HOUSEHOLD DEBT AND BUSINESS CYCLES WORLDWIDE*

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An increase in the household debt to GDP ratio predicts lower GDP growth and higher unemployment in the medium run for an unbalanced panel of 30 countries from 1960 to 2012. Low mortgage spreads are associated with an increase in the household debt to GDP ratio and a decline in subsequent GDP growth, highlighting the importance of credit supply shocks. Economic forecasters systematically over-predict GDP growth at the end of household debt booms, suggesting an important role of flawed expectations formation. The negative relation between the change in household debt to GDP and subsequent output growth is stronger for countries with less flexible exchange rate regimes. We also uncover a global household debt cycle that partly predicts the severity of the global growth slowdown after 2007. Countries with a household debt cycle more correlated with the global household debt cycle experience a sharper decline in growth after an increase in domestic household debt.

I. Introduction

The Great Recession has sparked new questions about the relation between household debt and the macroeconomy. The increase in household debt during the years leading up to the Great Recession predicts the severity of the downturn across U.S. counties (Mian and Sufi 2014) and across advanced economies (IMF 2012; Glick and Lansing 2010). A recent body of theoretical

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research explores the links between behavioral biases, household debt, house prices, macroeconomic frictions, and fluctuations in output. Much of this research emphasizes the importance of shifts in credit supply and behavioral biases by lenders such as underestimation of default risk.[1]

In this study, we begin by showing a systematic empirical relation between household debt and business cycles across 30 mostly advanced countries in an unbalanced panel from 1960 to 2012. Results from a vector auto regression (VAR) show that a shock to the household debt to GDP ratio in a country leads to a three to four year rise household debt, which then subsequently reverts. During the household debt boom, the consumption to GDP ratio increases, imports of consumption goods rise, and GDP experiences a boost. However, the boost is temporary, and GDP subsequently falls. As a result, the rise in the household debt to GDP ratio over a three to four year period in a given country predicts a decline in subsequent economic growth.[2]

This predictability is large in magnitude. A one standard deviation increase in the household debt to GDP ratio over the last 3 years (6.2 percentage points) is associated with a 2.1 percentage point decline in GDP over the next three years. This predictive relation is robust across time and space. Exclusion of the post-2006 Great Recession period leads an effect that is 30% smaller, but it remains statistically significant at the one percent level. A rise in non-financial firm debt is associated with a smaller and more immediate negative effect on GDP, but firm debt dynamics do not generate the boom-bust growth cycle associated with household debt. Over the medium-run horizon we examine, a rise in non-financial firm debt has only weak predictive power on subsequent GDP growth once household debt is taken into account.

After documenting this empirical relation, we focus in the rest of the study on the underlying economic model that is most consistent with the facts. We group theories explaining the rise in household debt into two broad categories: models based on credit demand shocks and models based on credit supply shocks. Within both categories, we consider both rational expectations and behavioral models of credit expansion, and we also focus on the role that macroeconomic frictions

[1]We discuss the theoretical research in detail in Section IV..

[2]We follow standard time-series econometrics terminology and use the term "predict" to refer to the predicted value of an outcome using the entire sample used to estimate the regression. This is in contrast to the term "forecast" that refers to the estimated value of the outcome variable for an observation that is not in the sample used to estimate the regression coefficients. See Stock and Watson (2011), chapter 14.

play in exacerbating the economic downturn that follows the rise in debt. We conclude that the empirical evidence is more supportive of models in which a positive credit supply shock driven in part by flawed expectations of lenders explains the rise in debt during the boom. Further, macroeconomic frictions play an important role in explaining the severity of the bust after a rise in household debt.

Models based on credit demand shocks alone are difficult to reconcile with our findings. In rational expectations-based credit-demand shock models, the underlying shock is an increase in future productivity or permanent income against which households today desire to borrow. Such models yield a positive correlation between contemporaneous changes in debt and subsequent economic growth: households borrow because they expect things are getting better. As already mentioned, we find a negative correlation between the rise in household debt and subsequent GDP growth.

Further, our results are inconsistent with behavioral models of credit demand shocks that focus exclusively on a change in borrower beliefs. In these models, a sudden rise in optimism by borrowers while credit supply remains fixed should lead to higher interest rate spreads during the boom. We construct a new cross-country panel series on mortgage credit spreads to test this prediction. We find the opposite: increases in household debt are associated with low interest rate environments.

The fact that low interest spreads are associated with increases in household debt supports credit supply shock-based models of the rise in debt. We also find that a measure of credit supply shocks based on the quantity of credit originated to low credit quality firms in the United States from Greenwood and Hanson (2013) is positively correlated with household debt booms. We use low interest spreads and the Greenwood and Hanson (2013) variable as instruments for a credit-supply induced rise in household debt, and we show that such rises in household debt predict lower subsequent growth.

Credit supply shocks lead to a rise in household debt which predicts subsequently lower growth. But what is the fundamental source of the increase in credit supply? Models of credit market sentiment suggest that lenders begin to ignore downside risks during debt booms, which makes them willing to make credit more available on cheaper terms (e.g., Gennaioli, Shleifer, and Vishny 2012; Greenwood, Hanson, and Jin 2016 ; Landvoigt 2016). While we do not have direct evidence on lender beliefs, we show that economic forecasters at the IMF and OECD systematically over-forecast GDP growth at the end of household debt booms. As a result, the rise in household debt over the last three years, which is known by forecasters at the time forecasts are made, predicts growth forecasting errors. These findings are consistent with a growing body of research showing that the negative consequences of aggressive lending by the financial sector are not understood by market participants (e.g., Baron and Xiong 2016; Fahlenbrach, Prilmeier, and Stulz 2016).

Our results also suggest that when the credit boom stalls, frictions such as nominal rigidities and monetary policy constraints exacerbate the decline in subsequent growth (Eggertsson and Krugman 2012; Guerrieri and Lorenzoni 2015; Farhi and Werning 2015; Korinek and Simsek 2016; Schmitt-Grohé and Uribe 2016; Martin and Philippon 2014). For example, the negative relation between the change in household debt and subsequent GDP growth is stronger under more rigid exchange rate regimes such as fixed compared to floating regimes. Similarly, an increase in the household debt to GDP ratio predicts an increase in the future unemployment rate, showing evidence of under-utilization of resources. Also, the relation between household debt changes and subsequent GDP is non-linear in a manner consistent with downward rigidity in wages and interest rates: a rise in household debt leads to lower subsequent growth, but a decline in household debt does not lead to higher subsequent growth.

Finally, we explore the global dimension of the household debt cycle by first showing that a rise in household debt to GDP leads to a subsequent reduction in the trade deficit as imports decline. The resulting increase in net exports partially offsets the large negative effect of the household debt boom on consumption and investment, and it points to the importance of external spillovers to other countries. We find that countries with a household debt to GDP cycle that is more correlated with the global debt cycle see a stronger decline in future output growth after a rise in household debt. This is driven by the inability of countries to boost net exports when many countries are suffering from a household debt hangover at the same time. Trade linkages lead to a global debt cycle: there is a stronger negative relation between the rise in global household debt to GDP and subsequent global growth. Our global regression model suggests that the severity of the Great Recession should not have been surprising given the large increase in global household debt that preceded it.

Our paper follows the recent influential work by Jordà et al. (2014a), Schularick and Taylor (2012), Jordà et al. (2013), and Jordà et al. (2014b) on the role of private debt in the macroeconomy. The authors put together long-run historical data for advanced economies to show that credit growth, especially mortgage credit growth, predicts financial crises (also see Dell'Ariccia et al. 2012).

Moreover, conditional on having a recession, stronger credit growth predicts deeper recessions.[3]

Our analysis provides a number of results that are new to the literature and help guide the nascent theoretical literature on private credit and business cycles. For example, our results on the predictability of labor market slackness and predictability of GDP forecast errors help rule out spurious factors that could produce a relation between changes in household debt and subsequent GDP growth. Our results on forecast errors also support the recent literature emphasizing the importance of errors in expectations by lenders in explaining credit booms. Our findings regarding the consumption boom, heterogeneity with respect to monetary regimes, and the importance of low spreads in predicting household debt growth are important for understanding the mechanisms that generate the negative relation between household debt changes and subsequent GDP growth. Finally, our results on the external margin spillovers highlight the importance of the "global household debt cycle," which was also an important precursor to the most recent global recession. We believe all of these results are novel to the literature.

While the existing literature in macro-finance has made important contributions in understanding the "investment" channel for business cycle dynamics (see e.g., Bernanke and Gertler 1989; Kiyotaki and Moore 1997; Caballero and Krishnamurthy 2003; Brunnermeier and Sannikov 2014; Lorenzoni 2008), our results highlight the importance of a debt-driven "consumption" channel for business cycle dynamics. We hope our results will help guide the burgeoning theoretical literature in this area.

The remainder of the paper is structured as follows. The next section presents the data and summary statistics. Section 2 presents the initial facts. Section 3 discusses the underlying theories, and Sections 4 through 7 report empirical findings designed to test which theories best fit the data. Section 8 presents evidence on the global household debt cycle, and Section 9 concludes.

[3] Cecchetti and Kharroubi (2015) find that the growth in the financial sector is correlated with lower productivity growth, and Cecchetti et al. (2011) estimate country-level panel regressions relating economic growth from t to $t+5$ to the level of government, firm, and household debt in year t. They do not find strong evidence that the level of private debt predicts growth. Reinhart and Rogoff (2009) provides an excellent overview of the patterns of financial crises throughout history.

II. Data and Summary Statistics

II.A. Data

We build a country-level unbalanced panel dataset that includes information on household and non-financial firm debt to GDP, national accounts, unemployment, professional GDP forecasts, credit spreads, and international trade. The countries in the sample and the years covered are summarized in Table A1 of the online appendix. The data are annual and range from 1960 to 2012, providing over 900 country-years and an average time series dimension of 30 years before taking differences.[4] Details on variable definitions and data sources are provided in the online data appendix. Here we describe the key variables measuring household and non-financial firm debt.

We measure the level of household and non-financial firm debt as the household debt to GDP ratio and non-financial firm debt to GDP ratio, and we refer to these as $d_{it}^{HH} = \frac{D_{it}^{HH}}{Y_{it}}$ and $d_{it}^{F} = \frac{D_{it}^{F}}{Y_{it}}$, respectively. Likewise, we measure the change in household and firm debt from year $t-k$ to year t as $\Delta_k d_{it}^{HH}$ and $\Delta_k d_{it}^{F}$. The household and non-financial firm debt measures, D^{HH} and D^{F}, are defined as the outstanding levels of credit to households and non-financial corporations from the Bank for International Settlement's (BIS) "Long series on total credit to the non-financial sectors" database.[5] The BIS credit data is intended to capture total credit to households and firms in the economy, including credit financed by domestic and foreign banks as well as non-bank financial institutions. Credit is defined as loans and debt securities (bonds and short-term paper). This definition of debt is thus broader than measures based on bank lending used in recent work by Schularick and Taylor (2012) and Jordà et al. (2014a), but only allows us to work with shorter time series for many countries. Outstanding credit is measured at the end of the fourth quarter in a given year.[6]

The BIS credit series are drawn from individual country sectoral financial accounts (flow of

[4] After differencing and relating the changing in debt between $t-4$ to $t-1$ to growth from t to $t+3$, as we outline below, the average size of the time dimension is 23 years.

[5] The series on credit to households and non-financial firms are available for 34 countries. We exclude China, India, and South Africa, as the decomposed credit series only start in 2006 for China and South Africa and 2007 for India. We also exclude Luxembourg, as the data on non-financial firm credit for Luxembourg is highly volatile, with changes of similar magnitude as annual GDP in some years.

[6] The BIS database provides credit aggregates at a quarterly frequency. In some cases the quarterly values are interpolated based on annual financial accounts.

funds) and are fairly comparable across countries (see Dembiermont et al. 2013). In some cases where financial accounts are not available, total credit is proxied with domestic bank credit and cross-border bank credit, which generally does not capture off-balance-sheet securitized lending or lending by non-bank financial institutions.[7] Changes in the underlying data source, measurement, or coverage induce breaks in the series, so we use the break-adjusted series provided by the BIS. Since the breakdown of credit by borrowing sector is usually only available from financial accounts, the majority of our sample is based on consistent information from financial accounts.

II.B. Summary Statistics

Table I displays summary statistics for the change in total private, household, and non-financial firm debt to GDP, as well as the other variables.[8] Our empirical analysis uses both the level of debt to GDP in panel VARs and changes over three years in a single equation estimation framework. Table I shows that total private sector debt to GDP, $d_{it}^{Private}$, which is the sum of household and non-financial firm debt, has been increasing by 3.11 percentage points per year on average, with household debt to GDP increasing slightly more quickly than non-financial firm debt. The change in non-financial firm debt is about two times as volatile as household debt, and both series are reasonably persistent. Other patterns documented in Table I are consistent with the small open economy business cycle literature. Total consumption expenditure is approximately as volatile as output, while durable consumption and investment are about 2.8 and 3.6 times as volatile as output, respectively. Imports and exports are roughly four times more volatile than output.

III. Household Debt, Firm Debt, and Economic Growth

We begin by documenting several facts about the relation between household debt, firm debt, and economic growth. We focus initially on the full dynamic relation between debt and growth,

[7] This issue is more common in earlier years and especially for the longer series on total credit to the non-financial private sector, since the sectoral breakdown is usually only provided by the financial accounts (see Dembiermont et al. [2013] for details on the construction of the BIS database).

[8] With the exception of the serial correlation, all statistics are computed by pooling observations from all countries. The serial correlation is a weighted average of the serial correlations for each country, with the underlying number of observations for each country as weights.

and then we move to single-equation specifications.

III.A. Full Dynamic Relation

The full dynamic relation between debt and GDP growth is most easily seen in a recursive VAR specification with impulse responses from a Cholesky identification scheme. We want to be clear from the outset that the VAR analysis is not meant to identify causal patterns. It is only meant to describe the dynamic relation between the three variables of interest.

More specifically, we estimate a VAR in the level of household debt to GDP, non-financial firm debt to GDP, and log real GDP, $\mathbf{Y}_{it} = (y_{it}, d_{it}^{F}, d_{it}^{HH})$. We normalize the debt variables by one-year-lagged GDP to avoid capturing innovations to GDP in the debt equations.[9] It is important to normalize debt so that d_{it}^{HH} and d_{it}^{F} refer to debt normalized by the size of the economy. In theory, it is the growth of debt relative to the size of the economy that matters. The danger in not normalizing debt is that episodes of large real debt growth from a small base can appear large without being economically meaningful.

The VAR in levels with country fixed effects is given by

$$\mathbf{A}\mathbf{Y}_{it} = \mathbf{a}_i + \sum_{j=1}^{p} \alpha_j \mathbf{Y}_{it-j} + \epsilon_{it},$$

where $\mathbf{a}_i$ is a vector of country fixed effects and ϵ_{it} is an $n \times 1$ vector of structural shocks with $\mathrm{E}[\epsilon_{it}\epsilon_{it}'] = I, \mathrm{E}[\epsilon_t \epsilon_s'] = 0$ for $s \neq t$, and I is the identity matrix. We set $p = 5$ based on the Akaike Information Criterion. The reduced form representation can then be written as

$$\mathbf{Y}_{it} = \mathbf{c}_i + \sum_{j=1}^{p} \delta_j \mathbf{Y}_{it-j} + \mathbf{u}_{it}, \tag{1}$$

where we define $\mathbf{S} = \mathbf{A}^{-1}$, $\mathbf{c}_i = \mathbf{S}\mathbf{a}_i$, $\delta_j = \mathbf{S}\alpha_j$, and $\mathbf{u}_{it} = \mathbf{S}\epsilon_{it}$ is the vector of reduced form shocks with covariance matrix $\mathrm{E}[\mathbf{u}_{it}\mathbf{u}_{it}'] = \mathbf{S}\mathbf{S}' = \Sigma$. The matrix $\mathbf{S}$ maps the structural shocks into the reduced form residuals. We identify the structural shocks through Cholesky decomposition, with real log GDP ordered first, followed by non-financial debt to lagged GDP, and household debt to

[9] The results are qualitatively and quantitatively similar if we normalize by same-period GDP.

lagged GDP, but the shape of the impulse responses is not sensitive to the ordering in this context.

We estimate the reduced form VAR on the full sample and employ an iterative bootstrap procedure to correct for potential Nickell bias from the inclusion of country fixed effects $\mathbf{a}_i$. The bias-corrected reduced form VAR estimates are only slightly different from the OLS estimates, and none of the results we present are sensitive to this procedure.[10] Dashed lines around the impulse responses are 95% confidence intervals computed by resampling cross-sections of the residuals using the wild bootstrap. The 95% confidence intervals thus account for contemporaneous cross-country correlation in the residuals.

We show three impulse responses from the VAR in Figure 1.[11] The left panel of Figure 1 shows the response of household debt to a shock to itself. This gives us a sense of the length of a "credit boom" in the data. After a shock to itself, household debt continues expanding for three years until peaking, and then it reverts. The reversion is substantial, with household debt returning to its initial level by 5 years after the peak of the boom. Given that household debt increases for three to four years after a shock, the single equation analysis we employ below focuses on the rise in household debt over a three year period.[12]

The middle panel shows the response of real GDP to a positive shock to household debt. An increase in household debt initially increases GDP. But the boost to GDP proves to be short-lived, as GDP eventually declines just as household debt begins to decline. Five years after the original shock, GDP has returned to the same level where it began.[13] We refer to the effect of the household debt shock on subsequent GDP from $t = 3$ to $t = 6$ as the medium-run effect of a rise in household debt on growth and label this as effect A in Figure 1.

From six years to ten years after the original household debt shock, the decline in GDP is large enough that it brings real GDP to a level lower than its starting point, as indicated by the letter B

[10] We do not expect the bias to be severe, as the average sample length in the VAR is 25 years. Figure A1 in the appendix compares the IRF for the original and bias-corrected VAR, showing that the bias is small in this context.

[11] All nine impulse response functions are shown in Figure A2 of the online appendix.

[12] Many other researchers have used a three to four year horizon of private credit changes to examine the effect of credit expansion on outcomes, e.g., Mian and Sufi (2014), King (1994), Baron and Xiong (2016), Jordà et al. (2014a). We believe we are the first to justify this horizon in a VAR setting.

[13] The IRF has the same general shape when the VAR is estimated in first differences (Figure A3 in the online appendix). One notable difference is that the medium-term response of log output to a household debt shock is more negative for the VAR in differences.

in Figure 1. This long-run lower level of GDP is an interesting result from the VAR, but it is not the focus of our study. For both theoretical and statistical reasons, we focus on the medium-run impact of household debt on GDP (effect A) instead of the longer run impact (effect B). From a theoretical perspective, the most relevant models we discuss in Section IV. are about the effect of credit shocks on business cycle fluctuations, not long run growth.[14] From a statistical perspective, it is difficult to precisely measure the long-run impact of a credit shock on GDP. The standard errors of estimates of the GDP response to the initial shock increase with the horizon following the shock.

The right panel shows the impulse response of GDP to a positive shock to non-financial firm debt. Firm debt leads to an immediate negative effect on GDP as opposed to household debt which initially boosts GDP. The negative effect of a rise in firm debt on GDP is realized more quickly compared to the effect of household debt, and the effect of a rise in firm debt reverts after five years. As we will show below, firm and household debt shocks have statistically distinct effects on GDP growth in the short and medium run.

In Table II, we utilize an alternative regression framework to illustrate the full dynamic relation between GDP growth and changes in household and firm debt. Let y_{it} be log real GDP, α_i be country fixed effects, Δ_3 refer to the change over three years, and d_{it}^{HH} and d_{it}^{F} be household and firm debt to GDP ratios, respectively. Table II reports estimates of the following regression:

$$\Delta_3 y_{it+k} = \alpha_i + \beta_{HH}\Delta_3 d_{it-1}^{HH} + \beta_F \Delta_3 d_{it-1}^{F} + u_{it+k},$$

for $k = -1, 0, ..., 5$. In other words, we fix the right hand side variable to be the change in household debt from four years ago to last year, and we vary three-year output growth on the left hand side from being contemporaneous to further into the future. For example, with $k = 4$, β_{HH} would be the effect of a rise in the household debt to GDP ratio from four years ago to last year on growth from next year to four years into the future.

As column 1 of Table II shows, the rise in household debt over a three year period is contemporaneously positively correlated with growth. However, as we examine output growth further

[14]Research by Charles et al. (2015), Borio et al. (2016), and Gopinath et al. (2015) suggests that debt booms may distort human capital accumulation and resource allocation in such a manner that reduces even longer run output, but this is not the focus of our study.

into the future, the correlation goes from being positive to negative. In contrast, the rise in firm debt is negatively correlated with GDP growth in the short-run, but as we extend the horizon for examining output growth, firm debt loses predictive power. A test for equality of β_F and β_{HH} shows that the boom and bust pattern is unique to household debt. Relative to a rise in firm debt, a rise in household debt has a statistically distinct effect, boosting short term growth (column 1) and reducing medium run growth (columns 5 through 7).[15]

III.B. Robustness Using Jordá Local Projections

How robust is the dynamic relation shown in Figure 1 and Table II? To answer this question we estimate impulse responses using Jordà (2005) local projections. Relative to a VAR, impulse responses from local projections are well suited for assessing robustness of the dynamic relation, as they have been found to be more robust to misspecification, easily allow for the inclusion of control variables, and allow for inference directly on the estimated impulse responses. The local projection impulse responses to household and firm debt shocks are given by the sequence of coefficients $\{\hat{\beta}^h_{HH,1}, \hat{\beta}^h_{F,1}\}$ estimated from the following specification, for $h = 1, .., 10$:

$$y_{it+h-1} = \alpha^h_i + X_{it-1}\Gamma^h + \sum_{j=1}^{5} \beta^h_{HH,j} * d^{HH}_{it-j} + \sum_{j=1}^{5} \beta^h_{F,j} * d^F_{it-j} + \sum_{j=1}^{5} \delta^h_j * y_{it-j} + \epsilon^h_{it+h-1},$$

where d^{HH}_{it-j} and d^F_{it-j} are nominal household and non-financial firm debt, respectively, both scaled by one period lagged nominal GDP.

We conduct two robustness tests using Jordá local projections: (1) inclusion of a time trend and (2) exclusion of the Great Recession. Controlling for a time trend ensures that the household debt estimate does not simply reflect a combination of the secular expansion in private credit over the past four decades (Jordà et al. 2014a) and the gradual decline in GDP growth in developed economies over the same period. We exclude the Great Recession because it was preceded by an

[15] We utilize an alternative methodology for testing whether firm and household debt shocks have distinct effects on output growth in Figure A4 of the appendix. We plot estimates from Jordá local projections comparing the effects of a shock to household debt versus firm debt on annual growth rates from 1 to 10 years after the shock. The effect of a household debt shock on the annual GDP growth rates is statistically significantly more negative than the effect of a firm debt shock in years 3, 4, 5, and 6 after the shock.

unprecedented increase in household debt in advanced economies, and we want to test whether the effect of household credit expansions is explained entirely by recent experience.

The top left panel of Figure 2 presents the baseline test without controls, along with 95% confidence intervals computed using standard errors dually clustered on country and year. The baseline estimates reveal a dynamic pattern similar to the impulse responses functions from the VAR.[16] The second and third panel of the top row estimate the Jordá projections with inclusion of a time trend and excluding data points after 2006, respectively. The far right panel of the top row both includes a time trend and excludes the Great Recession.

Inclusion of a time trend does little to alter the main finding. Excluding the Great Recession does not eliminate the boom and bust pattern associated with household debt, but the effect of an increase in household debt no longer leads to a lower level of GDP ten years after the initial shock. A specification that both includes a time trend and excludes the Great Recession yields estimates similar to only excluding the Great Recession.

The two right panels of the top row of Figure 2 show that the long-run lower level of GDP after a positive shock to household debt shown in Figure 1 is not robust to exclusion of the Great Recession period. As mentioned above, this long run effect is not the focus of our study. Instead, we focus on the decline in growth from the peak of the household debt boom ($t = 3$ in Figure 2) to three years later ($t = 6$ in Figure 2). This decline is present even if we exclude the Great Recession and include a time trend, and we will show below that the decline is statistically significant at the one percent confidence level.

In Figure 2, we also report coefficients from estimation of Jordá projections in first differences. More specifically, the bottom row shows the estimates of $\{\beta^h_{HH,1}, \beta^h_{F,1}\}$ from:

$$\Delta_h y_{it+h-1} = \alpha^h_i + X_{it-1}\Gamma^h + \sum_{j=1}^{5} \beta^h_{HH,j} * \Delta d^{HH}_{it-j} + \sum_{j=1}^{5} \beta^h_{F,j} * \Delta d^{F}_{it-j} + \sum_{j=1}^{5} \delta^h_j * \Delta y_{it-j} + u^h_{it+h-1},$$

for $h = 1, ..., 10$. The results from the first difference specifications are similar to the level specifi-

[16]In contrast to the orthogonalized impulse responses from the VAR in Figure 1, the local projection impulse responses in Figure 2 are responses to the reduced form shocks. The fact that the responses to the orthogonalized (ϵ_{it}) and reduced form shocks ($\mathbf{u}_{it}$) are quite similar squares with the observation that the results are not sensitive to the assumed causal ordering in the Cholesky decomposition.

cations. The baseline effect shows that an increase in household debt leads to an increase and then subsequent decrease in output growth. The long run negative effect is strong when we include the Great Recession but weaker if we exclude it. In all eight panels of Figure 2, a rise in household debt predicts a decline in output growth from $t = 3$ to $t = 6$.

III.C. Single Equation Estimation

The dynamic relation above shows that an increase in household debt predicts a decline in output growth in the medium run. The local projection impulse response in the top left panel of Figure 2 implies that a unit shock to household debt leads to a medium-run change in log output from $t = 3$ to $t = 6$ of -0.42 (standard error of 0.11). The corresponding effect on growth for a unit shock to firm debt is 0.03 (standard error of 0.06), and we can easily reject the hypothesis that firm and household debt have similar medium run effects on growth.

To further explore this result, we turn in this sub-section to estimation of single equation specifications of the following type:

$$\Delta_3 y_{it+3} = \alpha_i + \beta_{HH} \Delta_3 d^{HH}_{it-1} + \beta_F \Delta_3 d^{F}_{it-1} + X'_{i,t-1}\Gamma + \epsilon_{it}, \tag{2}$$

where $\Delta_3 d^{HH}_{it-1}$ and $\Delta_3 d^{F}_{it-1}$ are the change in household and firm debt to GDP ratios, respectively, from four years ago to last year. We choose to focus on the change in debt from four years ago to last year as the main right hand side variable for two reasons. First, the impulse response function of household debt to itself shown in Figure 1 suggests that a shock to household debt leads to a three to four year rise before reverting. Second, we lag the change by one period to ensure that professional forecasters have seen the rise in debt when making their forecast, which will be important when we discuss forecast errors below.

The vector X_{it} includes additional control variables such as several lags in the dependent variable to ensure that mean-reversion in GDP growth is not responsible for the results. Our baseline specification does not include year fixed effects, but we explore them in detail in this sub-section and in Section IX.. We dually cluster standard errors on country and year to account for within country correlation and contemporaneous cross-country correlation in the error term. In particular, this accounts for within country correlation induced by overlapping observations.

Table III presents estimates of equation (2). Column 1 sums household debt and non-financial firm debt and uses the overall change in private debt to GDP on the right hand side. Columns 2 through 4 separate out the two components of total private debt. There is a significant negative correlation between changes in private debt and future output growth. Moreover, at this horizon, the negative correlation is driven by the increase in household debt (column 4), and the difference between the household and firm debt coefficients is statistically significant at the 1% level. The magnitude of the negative correlation is large, with a one standard deviation increase in the change in household debt to GDP ratio (6.2 percentage points) associated with a 2.1 percentage point lower growth rate during the subsequent three years.

Figure 3 shows the scatter plot of the regressions shown in columns 2 and 4 of Table III, labeling each country-year in our sample. There is a strong negative relation, and this relation is not driven by outliers. Moreover, the relation is non-linear, a point which we return to in Section VII.. Ireland and Greece during the Great Recession show up in the bottom right part of the scatter plot, but several other episodes including Finland from 1989 to 1990 and Thailand during the East Asian financial crisis also help explain the robust correlation. Panels b and c show the partial correlation between future output growth and the change in household debt to GDP and non-financial firm debt to GDP ratios, respectively. As already shown in column 4 of Table III, the partial correlation is negative for household debt, but flat for non-financial firm debt.

Column 5 of Table III includes lagged one-year GDP growth variables over the same period as the change in debt, Δy_{it-1}, Δy_{it-2} and Δy_{it-3}. The estimate of β^h_{HH} is robust to the inclusion of lagged GDP growth controls, which shows that this result is not driven by some spurious mean reversion in the output growth process. Column 6 adds the change in government debt to GDP over the same period on the right hand side. A rise in government debt to GDP is associated with moderately stronger growth over the following three years, but the coefficient is small and not statistically significant.[17]

Columns 7 and 8 explore whether household debt is simply a proxy for periods in which a country accumulates net foreign liabilities. This is an important issue because theoretical models

[17]This result is true at all horizons between one and five years.

differ on whether gross debt burdens within a country matter, or simply the net financial position of a country vis-á-vis the rest of the world. As column 7 shows, the rise in net foreign liabilities does not predict subsequent GDP growth once household debt is taken into account. Column 8 shows that there is perhaps an amplifying effect: the rise in household debt has a stronger negative effect on subsequent GDP when the country has simultaneously increased net foreign liabilities. However, even countries that have not increased net foreign liabilities during the household debt expansion see a decline in subsequent output growth.

In Figure A5 of the appendix, we report coefficients from estimating equation (2) separately for each country. The coefficient on the household debt to GDP ratio is negative for twenty-four of the thirty countries in our sample, and none of the country coefficients is significantly positive with the exception of Turkey. The cross-country average of the estimates is -0.36 and the precision weighted average is -0.40.

Table IV provides robustness checks on sample selection, standard errors, and functional form of our debt variables. Column 1 of Panel A performs a robustness check by only using non-overlapping years for the left-hand-side variable to ensure that our findings are not driven by repeat observations. The estimate and standard errors are similar. The combination of country fixed effects and lagged dependent variables as controls introduces a potential "Nickell bias" in estimation of equation (2). The bias is likely to be small given the relatively long average panel length of 23 years in our sample. Nonetheless, column 2 uses the Arellano and Bond (1991) GMM estimator for the sample in column 1 and shows similar results. The Arellano-Bond estimator uses all the lags of three-year GDP growth as instruments for $\Delta_3 y_{it-1}$, and we also instrument $\Delta_3 d^{HH}_{it-1}$ and $\Delta_3 d^{F}_{it-1}$ with their (three-year) lag. As another check, column 3 estimates equation (2) without country fixed effects. The coefficient estimate on the change in the household debt to GDP ratio is similar.

Up to this point we have reported standard errors that are robust to correlation in the errors within countries over time and across countries in a given year. Column 4 reports standard errors that allow for arbitrary residual correlation across countries in proximate years, as well as within a country over time. Specifically, we apply the panel moving blocks bootstrap (Gonçalves 2011), which re-samples the data using the moving block bootstrap on the vector containing all countries in a given year.[18] These more conservative standard errors yield a similar but slightly lower t-statistic for the household debt estimate of $t = -4.02$, compared to $t = -4.31$ from two-way clustered standard errors.

Columns 5 and 6 report estimates with inclusion of a time trend and year fixed effects, respectively. Inclusion of a time trend or year fixed effects reduces the estimated coefficient on the rise in household debt by one-third, but the estimate remains statistically significant at the one percent level. We believe inclusion of year fixed effects may be over-controlling because of evidence of a global household debt cycle, and we will return to this point in Section IX..

The specification reported in column 7 of Panel A uses an alternative definition of growth in debt by scaling the change in household debt and non-financial firm debt from four years ago to last year with GDP from four years ago (i.e., for household debt, $\Delta_3 d^{HH}_{it-1} = \frac{D^{HH}_{it-1} - D^{HH}_{it-4}}{Y_{it-4}}$). The coefficient estimate is unchanged, showing that our results are not driven by spurious movement in the denominator of the debt to GDP variable. In all specifications in Panel A, the difference between the estimated coefficients on the rise in household debt and firm debt is statistically significant at the five percent level or better.

In Panel B, we explore the coefficient estimates when limiting to sub-samples. Columns 1 and 2 of Panel B show that the β_{HH} estimate is larger in absolute value for developed economies (-0.37), but the relation is also strong for emerging market economies (-0.24). The estimations reported in columns 3 and 4 exclude the post-1995 period and the post-2006 period, respectively. The coefficient estimates show that the boom and bust cycle around the Great Recession is not uniquely responsible for the negative effect of a rise in household debt on subsequent GDP growth. The estimates reported in columns 5 and 6 focus on the pre-Great Recession period with inclusion of either a time trend or year fixed effects. The coefficient estimate on the change in household debt remains negative and statistically significant at the one percent level, but the magnitude is smaller. Compared to our baseline estimate of -0.33, inclusion of year fixed effects and removal of the post-2006 data reduces the estimate by one-half.

The analysis in Panel B of Table IV also reveals that the difference between the estimates on

[18] We report standard errors for the block length that produces the highest standard errors. This leads to a block length of $l = 3$ years.

the change in household and firm debt is smaller in certain sub-samples. For example, the difference between the two coefficient estimates is only marginally statistically significant for emerging economies. While the difference is statistically significant in the sample that excludes the Great Recession, it is not significant in the sub-sample that focuses on pre-Great Recession data and includes either a linear time trend or year fixed effects.

III.D. What Happens during the Boom?

What happens to the real side of the economy during household debt booms? We address this question in Table V, which examines the contemporaneous correlation between consumption, investment, and the trade balance with changes in household debt to GDP ratios. As it shows, periods when household debt rises are associated with an increase in the consumption to GDP ratio. The rise in the consumption to GDP ratio is not only driven by durables: there is a rise in both the consumption of non-durables and services as well. In contrast, the investment to GDP ratio is flat during household debt boom.

Household credit booms are negatively associated with changes in both the net export and current account to GDP ratio (columns 6 and 7). A country increases its imports relative to exports as household debt rises. What types of goods are imported? Columns 8 shows that the share of total imports that are consumption goods increases, while there is no such equivalent increase in the consumption share of export goods (column 9).

IV. Theory

The results in the section above reveal a robust negative correlation between a three to four year change in household debt and subsequent economic growth. But why does household debt expand suddenly? And why might a large increase in household debt presage subsequently lower economic growth in the medium run? In this section, we describe existing theoretical models that help answer these questions. We place the existing models into two broad groups: those in which the increase in household debt is a result of an increase in credit demand by households, and those in which the increase in household debt is a result of an increase in credit supply. Within each category, there are models in which agents have rational expectations and models in which agents form flawed expectations. We note from the outset that it is unlikely that increases in household debt are uniquely driven by credit demand or credit supply shocks, and indeed a credit supply shock may induce an outward shift in credit demand. But a discussion of the theory can offer insights into which types of shocks are most important in the data.

IV.A. Shocks to Credit Demand

A natural reason for household debt to expand today is anticipation of higher income tomorrow, as in the standard permanent income hypothesis (e.g., Aguiar and Gopinath 2007). The anticipation of higher income tomorrow could be driven by shocks ranging from technology shocks to natural resource discovery to terms of trade shocks. Growth in debt in this type of model is driven by higher demand for credit in response to expected future income growth and a desire to smooth consumption. In the online appendix, we formalize this intuition and we show that increases in debt should be followed by higher economic growth on average.[19]

In addition to predicting higher future growth, positive credit demand shocks while credit supply remains fixed should be associated with higher interest rates during the debt boom. Justiniano et al. (2015) in particular emphasize this prediction, which they argue is counter-factual in the United States from 2000 to 2007 when household debt was rising sharply.

An alternative rational expectations-based explanation for the rise in debt would be liquidity hoarding in the face of bad news. Households see a negative economic shock coming, and as a result they borrow aggressively to preserve liquidity and ride out the storm. This model would yield a negative relation between a rise in debt and subsequent growth. But households would not consume out of borrowing, and therefore we would not see a rise in consumption concurrently with the rise in household debt. We have already shown evidence that consumption rises during debt booms, which is difficult to reconcile with liquidity hoarding by households.

Another class of relevant models are behavioral or preference-shock based models in which households suddenly consume more. This could be due to a preference shock as in Laibson (1997)

[19] In the international finance literature which uses a representative agent framework in a small open economy, the rise in debt represents net foreign debt. More broadly, one could introduce heterogeneity where some agents within a country receive a positive productivity shock and borrow from other agents in the same economy, which would yield a positive relation between gross debt in a country and future growth.

or Barro (1999), or general over-optimism about the future. In these models, there is nothing special about debt except that it fuels consumption. Consumption rises during the boom phase, and subsequent growth may be lower because of less productive investment policy during the boom or a sharp reversal of beliefs about the future which triggers the bust.

If credit supply remains fixed, even a shift in credit demand based on flawed expectations by households should lead to higher interest rates as credit demand rises. Therefore, a common prediction of all credit demand-shock models, whether they are based on rational expectations or behavioral factors, is that the rise in household debt should be accompanied by an increase in interest rates. This is a key prediction we take to the data in the empirical analysis below.

IV.B. Shocks to Credit Supply

An alternative interpretation of credit expansions is that they are driven by credit supply shocks. A credit supply shock represents a relaxation of lending constraints. For the same potential borrower and same true risk profile, lenders become willing to lend more or on cheaper terms. Such a shock is modeled in reduced form by Justiniano et al. (2015). In their model, the total amount creditors are willing to lend increases, which leads to higher household debt, lower interest rates, and an increase in house prices. Schmitt-Grohé and Uribe (2016) model a small open economy and assume a credit supply shock where the interest rate faced by the economy suddenly declines. Households boost their consumption of imported goods, and external debt rises.

But why does credit supply all of a sudden increase? In Favilukis et al. (2015), there is a sustained influx of foreign capital into the domestic bond market and a reduction in collateral constraints on mortgages. As a result, the housing risk premium falls which boosts debt and house prices. Justiniano et al. (2015) argue that the source of the credit supply shock could be increased international capital flows into a country or a new lending technology that allows the financial sector to transform more savings into lending. Deregulation of the financial sector is another potential source. Facing fewer restrictions, the financial sector expands lending for a given borrower.

Alternatively, credit supply may rise because of behavioral biases of lenders, what has been called "sentiment" in the literature. Such behavioral biases have been emphasized at least since Minsky (2008), and they are formally modeled in a number of recent studies. For example, in Gennaioli et al. (2012), investors neglect tail risks which leads to aggressive lending by the financial sector via debt contracts. In Landvoigt (2016), the lending boom is instigated when creditors underestimate the true default risk of mortgages. In Greenwood et al. (2016), exuberant credit market sentiment boosts lending because lenders mistakenly extrapolate previously low defaults when granting new loans. Bordalo et al. (2015) provide micro-foundations for such mistakes by lenders, which they refer to as "diagnostic expectations."

How can we distinguish between models in which credit demand shocks versus credit supply shocks play the larger role? In credit-supply shock models, periods of rising household debt should be associated with low interest rates, which is in direct contrast to the credit-demand based models. Also, if credit rationing is an important aspect of financial markets, then a credit supply-induced increase in household debt should be associated with an increase in credit originations for lower credit quality households or firms that typically are unable to satisfy their demand for credit. If credit rationing is extreme, an outward shift in credit supply may induce a large shift in originations toward low credit quality borrowers and a rise in interest rates.

IV.C. What Causes Growth to Decline?

We have so far focused on explaining the rise in household debt. But what is the shock that leads to lower growth? In "amplification" models, an exogenous negative shock lowers growth, and the effects of such a negative shock are amplified by the presence of elevated debt. The negative shock may not be caused by the prior expansion in debt, but the expansion of debt amplifies the effect of the negative shock on subsequent growth. This negative shock could be either a financial shock, such as a tightening of borrowing constraints, or a real economic shock, such as a negative productivity shock.[20] In these models, the negative shock precipitates a decline in growth regardless of whether the previous increase in debt was due to credit supply or credit demand.

Alternatively, in the "sentiment" models discussed above, the negative shock that triggers the bust may not be exogenous. Instead, the original positive sentiment shock may endogenously lead to an eventual reversal in sentiment. For example, the model by Bordalo et al. (2015) generates predictable reversals in credit supply given the biased expectations formed by investors. As they

[20] This is the spirit of models such as Kiyotaki and Moore (1997), Schmitt-Grohé and Uribe (2016), Eggertsson and Krugman (2012), and Korinek and Simsek (2016).

note, "following this period of narrow credit spreads, these spreads predictably rise on average ... while investment and output decline ...". While the exact timing of the reversal is not known, a rise in credit supply driven by lender optimism eventually reverts as lenders become pessimistic.

The idea that positive credit market sentiment shocks lead to predictable reversals is supported by a number of recent empirical studies. Krishnamurthy and Muir (2016) show that credit spreads appear too low prior to a financial crisis, and the crisis is triggered when spreads rise suddenly. Using data on the United States from 1929 to 2013, López-Salido et al. (2016) show that a sudden rise in credit spreads is predictable given the low spreads that precede it. Further, Baron and Xiong (2016) show that expansions in private debt predict a crash in bank equity prices. These models are also consistent with the left panel of Figure 1: a rise in household debt predicts a reversal in household debt from 3 to 7 years after the initial shock.

Regardless of why the credit boom ends, economic growth may be depressed when it ends due to a number of factors. A disruption in the financial system is an important factor, and such evidence is provided by Krishnamurthy and Muir (2016) and López-Salido et al. (2016). An additional source of depressed economic growth is the presence of nominal rigidities. The model by Schmitt-Grohé and Uribe (2016) assumes downward wage rigidity and a monetary policy constraint due to a fixed exchange rate. The negative credit supply shock in their model is the reversal of a temporary interest rate decline in a small open economy, which causes domestic demand for non-tradables to fall. However, the combination of downward wage rigidity and restricted monetary policy prevents real wages from falling, resulting in unemployment and decline in output. If the country could run its own monetary policy, it could boost investment and consumption through lower interest rates and boost net exports through a weaker currency and lower real wages.

A related but separate rationale for a decline in economic growth is provided by Eggertsson and Krugman (2012) and Korinek and Simsek (2016). These are closed economy models where the negative shock is a tightening of borrowing constraints faced by the impatient consumer. The authors show that if debt levels are sufficiently high, the deleveraging shock will tip the economy into a zero lower bound constraint and recession. The fixed exchange rate in the open economy models plays a similar role as the zero lower bound constraint in the closed economy models: both reduce the ability of monetary policy to lower interest rates to help boost demand. The zero lower bound argument also implies non-linearity in the effect of household debt booms on subsequent growth. The economic downturn must be severe enough to force equilibrium interest rates to be negative. As a result, especially large increases in household debt will trigger especially severe economic downturns.[21]

Given the presence of these ex post constraints in the models of Schmitt-Grohé and Uribe (2016) and Korinek and Simsek (2016), households do not internalize the negative macroeconomic consequences of their borrowing during the boom phase due to aggregate demand externalities. When choosing how much to borrow during the boom, a given household does not internalize that its lower consumption during the bust affects the income of other households. As a result, the economy during the boom phase in these models is characterized by "excessive" borrowing; the social planner would choose lower borrowing because she internalizes the negative aggregate demand externalities during the bust of excessive debt during the boom.

V. Interest Spreads and Riskier Borrowers

Several of the results from Section III. are difficult to reconcile with standard models in which movements in credit demand are the fundamental shock leading to a rise in household debt. In particular, in rational expectations-based credit demand shock models, it is difficult to explain why a rise in household debt systematically predicts a decline in subsequent growth. In this section, we explore interest rates on household debt, where credit demand and credit supply shock-based models have opposite predictions. We also examine measures of credit supply based on the credit quality of borrowers during the boom.

V.A. Mortgage Spreads in a VAR Setting

The VAR evidence shown in Section III. above provides a natural setting to explore how interest rates evolve during household debt booms. In the analysis below, we define the mortgage-sovereign spread, MS spread, as the difference between the interest rate on mortgage loans and

[21] There are other studies that share some of the features detailed here, including Martin and Philippon (2014) and Guerrieri and Lorenzoni (2015). There are additional models based on pecuniary or fire sales externalities that focus on the potential for excessive leverage among non-financial firms. Examples include Shleifer and Vishny (1992), Kiyotaki and Moore (1997), Lorenzoni (2008), and Dávila (2015). Pecuniary externalities can also amplify the effect of household debt, especially for collateralized borrowing such as mortgages.

the 10-year government bond in a country. We develop a Proxy structural vector auto regression (SVAR) approach based on Mertens and Ravn (2013). The idea of such an approach is to use the MS spread as an instrument for the rise in household debt. The "first stage" in this approach is showing that a rise in household debt is systematically related to low interest rate environments, and then the "second stage" is to show that these low interest rate environment-induced increases in household debt lead to lower subsequent output growth.

Recall the reduced form VAR representation from Section III.:

$$\mathbf{Y}_{it} = \mathbf{c}_i + \sum_{j=1}^{p} \delta_j \mathbf{Y}_{it-j} + \mathbf{u}_{it}, \quad \mathbf{u}_{it} = \mathbf{S}\epsilon_{it}.$$

Formally, the identification of a credit supply shock to household debt amounts to identifying the third column of $\mathbf{S}$, which we denote $\mathbf{s}$ and partition as $\mathbf{s} = (\mathbf{s}^{1:2\prime}, s^3)'$. An external instrument Z_{it} is valid to identify a credit supply shock if $\mathrm{E}[Z_{it}\epsilon^3_{it}] \neq 0$ and $\mathrm{E}[Z_{it}\epsilon^j_{it}] = 0, j = 1, 2$. The first condition requires that Z_{it} is correlated with the household credit supply shock ϵ^3_{it}. The second condition states that it is uncorrelated with shocks to the non-financial firm debt and GDP equations, such as productivity shocks.

Given these assumptions, the Proxy VAR estimation is as follows: First, we use OLS to estimate the reduced form VAR residuals $\mathbf{u}_{it}$ of the system (1) from Section III.. We then regress the residuals of the household debt equation (u^3_{it}) on the MS spread instrument. If the coefficient on the MS spread instrument in this regression is negative, it implies that unexplained increases in household debt from the VAR are related to low interest rate environments, which would support the argument that credit supply shocks are the more important driver of increases in household debt.

In the second stage, we estimate the ratio $\frac{\mathbf{s}^{1:2}}{s^3}$ from the 2SLS regression of $\mathbf{u}^{1:2}_{it}$ on u^3_{it} using the MS spread instrument Z_{it}. Here, s^3 is the response of u_{3it} to the credit supply shock ϵ_{3it}, and $\mathbf{s}^{1:2}$ is a vector that contains the response of $(u_{1it}, u_{2it})'$ to the credit supply shock. This step isolates variation in the non-financial firm debt and GDP equation residuals that is driven by credit supply shocks to household debt. With an estimate of $\frac{\mathbf{s}^{1:2}}{s^3}$ in hand, we can then identify s^3 using the additional restrictions imposed by the reduced form variance-covariance matrix Σ.

As in any macroeconomic setting, it is difficult for a potential instrument to convincingly satisfy the exclusion restriction. In our setting, it may be that the decline in the MS spread has an effect on subsequent output or firm debt independent of its effect on household debt. However, most alternative channels through which the MS spread affects subsequent growth would have the opposite sign of what we find here: a decline in the interest spread should occur in expectation of improved household income prospects coming from stronger growth. In other words, the omitted variables associated with a decline in the MS spread would likely lead to stronger subsequent growth. This argument suggests that the estimates we provide are conservative in quantifying the negative effect of credit supply shocks on subsequent growth.[22]

Table VI presents regressions of the reduced form VAR residuals for household debt and non-financial firm debt on the MS spread instrument. We estimate the VAR on the full sample, but identify the credit supply shock using the subsample where the MS spread is not missing, as in Gertler and Karadi (2015).[23] The regressions in Table VI use the MS spread directly (columns 1 and 3) and an indicator that equals one if the within-country standardized MS spread is below the sample median (columns 2 and 4).

Columns 1 and 2 show the first stage and reveal that a low MS spread is statistically significantly correlated with a higher household debt reduced-form residual. The F-statistics are 11.3 and 9.8 for the MS spread and low MS spread instruments. This is compelling evidence in favor of models in which credit supply shocks are on net more important than credit demand shocks. Booms in household debt that are "unexplained" by GDP growth and non-financial firm debt are systematically related to low interest rate environments.

Further, the results in columns 3 and 4 show that the low MS spread is uncorrelated with the residual from the firm debt equation. While this is not conclusive, it does help strengthen the exclusion restriction assumption; low MS spread environments boost household debt, but do not seem to affect firm debt directly.

[22]This would be consistent with the MS spread being an "imperfect instrumental variable" (Nevo and Rosen 2012) that leads to conservative estimates. A similar argument can be made for the OLS estimates. Since credit demand shocks from higher anticipated future income generate a positive relation between household debt expansion and subsequent growth, the OLS estimate of the effect of a credit supply shock in Section III. is biased upward by omitted credit demand shocks.

[23]The reduced form VAR is estimated on 752 observations and identification using the MS spread uses 580 of these country-years.

In the analysis that follows we rely on the low MS spread indicator variable as our instrument Z_{it} because we primarily want to capture positive shocks to credit supply. We do not want to capture large spikes in the MS spread that capture recessions and periods of financial distress.[24]

Figure 4 presents the responses to a household credit supply shock identified using the low mortgage spread indicator. As we saw in column 2 of Table VI, a low mortgage spread predicts a positive household debt equation residual. Figure 4 shows that a one unit shock to household debt identified using the low mortgage spread instrument raises output by a small 0.05% on impact. Output then rises for two periods, before reversing and falling sharply for several periods. The general shape of the output response from the Proxy SVAR mirrors the response using the Cholesky scheme shown in Section III.. In particular, a low MS spread induced rise in household debt is followed by a growth slowdown in the medium run.[25] An increase in household debt driven by an increase in credit supply is associated with lower subsequent GDP growth.

V.B. Cross-Sectional Analysis

In this section, we examine the experience of the Eurozone and countries prior to the Great Recession to show in a cross-sectional setting the relation between the interest spreads, household debt changes, and economic growth. We first show that the decline in the sovereign spread relative to U.S. Treasuries can be a useful proxy of a credit supply shock for the Eurozone in the years leading up to the Great Recession. The introduction of the euro led to a convergence of sovereign spreads between the Eurozone core and peripheral countries because of decreased currency and other risk premia. This in turn translated into an increase in credit supply in peripheral countries, who disproportionately benefited from converging sovereign spreads.[26] We use the convergence in sovereign spreads over 10 year U.S. Treasuries as an instrument for household debt expansion across

[24]See Gilchrist and Zakrajšek (2012) and Krishnamurthy and Muir (2016) for an analysis of the impact of spikes in corporate credit spreads on economic activity.

[25]In experiments using the raw MS spread and other cutoffs for a "low" MS spread indicator, we find that the shape and level of the IRF are generally similar the results shown in Figure 4.

[26]Changes in the sovereign yield spread are often due to changes in the risk premia (Remolona et al. 2007; Longstaff et al. 2011), and some recent evidence from the European Union suggests that changes in the sovereign spread have an independent effect on domestic credit supply to firms and households (e.g., Bofondi et al. 2013).

eurozone economies in a two stage least squares (2SLS) estimation:

$$\Delta_{02-07} d_i^{HH} = \alpha^f + \beta^f * z_i + u_i^f, \tag{3}$$

$$\Delta_{07-10} y_i = \alpha^s + \beta^s * \Delta \hat{d}_i^{HH} + u_i^s. \tag{4}$$

Columns 1 through 4 of Table VII and Figure 5 confirm this narrative using the decline in the real spread from 1996 to 1999 between a Eurozone country's 10 year government bond and that of the United States as the credit supply shock z_{it} in equation (3). Countries that saw the largest decline in their real sovereign yield spread from 1996 to 1999 saw the strongest expansion in household debt to GDP from 2002 to 2007 (column 2).[27] The top left panel of Figure 5 shows a strong first stage, with the change in the sovereign spread explaining 52.6% of the variation in the change in the household debt to GDP ratios from 2002 to 2007. The rise in household debt predicted by the interest rate convergence, in turn, predicts a more severe recession from 2007 to 2010 (column 3).

Some caution is warranted in interpreting these results. The decline in interest spreads in peripheral European countries from 1996 to 1999 affected these economies through channels other than household debt expansion. Some of these alternative channels push the opposite direction of our result: for example, lower spreads may have fueled productive investment which would boost long-term growth. However, if lower spreads misallocated resources toward unproductive industries (e.g., Charles et al. 2015; Borio et al. 2016; Gopinath et al. 2015), then the worse performance of peripheral European countries during the Great Recesion may be due to factors other than household debt expansion alone.

In columns 5 through 8 of Table VII and Figure 5(b), we consider the spread between mortgage loans and 10-year government bond (MS spread) as a credit supply shock to household debt in a broader sample of countries during the 2000s boom. We use the decline in the MS spread from 2000 to 2004 as the instrument z_{it}, as spreads bottomed between 2003-2005 in most countries. Column 6 shows a strong first stage, with lower spreads predicting significantly stronger household credit

[27] The result is similar if we consider the rise in household debt to GDP from 1999 to 2007. The fall in spreads does not, however, predict stronger growth in government debt to GDP ratios in this sample of 12 economies.

expansion. Countries like Spain, Denmark, and Portugal saw both the largest declines in the MS spread and the largest increases in household debt (top left panel of Figure 5(b)). This correlation supports the importance of credit supply in explaining the large increase in household debt in many countries during the 2000s. Column 7 shows that this expansion in household debt predicted by the fall in MS spread led to significantly slower growth from 2007 to 2010.

Overall, both the Proxy VAR evidence and the cross-sectional analysis point to the following mechanism: a positive credit supply shock (captured in lower spreads) boosts the household debt to GDP ratio and output growth. However, by three to four years after the initial shock, growth declines sharply.

V.C. Composition of Debt and Credit Supply

In the presence of credit rationing, an increase in the share of debt being originated to lower credit quality borrowers may measure a positive credit supply shock more accurately than a decline in the interest rate. The analysis by Greenwood and Hanson (2013) captures this intuition. They argue that the share of total corporate debt issuances by high yield (i.e., riskier) firms is a better measure of credit market conditions relative to interest spreads on corporate debt.[28] Unfortunately, in our setting, such a quantity-based measure requires microeconomic data on which households within a country receive credit, which is not readily available for our large sample of countries.

However, we can utilize the Greenwood and Hanson (2013) measure to see how it is related to household debt booms in the United States. In Table A2 of the online appendix, we use the high yield corporate bond issuance share as an instrument for household debt changes. We show that a rise in the high yield corporate bond issuance share is associated with a rise in household debt, which then subsequently predicts a decline in GDP growth. Of course, there may be other channels through which heightened lending to low credit quality firms affect GDP growth. For example, López-Salido et al. (2016) argue that elevated credit market sentiment predicts a credit market correction, and it is the credit market correction that reduces GDP. However, we view the evidence

[28] Greenwood and Hanson (2013) show that a high value of this share predicts low bond returns in the United States from 1962 to 2008. Ben-Rephael et al. (2016) find that mutual fund flow shifts towards high-yield bonds anticipate an elevated Greenwood and Hanson (2013) high yield share, which suggests that increased investor demand for risky assets drives lending to riskier borrowers.

in Table A2 as supporting the argument that credit supply shocks, as opposed to credit demand shocks, are important for explaining why the rise in debt occurs. We hope future researchers are able to construct quantity-based measures of credit supply shifts similar to Greenwood and Hanson (2013) for a large sample of countries.

VI. Rational or Biased Expectations?

What is the role of behavioral biases in generating the boom-bust cycle in credit and growth shown above? We explore this question in this section. More specifically, in Figure 6, we utilize GDP forecast data from the IMF World Economic Outlook (WEO) and the OECD Economic Outlook publications. The IMF forecasts growth five years out since 1990 for all countries in our sample, and also has one-year ahead forecasts for the G7 countries from 1972 onward. The OECD has one year growth forecasts since 1973 and two year forecasts since 1987 for OECD countries.

The top left panel of Figure 6 shows that an increase in the household debt to GDP ratio from four years ago to the end of last year is uncorrelated with the forecast of growth over the next three years by the IMF. The bottom left panel shows the same result using OECD forecasts of growth over the next two years. Neither the IMF nor OECD adjust their forecasts downward after seeing a rise in household debt from four years ago to last year.

Of course, we know from Table III that the change in the household debt to GDP ratio from four years ago to last year predicts lower subsequent growth, and so a rise in household debt to GDP must also predict negative GDP forecast errors. The top and bottom right panels of Figure 6 confirm this result by replacing the growth forecast of the IMF and OECD with the forecast error. The forecast error is defined as the difference between realized and forecasted growth. The figure shows that larger increases in the household debt to GDP ratio are associated with overoptimistic growth expectations and hence negative forecast errors. It is important to emphasize that the previous rise in the household debt to GDP ratio is already known by forecasters when they make their forecast.

Table VIII confirms these results in a regression setting. The estimates reported in columns 1 and 2 show that the rise in household debt from four years ago to last year has no effect on the growth forecasts made by the IMF or the OECD over the next two years. Columns 3 through

7 report coefficient estimates corresponding to forecast errors for forecasts made by the IMF and OECD one to three years out. As they show, the rise in household debt from four years ago to last year predicts forecasting errors. Columns 8 and 9 report the estimates for the pre-2006 period that does not include the Great Recession. The point estimates are about 2/3 as large in the pre-2006 period, and the estimate for the IMF forecast error is weaker in precision.

In Table A3 of the online appendix we estimate the same regression but replace the forecast error with the forecast revision between t and $t+1$, and between $t+1$ and $t+2$. If forecasts are optimal, then forecast revisions should not be predictable with information available at the time of the original forecast. But columns 1 through 4 of Table A3 show that lagged increases in the household debt to GDP ratio known at time t predict several subsequent downward forecast revisions. An implication is that time t forecasts can be improved by adjusting them downward in response to higher household debt growth from $t-4$ to $t-1$. This is true for both IMF and OECD forecasts. In the appendix (Figure A7), we also analyze the correlation between growth forecasts prior to the household debt expansion. We do not find evidence that forecasters are systematically over-confident about the economy just prior to the period in which credit expands. Forecasters predict growth quite accurately during the household debt boom, but then overstate growth significantly as the household debt boom is close to reverting.[29]

In our view, it is difficult to reconcile the results in Table VIII with rational expectations-based models, whether they are based on credit demand or credit supply shocks. We believe the evidence supports the growing body of research showing that market participants fail to understand the negative effects of increases in private debt (e.g., Baron and Xiong 2016; Fahlenbrach et al. 2016). While much of the previous literature focuses on return predictability, we show that credit booms predict forecasting errors for output growth.

One important question is: who exactly is making the expectations error? Creditors or borrowers? The errors by forecasters shown above do not answer this question. As mentioned above,

[29]We are not arguing that the IMF and OECD forecasts are bad forecasts in an absolute sense. For example, the IMF and OECD forecasts do better than the random walk forecast, and they do a marginally better job forecasting future growth than a forecast based on the panel VAR using GDP growth, the change in household debt to GDP, and the change in the firm debt to GDP (see online appendix Table A5). Our central point is that these forecasts could be improved by taking into account the change in private debt to GDP ratios.

a sudden increase in optimism by borrowers with constant credit supply should lead to a rise in interest rates during household debt booms, which is counter-factual. Bordalo et al. (2015) find that credit market analysts' forecasts tend to be too optimistic during booms when spreads are low, which suggests that creditors are prone to expectational errors from over-extrapolating the recent past.

Another test is to examine whether consumption booms in general lead to lower future economic growth. We conduct such a test, and report the results in Table A4 in the online appendix. We find no evidence that increases in consumption predict lower growth. Neither the change in the consumption to GDP ratio nor the change in the durable consumption to GDP ratio have predictive power on GDP growth once the change in household debt is taken into account.[30] The power of household debt booms in predicting lower growth does not merely reflect consumption booms. This provides further support to the idea that a shift in household beliefs alone is not sufficient to explain the negative effect of debt booms on subsequent growth: a shift in lender beliefs seems critical.

VII. The Role of Macroeconomic Frictions

Theoretical research relating elevated household debt to subsequently lower growth relies on frictions such as constraints on monetary policy and nominal rigidities to explain the decline in subsequent growth. We present evidence supporting the importance of these frictions in this section.

VII.A. Non-Linearity

First, theories in which macroeconomic frictions play an important role typically assume that a decline in demand is needed to trigger frictions that lead to a decline in output. For example, a large decline in demand may require a large reduction in interest rates, which increases the probability of hitting monetary policy constraints such as the zero lower bound on nominal interest rates. Rigidity in wages in particular may be more relevant on the downside, as is assumed in Schmitt-Grohé and Uribe (2016). As a result, increases in household debt to GDP ratios should be expected to predict

[30]We report the durables consumption to GDP ratio as a robustness test given evidence on the importance of the buildup in durables in explaining the severity of the Great Recession (Rognlie et al. 2015).

lower subsequent GDP, but a decline in household debt to GDP ratios may not lead to a rise in subsequent GDP. The non-parametric relation between a change in the household debt to GDP ratio and subsequent GDP growth in Figure 3 of Section III. confirms the presence of such a non-linearity.

Column 1 of Table IX shows this result in a regression context. We create indicator variables for whether the country has experienced a rise or fall in household debt or firm debt, and we interact these indicator variables with the rise in household debt and firm debt, respectively. As the regression coefficients show, the predictive power of household debt changes on subsequent output growth comes completely from situations in which a country sees a rise in household debt. A decline in household debt does not lead to higher subsequent output growth.

VII.B. Heterogeneity across Exchange Rate Regimes

A key macroeconomic friction that interacts with nominal rigidity is monetary policy constraints, which may bind because a country follows a fixed exchange rate regime. The results reported in columns 2 through 4 of Table IX show that the negative relation is indeed significantly stronger when a country follows a more rigid exchange rate system. It divides our sample into fixed, intermediate, and freely-floating exchange rate regimes using the de facto classification from Reinhart and Rogoff (2004) and updated by Ilzetzki et al. (2010).[31] A rise in the household debt to GDP ratio predicts the largest decline in growth in fixed regimes, followed by intermediate regimes, and the predicted decline in growth is smallest for floating regimes.[32] The difference between the coefficient estimate on changes in the household debt to GDP ratio for the fixed and freely floating sample is significant at the 5% level.

VII.C. Unemployment

Frictions such as wage rigidities predict an increase in unemployment after a rise in household debt. Table X replaces GDP growth over the next three years as the left hand side variable with

[31] Fixed regimes cover arrangements with no separate legal tender, currency boards, pegs, and narrow horizontal bands (coarse code 1 from Ilzetzki et al. [2010]). Intermediate regimes include crawling pegs, crawling bands, moving bands, and managed floats (coarse codes 2 and 3). We exclude 11 country-years in which the de facto arrangement is classified as freely falling (cases where 12-month inflation is greater than 40%).

[32] The volatility of $\Delta_3 d_{it}^{HH}$ is 7.5, 5.3, and 5.0 in fixed, intermediate, and floating regimes respectively.

the change in the unemployment rate over the same horizon. Column 1 shows that a rise in the household debt to GDP ratio predicts higher unemployment, and the magnitude is large. A one standard deviation increase in $\Delta_3 d^{HH}_{it-1}$ (6.2) predicts a 0.82 percentage point higher unemployment rate, which is one-third a standard deviation of the left hand side variable.

Column 2 shows that the results are robust to adding lagged annual changes in the unemployment rate to control for any dynamic structure.[33] In contrast to the GDP regressions, a firm debt expansion does have some predictability for unemployment at the three-year horizon. This is because changes in unemployment lag changes in output, and there is a small negative short-run relation between firm debt and growth. However, at longer horizons such as four or five years, we find that only household debt predicts higher unemployment.

The rise in unemployment following household debt expansion is strongest in fixed exchange rate regimes, followed by intermediate and floating regimes. Table X corroborates the evidence presented above that monetary policy flexibility matters for adjustment.

VIII. House Prices and Other Predictors of Growth

VIII.A. House Prices

There is a close connection between household debt and house prices, both from a theoretical and empirical standpoint. For example, Favilukis et al. (2015), Justiniano et al. (2015), and Landvoigt (2016) build models in which a change on the lending side of the market leads to changes in house prices. Further, an extensive body of empirical research shows that credit supply shocks affect house price movements.[34] In our sample, there is indeed a strong correlation between changes in household debt and real house price growth. This relation is shown in column 1 of Table XI. The real house price growth variable is the average real house price growth over the past three years for the country in question.

One potential concern with our results is that independent shocks to house prices are respon-

[33]These results are also robust to using only subsample of OECD harmonized unemployment rate observations, which are more internationally comparable than the series collected using different methodologies.

[34]See for example: Di Maggio and Kermani (2015), Landvoigt et al. (2015), Favara and Imbs (2015), and Adelino et al. (2014).

sible for the correlation between household debt changes and subsequent GDP growth. The most likely shock would be a change in beliefs about future house price growth. But if households suddenly become more optimistic on house price growth there is no change in credit supply, then the shift outward in the demand for mortgages would lead to a positive correlation between mortgage spreads and changes in household debt. This is counter-factual. In order to be consistent with the negative correlation between household debt changes and mortgage spreads, the changes in beliefs about house prices would have to be something about their volatility or downside risk. Of course, changes in beliefs about downside risk or volatility of house prices is almost identical to changes in the assessment of default risk on mortgages by lenders. Therefore, such changes in beliefs could be interpreted as the source of the shift in credit supply.

To shed light on this issue, columns 2 through 5 of Table XI add the lagged change in house price growth to the main regression specification. Both lagged house price growth and lagged changes in the household debt to GDP ratio predict lower subsequent output growth, and the coefficient on the change in household debt to GDP ratio declines slightly. However, the inclusion of time fixed effects or a focus on the pre-2006 data reveals that the rise in the household debt to GDP ratio is a more robust predictor of lower subsequent output growth than house prices. In the horse race between household debt changes and house price growth, household debt changes appear to win.

An alternative approach is to examine the dynamic relation between household debt and house prices. In Figure A8 of the appendix, we explore the relation between house prices and household debt in a bivariate recursive VAR. Interestingly, while house prices and household debt are strongly positively correlated, the data show an asymmetry between the effect of house price shocks and household debt shocks. House price shocks are associated with a gradual rise in household debt to a permanently higher level that begins roughly four quarters after the shock to house prices. Household debt shocks, in contrast, lead to a large and immediate increase in house prices, followed by substantial mean reversion starting roughly 4 years after the shock to household debt.

The impulse response of house prices to a household debt shock is consistent with a model in which the exogenous shock is an outward shift in credit supply which subsequently reverts. Such shocks induce a boom and bust in house prices. The microeconomic evidence in the existing literature also points to a causal effect of credit supply shifts on house prices. While caution is warranted in the interpretation, we believe the body of evidence suggests the chain of causality is more likely to run from credit supply shocks to house prices rather than vice versa.

VIII.B. Robustness to Other Predictors of Output Growth

One concern with our findings is that the predictability result is driven by real exchange rate overvaluation. Existing research shows that real exchange rate appreciation is a robust predictor of financial crises (Gourinchas and Obstfeld 2012), and real exchange rate overvaluation has in certain episodes been labeled as the culprit of slow growth and crises. However, column 4 in Table A4 in the appendix shows that controlling for the 3-year change in the real exchange rate change does not change the coefficient on change in household debt to GDP. Moreover, the coefficient on the real exchange rate is close to zero and insignificant in this sample of mostly advanced economies.

Another concern is that our results are explained by the effect on GDP of sharp movements in corporate credit spreads shown in Krishnamurthy and Muir (2016). They show that GDP growth in year t is negatively related to corporate credit spreads in year $t-1$ and positively related to corporate credit spreads in year $t-2$. Their interpretation of this correlation is almost identical to the interpretation we give our results: credit supply expansions predict a reversion, which negatively affects GDP. Their emphasis is on the financial crisis that results from the period of low credit spreads, but their results and our results are compatible and complementary.

However, we want to ensure that the predictive power of household debt changes on subsequent GDP is not completely subsumed by changes in corporate credit spreads. In Table A4 of the appendix, we first replicate the Krishnamurthy and Muir (2016) finding in our sample (column 7). We then show that including the corporate credit spread does not affect the estimated coefficient on household debt (column 9). These results suggest that the effect of household debt on subsequent GDP is not a mere reflection of a subsequent spike in corporate credit spreads related to banking-sector loan losses and distressed firm balance sheets. This suggests that elevated household debt has a negative effect on the economy for reasons not completely subsumed by financial crisis dynamics.

IX. The Global Household Debt Cycle

IX.A. Household Debt and External Adjustment

Table XII shows that an increase in household debt to GDP predicts an improvement in net exports. Column 1 shows an increase in net exports relative to initial GDP after a rise in household debt.[35] Column 2 shows that growth in exports relative to imports increases as well. Columns 3 and 4 separate the two components of net exports and the regression coefficients show that the increase in net exports is driven by a decline in imports rather than an increase in exports. Column 5 shows that the consumption share of imports falls. This evidence of a reversal in the external balance driven by a fall in imports is consistent with a consumption-driven growth slowdown due to a hangover of household debt. The change in non-financial firm debt has little predictive power for the net-export margin.

Household debt positively predicts a change in the net export margin, while it negatively predicts overall GDP growth and unemployment. This suggests that the external margin is useful in "cushioning" some of the negative consequences associated with a large increase in the household debt to GDP ratio. One would expect that the ability to cushion the decline in GDP through net exports is stronger for countries that are more open in terms of their reliance on external trade. Columns 6 and 7 test this hypothesis by interacting the change in household debt to GDP with "openness." Openness is defined as the sample period average of total exports plus imports scaled by GDP for a given country. The interaction term is positive and significant, suggesting that countries that rely more on trade adjust more on the external margin.

IX.B. Predicting Global Growth

Countries rely on net exports to boost GDP in the aftermath of a household debt boom. But what happens if all countries are experiencing a household debt hangover at the same time? To answer this question, we first estimate the correlation of each country's household debt cycle with

[35] We present results for the change in net exports relative to initial GDP, $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$, instead of the change in the net exports to GDP ratio in order to highlight the reversal of net exports. The pattern also holds using the change in the net export to GDP ratio.

the global household debt cycle:

$$\rho_i^{Global} = \text{corr}\left(\Delta_3 d_{it}^{HH}, \frac{1}{N-1}\sum_{j \neq i} \Delta_3 d_{jt}^{HH}\right). \tag{5}$$

The correlation tells us how much a change in household debt in country i is correlated with the contemporaneous change in global household debt, where the latter variable is constructed excluding country i.[36] Column 8 of Table XII shows that countries for which the household debt cycle is more correlated with the global household debt cycle experience a stronger slowdown in GDP in response to a household debt shock, although the result is only marginally statistically significantly distinct from zero.

Column 9 helps us understand why: the ability of a country to use net exports to boost economic activity after a rise in household debt is substantially weaker for countries that load more heavily on the global household debt cycle. For a country that is perfectly correlated with the global cycle ($\rho_i^{Global} = 1$), subsequent net exports do not adjust at all after an increase in the household debt to GDP ratio. Perfect correlation with the global credit cycle completely removes a country's ability to export its way out of difficulties.

Taken together, these results motivate the specification in column 10:

$$y_{it+3} - y_{it} = \alpha_i + \beta_{HH}\Delta_3 d_{it-1}^{HH} + \beta_F \Delta_3 d_{it-1}^{F} + \beta_G Global_{-i} \Delta_3 d_{it-1}^{HH} + \epsilon_{it},$$

where the third term is the global change in the household debt to GDP ratio excluding country i. The specification does not include year fixed effects, and we are interpreting the global change in the household debt to GDP ratio as the time series variable that matters most for GDP growth in a given country i. In other words, we are putting an economic interpretation on the year fixed effects.

As column 10 shows, the global household debt variable has strong predictive power for GDP growth in country i. But the increase in the household debt to GDP ratio for country i also has predictive power in addition to the global factor. Both the global and country-specific debt cycle

[36] Figure A9 in the appendix presents the correlation for each country in the sample.

matter for growth in a given country. Given these results, we believe inclusion of year fixed effects in the baseline specification leads to an under-estimate of the importance of household debt changes in predicting subsequent growth in a country. Year fixed effects remove variation in the global household debt cycle, and this variation is important for a country's future GDP growth.

The coefficient on global household debt changes in column 10 of Table XII motivates the following global time series regression:

$$\Delta y_{t+3} = \alpha + \beta * \Delta_3 d_{t-1}^{HH} + \gamma * \Delta_3 d_{it-1}^{F} + \epsilon_t.$$

The specification utilizes a single time series where we calculate the sample average of all variables for all countries for each year.

Table XIII presents the estimates. As column 1 shows, there is a strong global household debt cycle. An increase in global household debt from four years ago to last year predicts a decline in world GDP growth from this year to three years into the future. In terms of magnitudes, the coefficient estimate implies that a one standard deviation increase in global household debt to GDP ratio (2.0) predicts a 2.2% decline in GDP growth over the next three years. Similar to the results above, the global debt cycle is driven by changes in household debt; non-financial firm debt has no predictive power at the medium-run horizon we examine (columns 2 and 3). Column 4 shows robustness to controlling for distributed lags of the dependent variable.

Figure 7 plots each year in a scatter-plot of global changes in household debt to GDP ($\Delta_3 d_{t-1}^{HH}$) against subsequent global GDP growth ($y_{t+3} - y_t$). The global changes are equally-weighted averages across countries. The top panel shows the univariate relation between changes in global household debt to GDP and subsequent GDP growth, whereas the bottom two panels show the partial correlations of increases in household debt and non-financial firm debt after controlling for the other. Changes in household debt to GDP are strongly related to subsequent GDP growth.

The results in Table XIII are based on time series data alone, and therefore warrant caution in interpretation. Our panel is relatively short (40 years), and there are only two to three global debt cycles in this period. There may be global factors unrelated to household debt that explain the patterns in Table XIII. We test the robustness of these findings in column 5 of Table XIII and in Table A6 of the appendix. Column 5 of Table XIII shows that a regression of subsequent

GDP growth on changes in household debt to GDP using only pre-Great Recession data produces a coefficient estimate that is similar to the full sample estimate. This implies that a regression model relating changes in household debt to subsequent GDP using the pre-Great Recession data alone forecasts quite accurately the collapse in global GDP growth during the 2007 to 2012 period given the large rise in household debt during the 2000 to 2006 period.

Table A6 in the online appendix shows that the patterns in Table XIII are qualitatively similar but smaller in magnitude when controlling for a linear or quadratic time trend. The estimate on household debt falls most when controlling for a linear trend (from -0.966 to -0.406 when controlling for linear trend compared to -0.807 for a quadratic trend). Table A6 also presents tests that compute the global variables based on aggregates of the levels of debt and output across countries instead of taking unweighted averages, and we find similar qualitative patterns but smaller estimates. If we construct the time series variables using aggregated variables instead of country-level means and we use only pre-Great Recession data, the coefficient estimate falls to -0.316 and is no longer statistically significantly different than zero.

X. Conclusion

An increase in the household debt to GDP ratio predicts a subsequent reversal in debt and lower subsequent GDP growth. The predictive power is large in magnitude and robust across time and space. We show that household debt booms are associated with low interest spread environments and periods in which credit is flowing toward riskier borrowers. We also show that forecasters systematically overstate output growth toward the end of a boom in household debt.

Macroeconomic frictions are an important aspect of explaining the severity of the downturn following the rise in household debt. The effect of household debt on subsequent growth is non-linear: an increase in debt leads to lower subsequent GDP but a fall in debt does not boost GDP. Further, the negative effect of an increase in household debt on subsequent growth is stronger in situations in which monetary policy is constrained. A rise in debt is also associated with higher subsequent unemployment. We also uncover evidence of a global household debt cycle. Countries with a household debt cycle more correlated with the global cycle experience a sharper decline in GDP growth in response to rise in household debt.

Taken together, we believe the evidence is most consistent with a model in which an outward shift in credit supply is the fundamental shock that explains the rise in household debt. It is likely that incorrect expectations formation by lenders and investors, what has been referred to as "credit market sentiment" in the literature, is an important factor in explaining the outward shift in credit supply. Credit demand shocks may be an important part of the boom in household debt; but on net it appears that credit supply shocks are more salient.

Some caveats are in order. Our sample period focuses on the years since 1960, a period that has seen "an unprecedented surge in the scale and scope of financial activities in advanced economies" (Jordà et al. 2014a). The household debt channel we uncover in this paper may be a relatively new phenomenon that reflects heightened financialization. Further, our focus is on short- to medium-run business cycle frequency. As such our results do not necessarily speak to the literature that compares cross-country differences in financial development and growth. There are multiple institutional factors that drive differences across countries in their financial dependence and level of economic development. Our focus is instead on within-country business cycles and their relation with household debt.

Our paper is related to some promising avenues of research. First, more research is needed to understand the variation across time in credit supply. For example, some scholars have pointed to monetary policy in core countries such as the United States as a potential driver (Bruno and Shin 2015; Miranda-Agrippino and Rey 2014; Rey 2015). Others have highlighted behavioral factors by credit market participants. Whatever the fundamental source of the shift in credit supply, we believe that household debt plays a crucial role in explaining why credit supply shocks are related to subsequent output growth.

Second, why is the medium-run impact of household debt growth on output larger than that of firm debt growth? There is little theoretical or empirical research to help answer this question.[37] Here, we offer a few explanations to guide future research.

One reason could be the strong link between household debt and house prices (Jordà et al.

[37] An exception is Jappelli and Pagano (1994), who suggest that looser borrowing constraints faced by consumers lead to higher household debt and lower growth because the reduction in savings hampers capital accumulation by firms. If growth is endogenous then the lower level of investment slows productivity and output growth.

2014b). Mortgage credit expansion can cause a boom and bust in house prices, and mortgage borrowing exposes households to potentially large changes in net worth when house prices fall. Empirical estimates show that consumers and the local economy display high sensitivity to housing net worth shocks (Mian et al. 2013). In contrast to the central role that housing plays in household finances, firms employ many forms of collateral in addition to real estate in their financing and are therefore less exposed to real estate cycles.

Another reason may be behavioral biases. There is a growing literature which suggests that some households display high sensitivity to increases in available credit (Gross and Souleles 2002; Agarwal et al. 2015). This sensitivity may be driven by behavioral biases such as time inconsistency (Laibson 1997), overoptimism about the ability to repay, or overconfidence about the riskiness of future income (Brunnermeier and Parker 2005). In contrast, the owner or CFO of a representative firm may be more sophisticated than the average household and base borrowing on a more realistic assessment of debt service costs and future cash flow. Behavioral biases of households generate a large elasticity of household borrowing with respect to credit supply shocks, and therefore could explain why credit supply shocks work through the household as opposed to firm sector.

A related reason is that large investment grade firms smooth their cash flows and borrow substantially during recessions. For example, Erel et al. (2012) show that investment grade firms' borrowing is countercyclical, with public debt offerings increasing during recessions. Credit demand may thus be a more important driver of borrowing decisions for large firms that account for a substantial fraction of overall debt issuance.

Finally, there are typically more developed institutional arrangements (such as bankruptcy laws) to deal with debt-restructuring at the firm level compared to the household level. In several countries in our sample, there is no consumer bankruptcy framework that allows for debt adjustment or for individuals to discharge debt in a bankruptcy proceeding. Examples of such countries without consumer bankruptcy arrangements in our sample period include Hungary, Italy, and Poland. In European countries that have consumer bankruptcy laws in place, these are generally creditor-friendly with limits on the amount of debt that can be discharged (e.g., in Spain where at most 50% can be discharged), long discharge periods (e.g., Ireland with a 12 year waiting period), or requirements to attempt an amicable settlement outside of the courts. In practice few individuals actually undergo consumer bankruptcy proceedings in countries such as Ireland and Spain. Household overleveraging can therefore lead to a prolonged period of adjustment and cause a more sustained drag on demand.

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TABLE I
Summary Statistics

	N	Mean	Median	SD	$\frac{SD}{SD(\Delta y)}$	Ser. Cor.
Δy	695	2.90	3.08	2.98	1.00	0.29
$\Delta_3 y$	695	8.40	8.65	6.56	2.21	0.71
$\Delta d^{Private}$	695	3.11	2.52	6.96	2.34	0.39
$\Delta_3 d^{Private}$	695	8.52	7.28	16.04	5.39	0.74
Δd^{HH}	695	1.62	1.33	2.56	0.86	0.43
$\Delta_3 d^{HH}$	695	4.58	3.68	6.24	2.10	0.79
Δd^{F}	695	1.48	1.04	5.66	1.90	0.30
$\Delta_3 d^{F}$	695	3.89	3.11	12.21	4.10	0.69
$\Delta_3 d^{Gov}$	627	1.73	1.16	9.92	3.33	0.71
$\Delta_3 d^{Netforeign}$	636	-0.57	1.30	15.01	5.04	0.79
Δc	678	2.81	2.90	2.84	0.95	0.33
Δc^{dur}	469	4.91	5.35	9.27	3.12	0.21
Δc^{nondur}	469	1.53	1.47	2.53	0.85	0.26
$\Delta C/Y$	690	-0.06	-0.01	1.17	0.39	0.04
Δi	678	2.66	3.67	10.79	3.63	0.15
Δg	688	2.84	2.60	2.79	0.94	0.26
Δx	695	8.64	9.30	12.29	4.13	0.15
Δm	695	8.08	9.55	13.87	4.66	0.12
$\Delta NX/Y$	695	0.14	-0.01	2.11	0.71	0.03
$\Delta CA/Y$	648	0.08	-0.02	2.29	0.77	-0.01
Δs^{XC}	695	-0.15	-0.07	1.80	0.61	0.04
Δs^{MC}	695	0.16	0.15	1.67	0.56	0.00
$\Delta reer$	614	-0.03	0.59	6.75	2.27	0.05
Δu	669	0.08	-0.01	1.08	0.36	0.34
$\Delta_3 u$	662	0.19	-0.01	2.43	0.82	0.67
$\Delta_3 y^{WEO}_{t+3\|t}$	484	9.41	8.60	3.76	1.26	0.50
$\Delta_3 (y_{t+3} - y^{WEO}_{t+3\|t})$	484	-2.53	-1.79	5.35	1.80	0.54
$\Delta_3 \ln(P^{Housing})$	514	6.56	7.16	17.42	5.85	0.72
spr^{real}	622	0.43	0.40	2.11	0.71	0.42
spr^{MS}	517	1.15	0.99	1.52	0.51	0.45
spr^{corp}	460	0.76	0.65	1.03	0.35	0.42

Notes: Log changes and ratios are multiplied by 100 to report changes in percentages or percentage points. Δ and Δ_3 denote to one-year and three-year changes, respectively. The variables $y, d^{Private}, d^{HH}, d^{F}, d^{Gov}, \Delta_3 d^{Netforeign}, c, c^{dur}, c^{nondur}, C/Y, i, g, x, m, NX/Y, CA/Y, s^{XC}, s^{MC}, reer, u, y^{WEO}_{t+3|t}$, $\ln(P^{Housing}), spr^{real}, spr^{MS}$, and spr^{corp} denote log real GDP, private non-financial debt to GDP, household debt to GDP, non-financial firm debt to GDP, government debt to GDP, change net foreign liabilities (sum of current account to GDP deficits), log real consumption, log real durable consumption, log real nondurable consumption, consumption to GDP, log real investment, log real government consumption, log nominal exports, log nominal imports, net exports to GDP, current account to GDP, the share of consumption exports to total exports, the share of consumption imports to total imports, log real effective exchange rate, the unemployment rate, the IMF Fall *World Economic Outlook* time t forecast of growth from t to t+3, the log real house price index, the real 10 year government bond yield spread with respect to the United States, mortgage-sovereign spread, and the corporate-sovereign spread, respectively.

TABLE II

Credit Expansion and Contemporaneous and Future Three-Year GDP Growth

	Dependent variable: $\Delta_3 y_{it+k}, k = -1, 0, ..., 5$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	$\Delta_3 y_{it-1}$	$\Delta_3 y_{it}$	$\Delta_3 y_{it+1}$	$\Delta_3 y_{it+2}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+4}$	$\Delta_3 y_{it+5}$
$\Delta_3 d^{HH}_{it-1}$	0.176*	0.121	-0.0136	-0.178**	-0.337**	-0.410**	-0.405**
	(0.0793)	(0.0810)	(0.0680)	(0.0629)	(0.0779)	(0.0905)	(0.102)
$\Delta_3 d^{F}_{it-1}$	-0.0430	-0.140*	-0.159**	-0.108**	-0.0411	0.0327	0.0876*
	(0.0556)	(0.0550)	(0.0437)	(0.0362)	(0.0349)	(0.0395)	(0.0373)
Country fixed effects	✓	✓	✓	✓	✓	✓	✓
Test for equality of							
β_{HH} and β_F, p-value	.0465	.0184	.0905	.3558	.0017	.0002	.0002
R^2	0.0256	0.0631	0.0999	0.103	0.128	0.138	0.128
Observations	815	785	755	725	695	665	635

Notes: This table presents results from estimating the following specification $\Delta_3 y_{it+k} = \alpha_i + \beta_{HH}\Delta_3 d^{HH}_{it-1} + \beta_F \Delta_3 d^{F}_{it-1} + u_{it+k}$ for $k = -1, ..., 5$. Each column gradually leads the left-hand-side variable by one year. Reported R^2 values are from within-country variation. Standard errors in parentheses are dually clustered on country and year. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE III

Household Debt Expansion Predicts Lower Subsequent Growth

	Dependent variable: $\Delta_3 y_{it+3}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_3 d_{it-1}^{Private}$	-0.119**							
	(0.0313)							
$\Delta_3 d_{it-1}^{HH}$		-0.366**		-0.337**	-0.333**	-0.340**	-0.325**	-0.192*
		(0.0772)		(0.0779)	(0.0771)	(0.0868)	(0.0839)	(0.0959)
$\Delta_3 d_{it-1}^{F}$			-0.0978*	-0.0411	-0.0464	-0.0235	-0.0519	-0.0498
			(0.0391)	(0.0349)	(0.0354)	(0.0437)	(0.0395)	(0.0380)
$\Delta_3 d_{it-1}^{Gov}$						0.0534		
						(0.0430)		
$\Delta_3 d_{it-1}^{Netforeign}$							0.00793	
							(0.0523)	
$\mathbf{1}(\Delta_3 d_{it-1}^{Netforeign} > 0)$								0.736
								(1.005)
$\Delta_3 d_{it-1}^{HH} * \mathbf{1}(\Delta_3 d_{it-1}^{Netforeign} > 0)$								-0.235+
								(0.140)
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Distributed lag in Δy					✓	✓	✓	✓
Test for equality of β_{HH} and β_F, p-value				.002	.003	.003	.007	
R^2	0.0869	0.123	0.0364	0.128	0.131	0.126	0.168	0.181
Observations	695	695	695	695	695	627	636	636

Notes: This table reports regressions of real GDP growth from t to $t+3$ on the change in total private, household, and non-financial firm debt to GDP from the end of $t-4$ to the end of $t-1$. Columns 5-8 control for three lags of GDP growth over the same period as the change in debt to GDP, $\Delta y_{it-1}, \Delta y_{it-2}$, and Δy_{it-3}. Column 6 includes the increase in government debt to GDP over the same period, and column 7 controls for the change in net foreign debt, calculated as the sum of current account deficits to GDP over the same 3 year period. Column 8 interacts the increase in household debt with a dummy for whether the cumulated current account over the same period is negative. All specifications include country fixed effects. Reported R^2 values are from within-country variation. Standard errors in parentheses are dually clustered on country and year. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE IV

Household Debt Expansion Predicts Lower Growth: Robustness and Subsamples

Panel A: Robustness to Alternative Specifications

	Dependent variable: $\Delta_3 y_{it+3}$						
	(1) OLS	(2) AB-GMM	(3) OLS	(4) MBB SE	(5) OLS	(6) OLS	(7) OLS
$\Delta_3 d^{HH}_{it-1}$	-0.32**	-0.32**	-0.31**	-0.33**	-0.23**	-0.21**	
	(0.081)	(0.11)	(0.087)	(0.083)	(0.075)	(0.063)	
$\Delta_3 d^{F}_{it-1}$	-0.057	-0.069	-0.063	-0.046	-0.042	-0.037	
	(0.044)	(0.071)	(0.045)	(0.031)	(0.033)	(0.033)	
Trend					-0.23**		
					(0.063)		
$\Delta_3 d^{HH}_{it-1}$, alt norm.							-0.30**
							(0.070)
$\Delta_3 d^{F}_{it-1}$, alt. norm.							0.020
							(0.034)
Country fixed effects	✓			✓	✓	✓	✓
Distributed lag in Δy	✓	✓	✓	✓	✓	✓	✓
Year fixed effects						✓	
Sample	Non-overl.	Non-overl.	Full	Full	Full.	Full	Full
Test for equality of β_{HH} and β_F, p-value	.007	.0004	.035	.0043	.031	.012	.0002
R^2	0.15		0.18	0.13	0.26	0.50	0.15
Observations	232	203	695	695	695	695	695

Panel B: Subsamples

	Dependent variable: $\Delta_3 y_{it+3}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3 d^{HH}_{it-1}$	-0.37**	-0.24**	-0.29**	-0.22**	-0.19**	-0.16**
	(0.097)	(0.070)	(0.10)	(0.054)	(0.072)	(0.057)
$\Delta_3 d^{F}_{it-1}$	-0.027	-0.069	-0.038	-0.053	-0.055	-0.061
	(0.040)	(0.063)	(0.062)	(0.039)	(0.038)	(0.038)
Trend					-0.16*	
					(0.066)	
Country fixed effects	✓	✓	✓	✓	✓	✓
Distributed lag in Δy	✓	✓	✓	✓	✓	✓
Year fixed effects						✓
Sample	Developed	Emerging	Pre 1995	Pre 2006	Pre 2006	Pre 2006
Test for equality of β_{HH} and β_F, p-value	.005	.082	.009	.021	.116	.17
R^2	0.16	0.11	0.13	0.088	0.16	0.37
Observations	529	166	259	517	517	517

Notes: Panel A presents a variety of robustness tests of the main specification in Table III. Column 1 uses the non-overlapping sample that only includes every third year. This specification controls for $\Delta_3 y_{it-1}$. Column 2 uses the Arellano-Bond GMM estimator for the equation in differences on the same non-overlapping sample. We instrument for $\Delta_3 d^{HH}_{it-1}$ and $\Delta_3 d^{F}_{it-1}$ with a double lag, $\Delta_3 d^{HH}_{it-4}$ and $\Delta_3 d^{F}_{it-4}$. Column 3 omits country fixed effects from the main specification estimated using the full sample. Column 4 computes standard errors using the panel moving blocks bootstrap (Gonçalves (2011)) with a block length of $l = 3$. Column 5 includes a time trend, and column 6 includes country fixed effects. Column 7 replace the three year change in debt to GDP with the change in debt normalized by initial $(t-4)$ GDP.

Panel B reports estimates on various subsamples. Columns 1 and 2 present separate estimates for developed and emerging economies. Emerging market economies are the Czech Republic, Hong Kong, Hungary, Indonesia, Korea, Mexico, Poland, Singapore, Thailand, and Turkey. Developed economies are the remaining countries. Column 3 uses data up to 1995, and columns 4-6 use data up to 2006. Column 5 includes a time trend, and column 6 controls for year fixed effects.

Standard errors in all columns (except panel A column 4) are dually clustered on country and year. Reported R^2 values in regressions including country fixed effects are from within-country variation. $+$,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE V

Household Debt Increases Finance Consumption Booms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$\Delta_1 \frac{C}{Y}_{it}$	$\Delta_1 \frac{C^{nondur}}{Y}_{it}$	$\Delta_1 \frac{C^{dur}}{Y}_{it}$	$\Delta_1 \frac{C^{services}}{Y}_{it}$	$\Delta_1 \frac{I}{Y}_{it}$	$\Delta_1 \frac{NX}{Y}_{it}$	$\Delta_1 \frac{CA}{Y}_{it}$	$\Delta_1 s^{MC}_{it}$	$\Delta_1 s^{XC}_{it}$
$\Delta_1 d^{HH}_{it}$	0.120**	0.0432**	0.0333**	0.0709**	0.0174	-0.173**	-0.185*	0.152**	0.0371
	(0.0462)	(0.0152)	(0.00701)	(0.0230)	(0.0756)	(0.0582)	(0.0813)	(0.0500)	(0.0365)
$\Delta_1 d^{F}_{it}$	0.0249^{+}	0.0200*	-0.0161**	0.0293**	-0.0194	-0.0167	-0.0125	-0.0261	-0.0400*
	(0.0146)	(0.00781)	(0.00238)	(0.00923)	(0.0264)	(0.0247)	(0.0207)	(0.0204)	(0.0197)
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
R^2	0.0825	0.0802	0.0647	0.138	0.00216	0.0408	0.0374	0.0417	0.0129
Observations	690	466	466	466	688	695	648	695	695

Notes: This table shows the contemporaneous correlation between the change in household and firm debt to GDP and the change in total consumption to GDP, non-durable consumption to GDP, durable consumption to GDP, services consumption to GDP, investment to GDP, net exports to GDP, current account to GDP, the share of consumption imports in total imports, and the share of consumption exports in total exports. All specifications include country fixed effects. Reported R^2 values are from within-country variation. Standard errors in parentheses are dually clustered on country and year. $+$,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE VI

Proxy SVAR First Stage Regressions

	Residual from VAR Household Debt Equation		Residual from VAR Firm Debt Equation	
	(1)	(2)	(3)	(4)
	$\hat{u}_{it}^{d^{HH}}$	$\hat{u}_{it}^{d^{HH}}$	$\hat{u}_{it}^{d^{F}}$	$\hat{u}_{it}^{d^{F}}$
MS Spread, residual	-0.341**		-0.0182	
	(0.101)		(0.267)	
Low MS Spread Indicator, residual		0.689**		0.0347
		(0.220)		(0.588)
F statistic	11.372	9.834	.005	.003
R^2	.024	.021	0	0
Observations	580	580	580	580

Notes: This table shows regressions of the reduced form VAR residuals on the mortgage-sovereign spread instruments. The MS spread residual is the residual from a regression of the MS-spread on the VAR independent variables (including country fixed effects). The low MS spread indicator is the residual of a dummy variable that equals 1 if the standardized spread is below the sample median. Standard errors in parentheses account for contemporaneous correlation in residuals across countries, consistent with the bootstrap resampling procedure used to construct confidence intervals on the Proxy SVAR impulse responses in Figure 4. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE VII

Declining Spreads, Credit Expansion, and Output:

Sovereign Spread Convergence in the Eurozone and Falling Mortgage Spreads During the 2000s Credit Boom

	Eurozone Case and Sovereign Spread over U.S.				2000s Boom and Mortgage-Sovereign Spread			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta_{07-10}y_i$	$\Delta_{02-07}d_i^{HH}$	$\Delta_{07-10}y_i$	$\Delta_{07-10}y_i$	$\Delta_{07-10}y_i$	$\Delta_{02-07}d_i^{HH}$	$\Delta_{07-10}y_i$	$\Delta_{07-10}y_i$
$\Delta_{96-99}spr_i^{real}$		-11.66**						
		(3.428)						
$\Delta_{02-07}d_i^{HH}$	-0.170**		-0.222**	-0.218*	-0.180		-0.296*	-0.347
	(0.0404)		(0.0479)	(0.107)	(0.118)		(0.144)	(0.306)
$\Delta_{02-07}d_i^{F}$				0.0326				0.0975
				(0.0833)				(0.179)
$\Delta_{02-07}y_i$				-12.76				0.416**
				(14.36)				(0.103)
$\Delta_{00-04}spr_i^{MS}$						-10.28**		
						(2.889)		
Equation	OLS	FS	IV	IV	OLS	FS	IV	IV
First stage F-statistic		11.6				12.669		
R^2	0.530	0.526	0.480	0.537	0.164	0.398	0.0952	0.362
Observations	12	12	12	12	21	21	21	21

Notes: This table reports instrumental variables regressions of GDP growth from 2007 to 2010 on the expansion in household debt to GDP from 2002 to 2007. Column 1 shows the OLS estimate for the Eurozone countries and Denmark (in ERM II). Columns 2-4 use the change in the real sovereign spread (nominal spread minus inflation difference) with respect to the United States during 1996-1999 as an instrument for the 2002-2007 expansion in household or firm debt to GDP. Column 5 shows the OLS estimate for the broader sample of countries for which the mortgage-sovereign spread variable is non-missing. Columns 6-8 use the change in the mortgage spread over the 10 year government bond yield during 2000-2004 as an instrument for the increase in household or firm debt to GDP from 2002-2007. The regressions in columns 6-10 exclude Hungary, as Hungary's decline in the mortgage-sovereign spread is a large outlier in this period. Standard errors in parentheses are robust to heteroskedasticity. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE VIII

Rise in Household Debt Predicts Overoptimistic IMF and OECD Growth Forecasts

	Growth Forecast		Forecast Error					Forecast Error Sample up to 2006	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$\Delta_2 y^{IMF}_{t+2\|t}$	$\Delta_2 y^{OECD}_{t+2\|t}$	$e^{IMF}_{t+1\|t}$	$e^{IMF}_{t+2\|t}$	$e^{IMF}_{t+3\|t}$	$e^{OECD}_{t+1\|t}$	$e^{OECD}_{t+2\|t}$	$e^{IMF}_{t+1\|t}$	$e^{OECD}_{t+1\|t}$
$\Delta_3 d^{HH}_{it-1}$	0.0016	0.0013	-0.060**	-0.17**	-0.31**	-0.070**	-0.17*	-0.035+	-0.042**
	(0.023)	(0.028)	(0.020)	(0.057)	(0.091)	(0.023)	(0.071)	(0.021)	(0.015)
$\Delta_3 d^{F}_{it-1}$	-0.029	-0.041*	-0.019	-0.026	-0.031	-0.013	-0.0084	-0.029	-0.020*
	(0.021)	(0.017)	(0.027)	(0.045)	(0.051)	(0.015)	(0.029)	(0.020)	(0.0080)
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sample	Full	Full	Full	Full	Full	Full	Full	Pre 2006	Pre 2006
Test for equality of									
β_{HH} and β_F, p-value	.367	.227	.311	.089	.02	.053	.07	.863	.29
R^2	0.034	0.064	0.026	0.063	0.13	0.040	0.073	0.026	0.027
Observations	484	471	590	484	484	594	471	469	490

Notes: This table reports regression estimates of GDP growth forecasts and forecast errors on the change in household and non-financial firm debt to GDP from $t-4$ to $t-1$. The forecasts are from the fall issues of the IMF *World Economic Outlook* and the *OECD Economic Outlook*. $\Delta_h y^f_{t+h|t}$ is the forecasted change in log GDP from t to $t+h$ made in the Fall of year t, and $e^f_{t+h|t}$ is the realized forecast error. The IMF and OECD forecast errors are constructed using the realized log GDP change reported in the IMF's Historical WEO Forecasts Database and the *OECD Economic Outlook* reports, respectively. The *World Economic Outlook* forecast sample includes all 30 countries in the sample and covers the years 1990-2012, with one-year-ahead forecasts extending back to 1972 for the G7. One- and two-year-ahead *OECD Economic Outlook* forecasts are for years 1973-2012 and 1987-2012, respectively. We exclude Hong Kong, Indonesia, Singapore, and Thailand from the OECD sample because of gaps in the forecast series. The regressions in columns 8 and 9 are estimated using data to 2006.
Reported R^2 values are from within-country variation. Standard errors in parentheses are dually clustered on country and year. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE IX

Non-linearity and Heterogeneity across Exchange Rate Regimes

	Non-linearity	Fixed	Intermediate	Freely floating
	(1)	(2)	(3)	(4)
	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$
$\Delta_3 d^{HH}_{it-1} * \mathbf{1}(\Delta_3 d^{HH}_{it-1} > 0)$	-0.436**			
	(0.106)			
$\Delta_3 d^{HH}_{it-1} * \mathbf{1}(\Delta_3 d^{HH}_{it-1} \leq 0)$	0.0655			
	(0.156)			
$\Delta_3 d^{F}_{it-1} * \mathbf{1}(\Delta_3 d^{F}_{it-1} > 0)$	-0.0537			
	(0.0367)			
$\Delta_3 d^{F}_{it-1} * \mathbf{1}(\Delta_3 d^{F}_{it-1} \leq 0)$	-0.0396			
	(0.0631)			
$\Delta_3 d^{HH}_{it-1}$		-0.534**	-0.311**	-0.0673
		(0.128)	(0.0716)	(0.129)
$\Delta_3 d^{F}_{it-1}$		-0.113*	-0.0119	0.0519
		(0.0495)	(0.0425)	(0.116)
Country fixed effects	✓	✓	✓	✓
Distributed lag in Δy	✓	✓	✓	✓
Test for equality of β_{HH} and β_F, p-value		.008	.004	.535
R^2	0.146	0.281	0.114	0.0324
Observations	695	221	341	120

Notes: Column 1 explores non-linearity in the relation between credit expansion and growth in the full sample. For both household and firm debt, we estimate separate coefficients for positive and negative changes in debt to GDP. Columns 2-4 report separate regressions by *de facto* exchange rate arrangement in year t from Ilzetzki et al. (2010). Fixed regimes cover arrangements with no separate legal tender, currency boards, pegs, and narrow horizontal bands (coarse ERA code 1 from Ilzetzki et al. 2010). Intermediate regimes include crawling pegs, crawling bands, moving bands, and managed floats (coarse ERA codes 2 and 3). We exclude 11 country-years in which the *de facto* arrangement is classified as "freely falling" (cases where 12-month inflation is greater than 40%). All regressions include country fixed effects and three lags of GDP growth. Reported R^2 values are from within-country variation. Standard errors in parentheses are dually clustered on country and year. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE X
Unemployment and Household Debt Expansions

	Full Sample		Fixed ER Regimes	Intermediate	Freely floating
	(1)	(2)	(3)	(4)	(5)
	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$
$\Delta_3 d^{HH}_{it-1}$	0.132**	0.105**	0.264**	0.0709+	-0.0159
	(0.0380)	(0.0390)	(0.0736)	(0.0367)	(0.0587)
$\Delta_3 d^{F}_{it-1}$	0.0363*	0.0373*	0.0615+	0.0385*	0.0403
	(0.0153)	(0.0158)	(0.0319)	(0.0194)	(0.0332)
Country fixed effects	✓	✓	✓	✓	✓
Distributed lag in Δu		✓	✓	✓	✓
Test for equality of β_{HH} and β_F, p-value	.026	.131	.001	.425	.506
R^2	0.145	0.207	0.397	0.235	0.254
Observations	662	638	211	296	120

Notes: This table reports regression estimates of the change in the unemployment rate from t to $t+3$ on the change in household and non-financial firm debt to GDP from $t-4$ to $t-1$. All columns include country fixed effects. Columns 2-5 include three lags of the change in the unemployment rate as controls. Columns 3-5 estimate the regression across exchange rate regimes, as defined in Table IX. Reported R^2 values are from within-country variation. Standard errors in parentheses are dually clustered on country and year. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE XI
House Prices, Household Debt, and GDP Growth

	$\Delta_3 \ln(P_{it-1}^{Housing})$	$\Delta_3 y_{it+3}$			
	(1)	(2)	(3)	(4)	(5)
$\Delta_3 d_{it-1}^{HH}$	1.035**	-0.243**	-0.241**	-0.210**	-0.179*
	(0.263)	(0.0658)	(0.0709)	(0.0481)	(0.0742)
$\Delta_3 d_{it-1}^{F}$		-0.0443	-0.0575	-0.0676	-0.0348
		(0.0379)	(0.0381)	(0.0429)	(0.0348)
$\Delta_3 \ln(P_{it-1}^{Housing})$		-0.0607**	-0.0688*	-0.0552$^+$	-0.0288
		(0.0224)	(0.0280)	(0.0333)	(0.0269)
Country fixed effects	✓	✓	✓	✓	✓
Distributed lag in Δy			✓	✓	✓
Year fixed effects					✓
Sample	Full	Full	Full	Pre 2006	Full
R^2	0.109	0.175	0.184	0.184	0.502
Observations	514	514	514	395	514

Notes: This table explores the relationship between household debt and house prices and presents robustness to including house price growth in the main specification. Column 1 shows the correlation between the increase in household debt to GDP and real house price growth over $t-4$ to $t-1$. Real house price growth is constructed from the BIS's "Long series on nominal residential property prices" (fourth quarter value) deflated by the CPI. Columns 2-5 report results from robustness checks that include the change in real house prices from $t-4$ to $t-1$ in the main specification. Columns 3-5 control for three GDP growth lags. All columns include country fixed effects, and column 5 also includes year fixed effects. Reported R^2 values are from within-country variation. Standard errors in parentheses are dually clustered on country and year. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE XII

Credit Expansion, Net Exports, and Correlation with the Global Household Debt Cycle

	(1) $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$	(2) $\Delta_3 \ln \frac{X_{it+3}}{M_{it+3}}$	(3) $\frac{\Delta_3 X_{it+3}}{Y_{it}}$	(4) $\frac{\Delta_3 M_{it+3}}{Y_{it}}$	(5) $\Delta_3 s^{MC}_{it+3}$	(6) $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$	(7) $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$	(8) $\Delta_3 y_{it+3}$	(9) $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$	(10) $\Delta_3 y_{it+3}$
$\Delta_3 d^{HH}_{it-1}$	0.17**	0.39**	-0.061	-0.23	-0.076*	0.049	0.11+	-0.22*	0.25**	-0.22**
	(0.049)	(0.15)	(0.13)	(0.16)	(0.035)	(0.052)	(0.057)	(0.090)	(0.039)	(0.060)
$\Delta_3 d^{F}_{it-1}$	0.022	0.12+	-0.033	-0.055	0.013	0.031+	0.023	-0.045	0.024	-0.063*
	(0.021)	(0.069)	(0.057)	(0.063)	(0.015)	(0.019)	(0.020)	(0.036)	(0.020)	(0.027)
$\Delta_3 d^{HH}_{it-1} \times \text{openness}_i$						0.17**	0.14**			
						(0.027)	(0.036)			
$\Delta_3 d^{HH}_{it-1} \times \rho^{Global}_i$								-0.33	-0.22**	
								(0.22)	(0.071)	
$\text{Global}_{-i} \Delta_3 d^{HH}_{it-1}$										-0.74**
										(0.26)
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Distributed lag in Δy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year fixed effects							✓			
Test for equality of β_{HH} and β_F, p-value	.013	.144	.868	.359	.026					
R^2	0.062	0.075	0.021	0.039	0.058	0.080	0.19	0.16	0.080	0.22
Observations	695	695	695	695	695	695	695	693	693	693

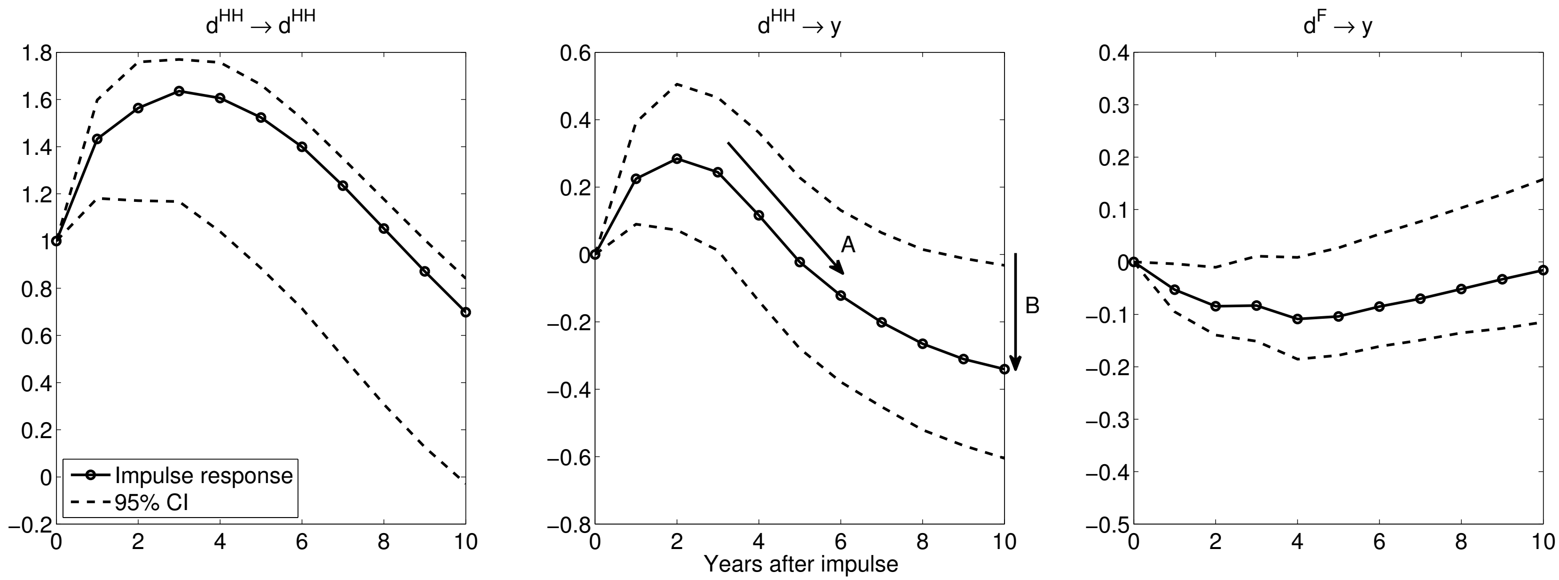
Notes: This table reports regressions of a variety of outcomes from t to $t+3$ on the expansion in household and non-financial firm debt to GDP from $t-4$ to $t-1$. The dependent variable in column 1 is the change in net exports from t to $t+3$ relative to GDP in year t. Column 2 uses the change in log exports minus log imports over the same period as the dependent variable. Columns 3 and 4 show results for the change in exports and imports relative to initial GDP. The dependent variable in column 5 is the change in the share of consumption imports in total imports. Columns 6 and 7 interacts the change in household debt with a country's openness to international trade, openness_i, defined as the average imports plus exports to GDP ratio during the sample period. Column 8 focuses on three-year ahead growth and includes the interaction of the increase in household debt with ρ^{Global}_i, the correlation between country i's three-year household debt expansion and the sample average household debt expansion excluding country i given by equation (5). Column 9 reports the same regression with the change in net exports from t to $t+3$ relative to GDP in year t as the dependent variable. Column 10 includes the global average change in household debt to GDP over $t-4$ to $t-1$ excluding country i. All regressions include country fixed effects and column 7 includes year fixed effects. Reported R^2 values are from within-country variation. Standard errors in parentheses are clustered at the country level. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

TABLE XIII
Global Household and Firm Debt and Global Growth

	Dependent variable: global average $\Delta_3 y_{t+3}$				
	(1)	(2)	(3)	(4)	(5)
Global $\Delta_3 d^{HH}_{t-1}$	-1.094**		-1.097**	-0.966**	-0.928**
	(0.300)		(0.311)	(0.252)	(0.288)
Global $\Delta_3 d^{F}_{t-1}$		-0.103	0.00896	-0.0756	0.0727
		(0.192)	(0.177)	(0.149)	(0.192)
Global Δy_{t-1}				0.341	0.342
				(0.244)	(0.257)
Global Δy_{t-2}				0.390^{+}	0.426*
				(0.224)	(0.189)
Global Δy_{t-3}				0.477^{+}	0.532^{+}
				(0.258)	(0.280)
Sample	Full	Full	Full	Full	Pre 2006
Test for equality of β_{HH} and β_F, p-value			.0072	.0076	.0037
R^2	.295	.007	.295	.471	.426
Observations	46	46	46	46	40

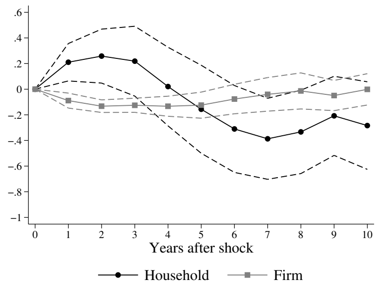
Notes: This table reports time series regressions of the sample average real GDP growth from t to $t+3$ on the sample average change in household and firm debt to GDP from $t-4$ to $t-1$. Newey-West standard errors in parentheses are computed with 6 lags. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Figure 1: Impulse Responses from a Recursive VAR in Real GDP, Non-financial Firm Debt, and Household Debt

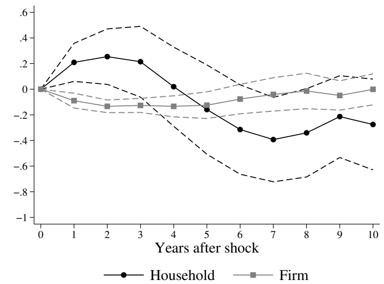


Notes: This figure presents impulse responses from a three variable VAR in log real GDP, firm debt to lagged GDP, and household debt to lagged GDP. The left panel shows the household debt response to a household debt shock. The middle panel presents the real GDP response to a household debt shock. The right panel shows the real GDP response to a firm debt shock. The shocks are identified using a Cholesky decomposition with the ordering $\left(y_{it}, d_{it}^{F}, d_{it}^{HH}\right)$. The VAR is estimated in levels with country fixed effects on the 30 country sample. The reduced form VAR coefficients are corrected for Nickell bias using an iterative bootstrap procedure. Dash lines represent 95% confidence intervals that account for contemporaneous cross-country residual correlation and are computed by resampling cross-sections of residuals using the wild bootstrap.

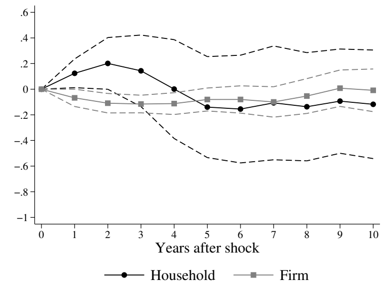
Figure 2: Robustness with Jordà (2005) Local Projection Impulse Responses



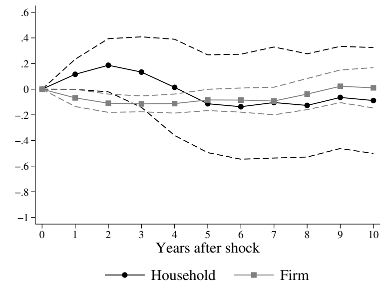
(a) Baseline: Jordà (2005) Local Projection VAR in levels on full sample



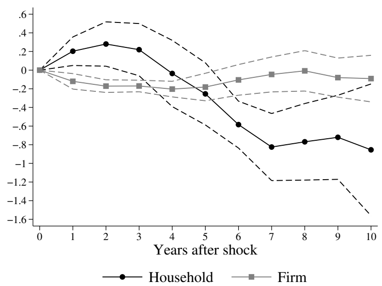
(b) Levels, include time trend



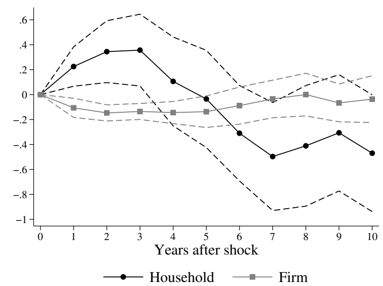
(c) Levels, excluding Great Recession



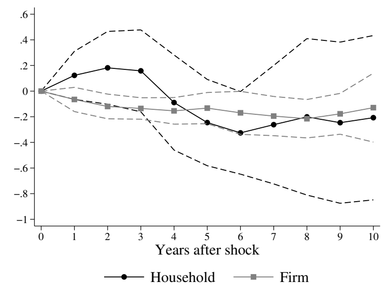
(d) Levels with time trend, excluding Great Recession



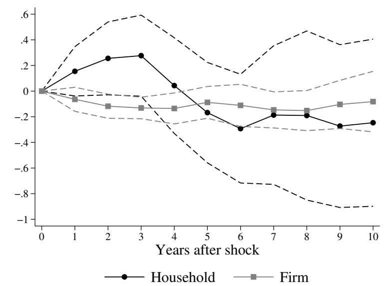
(e) First differences



(f) First difference, include time trend



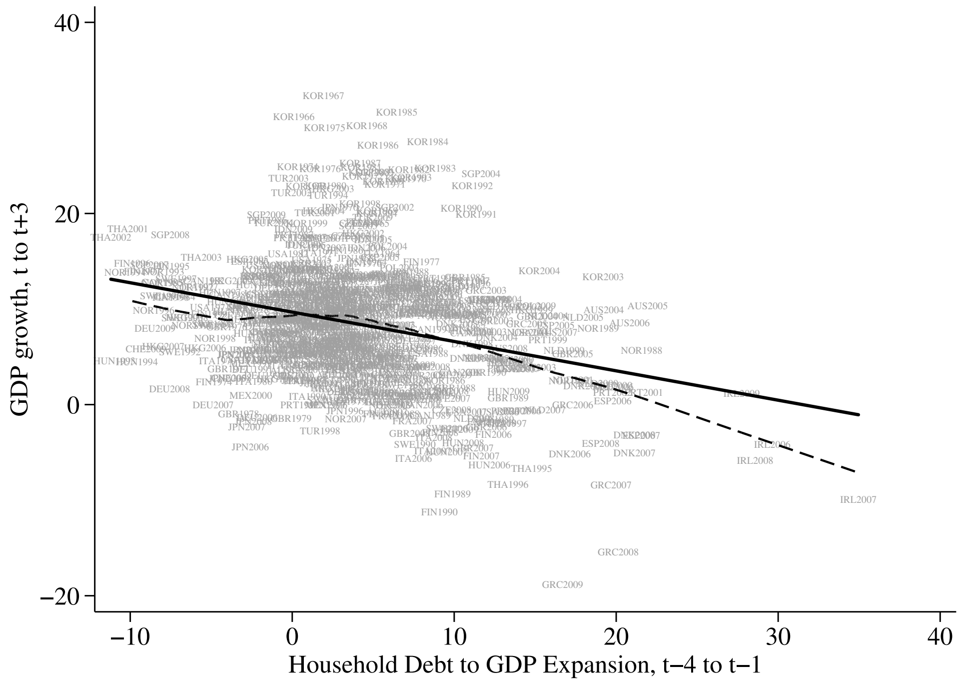
(g) First difference, excluding Great Recession



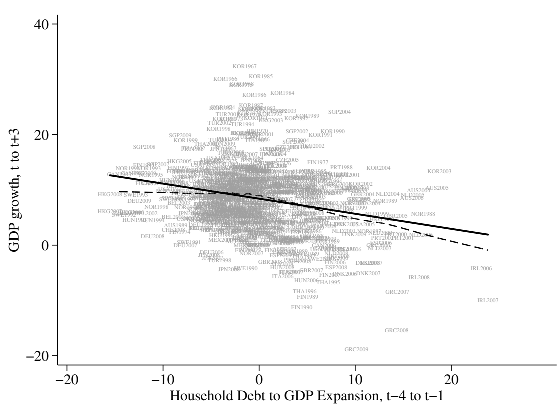
(h) First difference with time trend, excluding Great Recession

Notes: This figure presents impulse responses from Jordà (2005) local projections estimated in levels and first differences. The specification in levels is: $y_{it+h-1} = \alpha_i^h + X_{it-1}\Gamma^h + \sum_{j=1}^{5} \beta_{HH,j}^h d_{it-j}^{HH} + \sum_{j=1}^{5} \beta_{F,j}^h d_{it-j}^{F} + \sum_{j=1}^{5} \delta_j^h y_{it-j} + \epsilon_{it+h-1}^h$ for horizons $h = 1, ..., 10$. To be consistent with the VAR model, d_{it}^s is nominal debt in sector $s = HH, F$ in year t scaled by nominal GDP in $t-1$. The model in first differences is $\Delta_h y_{it+h-1} = \alpha_i^h + X_{it-1}\Gamma + \sum_{j=1}^{5} \beta_{HH,j}^h \Delta d_{it-j}^{HH} + \sum_{j=1}^{5} \beta_{F,j}^h \Delta d_{it-j}^{F} + \sum_{j=1}^{5} \delta_j^h \Delta y_{it-j} + u_{it+h-1}^h$, for horizons $h = 1, ..., 10$, where here d_{it}^s refers to the debt to GDP ratio in sector $s = HH, F$. Models that exclude the Great Recession use data up to 2006. Dash lines represent 95% confidence intervals computed using standard errors dually clustered on country and year.

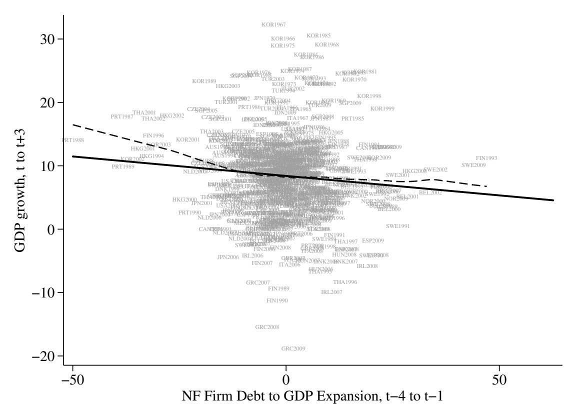
Figure 3: Household Debt to GDP Expansion and Growth



(a) Household Debt



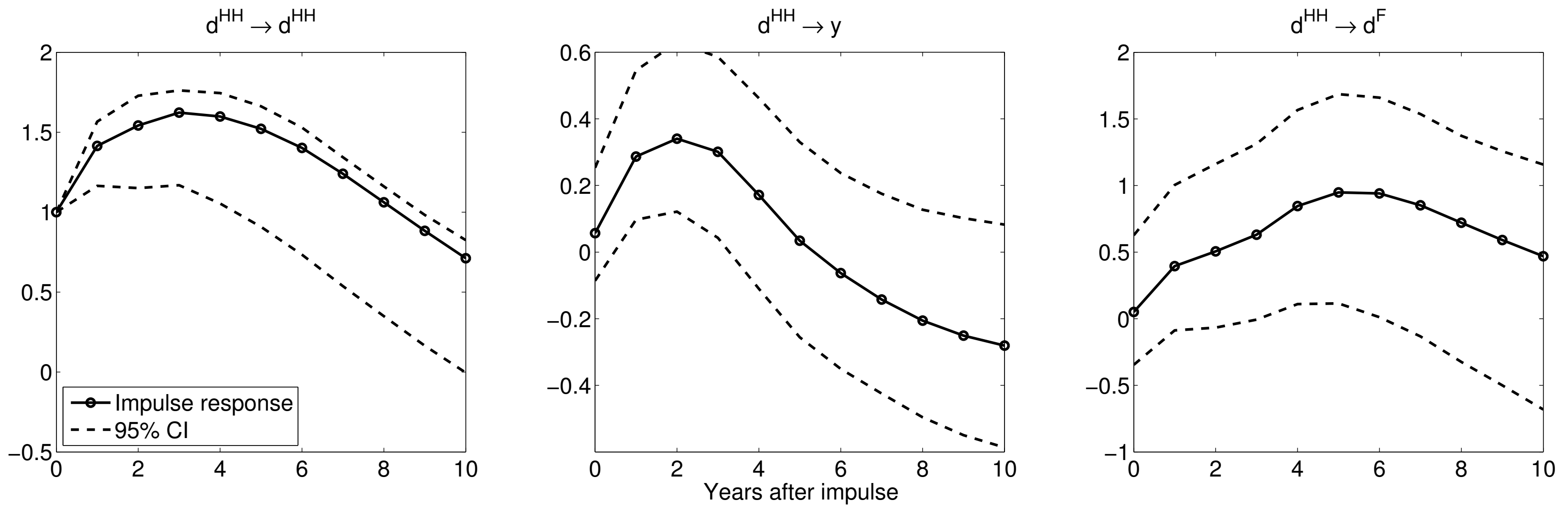
(b) Household Debt, Partial Correlation



(c) NF Firm Debt, Partial Correlation

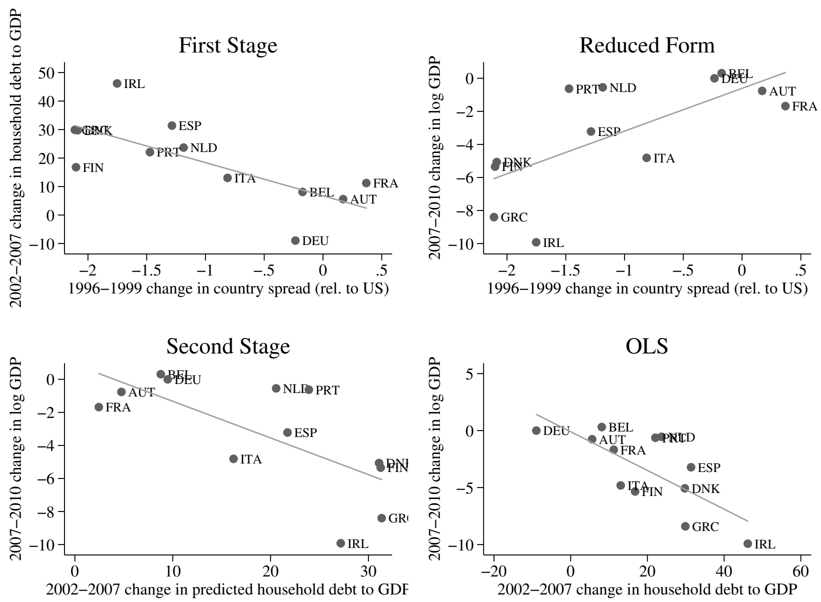
Notes: This figure plots the relationship between GDP growth from t to $t+3$ and the expansion in household and firm debt to GDP from $t-4$ to $t-1$. Each point refers to year t. The dashed line is the non-parametric plot of GDP growth from t to $t+3$ against the increase in household or firm debt to GDP from $t-4$ to $t-1$. In panel (b) household debt is partialed out with the expansion in non-financial firm debt to GDP, while in panel (c) non-financial firm debt is partialed out with the expansion in household debt to GDP.

Figure 4: Impulse Responses to a Household Debt Shock Identified with the Mortgage Lending Spread in a Proxy SVAR

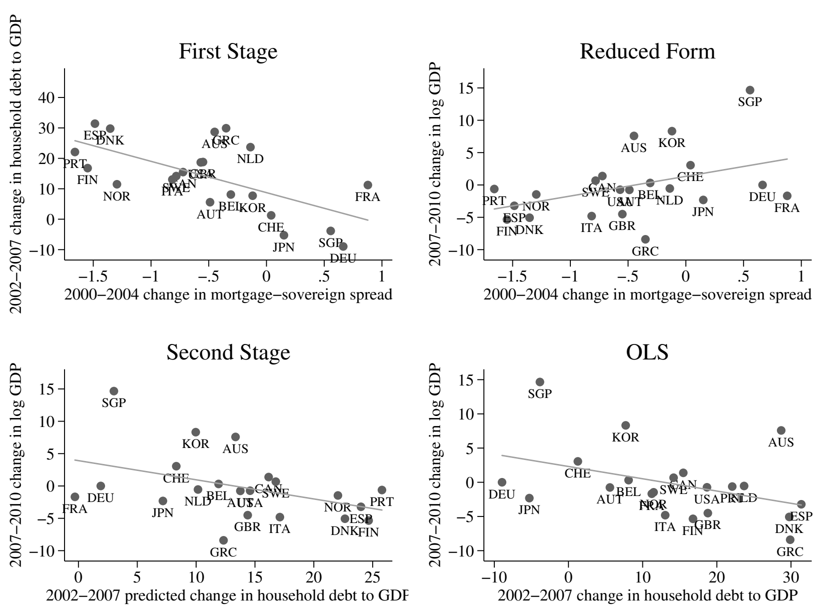


Notes: This figure shows impulse responses to a household debt shock identified using an indicator variable for whether the standardized mortgage spread is below the median as an external instrument in a Proxy SVAR. The reduced form VAR coefficient estimates are corrected for Nickell bias using an iterative bootstrap procedure. Dash lines represent 95% confidence intervals that account for contemporaneous cross-country residual correlation and are computed by resampling cross-sections of residuals using the wild bootstrap.

Figure 5: Declining Spreads, Credit Growth, and Output Growth



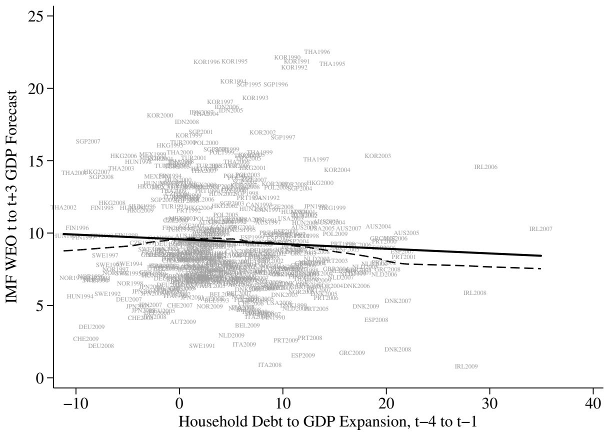
(a) Eurozone Case and Sovereign Spread over U.S. 10-Year Treasury



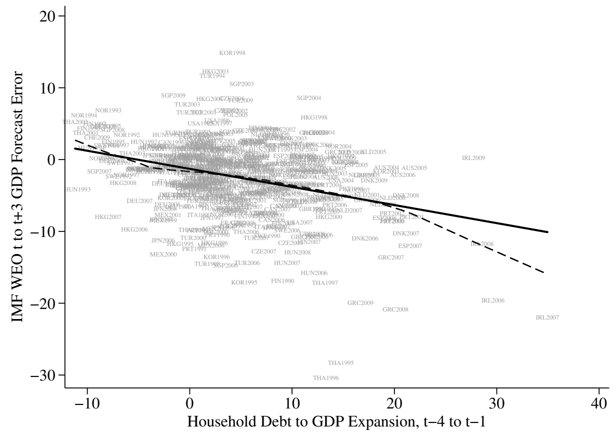
(b) 2000s Mortgage Credit Boom and Mortgage-Sovereign Spread

Note: Panel (a) illustrates the relation between the decline in real sovereign spreads (nominal spread minus difference in inflation) between 1996 and 1999, the expansion in household debt from 2002 to 2007, and the change in log real GDP from 2007 to 2010 for 11 Eurozone countries and Denmark (in ERM II).
Panel (b) illustrates the relation between the change in the mortgage lending rate relative to the 10-year government bond yield between 2000 and 2004, the expansion in household debt to GDP from 2002 to 2007, and the change in log real GDP from 2007 to 2010. The figures in panel (b) include 21 countries in the sample with non-missing mortgage lending rate data. These figures exclude Hungary, as the decline in spreads is a large outlier for this observation.

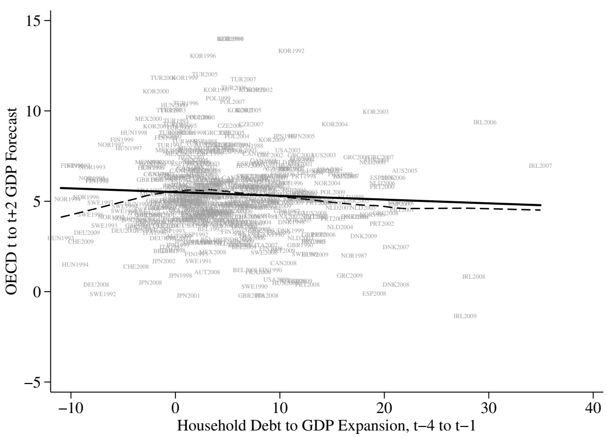
Figure 6: Household Debt Expansion Predicts Negative GDP Growth Forecast Errors



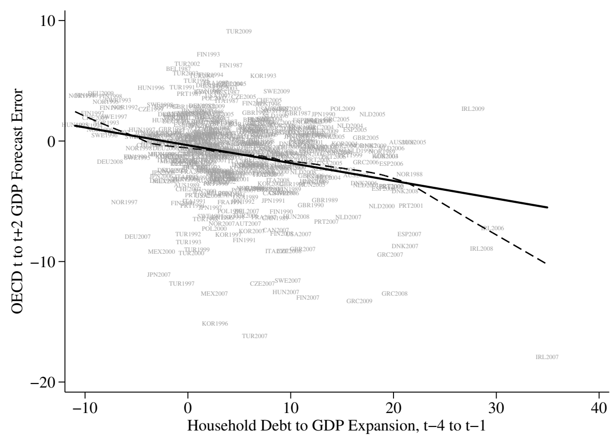
(a) IMF Forecast



(b) IMF Forecast Error



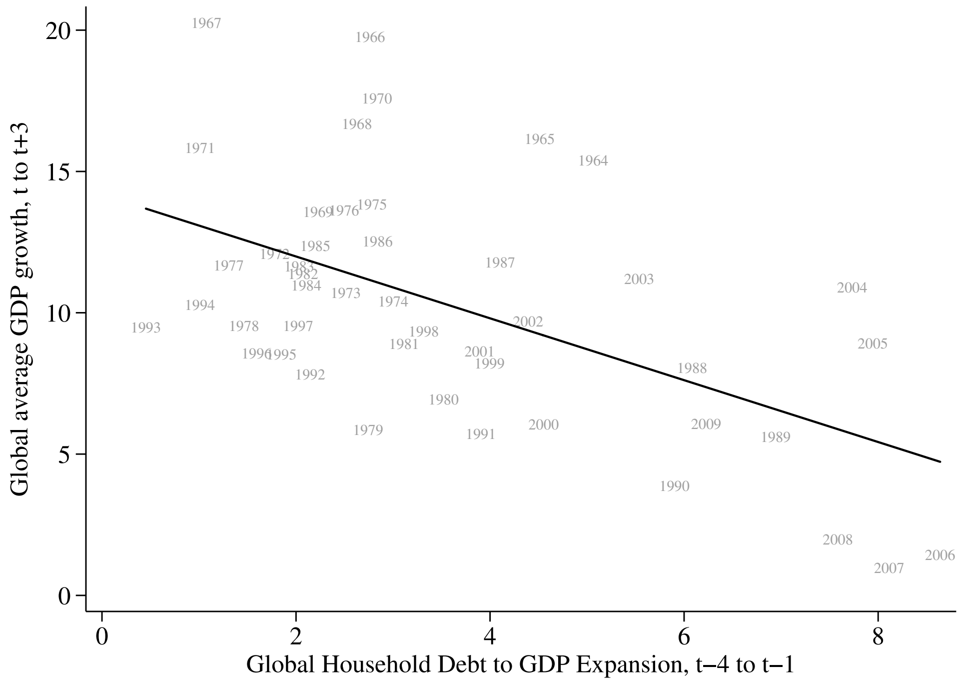
(c) OECD Forecast



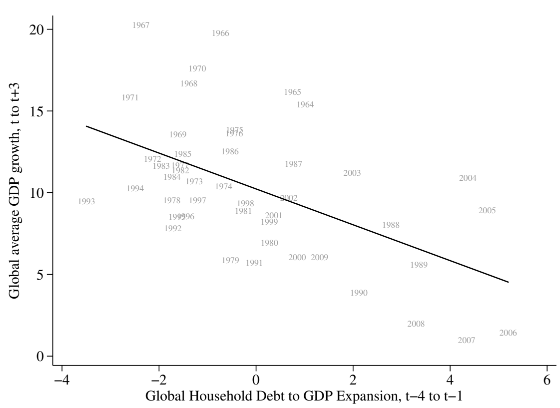
(d) OECD Forecast Error

Notes: Panels (a) and (b) plot the three-year GDP forecasts and forecast errors from the Fall issue of the IMF World Economic Outlook against the change in household debt to GDP from $t-4$ to $t-1$. The IMF WEO sample for the three-year ahead forecasts includes years 1990-2012. Panels (c) and (d) plot the two-year GDP forecasts and forecast errors from the Fall OECD Economic Outlook against the change in household debt to GDP from $t-4$ to $t-1$. The OECD sample includes years 1987-2012. We exclude Hong Kong, Indonesia, Singapore, and Thailand from the OECD sample because of gaps in the forecast series. Each point refers to year t.

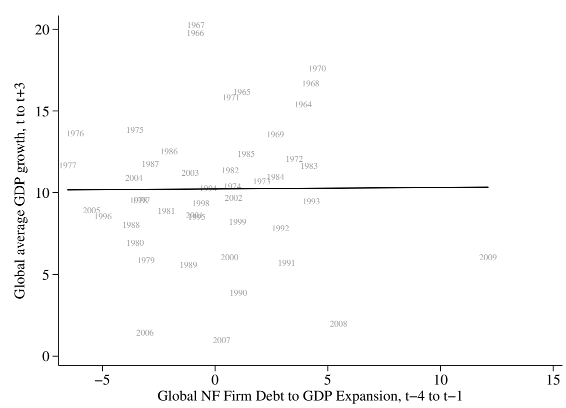
Figure 7: Global Household Debt Expansions and Global Growth



(a) Household Debt



(b) Household Debt, Partial Correlation



(c) NF Firm Debt, Partial Correlation

Note: This figure illustrates the relationship between the sample average of real GDP growth from t to $t+3$ and the sample average of the change in household and firm debt to GDP from $t-4$ to $t-1$. Each point refers to year t. In panel (b) household debt is partialed out with the expansion in non-financial firm debt, while in panel (c) non-financial firm debt is partialed out with the expansion in household debt.