall, our panel dataset includes 180 austerity measures of which 45% were implemented when private debt was high, whereas the remaining 55% occurred during periods of low private debt.

Figure 1: U.S. Private Debt Cycle.



Notes: Detrended private debt to GDP ratio for the U.S. economy (HP-filter, $\lambda = 100$).

3 Results

This section presents our estimation results. First, we present evidence for private debt-dependent effects of fiscal consolidations on income equality, based on our baseline specification. Second, we discuss a series of robustness checks for our baseline results, including an alternative identification scheme that controls for fiscal foresight, alternative debt state definitions, and an alternative measure of income inequality. Moreover, we check whether the composition of the fiscal consolidation (spending-based or tax-based) is important for our results and we show that our results are robust when leaving out the Global Financial Crisis years. Finally, we demonstrate that our results are robust to controlling for the state of the business cycle.

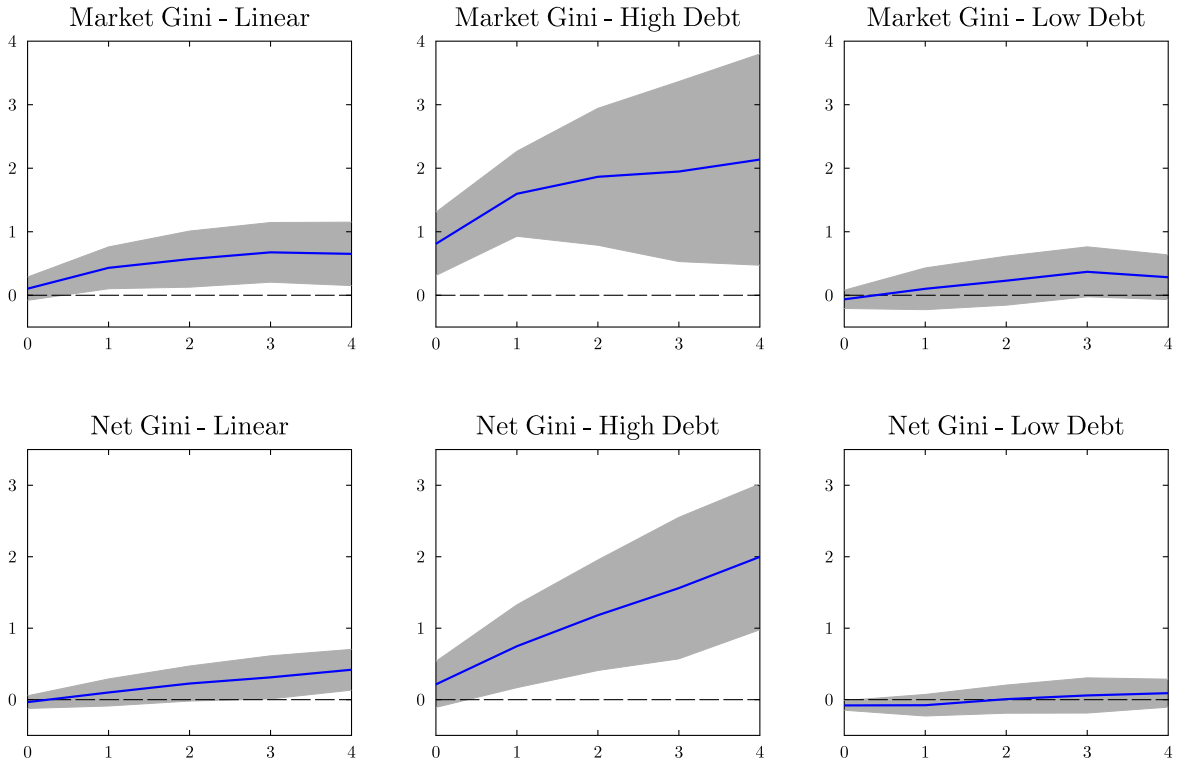
3.1 Baseline Results

Figure 2 displays the change in income inequality after fiscal consolidations. The upper row presents responses for the Gini coefficient of market income whereas the lower row show estimates for the Gini coefficient of net income. To facilitate the interpretation of the results, we normalize responses so that the cyclically-adjusted primary balance rises by one percentage point on impact. For comparison, the left column shows responses based on a model with no state dependence. The middle and right column show results from our baseline nonlinear estimation. The middle column displays the change in income inequality during periods of private debt overhang, whereas the right column shows responses when private debt is low. The solid lines correspond to the point estimates and the shaded areas indicate 90% confidence intervals based on Driscoll and Kraay (1998) standard errors. These standard errors are robust with respect to heteroskedasticity as well as serial and cross-sectional correlation. Numbers on the horizontal axes denote years after the shock and the responses are expressed in percentage points.

We begin by considering the distributional consequences of fiscal consolidations in the model with no state dependence. The left column of Figure 2 displays a moderate increase in both Gini coefficients. The increase in market inequality is somewhat larger compared to the rise in net inequality. At horizon $k = 4$, the Gini coefficient based on market income increases by 0.65 Gini points whereas net inequality rises by 0.42 Gini points. While the response of market inequality is statistically significant for most periods of the forecast horizon, the increase in net inequality only becomes statistically significant after around three years following the consolidation shock.

The most interesting aspects are seen by comparing the responses across columns of Figure 2. It is evident that there are pronounced nonlinearities in the distributional con-

Figure 2: Effects of Fiscal Consolidations on Income Inequality.



Notes: Changes in market and net income inequality in response to a shock of 1% of GDP to the cyclically-adjusted primary balance over $k = 0, 1, 2, 3, 4$ years. The shaded areas indicate 90% confidence bands based on Driscoll-Kraay standard errors.

sequences of fiscal consolidations, in the sense that the effects differ substantially across states of the private debt cycle. During periods of high private debt, fiscal consolidations lead to a strong and long-lasting rise in income inequality. Four years after the consolidation, both Gini coefficients increase by around 2 percentage points. Thus, fiscal consolidations have a much larger adverse impact on market and net income inequality during periods of private debt overhang than is predicted by a model abstracting from state dependence. In contrast, when private debt is low, fiscal consolidations are followed by hardly any change in market and net income inequality. Note that the difference between the responses of income inequality, conditional on different debt states, is also statistically significant. Using a standard F-test, we can reject the null hypothesis of equal responses in high-debt states and low-debt states at the 5% level for horizons $k = 1$ and $k = 4$. For the remaining horizons, the coefficients across debt states are estimated to be significantly different at the 10% level.

It is important to mention that austerity increases market and net income inequality rather equally within a certain private debt state. As seen in Figure 2, the difference between both inequality measures, reflecting redistribution, is small. This stands in sharp contrast to the observation that, in general, net income inequality rises considerably less during economic downturns than market income inequality, reflecting the significant role played by automatic stabilizers implicit in the government tax and transfers system, see, e.g., Krueger, Perri, Pistaferri, and Violante (2010).

To corroborate this, we investigate the distributional consequences of a generic business cycle shock within our empirical model, identified using the following two-step procedure. First, we regress GDP growth on a set of explanatory variables (lagged real GDP growth, CPI inflation, unemployment rate, cyclically-adjusted primary balance, country and time

fixed effects). The residual of this regression then measures the unpredictable component of GDP growth and is interpreted as a business-cycle shock. In a second step, income inequality is regressed on the business cycle shock including additional control variables, thereby allowing the effects to vary depending on the state of the private debt cycle. In line with the aforementioned evidence, we find that automatic stabilizers dampen the distributional consequences of economic contractions considerably. *Net* income inequality does not rise significantly in response to contractionary business cycle shocks, irrespective of the state of the private debt cycle (see Figure A1 in the appendix).

Moreover, in contrast to the effects of fiscal consolidations, we find no evidence of significant debt-dependent distributional consequences in response to generic business cycle shocks. Contractionary business cycle shocks tend to increase *market* income inequality in both debt states. However, the difference across private debt states is found to be small and statistically indistinguishable from zero.

Overall, our main findings reveal that the distributional consequences of fiscal consolidations vary considerably with the level of private debt; debt carried by firms and households. This implies that an estimation approach ignoring debt-dependence may well lead to wrong policy conclusions.

3.2 Robustness and additional results

We now re-specify our baseline empirical approach in order to check the robustness of our main result that the distributional consequences of fiscal consolidations vary considerably over the credit cycle.

For brevity, we focus on net income inequality and report responses for horizon $k = 1$ in tabular form (our main results are robust across alternative forecast horizons and to using market income inequality). The first line of Table 1 repeats our baseline results. Columns

Table 1: Robustness (Effect on Net Income Inequality in Year $k = 1$).

	High Debt	Low Debt	Difference
Baseline	0.748***	−0.078	0.826***
	(0.353)	(0.092)	
Alternative Identification	1.131***	−0.076	1.207***
	(0.559)	(0.101)	
Alternative Debt States Definitions			
$\lambda = 1000$	0.232**	−0.096	0.328**
	(0.129)	(0.159)	
Smooth Transition	0.865**	−0.119	0.983***
	(0.486)	(0.121)	
Differentiating between Private Debt			
Household Debt	0.318**	−0.025	0.342*
	(0.184)	(0.115)	
Corporate Debt	0.365***	−0.025	0.391*
	(0.176)	(0.166)	
Alternative Gini index (UTIP-EHII)	0.293***	−0.090	0.383***
	(0.097)	(0.159)	
Leaving out GFC	0.367**	−0.007	0.373*
	(0.215)	(0.206)	

Notes: The table reports point estimates and Driscoll-Kraay standard errors in parentheses. In each case the shocks are normalized so that the cyclically-adjusted primary balance rises by 1% of GDP in year $k = 0$. *Significant at 16%; **significant at 10%; ***significant at 5%.

2 and 3 display the estimated change in the Gini coefficient for net income one year after the fiscal consolidation for high-debt states and low-debt states, respectively. Driscoll-Kraay standard errors are reported in parentheses. Column 4 reports the estimated difference across states. *, **, or *** indicate significance at the 16%, 10%, or 5% level.[10].

Alternative Identification. Jordà and Taylor (2016) argue that the narrative measure has a predictable component and, therefore, results could be biased due to fiscal foresight. To account for possible anticipation effects, we combine the approach suggested by Jordà

[10]The 16% level is chosen as lower threshold because 16-84% confidence bands are widely used in the empirical macro literature (see, for example, Castelnuovo and Surico 2010 and Hofmann, Peersman, and Straub 2012)

and Taylor (2016) with the forecast error-approach proposed by Auerbach and Gorodnichenko (2012).[11] The procedure consists of two steps. First, we regress the narrative consolidation measure, $D_{i,t}$, on a set of control variables that might include information that helps to predict the outcome variable (real GDP growth, change in cyclically-adjusted primary balance, CPI inflation). The residuals of this regression measure the unpredictable component of fiscal consolidations. In a second step, the residuals are used as proxy for exogenous austerity innovations in the estimation of Equation (1).

The second row of Table 1 shows that we also find strong and significant differences in the distributional consequences of fiscal consolidations across the private debt cycle under this alternative identification scheme. Fiscal consolidations lead to a severe and significant increase in income inequality when private debt is high. In contrast, austerity is not associated with significant distributional consequences when private debt is low. Compared to our baseline specification, the difference between debt states is estimated to be larger when applying this alternative identification approach.[12] This exercise shows that the finding of private debt-dependent distributional effects of fiscal consolidation is robust to alternative ways of identifying fiscal consolidation episodes.

Alternative Debt States Definitions. We define high (low) private debt states as positive (negative) deviations of private debt-to-GDP ratios from (country-specific) HP trends. For our benchmark estimation, we set the smoothing parameter λ equal to 100, motivated by recent evidence showing that the average duration of the credit cycle is similar to the average duration of the business cycle (Jordà, Schularick, and Taylor 2016). In contrast to this evidence, Borio (2014) and Drehmann, Borio, and Tsatsaronis (2012)

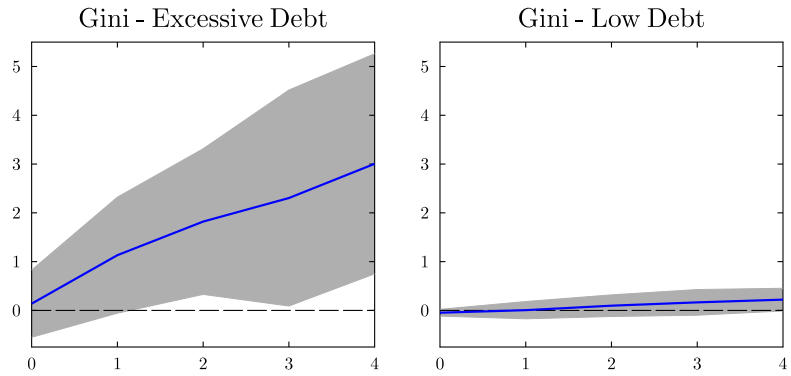
[11] Auerbach and Gorodnichenko (2012) use the unpredictable component of government spending as proxy for exogenous variations in fiscal expenditures.

[12] This is consistent with Jordà and Taylor (2016), who find that the effects of fiscal consolidations on macroeconomic aggregates are amplified once they control for possible anticipation effects in the narrative measure.

argue that the credit cycle is significantly longer and has a much greater amplitude than the standard business cycle. Therefore, Drehmann, Borio, and Tsatsaronis (2011) propose using a smooth HP-trend in order to capture the low frequency of credit cycles. To account for the possible longer duration of the credit cycle, we re-estimate Equation (1) but set $\lambda = 1000$, which implies a relatively smooth HP-trend. Table 1 shows the results of this exercise. Our results are robust when allowing for a smoother trend. We again find significant differences in the distributional consequences of fiscal consolidations over the credit cycle. In periods of private debt overhang, income inequality increases significantly after fiscal consolidations, whereas income inequality is barely affected when private debt is low.

In our previous analysis, we defined any positive (negative) deviation from trend as a period of high (low) private debt. This definition of debt states does not take into account the scope of private debt overhang or the amplitude of the credit cycle. Figure 3 shows results of an alternative definition of debt states in which we distinguish between periods with excessive debt overhang (defined as those debt to GDP deviations from trend that are larger than the country-specific mean of positive deviations from trend) and periods with lower debt. In periods of excessive debt overhang, we again find evidence for strong and significant distributional consequences of fiscal consolidations. Compared to our baseline specification, the point estimates are even more pronounced, but also more uncertain. Four years after the consolidation, the Gini coefficient increases by 3 (instead of 2) percentage points. Thus, the higher the level of private debt overhang, the more severe inequality is affected by fiscal consolidations. In low-debt states, though, austerity does not affect income inequality.

Figure 3: Effects of Fiscal Consolidation on Income Inequality, Excessive Debt Overhang.



Notes: Changes in net income inequality in response to a shock of 1% of GDP to the cyclically-adjusted primary balance over $h = 0, 1, 2, 3, 4$ years. The shaded areas indicate 90% confidence bands based on Driscoll-Kraay standard errors.

So far, our indicator variable $I_{i,t}$ was computed as a dummy variable, with observations 0 and 1. To account for a gradual regime change, we calculate a continuous indicator function based on the smooth-transition approach applied by several contributions studying state-dependent effects of policy interventions, see, e.g., Auerbach and Gorodnichenko (2013), Caggiano, Castelnuovo, Colombo, and Nodari (2015), and Tenreyro and Thwaites (2016). Table 1 shows the results of this exercise.[13] As it turns out, the estimates are pretty similar to our baseline case. Consolidations implemented when private debt is high lead to a significant increase in income inequality, whereas austerity undertaken when private debt is low has no significant effect on inequality. In line with our benchmark results, the state-dependent coefficients are also estimated to be significantly different when relying on a smooth transition approach.

In sum, these exercises reveal that our findings do not rely on the specific method of defining low and high private debt states.

Differentiating between Household and Corporate Debt. The private debt series used so far measures the sum of debt held by private household and firms. To analyze

[13]Details on the calculation of the indicator function are presented in the Appendix.

whether our results are primarily driven by a specific source of private debt, we now differentiate between household debt and corporate debt. Series on corporate debt and household debt are taken from the Bank for International Settlements, where, due to data limitations, the panel includes only 13 out of the 17 countries of our baseline sample. As before, low/high corporate debt and low/high household debt periods are identified as deviations from a smooth country-specific trend (HP-filter with $\lambda = 100$). Table 1 presents responses of the Gini coefficient for net income in low/high household and low/high corporate debt states. Equation 1 is separately estimated for both types of private debt. We find that income inequality rises significantly in periods of high household and high corporate debt. In contrast, when household or corporate debt is below trend, inequality does not respond significantly to austerity. Moreover, the difference between high and low debt responses is estimated to be significant for both types of private debt. This exercise reveals that the finding of private debt-dependent inequality effects of fiscal consolidations is not primarily driven by one specific source of private debt but is a common feature of the household and corporate credit cycle.

Alternative Gini index. So far, our results rely on the Gini index provided by the SWIID database. Although the SWIDD database offers data for most countries and for a substantial period of time, there are some concerns about its data comparability (see, e.g., Jenkins 2015). For this reason, we test whether our findings are robust when using an alternative time series for the Gini index. More specifically, we use the Gini index of the Estimated Household Income Inequality (EHII) Data Set built by the University of Texas Inequality Project (UTIP). Unfortunately, this dataset is only available for the period 1980-2005 and just covers 15 out of the 17 countries of our baseline sample. Keeping this loss of information in mind, the second last row of Table 1 shows the results when using

the UTIP-EHII Gini index as dependent variable. As seen in the table, our finding of private debt-dependent distributional effects of fiscal consolidations holds true also when using this inequality measure.

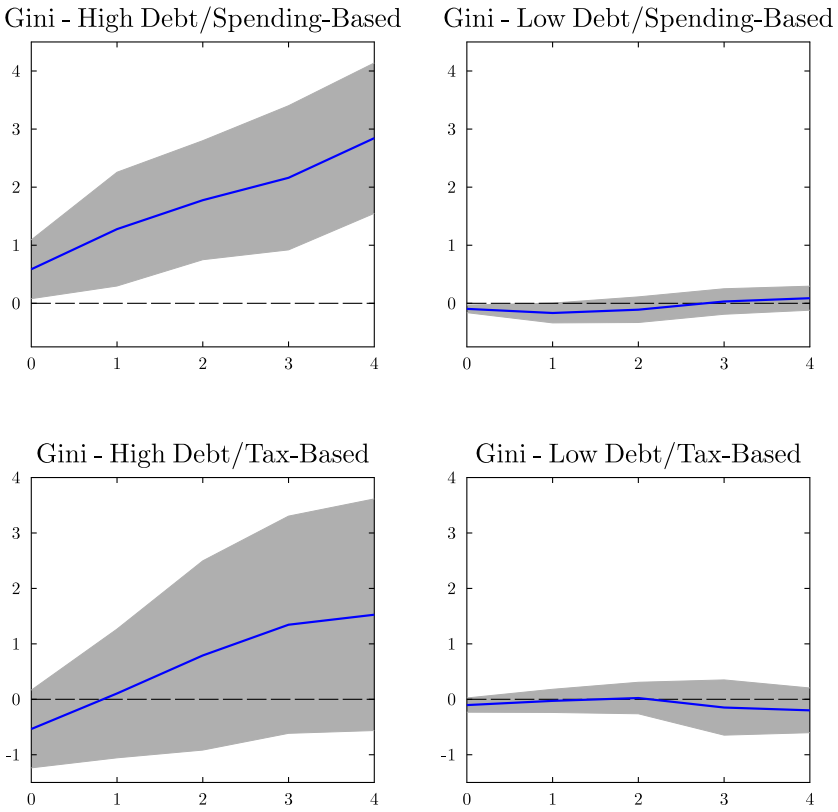
Changes in the sample. The results presented so far are based on a sample that includes the Global Financial Crisis (GFC) period and its aftermath in which large-scale austerity programs were undertaken. Thus, the question arises of whether our findings are mainly driven by the GFC and its aftermath. To check, we remove observations from the GFC and its aftermath and then re-estimate our model on a sample ending in 2006. The last row of Table 1 shows that our main result remains intact. Austerity raises inequality when private debt is high, whereas we do not find discernible distributional consequences when private is low.

In an additional exercise, we investigate whether the results are driven by any key country in the sample. To do so, we have re-estimated Equation (1) by sequentially dropping one country at a time. We find that the baseline result is not driven by any key player in the sample.[14]

Composition. Guajardo, Leigh, and Pescatori (2014) find that the aggregate costs of austerity differ with the composition of fiscal consolidations. To analyze whether the finding of debt-dependent distributional consequences of consolidations depends on the composition, we re-estimate equation (1), where we make use of the composition definition stated by Guajardo, Leigh, and Pescatori (2014). The authors define fiscal policy changes as tax-based and spending-based if the budgetary impact of tax hikes and spending cuts, respectively, is greater than half the total impact.

[14]Results of these estimations are available upon request.

Figure 4: Effects of Fiscal Consolidation on Income Inequality, the Role of Composition.



Notes: Changes in net income inequality in response to a shock of 1% of GDP to the cyclically-adjusted primary balance over $h = 0, 1, 2, 3, 4$ years. The shaded areas indicate 90% confidence bands based on Driscoll-Kraay standard errors.

Figure 4 shows that both spending-based and tax-based consolidations tend to have adverse distributional consequences during periods of high private debt, whereas there is no evidence of rising income inequality during periods of low private debt. While the effects of spending-based consolidations in high-debt states are estimated very precisely, the effects of tax-based consolidations on inequality are more uncertain (the estimates are significant only when 68% confidence bands are considered). This is presumably due to the limited number of tax-based consolidations representing only 1/3 of all consolidations in our sample.

3.3 Controlling for the Business Cycle

This paper emphasizes the credit-cycle dependency of the distributional consequences of austerity. Jordà and Taylor (2016) and Agnello and Sousa (2014) find that the aggregate and distributional effects of fiscal consolidations are amplified in periods of economic slack, respectively. Given this, it is possible that our emphasis on nonlinear effects across the credit cycle are simply a relabeling of nonlinear effects across the business cycle. This, however, is not the case as we show in the following.

To investigate the role of the business cycle for our results, we now differentiate between booms (B) and slumps (S) and estimate the following specification separately for low (L) and high (H) private debt states:

$$\begin{aligned} Y_{i,t+k} - Y_{i,t-1} = {} & I^j_{S,i,t-1}\left[\psi^j_{S,k} X_{i,t-1} + \beta^j_{S,k} D_{i,t}\right] \\ & + I^j_{B,i,t-1}\left[\psi^j_{B,k} X_{i,t-1} + \beta^j_{B,k} D_{i,t}\right] \\ & + I^j_{O,i,t-1}\left[\psi^j_{O,k} X_{i,t-1} + \beta^j_{O,k} D_{i,t}\right] \\ & + \alpha^j_{i,k} + \eta^j_{t,k} + \epsilon^j_{i,t+k}, \quad \text{for } j \in \{L, H\}. \end{aligned} \tag{2}$$

$I^j_{S,i,t}$ and $I^j_{B,i,t}$ now indicate the state of the business cycle within the private debt state $j \in \{L, H\}$. In the estimation for high private debt states, $I^H_{S,i,t}$ measures periods of high private debt that coincide with periods of economic contractions, whereas $I^H_{B,i,t}$ indicates periods of high private debt that are also characterized by economic expansions. $I^H_{O,i,t}$ is then a dummy variable for being in the opposing private debt state (which is the low-debt regime) irrespective of the state of the business cycle. $\beta^H_{S,k}$ and $\beta^H_{B,k}$ then provide the state-dependent responses in slumps and booms within the high-debt regime, respectively. Analogously, in the estimation for low private debt states, $I^L_{S,i,t}$ ($I^L_{B,i,t}$) measures periods of low private debt that coincide with periods of economic slumps (booms) and $I^L_{O,i,t}$ is the

dummy variable for being in the opposing private debt state (which is now the high-debt regime). $\beta^L_{S,k}$ and $\beta^L_{B,k}$ then provide the state-dependent responses in slumps and booms within the low-debt regime, respectively.

We define booms and slumps in two ways. First, we consider the output gap as an indicator of the state of the business cycle. More precisely, we follow Jordà and Taylor (2016) and define booms (slumps) as positive (negative) deviations of log real GDP from country-specific HP trends, where we use a smoothing parameter of $\lambda = 100$. Second, similar to Ramey and Zubairy (2014) we use the detrended unemployment rate as an indicator of economic slack.[15]

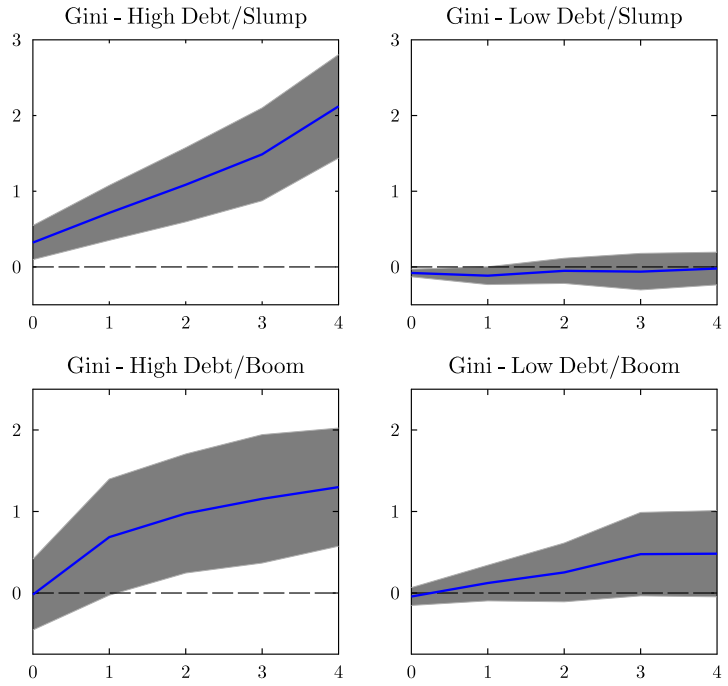
Figure 5 shows that our results appear in both business cycle states. Due to the limited observations of each of the four regimes (high debt/slump, high debt/boom, low debt/slump, low debt/boom), Figure 5 presents 68% (one standard error) confidence bands. If private debt is high, inequality increases significantly, irrespective of the state of the business cycle (see the left column of Figure 5). Likewise, if private debt is low, consolidations do not significantly impact income inequality, neither during booms nor during slumps (see the right column of Figure 5). This holds irrespective of whether we identify booms and slumps via the output gap, see Figure 5(a), or via the detrended unemployment rate, see Figure 5(b).

Figure 5 also makes clear that economic slumps amplify the adverse distributional consequences of fiscal austerity during *high* private debt states, compared to periods in which economic activity is booming. This is particularly evident if economic slumps are identified using the unemployment rate. Four years after the consolidation, the Gini coefficient increases by 4 (instead of around 1) percentage points, see the left column of Figure 5(b). In contrast, economic slumps do not amplify the distributional consequences

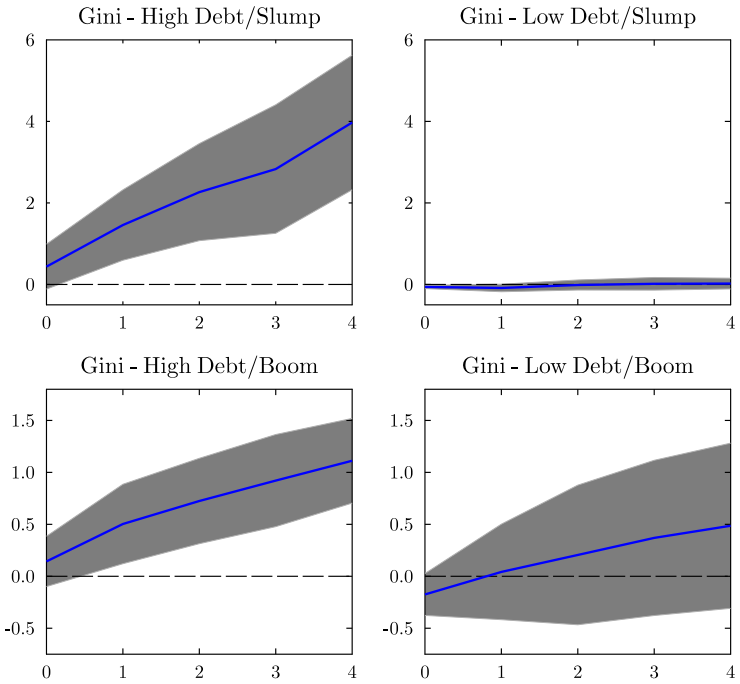
[15] We again compute country-specific HP trends with a smoothing parameter $\lambda = 100$.

Figure 5: Controlling for the Business Cycle.

(a) Output gap



(b) Unemployment



Notes: Changes in net income inequality in response to a shock of 1% of GDP to the cyclically-adjusted primary balance over $h = 0, 1, 2, 3, 4$ years. The shaded areas indicate 68% confidence bands based on Driscoll-Kraay standard errors.

of austerity during *low* private debt states. Interestingly, when private debt is low, the point estimates associated with economic expansions are even larger than the respective slump-estimates, although the coefficients are not statistically different from zero. But what is most important to note is that austerity does not affect income inequality if private debt is low, irrespective of whether the economy is experiencing a boom or a slump.

In sum, our results suggest that the distributional consequences of austerity are mainly determined by the level of private indebtedness in the economy, whereas the state of the business cycle seems to play a minor role for the inequality effects of fiscal consolidations.

4 Potential Explanations

The evidence shown in the previous section suggests that the distributional consequences of fiscal consolidations crucially depend on the state of the credit cycle. We now investigate potential mechanisms underlying the debt-dependent inequality responses. Specifically, we highlight the role of three distinguished channels through which our results can be rationalized: the earnings heterogeneity channel, the income composition channel, and the savings redistribution channel.[16]

Earnings heterogeneity channel. The earnings heterogeneity channel explains changes in income inequality through heterogeneous dynamics of labor earnings of high-income and low-income groups. Heathcote, Perri, and Violante (2010) show that labor earnings at the bottom of the distribution are most negatively affected by economic downturns. This can be explained by the fact that employment losses fall disproportionately upon low-income groups, see, e.g., Jefferson (2008) and Carpenter and Rodgers (2004). To analyze whether employment dynamics can help to understand the debt-dependent distributional consequences, we investigate the effect of fiscal consolidations on aggregate employment,

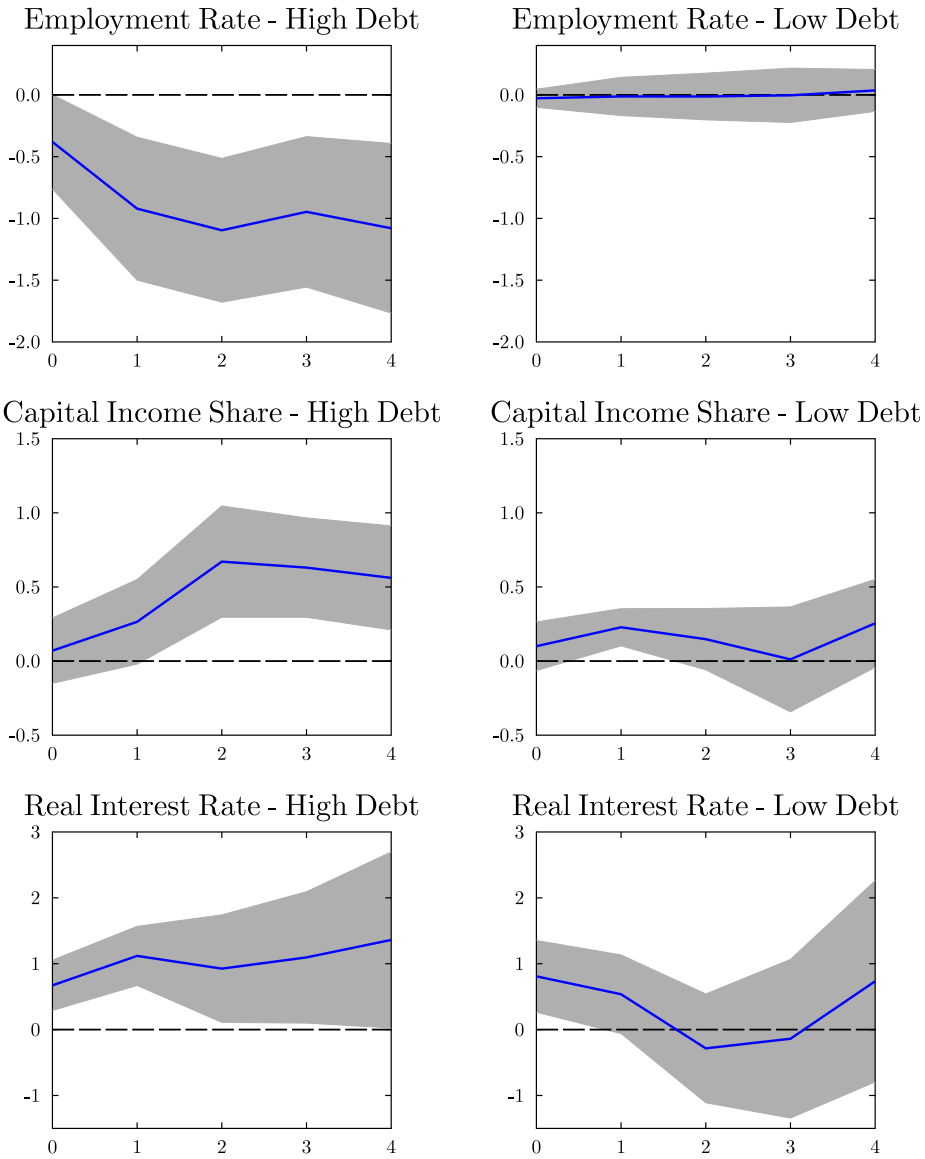
[16]In classifying these channels, we follow Coibion, Gorodnichenko, Kueng, and Silvia (2012).

allowing again for different responses in high-debt and low-debt regimes. We do so by regressing, for each horizon, $k = 0, \ldots, 4$, the change in the aggregate employment rate on our measure of fiscal consolidations and include lags of employment growth and output growth in the control vector $X_{i,t-1}$. If we find that the effects of the employment rate in response to fiscal consolidations differ across the credit cycle, the earnings heterogeneity channel offers an explanation for private debt-dependent inequality changes to austerity.

The results are shown in Figure 6. Notably, we only observe a significant fall in employment when private debt is high. At the end of the forecast horizon, the employment rate declines by more than 1 percentage point. The evidence described above suggests that this is associated with a disproportionate decline in employment for low-income groups that, in turn, translates into a rise in income inequality. In contrast, when private debt is low, the employment rate shows hardly any change in response to fiscal consolidations. Four years after the implementation of the consolidation, the effect on the employment rate is almost zero. This may explain why we do not observe an increase in income inequality in periods when private debt is below trend.

The finding that job losses in response to fiscal consolidations are amplified by private indebtedness is related to theoretical contributions showing that the aggregate effects of fiscal policy interventions are larger during periods of private debt overhang, see, e.g., Eggertsson and Krugman (2012) and Andrés, Boscá, and Ferri (2015). An explanation for why private debt elevates the effects of fiscal policy is the existence of borrowing-constrained households. Such households are characterized by a higher marginal propensity to consume out of income, compared to non-constrained households. If the share of these agents is large enough – which is positively related to the level of private indebtedness – Keynesian-type multiplier effects emerge. Similar considerations may apply for

Figure 6: Employment Rate, Capital Income Share, and Real Interest Rate.



Notes: Changes in the respective variable in response to a shock of 1% of GDP to the cyclically-adjusted primary balance over $h = 0, 1, 2, 3, 4$ years. The shaded areas indicate 90% confidence bands based on Driscoll-Kraay standard errors.

borrowing-constrained firms. Giroud and Mueller (2016), for example, show that the level of firm's indebtedness amplifies job losses after adverse demand shocks.

Income composition channel. While the earnings heterogeneity channel focuses on heterogeneous outcomes within one income source (labor income), the income composition channel explains changes in income inequality through heterogeneous dynamics across different sources of income (capital versus labor income). While, for most households, labor earnings are the primary source of income, others receive a larger share of their income from capital income. Low-income households typically rely on wage income, whereas high-income households tend to receive a relatively larger share of their income from capital income. When fiscal consolidations affect these different types of income heterogeneously, then the different household types experience different income outcomes. According to the income composition channel, a rise in the capital income share in response to austerity benefits high-income households relatively more strongly, which ultimately leads to an increase in income inequality.

To analyze whether different types of incomes are affected heterogeneously, we investigate the response of the capital income share to fiscal consolidation shocks. We do so by re-estimating the regression model (1) but considering the change in the capital income share as the dependent variable. Thereby, the obtained estimation results allow us to detect the possible debt-dependent effects of austerity on the capital income share. We include lags of the change in the capital income share together with real GDP growth in the control vector $X_{i,t-1}$.

As the second row of Figure 6 shows, fiscal consolidations affect different types of income in a heterogeneous manner. After fiscal consolidations, the capital income share

increases.[17] As mentioned before, the relative rise in capital income primarily benefits households in the upper part of the income distribution, generating a mechanism through which fiscal consolidations influence inequality. Turning to the role of private indebtedness, we see that the rise in the capital income share is estimated to be strong and significant when austerity is implemented during a period when private debt is high. The capital income share rises by more than 0.5 percentage points four years after the consolidation was implemented. When private debt is low, we only observe small and mostly insignificant changes in the capital share of income. At the end of the forecast horizon, the response of the capital income share in low-debt states is less than half as strong as the response in high-debt states. Thus, as austerity has different effects on the capital income share across the credit cycle, the income composition channel offers a further explanation for the debt-dependent inequality responses to fiscal consolidations.

Savings redistribution channel. An unexpected increase in real interest rates (through a rise in the nominal interest rate or a decrease in inflation) redistributes resources from borrowers to savers. Since borrowers are generally at the lower part of the income distribution, this generates a rise in income inequality. By studying nominal asset positions in the United States, Doepke and Schneider (2006) provide evidence for the importance of this channel. Moreover, Eggertsson and Krugman (2012) demonstrate that debt deflation is important for understanding the prolonged economic downturn that followed the latest financial crisis.

The last row of Figure 6 highlights the role of the savings redistribution channel for understanding our results. The figure shows results of an estimation exercise where we

[17] This response of the capital share stands in contrast to the general procyclical behavior documented by, e.g., Shao and Silos (2014). In contrast to the findings related to fiscal consolidations, we indeed find that the capital income share declines in response to a contractionary business cycle shock, identified as described above.

regress the change in the real interest rate on fiscal consolidation shocks, again adding the lag of the dependent variable to the vector of control variables. Due to data limitations, the panels includes only 9 out of the 17 countries of our baseline sample. As seen in the figure, the real interest rate increases significantly when consolidations are implemented during high private debt periods.[18] The increase in the real interest rate induces a rise in debt repayments that, according to the savings redistribution channel, positively affect income received by richer households. In contrast, when private debt is low, the real interest rate changes significantly only on impact, while for the remaining forecast horizons there is no statistically significant effect.

To summarize, we presented evidence indicating that the earnings heterogeneity channel, the income composition channel, and the savings redistribution channel all offer mechanisms through which private debt-dependent distributional consequences of fiscal consolidations can be rationalized.

5 Conclusion

This paper reveals important private debt-dependent effects of austerity. Estimating state-dependent local projections for a panel of OECD countries, we provide evidence that the distributional consequences of fiscal consolidations vary considerably over the credit cycle. Fiscal consolidations lead to a strong and persistent increase in income inequality during periods of private debt overhang. By contrast, there are no discernible distributional effects when private debt is low. This finding is robust to taking into account possible anticipation effects, to different definitions of private debt overhang, to varying the sample period, and to controlling for the state of the business cycle. Private

[18] The rise in the real interest rate is difficult to reconcile with standard macroeconomic theory that predicts a decrease in real interest rates when the fiscal deficit decreases. Notice, though, that our documented pattern is in line with recent empirical evidence showing that U.S. fiscal expansions are associated with falling real interest rates, see, e.g., Mountford and Uhlig (2009) and Ramey (2016).

debt-dependent dynamics in aggregate employment, in the composition of income, and in real interest rates can help to understand our findings.

Our results have important policy implications. Empirical evidence on the nonlinear effects of fiscal consolidations helps inform policy about the right time for austerity. According to our evidence, policy makers concerned about inequality should implement austerity measures when private debt is low.

Our contribution also provides guidance for theoretical models that seek to study aggregate and distributional consequences of policy interventions. We show that private debt matters for the inequality effects of fiscal policy. Thus, the growing macroeconomic literature that integrates heterogeneous agents and distributional changes into New Keynesian models should elaborate on private indebtedness when studying the implications of fiscal policy interventions. Moreover, our results may help to differentiate between competing classes of heterogeneous agent models. Finally, the heterogeneity in income responses across households and the channels through which we try to explain the baseline findings may help to provide a better understanding of the transmission mechanism of fiscal policy.

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Appendix

A1 Data Definitions and Sources

The baseline sample covers the period 1980-2011 and the countries Australia, Austria, Belgium, Canada, Germany, Denmark, Ireland, Spain, Portugal, France, Finland, United Kingdom, Italy, Japan, the Netherlands, Sweden and the United States.

The sample of the robustness exercises in which we differentiate between household and corporate debt covers the period 1980-2011 and the countries Australia, Belgium, Canada, Germany, Spain, Portugal, France, Finland, United Kingdom, Italy, Japan, Sweden and the United States.

The sample of the robustness exercises in which we use the Gini index of the University of Texas Inequality Project covers the period 1980-2005 and the countries Austria, Belgium, Canada, Germany, Denmark, Ireland, Spain, Portugal, France, Finland, United Kingdom, Italy, Japan, the Netherlands and the United States.

The sample of the estimates on the real interest rate covers the period 1980-2011 and the countries Australia, Belgium, Canada, Germany, Spain, France, United Kingdom, Italy and the United States.

Table A1: Data Definitions and Sources

Variable	Definition	Source
GDP, real	Gross domestic product, constant prices, OECD base year	OECD
GDP, nominal	Gross domestic product, current prices, current PPPs, in US Dollar	OECD
CAPB	Cyclically-adjusted primary balance relative to GDP	Alesina and Ardagna (2010), for 2010, 2011 OECD series used
Narrative fiscal consolidation measure	Changes in fiscal policy motivated by a desire to reduce the budget deficit and not by responding to prospective economic conditions	Devries, Guajardo, Leigh, and Pescatori (2011) and extended for the years 2010, 2011
Income inequality (SWIID)	Gini coefficients for net and market income	Standardized World Income Inequality Database
Income inequality (EHII)	Gini coefficient gross household income	University of Texas Inequality Project
Employment rate	Civilian employment as % population (15-64 years old)	OECD
GDP deflator	Gross domestic product, deflator, index, hundreds, base year 2010	OECD
Total credit to private sector	End-of-year credit to private non-financial sector from all sectors, market value, in US Dollar, Adjusted for breaks	Bank for International Settlements
Private debt-to-GDP ratio	Total credit to private sector divided by GDP, nominal	Own calculation
Capital income share	1-labor income share, real unit cots, total economy	OECD
Unemployment rate	Unemployment rate as % of civilian labor force	OECD
Interest rate	Short-term interest rate, per cent per annum	OECD
Real interest rate	Interest rate minus log difference of GDP deflator	Own calculation

A2 Extension of the Narrative Measure

In extending the narrative consolidation measure, we follow Dell' Erba, Mattina, and Roitman (2015), who provide data for the consolidation measure of 2010 and 2011. The extension of the dataset is based on the following two OECD reports: *Restoring Public Finances, 2011* and *Restoring Public Finances, 2012 Update*. These reports outline the economic situation, fiscal consolidation strategy, and major consolidation measures for each OECD member country. The country notes in each report lay out each government's rationale for pursuing fiscal adjustment and are used to identify consolidation periods that were motivated by a desire for deficit reduction.

Table A2: Narrative Fiscal Shock, 2010-2011 (% GDP)

Country	2010	2011
Australia	0.00	0.00
Austria	0.00	0.90
Belgium	0.40	0.40
Canada	0.00	0.10
Germany	0.00	0.50
Denmark	0.00	0.90
Finland	0.20	0.30
Spain	2.70	2.20
France	0.00	1.10
Ireland	2.70	4.00
United Kingdom	0.60	1.20
Italy	0.00	0.90
Japan	0.00	0.00
Portugal	2.30	3.40
Netherlands	0.00	0.30
Sweden	0.00	0.40
United States	0.00	0.00

A3 Smooth Transition

The smooth transition results presented in Section 3.2 are obtained by estimating the following equation:

$$\begin{aligned} Y_{i,t+k} - Y_{i,t-1} = & F\left(z_{i,t-1}\right)\left[\beta_{H,k} D_{i,t} + \psi_{H,k} X_{i,t-1}\right] \\ & + \left(1 - F\left(z_{i,t-1}\right)\right)\left[\beta_{L,k} D_{i,t} + \psi_{L,k} X_{i,t-1}\right] + \alpha_{i,k} + \eta_{t,k} + \epsilon_{i,t+k}\,, \end{aligned}$$

where $F\left(z_{i,t}\right)$ is a smooth increasing function of an indicator of the state of the credit cycle. Following Tenreyro and Thwaites (2016), Auerbach and Gorodnichenko (2013) and Caggiano, Castelnuovo, Colombo, and Nodari (2015), we employ the logistic function

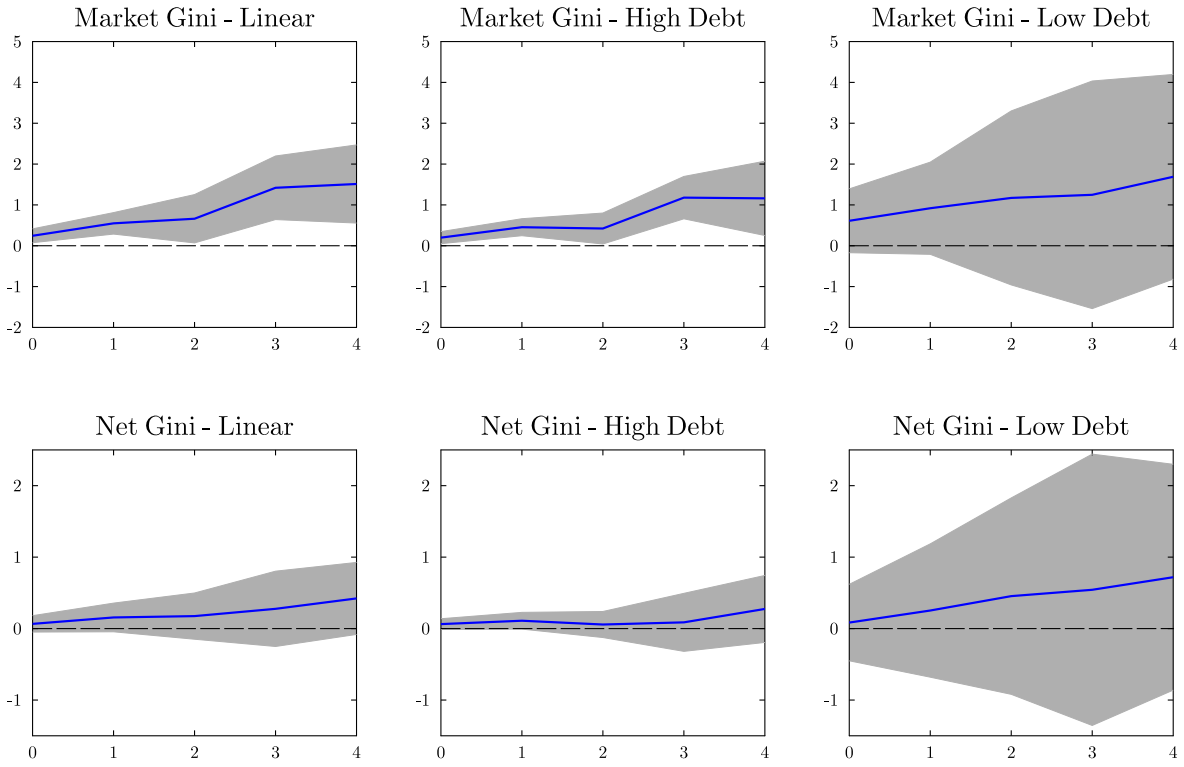
$$F\left(z_{i,t}\right) = \frac{\exp\left(\theta \dfrac{(z_{i,t} - c)}{\sigma_z}\right)}{1 + \exp\left(\theta \dfrac{(z_{i,t} - c)}{\sigma_z}\right)}\,,$$

where c is a parameter that controls what proportion of the sample the economy spends in either private debt state and σ_z measures the standard deviation of the state variable z. θ determines how violently the economy switches from a high-debt to a low-debt state when z_t changes.

Given the mentioned evidence showing that the credit cycle has similar characteristics as the traditional business cycle (Jordà, Schularick, and Taylor 2016), we define $z_{i,t}$ following the approach of Tenreyro and Thwaites (2016), who study business cycle-dependent effects of monetary policy shocks. Thus, $z_{i,t}$ is defined as a two year moving average in the change of the private debt-to-GDP ratio. Moreover, θ and c are set as in Tenreyro and Thwaites (2016) ($\theta = 3,\ c = 20$).

A4 Effects of Business Cycle Shock

Figure A1: Effects of Contractionary Business Cycle Shocks on Income Inequality.



Notes: Changes in income inequality in response to a contractionary business cycle shock over $k = 0, 1, 2, 3, 4$ years. Responses are normalized so that the cyclically-adjusted primary balance decreases by one percentage point on impact. The shaded areas indicate 90% confidence bands based on Driscoll-Kraay standard errors.