Household Debt and Business Cycles Worldwide

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Abstract

A rise in the household debt to GDP ratio predicts lower output growth and higher unemployment over the medium-run, contrary to standard macroeconomic models. GDP forecasts by the IMF and OECD underestimate the importance of a rise in household debt to GDP, giving the change in household debt to GDP ratio of a country the ability to predict growth forecasting errors. We use lower credit spreads and increases in risky debt issuance as instruments for the rise in household debt to GDP to argue that our results are supportive of recent models where debt growth is driven by changes in credit supply, borrowing constraints, or risk premia. We also show that a rise in household debt to GDP is associated contemporaneously with a rising consumption share of output, a worsening of the current account balance, and a rise in the share of consumption goods within imports. This is followed by strong external adjustment when the economy slows as the current account reverses and net exports increase due to a sharp fall in imports. Finally, an increase in *global* household debt to GDP also predicts lower global output growth. The pre-2000 predicted relationship between global household debt changes and subsequent global growth matches closely the actual decline in global growth after 2007 given the large increase in household debt during the early to mid-2000s.

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1 Introduction

Most macroeconomic models have the feature that growth in debt is driven by expected future productivity shocks. An implication of this feature is that we should observe a positive correlation between debt growth and subsequent output growth in the data. We begin this study by showing that this basic prediction, which is common across most representative agent models, is soundly rejected in the data for 30 (mostly advanced) countries from 1960 to 2012. Instead, growth in private debt over a three to four year period predicts subsequently *lower* output growth and an *increase* in unemployment. Moreover, the predictive power of private debt growth on future output growth is driven primarily by growth in household debt, as opposed to non-financial firm debt.[1]

The negative association between household debt growth and subsequent output growth suggests a need to rethink the role of debt in macroeconomic models. In fact, we show that even official forecasts by the IMF and the OECD underplay the negative association between growth in household debt and subsequent GDP growth. More specifically, we show that forecasts by the IMF and OECD consistently overestimate GDP growth following a large rise in the household debt to GDP ratio. Consequently, an increase in a country's household debt to GDP ratio predicts *negative* economic growth forecasting errors. This result holds across different sub-periods and countries.

Why is there a robust negative relationship between household debt growth and subsequent output growth? And what are the implications for global growth and the most recent economic crisis in particular? This study is an empirical investigation of potential answers to these question. We are motivated in particular by a new class of theories that depart from the representative agent model; these models highlight the potential negative externalities of debt on growth.

Models such as Eggertsson and Krugman (2012) and Guerrieri and Lorenzoni (2015) introduce heterogeneity in discount rates and a monetary policy friction which implies that gross private debt matters for aggregate demand dynamics. Farhi and Werning (2015) and Korinek and Simsek (2014) build on this intuition to show that households ignore the effect of their borrowing on aggregate dynamics, leading to excessive debt. A common assumption in these models is that variation in business cycle dynamics can be driven by changes in the *supply* of credit, either through loosened

[1] We follow standard time-series econometrics semantics 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.

borrowing constraints or a reduction in the risk premium required by financiers. Further, these models predict that rapid growth in private debt driven by loosened borrowing constraints may *negatively* forecast economic growth.

We find a number of results that are consistent with this class of models. We show that the rise in household debt during credit booms is used to finance consumption. The growth in household debt is contemporaneously correlated with a rise in the consumption share of output and a decline in the net export to output ratio. Looking at the net export margin more closely reveals that the decline in net exports is driven by a rise in the share of imports that are consumption goods. In other words, household spending as a share of income rises during household debt booms, as do total imports and the share of consumption goods in total imports. We also find that household debt booms predict lower growth in fixed exchange rate regimes than in regimes where monetary policy has more flexibility to offset the subsequent fall in demand. This result is consistent with the relevance of nominal rigidities coupled with monetary policy frictions.

A perfect test of these models would utilize exogenous variation in credit supply conditions. It is difficult to find an exogenous credit supply shock that generates debt cycles in a cross-section of countries, and there is certainly no perfect instrument here. However, we argue that time-series variation in the sovereign yield spread of a country relative to U.S. Treasuries can be useful in testing the impact of a relaxation in credit conditions on private debt growth and subsequent output growth. Prior research has shown that variation in sovereign yield spreads can be driven by non-country specific fundamentals such as changes in the risk premium required by financiers (Remolona et al. (2007), Longstaff et al. (2011), and Bofondi et al. (2013)). Further, to the extent country fundamentals are driving the variation in the sovereign yield spread, it would lead to the opposite prediction to the one we find in the data. In particular, a fall in the sovereign yield spread should be reflective of *better* economic fundamentals going forward.

We use the lagged sovereign yield spread as an instrument for household debt growth, and we show that a fall in sovereign spread leads to an increase in the country's household debt to GDP ratio. The second-stage shows that the sovereign spread-induced growth in household debt predicts *lower* subsequent GDP growth. The same results holds for the United States when we use the high yield share of firm debt issuances as a proxy for relaxed credit conditions, as suggested by Greenwood and Hanson (2013).

As already mentioned, the household debt boom ends badly. An increase in a country's household debt to GDP ratio negatively predicts subsequent growth in output, driven by a decline in consumption and investment. However, net exports adjust in the opposite direction. In particular, a sustained increase in household debt predicts *stronger* subsequent growth in net exports. The net export result is driven by a stronger contraction in imports following an increase in the household debt to GDP ratio, as opposed to a rise in exports. Moreover, the external adjustment mechanism is stronger for countries that are more reliant on international trade.

The adjustment on the external margin suggests that an increase in the household debt to GDP ratio may have even stronger predictive power for output growth if a country's household debt cycle is more correlated with the *global* household debt to GDP cycle. In other words, if many countries are experiencing a post-debt hangover, the net export margin will be less likely to stabilize the economy of any given country. We test for the predictive power of a global household debt cycle using the same three to four year horizon, and we find two main results.

First, countries with a household debt to GDP cycle that is more strongly correlated with the global debt cycle see stronger decline in future output growth after a rise in household debt to GDP ratio. Second, there is a large and robust relationship between the rise in global household debt to GDP and subsequent global growth. This negative relation is only associated with the household debt to GDP ratio. A rise in the global non-financial firm debt to GDP ratio has no predictive power for global GDP growth over the medium term horizon.

The relationship between rise in global household debt and subsequent slowdown in GDP growth is not driven by the post-2000 period alone. In fact, using estimates from only pre-2000 data, we show that the model does well in predicting (out-of-sample) the slow global growth during the late 2000s given the dramatic rise in global household debt during the mid-2000s.

There is a growing literature on the role of private debt in the macroeconomy. Jordà et al. (2014a) show that there has been a rapid expansion in global credit – especially credit to the household sector – over the last many decades in advanced economies. A series of papers, Schularick and Taylor (2012), Jordà et al. (2013), and Jordà et al. (2014b), use long-run historical data 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.[2] 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.

Our study presents a number of results that are new to this research area. The results on the global debt cycle, the results on IMF and OECD forecasting errors, house prices, and results using the sovereign spread as an instrument for household debt changes are new to the literature, as is the panel VAR evidence. Further, we are the first to examine the components of GDP and the components of imports during the period in which household debt is rising, and we show that household debt booms are correlated with increases in consumption. Finally, previous research has estimated the effect of credit growth on recession severity *conditional* on having a recession; we are the first to estimate the *unconditional* relation between household debt growth and subsequent GDP growth. As we explain below, the unconditional relation helps us discern which theory is most accurate.

Overall, we believe these new findings on household debt will help researchers explore the underlying economic model that is most consistent with the empirical facts. Currently, the large open economy macro literature discussed in the excellent new book by Uribe and Schmitt-Grohé (2015) does not point out any particular role for household debt in forecasting output growth.[3] The only emphasis in these models is on net foreign debt, and typically the models suggest a positive association between net foreign debt accumulation and subsequent output growth. Our results suggest that we also need to understand why gross domestic household debt has strong negative predictive power for output growth.

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) and Kiyotaki and Moore (1997), Caballero and Krishnamurthy (2003), Brunnermeier and Sannikov (2014) and Lorenzoni (2008)). Our results highlight the importance of the debt-driven "consumption" channel for business cycle dynamics.

[2] There is also cross-sectional evidence from the recent recession in the United States and Europe (see e.g. Mian and Sufi (2014), Glick and Lansing (2010), and IMF (2012)) that shows that areas with the largest rise in household debt during the boom saw the biggest decline in economic activity during the bust. Baron and Xiong (2014) show that large increase in bank credit to GDP predicts lower equity returns, and Cecchetti and Kharroubi (2015) find that the growth in the financial sector is correlated with lower productivity growth.

[3] A recent exception is Martin and Philippon (2014).

The remainder of the paper is structured as follows. The next section presents the data and summary statistics. Section 3 presents the relation between debt and growth in standard macroeconomic models, and details the empirical specification and tests. Section 4 presents results testing the standard macroeconomic model predictions, and Section 5 shows results more consistent with alternative models in which debt may impose negative externalities on growth. Section 6 explores the global household debt cycle, and Section 7 concludes.

2 Data and Summary Statistics

2.1 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, and international trade. The countries in the sample and the years covered are summarized in Table 1. The data are annual and range from 1960 to 2012, providing over 900 country-years before taking differences. Details on variable definitions and data sources are provided in the data appendix. Here we briefly describe the key variables measuring expansions in household and non-financial firm debt.

Household and non-financial firm debt expansions are defined as the change in household debt to GDP and non-financial firm debt to GDP. We denote the change in household and firm debt to GDP from year $t-h$ to year t by $\Delta_h(HHD/Y)_t$ and $\Delta_h(FD/Y)_t$, where HHD and FD are the outstanding levels of credit to households and non-financial corporations, respectively, at the end of year t. Credit is defined as loans and debt securities financed by domestic and foreign banks, as well as non-bank financial institutions. Outstanding credit to households and non-financial corporations are from the BIS's "Long series on credit to the private non-financial sector" database. This database has quarterly information on total credit to the private non-financial sector and decomposes total credit into credit to households and credit to non-financial firms.[4]

[4]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 are only available from 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.

In our main single equation results we use the three year change in debt to GDP to measure a sustained increased in debt.[5] We scale outstanding household and firm debt at the end of the fourth quarter by annual GDP in order to measure credit expansions relative to the size of the economy. For example, in models such as Eggertsson and Krugman (2012) the size of the change in gross debt relative to GDP determines whether the fall in demand is sufficient to send the economy into a liquidity trap. An alternative would be to use real debt growth instead of the change in debt to GDP. Focusing on real debt growth has the disadvantage that episodes of large real debt growth often involve small absolute increases in debt from a low initial level, which are not likely to be important from a macroeconomic perspective. In a robustness exercise we verify our results using an alternative measure of credit expansions that scales the change in household and non-financial firm debt by initial GDP, $(\Delta_h HHD_t)/Y_{t-h}$ and $(\Delta_h FD_t)/Y_{t-h}$.

2.2 Summary Statistics

Table 2 displays summary statistics for the change in total private, household, and non-financial firm debt to GDP, as well as the other variables.[6] Our empirical analysis uses both annual changes in panel VARs and changes over three years in a single equation estimation framework. Table 2 shows that total private sector debt to GDP, PD/Y, has been increasing by 3.11 percentage points per year on average, with household debt to GDP increasing slightly more quickly than that. 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 2 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.

[5] We will justify this horizon based on the data in the next section. Baron and Xiong (2014) use the three-year change in credit to GDP, although their variable is total bank credit to GDP. Dell'Ariccia et al. (2012) find that the median bank credit boom lasts three years.

[6] 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.

3 Theory and Empirical Specification

How should one interpret the sharp increase in debt, and in particular household debt, the world over? Is the growth in debt benign and largely driven by increasing capital flows across countries and real productivity growth? Or should we be concerned that the sharp rise in debt makes economies vulnerable to periods of low growth?

We begin addressing this question through the lens of standard macroeconomic models with private debt. Debt and growth in these models are linked to each other via productivity shocks as people borrow in anticipation of higher productivity going forward. The result is that higher debt growth is a precursor to higher GDP growth. Our empirical methodology is designed to test if the cross-country panel data on debt and growth supports such predictions.

3.1 Debt and Growth in Standard Open Economy Models

Consider a small open economy with a continuum of infinitely lived households with utility function,

$$E_0 \sum_{t=0}^{\infty} \beta^t U(c_t).$$

Households face no borrowing constraints, and there is a risk-free one period bond that can be traded internationally. Output y_t is given exogenously by a stochastic process, and each household faces an inter-temporal budget tradeoff of the form,

$$c_t + (1+r)d_{t-1} = y_t + d_t. \tag{1}$$

Optimal allocation of consumption across periods requires that a no-Ponzi game constraint hold with strict equality,

$$\lim_{j\to\infty} E_t \frac{d_{t+j}}{(1+r)^j} = 0. \tag{2}$$

Maximizing utility subject to the stochastic income process and the inter-temporal budget constraint gives us the traditional Euler equation,

$$U'(c_t) = \beta(1+r)E_t U'(c_{t+1})$$

We assume $\beta(1+r) = 1$, which gives us constant consumption in steady state and simplifies the exposition. Furthermore, we assume quadratic utility with $U(c) = -\frac{1}{2}(c - \overline{c})^2$ with $c \leq \overline{c}$, which makes marginal utility linear and hence consumption a random walk with $c_t = E_t c_{t+1}$. Iterating forward (1) and using (2) and $c_t = E_t c_{t+1}$, we get that consumption equals expected permanent income $E_t y_t^p$ minus interest payments outstanding debt rd_{t-1} in equilibrium,

$$c_t = E_t y_t^p - rd_{t-1} = \frac{r}{(1+r)} E_t \sum_{j=0}^{\infty} \frac{y_{t+j}}{(1+r)^j} - rd_{t-1} \tag{3}$$

Plugging $c_t = E_t y_t^p - rd_{t-1}$ into equation (1) tells us how debt evolves in standard open economy models,

$$d_t - d_{t-1} = E_t y_t^p - y_t \tag{4}$$

In the standard model, growth in debt is determined by the difference between expected permanent income and income today. Higher expected permanent income relative to income today translates one-for-one into higher debt growth today. The problem with testing whether equation (4) holds in practice is that expected permanent income is not observed directly. Nonetheless, equation (4) does have clear predictions for observed variables that we can then take to data.

To see this, let $\Delta d_t = d_t - d_{t-1}$ and consider estimating the following equation using realized income growth as the dependent variable:

$$\Delta y_{i,t+h} = \alpha_i + \beta \Delta d_{it} + u_{it} \tag{5}$$

where $\Delta y_{i,t+h} = y_{i,t+h} - y_{it}$ and i indexes a country. According to equation (4), Δd_{it} is driven by shocks to permanent income in country i, and permanent income shocks should be *positively* correlated with $\Delta y_{i,t+h}$ given that both rely on future income realizations.

Hence, $\hat{\beta}$ in equation (5) is predicted to be positive according to the standard macro model. This is the key prediction we will take to data in the next section. The positive relationship between lagged debt growth and subsequent income growth is driven by two forces. First, and more importantly, expectation of higher income growth at time t raises permanent income y_t^p relative to income today. This results in consumers increasing their net borrowing in an effort to smooth consumption over time. Second, the positive relationship between debt growth and subsequent income growth may also be driven by *transitory* income shocks. If there is a temporary fall in income today y_t while expected permanent income y_t^p remains the same, consumers will borrow more to smooth out the temporary reduction in income.

The estimate of β represents the *equilibrium* relationship between debt and growth. It is clear from the discussion above that it should not be interpreted in any causal sense–a change in debt does not cause a change in permanent income in the standard model. While equation (5) is derived under the assumptions of representative agent, quadratic utility and exogenous income process, the positive predictive relationship between debt and growth is robust to more generic utility functions and the introduction of capital and endogenous output.[7]

Finally, strictly speaking, the debt in (5) represents net foreign debt. This is due to the assumption of a representative agent. 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. We do not fully derive such a model here, but we believe it has similar implications. Consequently, our empirical section uses total private debt, whether borrowed domestically or from abroad, but we also show results for net foreign debt.

3.2 Full Empirical Specification

We estimate equation (5) after normalizing debt by GDP for reasons discussed in Section 2. While equation (5) is flexible in allowing horizon of various lengths for the dependent variable, a question arises as to the length of time over which change in debt should be calculated. We let the data tell us about the appropriate window over which debt should be differenced. Specifically, for each of the two components of private debt, household debt and non-financial firm debt, we estimate an

[7] See Uribe and Schmitt-Grohé (2015) for an excellent exposition of the broader open economy macro literature.

autoregressive model:

$$\Delta \frac{HHD_{it}}{Y_{it}} = \mu^{HH} + \sum_{j=1}^{5} \varphi_j^{HH} \Delta \frac{HHD_{it-j}}{Y_{it-j}} + \epsilon_{it}^{HH}$$
$$\Delta \frac{FD_{it}}{Y_{it}} = \mu^{F} + \sum_{j=1}^{5} \varphi_j^{F} \Delta \frac{FD_{it-1}}{Y_{it-j}} + \epsilon_{it}^{F}.$$

The AR models include five lags and are estimated on the pooled sample.[8]

Figure 1 plots the cumulative impulse responses for household and firm debt to GDP from these autoregressive models. The figure shows that an initial unit impulse to $\Delta \frac{HHD}{Y}$ is amplified for three to four years before dying out. The cumulative effect is about 2.3 units by the fourth year after the increase. A shock to $\Delta \frac{FD}{Y}$ also leads to a persistent increase, although the effect of the shock on firm debt expansion fades more quickly. The cumulative effect on firm debt to GDP is about 1.6 percentage points after 4 years.

Thus the time period over which a shock to household debt persists is three to four years. This is consistent with studies that have examined particular episodes such as the growth in household debt in the United States, where Mian and Sufi (2010) use years from 2002 to 2006, or the growth in household debt in the United Kingdom, where King (1994) uses years from 1984 to 1988. Using the 3 year window for change in debt, we estimate the following relationship between growth in debt and subsequent GDP growth over any horizon h:

$$\Delta y_{i,t+h} = \alpha_i + \beta_{PD}^{h} \Delta_3 \frac{PD_{it-1}}{Y_{it-1}} + \epsilon_{it+h}, \tag{6}$$

where y_{it} is log GDP for country i in year t, α_i are country fixed effects, Δ_3 refers to differences over three years[9], PD is private debt of a country and $h = 1, 2, ...$ is the forecast horizon.

Since we normalize the debt variable by output on the right hand side, there may be a concern that the normalization induces mechanical correlation between output growth and lagged debt to GDP growth. In particular, changes in debt to output ratio might largely be driven by movements in output rather than changes in debt. To test for this possible concern, we perform robustness

[8]We choose a lag length of five to be consistent with our VAR results presented below, which use five lags chosen by the AIC. Schularick and Taylor (2012) also use five lags of credit growth, noting that credit booms are typically persistent events.

[9]So $\Delta_3 \frac{PD_{it-1}}{Y_{it-1}} = (\frac{PD_{it-1}}{Y_{it-1}} - \frac{PD_{it-4}}{Y_{it-4}})$

checks by replacing $\Delta_3 \frac{PD_{it-1}}{Y_{it-1}}$ with $(\frac{PD_{it-1}-PD_{it-4}}{Y_{it-4}})$. As we will show, results are qualitatively similar.

We also supplement equation (6) by breaking down private debt into household debt and non-financial firm debt. Formally, we estimate,

$$\Delta y_{i,t+h} = \alpha_i^h + \beta_{HH}^h \Delta_3 \frac{HHD_{it-1}}{Y_{it-1}} + \beta_F^h \Delta_3 \frac{FD_{it-1}}{Y_{it-1}} + \epsilon_{it+h}, \tag{7}$$

where HHD and FD correspond to household debt and non-financial firm debt, respectively. In some specifications, we also augment (7) to include additional control variables, including higher order lag structure in the spirit of the local projections method introduced by Jordà (2005).

One advantage of our study relative to most of the existing research is that it tests the predictive power of both household debt and non-financial firm debt on growth in the same specification. In particular, some economic models feature fundamental shocks that should in principle lead to a similar correlation of subsequent GDP growth with both household debt and firm debt. Examining whether there are different correlations of household debt changes and non-financial firm debt changes with subsequent growth can help us explore which models are most accurate.

In all specifications, standard errors are clustered at the country level to allow for arbitrary correlation between errors within countries. In particular, this accounts for residual autocorrelation induced by the overlapping observations. In a robustness check, we use only every third year to construct a sample of non-overlapping observations, and we show the results are similar.

4 Household Debt Expansions and Output Growth

4.1 Basic Result and Robustness

Figure 2 plots the coefficient estimate on $\Delta_3 \frac{PD_{it-1}}{Y_{it-1}}$ from estimation of equation (6) at various future horizons. An increase in the private debt to GDP ratio from four years ago to last year predicts lower subsequent GDP growth at all horizons. Figure 3 plots coefficients from equation (7) which splits out the negative relation between private debt and GDP growth into the household debt and firm debt components of private debt. The negative relation comes exclusively from the rise in household debt.

We explore these patterns further in Table 3. Column 1 uses the overall change in private debt to GDP on the right hand side, where private debt includes both household debt and non-financial firm debt. Columns 2 though 4 separate out the two components of total private debt and show once again that the negative assocation is entirely driven by the growth in household debt (column 4). In terms of magnitudes, the estimate in column 4 implies that a one standard deviation increase in the change in household debt (6.2) is associated with a 2.1% lower growth over the subsequent three years.

Column 5 shows that the coefficient estimate is robust to inclusion of lagged GDP growth. In column 6 we add the increase in government debt to GDP over the same period. 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.[10] The relationship between expansions in debt and subsequent growth thus differs significantly across potential borrowing sectors.

Column 7 tests if the negative predictive effect of household debt on output is stronger when a country accumulates net foreign debt. In particular, we include an indicator variable for whether a given country has accumulated additional net foreign debt from $t-4$ to $t-1$, and we interact the indicator variable with the change in household debt to GDP ratio from $t-4$ to $t-1$. As the coefficient estimates show, an increase in household debt leads to lower subsequent growth even if the country has not increased net foreign debt during the household debt boom. However, the negative association of household debt on subsequent growth is larger if the rise in household debt is partly funded by borrowing from abroad. This result is consistent with the notion that household borrowing funded from abroad is associated with lower subsequent growth.

Panel a of Figure 4 shows the scatter plot of the change in household debt to GDP ratio and subsequent GDP growth. 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 correlations of the change in household debt to GDP and non-financial firm debt to GDP ratios, respectively. As already shown in column 4 of Table 3, the partial correlation is negative for household debt, but flat for non-financial firm debt.

[10] In Figure A2 in the online appendix we show that this result holds at all horizons between one and five years.

In Figure 4, we also estimate a non-parametric fit of the data to see whether there are strong non-linearities in the relation between the change in household debt and subsequent growth. There does appear to be a non-linear relation with household debt, with an increasingly negative relation as the change in household debt gets larger. However, the relation is negative even toward the middle of the distribution, so it is not driven only by very large debt booms. We will discuss this non-linearity result in more detail in Section 5.

In Figure 5, we explore the relation between household debt changes and subsequent economic growth country-by-country. More specifically, Figure 5 plots the country-specific coefficient on $\Delta_3 \frac{HHD_{it-1}}{Y_{it-1}}$ from a regression with 3-year forward GDP growth on the left hand side, controlling for a distributed lag in GDP growth. The coefficient is negative for twenty-four of the thirty countries in our sample, and none of the country coefficients are significantly positive with the exception of Turkey.[11] The cross-country average of the estimates is -0.36 and the precision weighted average is -0.40. The average estimates are thus similar to the panel data regression estimate in Table 3, which suggests that bias arising from heterogeneous coefficients is not likely to be an important concern.[12]

In Table 4, we report additional robustness tests. Columns 1 and 2 show that the correlation between $\Delta_3 \frac{HHD_{it-1}}{Y_{it-1}}$ and subsequent economic growth is similar for emerging and developed countries. Columns 3 and 4 exclude the post-1990 period and post 2000 period to make sure that the boom and bust cycle of the Great Recession of 2008 is not driving our results. In column 5, we focus only on the last 30 years, and find a similar correlation. While we adjust all our standard errors to account for the overlapping nature of our differenced data, columns 6 through 8 perform another 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. We find the same result for all three non-overlapping sub-samples. Column 9 scales the change in household debt and non-financial firm debt from four years ago to previous year with GDP from four years ago. The coefficient estimate

[11] The coefficient for Turkey is significantly positive at the 10% level. Japan represents an interesting case and helps reveal the difficulty in specifying a "timing" of the recessionary effects of a household debt boom. As we show in Figure A2 in the online appendix, the relation between the change in household debt to GDP ratio and subsequent growth for Japan is negative and strong if we use a sample period of 1964 to 1995, which includes the beginning of the lost decades period. But after 1995, the Japanese economy continued to exhibit very low growth, and household debt was shrinking during this period of anemic growth, inducing a positive relation. Related to this observation, controlling for lagged GDP growth mitigates the positive coefficient for Japan when using the full sample period.

[12] The raw and precision-weighted averages for the 15 countries with at least 26 observations in the time series regressions are -.366 and -0.335, respectively.

is unchanged.[13]

Table 5 replaces GDP growth over the next three years with the change in the unemployment rate over the same time horizon. This is a useful left hand side variable because the unemployment rate is a measure of slack in the economy that may not show up in realized GDP numbers. As Table 5 shows, the rise in private debt to GDP ratios predicts higher unemployment. The correlation is stronger using the change in the household debt to GDP ratio, but there is a positive correlation even with the change in non-financial firm debt. The magnitude of the coefficient on $\Delta_3 \frac{HHD_{it-1}}{Y_{it-1}}$ is large. A one standard deviation increase in $\Delta_3 \frac{HHD_{it-1}}{Y_{it-1}}$ (6.2%) predicts 0.82 percentage point higher unemployment rate, which is one third a standard deviation of the left hand side variable.

Column 3 shows that the results are robust to adding lagged annual changes in the unemployment rate to control for any dynamic structure in the change in unemployment rate. Column 4 excludes the post-2000 Great Recession period to again confirm that the result is not driven by the most recent global recession. Finally, column 5 only uses the subsample of OECD harmonized unemployment rate observations, which are more internationally comparable than the series collected using different methodologies. The estimates are similar to the overall sample.

4.2 Evidence from Panel VAR

So far we relied on single equation estimation to estimate the relationship between change in debt and subsequent output growth. This section analyzes the relationship using a panel VAR approach. We estimate a three variable recursive model with 5 lags where the three variables are the change in the household debt to GDP ratio in a year ($\Delta(HHD/Y)_{it}$), the change in the non-financial firm debt to GDP ratio in a year ($\Delta(FD/Y)_{it}$), and the change in the natural logarithm of output in a year (Δy_{it}).[14]

The ordering of the variables in the recursive VAR is Δy_{it}, $\Delta(FD/Y)_{it}$, and $\Delta(HHD/Y)_{it}$. There is no strong theoretical justification for ordering $\Delta(FD/Y)_{it}$ before $\Delta(HHD/Y)_{it}$, and the impulse responses are very similar if we reverse the order of these variables. The VAR is estimated on the pooled 30 country sample.

The left panel of Figure 6 shows the impulse response functions of $\Delta(HHD/Y)_{it}$ and $\Delta(FD/Y)_{it}$

[13] In Table A5 of the online appendix, we show that the results are similar if we scale the increase in debt with GDP as of $t-4$, or if we exclude country fixed effects.

[14] We choose 5 lags based on minimizing the AIC over 6 lags in our three variable VAR discussed below.

to their own shocks. The persistence of the shock is stronger for household debt. A one unit shock $\Delta(HHD/Y)_{it}$ leads to an increase in household debt to GDP which persists for four years before slowing down and eventually reversing. The cumulative effect is about 2.75 units in the fourth year after the increase. A one unit shock to $\Delta(FD/Y)_{it}$ has a smaller and less persistent effect on firm debt to GDP, lasting two to three years and leading to an increase of only 1.5 units.

The right panel of Figure 6 shows a short-run negative effect of non-financial firm debt on GDP. In contrast, an increase in household debt initially *increases* GDP growth. But the long-run response of GDP to the initial increase in household debt is negative and very strong. From the third year after the initial increase in household debt to the eigth year after, the cumulative decline in GDP is 0.8 log points. The medium-term impact of an increase in household debt on GDP growth is about twice as large as the shorter run impact of an increase in firm debt on GDP.

The VAR analysis shows that growth may contemporaneously *increase* while household debt is expanding, but that pattern reverses once household debt growth stalls. The timing does not match perfectly: growth appears to initially decline one to two years earlier than the reversal of debt growth. But the decline in GDP accelerates once debt stops growing.

4.3 Household Debt Expansion and Professional GDP Forecasts

As equation (5) illustrates, standard macroeconomic models imply that permanent income shocks generate a positive predictive relation between growth in debt and subsequent income growth. However, the empirical results are completely the opposite; $\hat{\beta}$ is negative. What explains this result?

One possibility is that there is some fundamental shock that happens to be positively correlated with household debt growth, but negatively correlated with future output growth. In equation (5), this shock would show up in the error term u_{it}. While we as econometricians cannot observe u_{it}, one argument is that market participants and real time forecasters observe this shock. If this were the case, then inclusion of professional forecasts would eliminate the negative relation between output growth and lagged debt growth.

We test for this possibility using 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.

Figure 7 tests if IMF forecasts are able to predict the negative relationship between household debt growth and future output growth. The left panel reveals that an increase in 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 one to five years. Column 2 of Table 6 shows that the same holds for OECD forecasts of growth over the next two years. There is some evidence that firm debt to GDP increases are associated with lower growth forecasts.

IMF and OECD forecasts made at time t are uncorrelated with rise in household debt from $t-4$ to $t-1$, even though the rise in household debt predicts lower GDP growth from t to $t+3$. This suggests that GDP forecast errors of the IMF and OECD should be predictable, and a rise in household debt should predict negative forecasting errors or *over-optimistic* growth expectations as of time t. The right panel of Figure 7 confirms this result by replacing the IMF growth forecast with the *forecast error* at the one to five year horizon. The forecast error is defined as the difference between realized and forecasted growth. The figure shows that larger increases in household debt to GDP are associated with overoptimistic growth expectations and hence negative forecast errors at the one to five year horizon.

Table 6 columns 3 through 5 report coefficient estimates corresponding the first three years of the right panel of Figure 7. Columns 6-7 shows that this relationship also holds at different forecasting horizons for OECD forecasts. Columns 8 and 9 interact the increase in household debt with a dummy for the post 2000 period. The interaction term is not significant, showing that the results are not driven by the post-2000 sample alone. Focusing on a fixed horizon, the top panel of Figure 8 plots the IMF growth forecast error over the next three years against $\Delta_3(HHD/Y)_{it-1}$. The bottom panel of Figure 8 shows the same negative relationship for OECD forecast errors.

Column 10 of Table 6 shows the same regression where the dependent variable is the revision of the OECD $t+2$ GDP growth forecast made between t and $t+1$. If forecasts are optimal, then forecast revisions should not be predictable with information available at the time of the first forecast. But column 10 shows that lagged increases in the household debt to GDP ratio predict downward revisions in growth forecasts between t and $t+1$. 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 $t-1$. We have confirmed that this result also holds for the IMF forecast revisions. Firm credit expansions also predict downward forecast revisions.

So far we have seen that the IMF and OECD forecasts underweight the importance of household debt growth in predicting negative output growth.[15] This suggests that the role of household debt in business cycles is not properly incorporated by professional forecasters.

Professional forecasts can also help us assess another hypothesis: that the rise in household debt is associated with optimism about growth prospects that end up being incorrect *ex post*. Figure 9 relates $t-5$ forecasts of growth from $t-5$ to t to the increase in household and firm debt to GDP from $t-4$ to $t-1$. These are forecasts of growth made prior to the increase in private debt. The left panel of Figure 9 shows that the rise in household and non-financial firm debt is *not* preceded by expectations of relatively higher growth by the IMF. The right panel of Figure 9 shows that $\Delta_3(HHD/Y)_{it-1}$ is also uncorrelated with forecast errors associated with $t-5$ forecasts.[16] On the other hand, $\Delta_3(FD/Y)_{it-1}$ is positively correlated with $t-5$ forecast errors, which suggests that firm debt expands when growth is stronger than anticipated. The results in Figure 9 show that the rise in household debt is not associated with *ex ante* optimistic views on GDP growth of professional forecasters. We cannot know whether optimistic beliefs by households taking on debt are responsible for their borrowing behavior, but professional forecasts do not reflect optimistic beliefs.

4.4 Household Debt and House Prices

Large increases in household debt in a country are often associated with an increase in house prices. As column 6 in Table A2 of the online appendix shows, we see this pattern in our data. Identifying the independent effects of house prices and household debt on subsequent outcomes is a challenge, given that house prices could drive household debt or a shift in credit supply could simultaneously drive household debt and house price growth.[17] Our approach is to explore the relationship between

[15] 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 A2). Our central point is that these forecasts could be improved by taking into account the change in private debt to GDP ratios.

[16] The correlation is significantly positive at the 10% level at the one-year horizon.

[17] See Mian and Sufi (2009) for an attempt to separate out the effect of house prices and credit supply shifts on debt growth.

house prices and household debt without taking a strong stand on causation.

Column 1 of Table A2 of the online appendix shows that house price growth from $t-4$ to $t-1$ also predicts lower subsequent output growth over the next three years. If we include both the increase in household debt to GDP ratio and house price growth, both predict lower subsequent output growth. Further, the coefficient estimate on the increase in household debt to GDP ratio declines slightly (by just less than one third). However, the inclusion of time fixed effects or a focus on the pre-2000 data reveals that the rise in household debt to GDP ratios is a more robust predictor of lower subsequent output growth than house prices. More work is needed to separately identify the effect of household debt and house price movements, but the results presented in Table A2 suggest that household debt robustly predicts lower subsequent growth even taking house prices into account.

5 Understanding the Negative Relation between Debt and Growth

5.1 Alternative Models of Debt and Growth

There is a growing theoretical literature in macro-finance that discusses scenarios under which an economy can end up with "excessive" debt that is harmful for the economy. Since our focus is on household debt, we limit our discussion to models that explicitly deal with household debt.[18] Generally speaking, there are four key ingredients in these models.

First, there is heterogeneity across households within an economy, typically in discount rates. This gives rise to savers and borrowers, with borrowing by impatient households typically limited by a borrowing constraint. Second, variation in household debt over time does not come from productivity or permanent income shocks. Instead, shocks to credit supply, the risk premium, or borrowing constraints are the fundamental shocks changing household debt dynamics (e.g. Justiniano et al. (2015) and Favilukis et al. (2015)). Third, there are frictions that translate borrowing/spending by some agents in the economy into aggregate changes in output. These frictions are typically wage rigidities and/or monetary policy constraints such as the zero lower bound. This leads to *aggregate demand externalities* where the consumption of some agents affects the income of others. Fourth,

[18]There are additional models based on pecuniary or fire sales externalities that focus on the potential for excessive leverage in the non-financial corporate sector. Examples include, Shleifer and Vishny (1992), Kiyotaki and Moore (1997), Lorenzoni (2008), and Dávila (2015).

ex-ante borrowing can be excessive from the social planner's perspective, because of aggregate demand or other pecuniary/fire sales externalities associated with debt financing.

A number of recent papers have used some or all of these ingredients to generate dynamics where a high level of household debt can lead to macroeconomic downturn. A short list includes, Martin and Philippon (2014), Eggertsson and Krugman (2012), Guerrieri and Lorenzoni (2015), Korinek and Simsek (2014), and Farhi and Werning (2015).[19] In the online appendix, we solve a model based on Korinek and Simsek (2014) (KS henceforth) that shows that a perfectly anticipated temporary relaxation in credit constraints (e.g., a credit supply shock) generates excessive household debt growth and low subsequent output. The key ingredient in this model is an aggregate demand externality that is not properly internalized by borrowing households at the time they make their borrowing decision.

The KS study, and others cited above, differ fundamentally with the standard macroeconomic model in terms of the drivers of household debt growth. Recall from (5) that the only driver of household debt growth in a standard model is a permanent income shock. However, in models such as KS, the driver of household debt growth is heterogeneity in discount rates coupled with a credit supply shock. A relaxation in credit supply enables impatient households to borrow more. But they disregard the aggregate demand externality when making their individual borrowing decisions. The result is that future output growth declines when the consequences of too much household debt show up in the form of a shortage of aggregate demand in the future.

We can summarize the result of KS model with two equations. First, a credit supply shock z_{it} leads to an increase in household debt driven by impatient households. Second, because households disregard the aggregate demand externality and tend to borrow too much, the corresponding increase in household debt leads to lower future output growth. Formally, the two equations are:

$$\Delta d_{it} = \alpha_i^f + \beta^f * z_{it} + u_{it}^f \tag{8}$$

$$\Delta y_{i,t+h} = \alpha_i^s + \beta^s * \Delta\hat{d}_{it} + u_{it}^s \tag{9}$$

where $\Delta\hat{d}_{it}$ is the predicted change in household debt from the first stage regression (8). The key

[19]Households may overborrow for behavioral reasons as well, such as hyperblic preferences as in Laibson (1997) or "neglected risk" as in (Gennaioli et al. (2012). Such excessive borrowing can then lead to slowdown in output growth, as in Barro (1999).

testable implication of this model is that β^s is negative, which is certainly consistent with our earlier results.[20] However, a more explicit test of the KS model requires that household debt growth be driven by some credit supply shock z_{it}.

As a final note, the qualitative theory from models with aggregate demand externalities suggests that the relation between the expansion in debt and future GDP growth may be non-linear. Only large increases in debt result in a binding monetary policy constraint that leads to lower growth, which implies a concave relation between the increase in debt and future growth. Figure 4 shown above explores this non-linearity. The non-parametric relation between an increase in household debt to GDP and subsequent growth is non-linear, with larger increases in household debt predicting increasingly lower growth.[21]

5.2 Household Debt and Consumption Booms

A salient feature of the KS and other models described above is that growth in household debt is closely tied to consumption, and not business investment. Moreover, the boom in consumption also puts downward pressure on a country's trade balance (e.g., Martin and Philippon (2014)). In this section, we report results from tests of these implications.

Table 7 shows that changes in the household debt to GDP ratio are positively correlated with contemporaneous changes in consumption to GDP ratio (column 1).[22] In contrast, a change in the household debt to GDP ratio is negatively correlated with changes in both the net export or current account to GDP ratio (columns 2 and 3). What types of goods are imported during times of increasing household debt? Column 4 shows that the share of total imports that are consumption goods increases.

The result that household debt expansion is associated with a deterioration of the current account and a consumption boom (but not an investment boom) is reminiscent of the empirical regularities described in the literature on emerging market boom-recession cycles and exchange rate based stabilizations (see e.g. Calvo and Végh (1999)). A central feature of these episodes is

[20] More specifically, β^s is negative in the KS model for sufficiently large Δd_{it} and zero otherwise. As a result, we expect the estimate across all observations to be negative as long as there are debt booms in the sample.

[21] Alternatively, including a quadratic term for the increase in household debt to GDP yields a negative estimate that is significant at the 10% level.

[22] The same is not true for the investment to GDP ratio. Specifically, replacing the change in consumption to GDP with the change in the investment to GDP ratio as the dependent variable yields a much smaller estimate on the change in household debt to GDP that is not significantly different from zero (not shown).

the strong real exchange rate appreciation during the boom. Column 6 of Table 7 uses the real effective exchange rate from the BIS to test whether household debt expansions are correlated with real currency appreciations. Increases in household debt to GDP in our sample of mostly advanced economies are positively correlated with real exchange rate appreciations, although the correlation is not significant.[23] In Table A5 of the online appendix we also show that including the real effective exchange rate appreciation from $t-4$ to $t-1$ in our main specification (7) does not affect the estimate on household debt. Moreover, while the existing literature shows that real exchange rate appreciation is a robust predictor of financial crises (Gourinchas and Obstfeld (2012)), a real appreciation over three years does not predict a subsequent growth slowdown in our sample.

The results in Table 7 are also remarkable for what they do not show. Changes in non-financial firm debt are not strongly correlated with any outcome in Table 7 except for the real exchange rate. If productivity shocks were the primary driver of debt changes, we would likely see rising non-financial firm debt used to import capital goods. We do not see this in the data. In short, a rise in household debt to GDP is associated with a significant increase in the consumption to GDP ratio, a fall in trade balance, and an increase in the consumption good share of total imports.

5.3 Heterogeneity across Exchange Rate Regimes

The KS model and related theories discussed above rely on nominal rigidity and monetary policy friction in order for reductions in spending from borrowers to reduce overall output. Monetary policy friction plays a crucial role because it prevents a reallocation of spending from borrowers to savers or the external sector through lower interest rates and exchange rate depreciation. In practice, this monetary policy friction can manifest itself in at least two ways. The first is through the adoption of monetary policy goals that target other outcomes, notably stabilizing the exchange rate. The second, which is familiar from the recent experience in the United States and other advanced economies, is the zero lower bound constraint on nominal interest rates, which can prevent otherwise optimal monetary policy from achieving a sufficiently low real interest rate to stabilize output.

In Figure 10 we explore whether the predictive relationship between household debt and subsequent growth is stronger in fixed exchange rate regimes relative to other arrangements where

[23] The correlation is significant at the 10% level when considering changes over three years.

monetary policy has more flexibility. We divide the 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). We then re-estimate our main specification across these subsamples.[24] Figure 10 shows that a rise in household debt to GDP predicts the largest growth slowdown in fixed regimes, followed by intermediate regimes, and the predicted decline in growth is smallest for floating regimes. This result is consistent with models arguing that the fall in output is driven by a fall in demand that is not offset by looser monetary policy.

Table 8 shows the regression version of Figure 10 for the three-year horizon. The difference between estimate on household debt for the fixed and freely floating is significant at the 5% level.[25] In column 4 we interact household debt with an indicator for whether the economy is a the zero lower bound in any year between t and $t + 3$. While a rise in household debt does not predict significantly lower growth in floating regimes, when the rise in household debt leads to or coincides with a period at the zero lower bound, the estimate is negative, significant, and economically large. Of course, we cannot rule out that this estimate is partly driven by other adverse shocks that send the economy to the zero lower bound, but it is consistent with idea that the zero lower bound limits the ability to cushion the fall in demand following a rise in household debt.

These results are consistent with the presence of nominal rigidities and monetary policy frictions that lead movements in aggregate demand driven by household debt cycles to affect output. However, one potential concern with comparing the relationship between household debt and subsequent growth across exchange rate regimes is that the nature of the household debt booms may differ across regimes. For example, countries with fixed exchange rate regimes may experience larger credit booms in the first place. In our sample the volatility of $\Delta_3(HHD/Y)$ is higher in fixed exchange rate regimes.[26] If the relationship between household debt and subsequent growth is non-linear for reasons not related to monetary policy frictions (e.g. costs in reallocating production from the non-tradable to the tradable sector), then the estimate will be larger (in absolute

[24] 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%).

[25] The difference is not significant when we exclude Japan from the floating category. See footnote 11 for a discussion of the case of Japan.

[26] The standard deviation of the right-hand-side variable $\Delta_3(HHD/Y)_{it-1}$ is 7.5, 5.3, and 5.0 in fixed, intermediate, and floating country-years, respectively.

value) for fixed regimes with more volatile household debt cycles without this being explained by monetary policy frictions.

5.4 Credit Supply, Debt Growth, and Output Growth

We now turn to estimation of equations (8) and (9). It is hard to come up with a single measure of credit supply shocks that applies uniformly across countries. However, we consider two variables that have been suggested by recent empirical studies: the sovereign yield spread relative to U.S. Treasuries for non-U.S. economies and the share of debt issuance by risky firms for the United States.

Panel A of Table 9 uses the spread between a country's 10 year government bond and that of the U.S., which we label spr_{it}, as the credit supply shock z_{it} in equation (8). Changes in the sovereign yield spread are often due to changes in the risk premia (Remolona et al. (2007) and 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)). For example, the introduction of the euro led to a covergence of sovereign spreads between Eurozone peripheral countries because of decreased currency and other risk premia. This in turn translated into an increase in credit supply among the peripheral countries, who disproportionately benefited from converging sovereign spreads. Since the sovereign spread measure uses the United States as a benchmark, we naturally exclude the United States from Panel A.

Columns 1 through 3 estimate the first stage equation (8). There is a strong negative relation between the sovereign spread of a country measured at $t-4$ and the subsequent change in the private debt to GDP ratio (column 1) and the household debt to GDP ratio (columns 2 and 3).[27] In terms of magnitudes, a one standard deviation decrease in the country sovereign spread relative to the United States leads to a 2.1 percentage point increase in the household debt to GDP ratio over the subsequent three years, which is about a 1/3 standard deviation. These results are consistent with models discussed above in which changes in credit supply or risk tolerance explain movements in debt.

[27] Results are similar using $t-4, t-3$, and $t-2$ spreads jointly, as well as using the standardized spread instead of the raw spread.

Is the expansion in debt predicted by lower spreads also associated with heightened expectations about growth from $t-4$ to $t-1$? Column 4 relates spr_{it-4} to the $t-4$ IMF forecast of growth from $t-4$ to $t-1$ for the subsample for which these forecasts are available. While lower spreads predict higher credit growth, they are not associated with more optimistic forecasts over the same period by the IMF.

The second stage equation (9) estimates are presented in columns 5 through 7.[28] The second stage estimates are about twice as large as the OLS estimates. The likely explanation for the larger magnitude is that variation in sovereign credit spreads is driven primarily by international capital flows. We know from Table 3, column 7 that an increase in the household debt to GDP ratio has a stronger effect on subsequent growth if it happens concurrently with an increase in the net foreign debt position of a country. The IV specification using sovereign credit spreads isolates household debt booms financed by foreigners.[29]

What are the possible limitations of using the sovereign spread as an instrument for credit supply shocks? One concern is that the sovereign spread impacts future output growth through channels other than its impact on private debt growth. However, to the extent that the sovereign spread enters the output growth equation, a lower spread should be *good* news for future output growth. If foreign investors are viewing a country's sovereign debt as safer, then such views should reflect good news for future output growth. Yet we find that a lower sovereign spread is associated with stronger growth in private debt and *lower* future output growth. An explanation based on the sovereign spread entering the output growth equation directly is unlikely to rationalize the negative coefficients in columns 5 through 7 of Panel A. The fact that the IMF does not forecast higher growth when the spread declines supports the view that the decline in sovereign spreads is not driven by expectations of stronger growth.

In Panel B of Table 9 we explore another instrument for credit growth, this time focusing on the United States. We use the corporate bond high yield share from Greenwood and Hanson (2013), averaged over $t-3$ to $t-1$.[30] As argued in Greenwood and Hanson (2013) and López-Salido et al.

[28]Since we have only one instrument, we cannot separately instrument for the two components of private debt. Thus to the extent credit spreads also influence firm debt, and higher firm debt predicts lower future output growth, our IV estimate includes the combined effect of household and firm debt on output growth.

[29]We also added time fixed effects to the regression in Panel A, with qualitatively similar results (see Table A3 in the online appendix). We prefer to exclude time fixed effects since global risk premia could be one component driving the change in sovereign spreads. We discuss time fixed effects in more detail in Section 6.

[30]The estimates are similar using the $t-3, t-2$, and $t-1$ high yield shares separately.

(2015) a high fraction of high yield issuance in total corporate bond issuance may reflect “elevated” credit market sentiment and therefore an outward shift in the supply of credit. Once again, this instrument does not necessarily only affect household debt issuance, but it is intended to capture periods when overall creditor risk appetite is high.

Columns 2 through 4 of Panel B show a positive first stage relationship between the high yield share and the increase in the debt to GDP ratio over the same period. Times when the credit quality of corporate debt issuers deteriorates are also times when private and household debt to GDP increase. Columns 5 through 7 show the IV estimates. The variation in household debt that is associated with elevated borrowing by risky firms predicts slower growth over the next three years. For comparability, column 1 shows the OLS estimate for the U.S. The IV estimates are of similar magnitude to the OLS estimates.

As before, there may be other channels through which heightened lending to low credit quality firms affect GDP growth. For example, López-Salido et al. (2015) argue that elevated credit market sentiment predicts a credit market correction, and it is the credit market correction that reduces GDP. We view the estimates in Table 9 as descriptive evidence broadly consistent with the view that credit supply shocks matter. And more specifically, elevated lending to risky firms and lower sovereign spreads predict a *decline* in GDP growth following the debt boom.

6 The Global Household Debt Cycle

So far our analysis focused on the relationship between household debt and GDP within a given country. We next explore the global dimension of household debt growth and GDP. There are two reasons why understanding the global household debt cycle is important. First, it is well known that credit cycles are often correlated across countries. In other words, there is an important *global* component in cross-country credit cycles (Rey (2015)). Second, to the extent a country is adversely affected by its own credit cycle, it may rely on the global economy to export its way out of trouble. However, whether a country can use the external adjustment mechanism to cushion negative domestic shocks depends on how much its own credit cycle is correlated with the global cycle. We investigate these connections between the local and global credit cycles in this section.

6.1 Household Debt Growth and External Adjustment

We begin by comparing the predictive effect of household debt growth on various components of GDP and the net export margin. Panel A of Table 10 shows that changes in the household debt to GDP ratio predict subsequent consumption growth strongly, and in particular the consumption of durables. The share of durables in overall consumption drops sharply after a rise in the household debt to GDP ratio. Investment also reacts. Perhaps most interestingly, changes in *household debt* predict *investment* better than changes in *non-financial firm debt*. There is also evidence that a rise in non-firm financial debt predicts lower government spending.

Panel B of Table 10 explores how changes in debt to GDP ratios are related to external adjustment. The key result is that growth in household debt to GDP predicts an *improvement* in the net export to GDP ratio. Column 1 shows that net exports as a share of GDP rise in the three years after a rise in household debt. Column 2 shows that growth in exports relative to imports increases as well. Columns 3 and 4 separately look at the two components of the net export margin and 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 as well. Consistent with all of our earlier findings, the change in non-financial firm debt continues to have no predictive power for the net-export margin in columns 1 through 5 of panel B.

Household debt positively predicts a change in the net export margin, while it negatively predicts overall GDP growth and all other components of GDP in Panel A. 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 of panel B 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.

An increase in the household debt to GDP ratio negatively predicts GDP growth and all of its components except for net exports. The other component of private debt, namely a change in the non-financial firm debt to GDP ratio, has no predictive power. The fact that external margin is useful in cushioning a fall in GDP growth suggests that household debt may have even stronger power if many countries increase household debt at the same time. In other words, if there is a global cycle in household debt to GDP, the global cycle might prove to be even more destructive because countries will be less able to use the external margin for adjustment when more of the global economy is affected by household debt cycle.

6.2 Predicting Global Growth

We have so far focused on variation *within* a given country, but the evidence on trade in the subsection above suggests that there may be an important *global* debt cycle. In other words, if many countries simultaneously see a large increase in household debt, the ability of any given country to export their way out of an economic downturn will be limited.

In Table 11, we explore whether there is a global household debt cycle that predicts subsequent global growth. We aggregate all countries into one observation per year, and estimate the following global time series regression:

$$\Delta y_{i,t+3} = \alpha + \beta * \Delta_3 \frac{HHD_{t-1}}{Y_{t-1}} + \gamma * \Delta_3 \frac{FD_{t-1}}{Y_{t-1}} + \epsilon_t.$$

Table 11 presents the estimates. As column 1 shows, there is a very 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.

Figure 11 plots each year in a scatter-plot of global changes in household debt to GDP ($\Delta_3 \frac{HHD_{t-1}}{Y_{t-1}}$) against subsequent global GDP growth ($y_{t+3} - y_t$). 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. As the figure shows, changes in household debt to GDP are strongly related to subsequent GDP growth.

One important pattern that emerges from both Table 11 and Figure 11 is that the relation between global GDP growth and changes in household debt is not driven exclusively by the Great Recession. Column 4 of Table 11 shows that a regression of subsequent GDP growth on changes in household debt to GDP using only pre-2000 data produces a coefficient estimate that is almost identical to the full sample estimate. Figure 11 confirms that excluding the post 2000 years at the bottom right would not significantly alter the slope of the regression line. Taken together, these results suggest that the regression model relating changes in household debt to subsequent GDP predicted accurately the collapse in global GDP growth during the 2007 to 2012 period. The Great Recession was not an extreme outlier; instead, it followed a pattern we would expect given the tremendous rise in global household debt that preceded it.

One other pattern that emerges from analysis of the global household debt cycle is that the coefficient estimate on changes in household debt is much larger than in the country-level analysis. In other words, a given global increase in household debt predicts a larger decline in subsequent global GDP growth relative to how the same increase in household debt in a given country predicts the country's subsequent GDP growth. The magnitude is three times as large. One explanation of the larger magnitude is the net export channel mentioned above. When one country sees a rise in household debt, the subsequent GDP decline is cushioned by the ability to export to other countries. However, this channel is no longer as strong if many countries simultaneously see a large rise in household debt.

6.3 Time Fixed Effects and Loading on the Global Debt Cycle

In the regressions in Section 4, we include country fixed effects but not year fixed effects. The reasoning behind this decision is evident in Table 11 and Figure 11: there is a global household debt cycle that may be important for considering how household debt in a given country affects GDP growth. Using year fixed effects isolates the variation in changes in household debt to within-country, within-year effects, therefore partialling out the global debt cycle that is of independent interest.

To explore further how the global household debt cycle is related to the effect of household debt on GDP growth in a given country, we first estimate the loading of a given country on the global debt cycle. More specifically, for every country, we estimate the following correlation:

$$\text{corr}\left(\left(\Delta_3 \frac{HHD}{Y}\right)_{it}, \frac{1}{N-1}\sum_{j \neq i}\left(\Delta_3 \frac{HHD}{Y}\right)_{jt}\right) \tag{10}$$

Where HHD is household debt, and Δ_3 is the change over the past three years. The correlation tells us how much a change in household debt in country i is correlated with the contemporaneous global change in household debt, where the latter variable excludes country i. Figure 12 presents the correlation for each country in the sample. Countries that load more on the global household debt cycle are those that are likely to have a downturn when global GDP growth is weak. As a result, these countries have a hard time using net exports to escape a domestic downturn.

The first column of Table 12 shows this result. We run the standard regression at the country-year level without year fixed effects, but we include an additional variable which is the interaction of changes in the household debt to GDP ratio with a country's loading on the global debt cycle. As column 1 shows, increases in household debt predict lower GDP growth more strongly for countries that load more heavily on the global debt cycle.

Column 5 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. The magnitudes are easy to interpret: for a country with zero loading on the global debt cycle ($\rho_i^{Global} = 0$), column 5 shows that net exports increase substantially after a rise in the country's household debt to GDP ratio. However, for a country that moves exactly with the global debt cycle ($\rho_i^{Global} = 1$), this channel is eliminated completely.

In column 2, we include both year and country fixed effects, and the coefficient estimate on the change in the household debt to GDP ratio is weakened by from -0.34 to -0.22 compared to the specification in 3 column 4. This is not surprising. Year fixed effects remove the global debt cycle component, which we know from the results above play an important role in explaining why changes in household debt predict GDP growth at the country level. More formally, let $X = \Delta_3 \frac{HHD}{Y}$. Then the inclusion of year fixed effects means the variation in changes in household debt being used to estimate the coefficient is $X_{it} - \bar{X}_t$, where the latter term is the average increase in household debt to GDP across the countries in the sample. But when we partial out the average increase in household debt, $\bar{X}_t$, we are partialling out variation that is important in describing why household debt at the country level predicts lower GDP growth.

In column 3, we include both year fixed effects and the interaction term from column 1, and we find the coefficient estimate on the interaction term is no longer significantly different than zero. To understand why, recall from above what the year effects are doing. They are de-meaning all right hand side variables by the average rise in household debt across all countries in the sample during the same time period. Once we take out this global effect, the effect of a rise in household debt in a given country on subsequent GDP growth is no longer stronger for countries that load more heavily on the global debt cycle. In other words, the coefficient estimate on the interaction term in column 1 is only statistically significantly negative because countries that load more heavily on the global debt cycle have recessions when global household debt is high. Once we account for year fixed effects, they no longer see differentially worse recessions based on their *own* household debt level during times of high *global* household debt.

Taken together, these results motivate the specification in column 4. More specifically, we estimate:

$$y_{it+3} - y_{it} = \alpha_i^h + \beta_{HH}^h \Delta_3 \frac{HHD_{it-1}}{Y_{it-1}} + \beta_F^h \Delta_3 \frac{FD_{it-1}}{Y_{it-1}} + \beta_G^h Global_{-i} \Delta_3 \frac{HHD_{t-1}}{Y_{t-1}} + \epsilon_{it+h}$$

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 4 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.

Columns 6 through 8 of Table 10 explore the trade channel in more depth. Column 6 is analogous to column 4: countries with a high loading on the global household debt cycle see a weaker net export channel when their own household debt is high (column 5) only because their own household debt is high when global household debt is high. The net export channel is weaker for *all countries* when there has been a large increase in the global household debt to GDP ratio.

7 Conclusion

An increase in the household debt to GDP ratio over a three to four year period predicts lower GDP growth in a panel of 30 countries from 1960 to 2012. This finding is contrary to the standard macroeconomic model which yields an equilibrium positive relation between debt growth and subsequent GDP growth. Economic forecasters appear to underweight the importance of household debt when forecasting GDP. Private debt growth associated with an increase in measures of credit supply or risk tolerance is correlated with lower future GDP growth. Further, household debt growth episodes are associated with a consumption boom and a deterioration in the net foreign asset position of a country. We argue that these results are more consistent with a class of models that emphasizes household heterogeneity, the importance of credit supply shocks over productivity shocks, and the possibility of too much leverage given aggregate demand and pecuniary externalities associated with debt.

We also show a strong global household debt cycle that we believe is new to the literature. A rise in the global household debt to GDP ratio predicts lower global GDP growth. Using pre-2000 data, we are able to predict the severity of the global recession from 2007 to 2012 given the large increase in household debt in the mid-2000s. Countries with a household debt cycle more correlated with the global household debt cycle see lower GDP growth after a rise in household debt, and this is in part due to the inability to soften the blow through net exports.

There are many questions that remain to be answered. Our findings here focus on an equilibrium relation between household debt growth and subsequent GDP growth, but we do not specify nor estimate a counter-factual model. As a result, we cannot determine whether household debt growth is a good or bad thing. For example, we do not know what would have happened in the world economy had household debt not grown dramatically from 2000 to 2007. Martin and Philippon (2014) specify and estimate a model, and they attempt to take a stronger stand on what would have happened within Europe had capital flows not increased so substantially.

Further, while we use variation in credit supply shocks as an instrument for household debt growth, we do not know why credit supply (or the risk premium) varies over time. Other scholars have pointed to monetary policy in core countries such as the United States (Rey (2015), Bruno and Shin (2015)). We look forward to more research on these and other related questions.

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Data Appendix

Household debt and non-financial firm debt. Household and non-financial firm debt are from the BIS's "Long series on credit to the private non-financial sector" database. See text for details on the private debt to GDP variables.

National accounts. National accounts data are from the World Bank's World Development Indicators (WDI) database. We use annual data in current and constant prices from the WDI on GDP, Y, household consumption, C, gross capital formation, I, and government consumption, G. We supplement WDI data on total household consumption with data on household consumption expenditure on durable goods, C^{dur}, and non-durable goods, C^{nondur}, from the Organization for Economic Cooperation and Development (OECD).[31]

Exports, imports, and the current account. Data on exports, X, and imports, M, in current prices are from the OECD or International Monetary Fund's International Financial Statistics (IFS) database, depending on data availability. Net exports is the difference between exports and imports, $NX = X - M$. Current account series, CA, are from the OECD or IFS.

Disaggregated exports and imports. In addition to overall exports and imports, we construct variables for consumption and non-consumption (capital and intermediate) trade using disaggregated trade data from the NBER-UN World Trade database (from 1962-2000) and UN Comtrade (from 2000-2012). We aggregate four digit SITC revision 2 trade flows into consumption, capital, and intermediate imports and exports following the Basic Economic Categories classification scheme from UN Comtrade. With consumption exports and imports, XC and MC, we construct the share of consumption in total exports and imports, s^{XC} and s^{MC}.

Unemployment rate. Data on national unemployment rates, u, are from the OECD harmonized unemployment rate database, where possible. For countries where the OECD harmonized unemployment rate is series is short or missing, we use unemployment rate data from the IFS, other OECD series, or national central banks. The harmonized unemployment rate is measured by applying the same definition of unemployment across OECD member countries to obtain estimates that are more internationally comparable. However, since we focus on changes in the unemployment

[31] These series are available for 23 of the 30 countries in the sample. Information on durable and non-durable consumption is missing for Hong Kong, Indonesia, Singapore, Switzerland, Thailand, Thailand, Turkey, and the United Kingdom. The OECD decomposes final consumption expenditure of "households on the territory" into non-durable, semi-durable, durable, and services consumption.

rate, level differences in definitions that are constant over time will not bias the results.

Sovereign spread. The sovereign spread, spr, is constructed as the difference between the 10 year bond yield and the 10 year U.S. Treasury yield. Government 10 year bonds yields are from Global Financial Data. This variable is therefore missing for the United States (the base country), as well as Indonesia and Turkey because if limited data availability.

Professional GDP growth forecasts and forecast errors. We use GDP growth forecasts and forecast errors from the IMF *World Economic Outlook* (WEO) Historical Forecasts Database and from print editions of the *OECD Economic Outlook*. Forecasts from the *OECD Economic Outlook* are hand-collected. Forecast errors are defined as the difference between realized and forecasted growth. To construct forecast errors we use realized GDP growth for year t reported in year $t+2$. This allows us to compare forecasts with realized growth rates based on proximate vintages of data.[32] The WEO Historical Database reports forecasts for growth up to the five year horizon since 1990. We supplement this information with IMF one-year ahead forecasts for the G7 countries from 1972 onward. One-year and two-year ahead forecasts from the *OECD Economic Outlook* are available since 1973 and 1987, respectively.

Government debt to GDP. The government debt to GDP ratio, GD/Y, is from the IMF's Historical Public Debt Database (Abbas et al. (2010)). To construct changes in government debt to GDP, we do not take differences across breaks in the series.

Real house prices. Real house prices, HPI, are constructed from the BIS's "Long series on nominal residential property prices." These series cover 20 countries in our sample and start in 1970 or 1971.[33] Annual growth in real house prices are constructed from changes in fourth quarter values, deflated by the CPI.

Real effective exchange rates. Real effective exchange rates, $REER$, are from the BIS's "Effective exchange rate indices" database. We use the narrow indices, which extend back to 1964 for 24 countries in our sample.[34] An increase in the index indicates an appreciation.

Exchange rate regime. Information on the *de facto* exchange rate regime is from Reinhart and Rogoff (2004), updated to 2010 in Ilzetzki et al. (2010). We define "Fixed regimes" as arrangements

[32]All results based on forecast errors are robust to using realized GDP growth from the WDI instead of the WEO Historical Database or the *OECD Economic Outlook*.

[33]The countries without house price series from the BIS are Austria, Czech Republic, Greece, Hungary, Indonesia, Mexico, Poland, Portugal, Singapore, and Turkey.

[34]Countries without REER series are Czech Republic, Hungary, Indonesia, Poland, Thailand, and Turkey.

with a coarse classification code equal to 1 (currency boards, a pre-announced horizontal band that is narrower than or equal to ±2%, or a de facto peg). "Intermediate regimes" are defined as arrangements with a classification code of 2 or 3 (crawling pegs, crawling bands, managed floating, moving bands, etc.).

Table 1: Summary of Countries in the Sample and Key Statistics

Country	Years	Average $\Delta(HHD/Y)$	Average $\Delta(FD/Y)$	Std. dev. $\Delta(HHD/Y)$	Std. dev. $\Delta(FD/Y)$
Australia	1977-2012	2.23	1.00	2.55	4.40
Austria	1995-2012	0.71	1.98	1.26	2.91
Belgium	1980-2012	0.82	3.09	1.13	6.47
Canada	1969-2012	1.42	1.00	2.37	3.54
Czech Republic	1995-2012	1.24	-0.85	1.71	5.46
Denmark	1994-2012	3.72	2.52	3.96	5.96
Finland	1970-2012	1.12	0.87	3.04	7.55
France	1977-2012	1.08	1.10	1.20	2.41
Germany	1970-2012	0.51	0.23	1.79	1.65
Greece	1994-2012	3.22	1.98	2.25	2.43
Hong Kong	1990-2012	1.21	1.88	2.68	10.40
Hungary	1989-2012	0.52	2.06	3.41	5.34
Indonesia	2001-2012	0.96	-0.22	0.77	1.83
Ireland	2002-2012	5.02	14.11	7.97	15.63
Italy	1960-2012	0.70	0.52	1.55	2.98
Japan	1964-2012	0.92	0.14	1.77	4.39
Korea, Rep.	1962-2012	1.71	1.74	2.22	5.83
Mexico	1994-2012	0.20	-1.07	0.86	2.12
Netherlands	1990-2012	3.62	0.95	2.75	4.10
Norway	1975-2012	1.17	1.37	3.42	5.89
Poland	1995-2012	1.91	1.37	2.03	2.59
Portugal	1979-2012	2.57	1.18	2.51	7.22
Singapore	1991-2012	1.78	-0.21	2.88	5.28
Spain	1980-2012	1.78	1.64	2.64	5.01
Sweden	1980-2012	1.11	3.66	2.66	8.47
Switzerland	1999-2012	0.95	0.76	3.27	4.01
Thailand	1991-2012	1.99	-0.85	3.32	7.86
Turkey	1986-2012	0.72	0.66	1.19	3.51
United Kingdom	1976-2012	1.38	1.66	2.43	4.27
United States	1960-2012	0.75	0.54	2.14	1.76

Table 2: 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
$\Delta(PD/Y)$	695	3.11	2.52	6.96	2.34	0.39
$\Delta_3(PD/Y)$	695	8.52	7.28	16.04	5.39	0.74
$\Delta(HHD/Y)$	695	1.62	1.33	2.56	0.86	0.43
$\Delta_3(HHD/Y)$	695	4.58	3.68	6.24	2.10	0.79
$\Delta(FD/Y)$	695	1.48	1.04	5.66	1.90	0.30
$\Delta_3(FD/Y)$	695	3.89	3.11	12.21	4.10	0.69
Δc	678	2.81	2.90	2.84	0.95	0.33
Δc^{dur}	405	4.17	4.66	8.20	2.76	0.23
Δc^{nondur}	405	1.18	1.39	1.79	0.60	0.29
$\Delta C/Y$	688	-0.06	0.00	1.18	0.40	0.05
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
$\Delta_3 hpi$	514	6.56	7.16	17.42	5.85	0.72
$\Delta_3(GD/Y)$	627	1.73	1.16	9.92	3.33	0.71
spr	547	1.14	0.66	2.43	0.82	0.66
Avg HYS, t-3 to t-1	46	22.18	20.78	13.47	4.53	0.89

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 $y, PD/Y, HHD/Y, FD/Y, c, c^{dur}, c^{nondur}, C/Y, i, g, x, m, NX/Y, CA/Y, s^{XC}, s^{MC}, reer, u, y^{WEO}_{t+3|t}, hpi, GD/Y, spr$, and HYS denote log real GDP, private non-financial debt to GDP, household debt to GDP, non-financial firm debt to GDP, 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 house price index, government debt to GDP, the 10 year government bond yield spread with respect to the United States, and the US corporate bond issuance high yield share from Greenwood and Hanson (2013), respectively.

Table 3: Household Debt Expansions Predict Lower Subsequent Growth

	Dependent variable: $\Delta_3 y_{it+3}$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta_3(PD/Y)_{it-1}$	-0.119**						
	(0.0297)						
$\Delta_3(HHD/Y)_{it-1}$		-0.366**		-0.337**	-0.333**	-0.340**	-0.192+
		(0.0691)		(0.0675)	(0.0641)	(0.0722)	(0.0975)
$\Delta_3(FD/Y)_{it-1}$			-0.0978*	-0.0411	-0.0464	-0.0235	-0.0498
			(0.0363)	(0.0328)	(0.0332)	(0.0387)	(0.0358)
$\Delta_3(GD/Y)_{it-1}$						0.0534	
						(0.0441)	
$\Delta_3(HHD/Y)_{it-1} \times \mathbf{1}_{\Delta_3 NFD_{it-1}>0}$							-0.235
							(0.143)
$\mathbf{1}_{\Delta_3 NFD_{it-1}>0}$							0.736
							(0.874)
R^2	0.087	0.123	0.036	0.128	0.131	0.126	0.181
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓
Distributed lag in Δy					✓	✓	✓
Observations	695	695	695	695	695	627	636

Notes: This table reports regression estimates of real GDP growth from t to $t+3$ on the change in household and non-financial firm debt to GPD from the end of $t-4$ to the end of $t-1$. Column (6) includes the increase in government debt to GDP over the same period. All specifications include country fixed effects. Standard errors in parentheses are clustered at the country level. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 4: Household Debt Expansions Predict Lower Growth: Subsamples and Alternative Variables

	Dependent variable: $\Delta_3 y_{it+3}$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta_3(HHD/Y)_{it-1}$	-0.367**	-0.258*	-0.409**	-0.233**	-0.351**	-0.306**	-0.329**	-0.367**	
	(0.0831)	(0.0940)	(0.101)	(0.0779)	(0.0718)	(0.0746)	(0.0766)	(0.0708)	
$\Delta_3(FD/Y)_{it-1}$	-0.0247	-0.0768	0.0218	-0.0471	-0.0468	-0.0532	-0.0562	-0.0203	
	(0.0312)	(0.0865)	(0.0522)	(0.0288)	(0.0334)	(0.0496)	(0.0399)	(0.0308)	
$(\Delta_3 HHD_{it-1})/Y_{it-4}$									-0.289**
									(0.0667)
$(\Delta_3 FD_{it-1})/Y_{it-4}$									0.0235
									(0.0348)
R^2	0.157	0.081	0.099	0.068	0.158	0.120	0.151	0.119	0.150
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sample	Developed	Emerging	Pre 1990	Pre 2000	Post 1980	N.O. 1	N.O. 2	N.O. 3	Full
Observations	529	166	227	436	617	221	233	241	695

Notes: This table reports regression estimates of real GDP growth from t to $t+3$ on the change in household and non-financial firm debt to GPD from $t-4$ to $t-1$ (columns 1-8) and the change in household and non-financial firm debt from $t-4$ to $t-1$ normalized by GDP in $t-4$ (column 9). All specifications include country fixed effects. Emerging market economies are the Czech Republic, Hong Kong, Hungary, Indonesia, Korea, Mexico, Poland, Singapore, Thailand, and Turkey. Developed economies are the remaining countries. The Pre 1990, Pre 2000, and Post 1980 samples refer to the observations for which $t \leq 1990$, $t \leq 2000$, and $t \geq 1980$, respectively. Samples N.O. 1, 2, and 3 refer to the three samples of non-overlapping dependent variable observations. Standard errors in parentheses are clustered at the country level. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 5: Household Debt Expansion Predicts Increasing Unemployment Rate

	Full Sample			Subsamples	
	(1)	(2)	(3)	(4)	(5)
	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$
$\Delta_3(PD/Y)_{it-1}$	0.0605**				
	(0.0138)				
$\Delta_3(HHD/Y)_{it-1}$		0.132**	0.105**	0.133**	0.150**
		(0.0320)	(0.0313)	(0.0460)	(0.0409)
$\Delta_3(FD/Y)_{it-1}$		0.0363**	0.0373**	0.0377+	0.0491**
		(0.0129)	(0.0121)	(0.0190)	(0.0170)
Δu_{it-1}			-0.343**		
			(0.114)		
Δu_{it-2}			-0.236**		
			(0.0806)		
Δu_{it-3}			-0.292*		
			(0.117)		
R^2	0.119	0.145	0.207	0.121	0.183
Country Fixed Effects	✓	✓	✓	✓	✓
Sample	Full	Full	Full	Pre 2000	OECD Harm.
Observations	662	662	638	410	527

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 GPD from $t-4$ to $t-1$. All columns include country fixed effects. The OECD Harm. sample refers to the sub-sample of country-years where the unemployment rate measure is the OECD Harmonized unemployment rate. Standard errors in parentheses are clustered at the country level. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 6: Rise in Household Debt Predicts Overoptimistic IMF and OECD Growth Forecasts

	Growth Forecast		Forecast Error $e_{t+h\|t}$ and Forecast Revision $rev_{t+2\|t,t+1}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$\Delta_2 y^{IMF}_{t+2\|t}$	$\Delta_2 y^{OECD}_{t+2\|t}$	$e^{IMF}_{t+1\|t}$	$e^{IMF}_{t+2\|t}$	$e^{IMF}_{t+3\|t}$	$e^{OECD}_{t+1\|t}$	$e^{OECD}_{t+2\|t}$	$e^{IMF}_{t+1\|t}$	$e^{OECD}_{t+1\|t}$	$rev^{OECD}_{t+2\|t,t+1}$
$\Delta_3(HHD/Y)_{it-1}$	0.0016	0.0013	-0.060**	-0.17**	-0.31**	-0.070**	-0.17**	-0.068+	-0.060**	-0.031**
	(0.025)	(0.022)	(0.018)	(0.043)	(0.073)	(0.013)	(0.038)	(0.033)	(0.018)	(0.0090)
$\Delta_3(FD/Y)_{it-1}$	-0.029*	-0.041*	-0.019+	-0.026	-0.031	-0.013	-0.0084	-0.018	-0.013	-0.014**
	(0.013)	(0.015)	(0.010)	(0.025)	(0.037)	(0.0090)	(0.020)	(0.011)	(0.0092)	(0.0041)
$\Delta_3(HHD/Y)_{it-1} \times \mathbf{1}_{t>2000}$								0.00080	-0.019	
								(0.035)	(0.029)	
$\mathbf{1}_{t>2000}$								0.27	0.073	
								(0.24)	(0.34)	
R^2	0.034	0.064	0.026	0.063	0.132	0.040	0.073	0.029	0.041	0.049
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	484	471	590	484	484	594	471	590	594	462

Notes: This table reports regression estimates of GDP growth forecasts, forecast errors, and forecast revisions 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 at in the Fall of year t. 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 forecast revisions are the difference between the forecast of year $t+2$ growth made in year $t+1$ and the forecast of year $t+2$ growth from year t: $rev_{t+2|t,t+1} = \Delta y_{t+2|t+1} - \Delta y_{t+2|t}$. The *World Economic Outlook* forecast sample includes all 30 countries our 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 from 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. $\mathbf{1}_{t>2000}$ is an indicator variable that equals one in all years after 2000. All columns include country fixed effects. Standard errors in parentheses are clustered at the country level. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 7: Household Debt Increases Finance Consumption Booms

	(1) $\Delta_1 \frac{C}{Y}_{it}$	(2) $\Delta_1 \frac{NX}{Y}_{it}$	(3) $\Delta_1 \frac{CA}{Y}_{it}$	(4) $\Delta_1 s^{MC}_{it}$	(5) $\Delta_1 s^{XC}_{it}$	(6) $\Delta_1 reer_{it}$
$\Delta_1(HHD/Y)_{it}$	0.120**	-0.173*	-0.185*	0.152**	0.0371	0.153
	(0.0402)	(0.0665)	(0.0843)	(0.0361)	(0.0326)	(0.130)
$\Delta_1(FD/Y)_{it}$	0.0249+	-0.0167	-0.0125	-0.0261	-0.0400+	-0.235*
	(0.0126)	(0.0205)	(0.0186)	(0.0167)	(0.0204)	(0.100)
R^2	0.082	0.041	0.037	0.042	0.013	0.030
Country Fixed Effects	✓	✓	✓	✓	✓	✓
Observations	688	695	648	695	695	614

Notes: This table shows the contemporaneous correlation between the change in household and firm debt to GDP and the change in consumption to GDP, net exports to GDP, the current account to GDP, the share of consumption imports in total imports, the share of consumption exports in total exports, and the log real effective exchange rate. An increase in *reer* is an appreciation of the real effective exchange rate. All specifications include country fixed effects. Standard errors in parentheses are clustered at the country level. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 8: Heterogeneity across Exchange Rate Regimes

	Fixed	Intermediate	Freely floating		Freely floating excl. Japan	
	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$
$\Delta_3(HHD/Y)_{it-1}$	-0.53**	-0.31**	-0.067	0.016	-0.24	-0.16
	(0.14)	(0.062)	(0.16)	(0.10)	(0.21)	(0.15)
$\Delta_3(FD/Y)_{it-1}$	-0.11*	-0.012	0.052	0.074	-0.15*	-0.13+
	(0.054)	(0.040)	(0.13)	(0.13)	(0.026)	(0.045)
$\Delta_3(HHD/Y)_{it-1} \times ZLB$				-0.59*		-0.72**
				(0.21)		(0.080)
R^2	0.281	0.114	0.032	0.088	0.367	0.487
Country Fixed Effects	✓	✓	✓	✓	✓	✓
Distributed lag in Δy	✓	✓	✓	✓	✓	✓
Observations	222	342	120	120	88	88

Notes: This table estimates 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%). Columns 4 and 6 interact the expansion in household debt with a dummy variable, ZLB, that equals 1 if the three month T-bill yield is below 1% in year $t, t+1, t+2$, or $t+3$. All columns include country fixed effects and three lags in GDP growth. Standard errors in parentheses are clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Table 9: Credit Supply, Debt Growth, and Output Growth

Panel A: Country spread in $t-4$ spr_{it-4} as an instrument for credit expansion

	First stage			IMF Forecast	IV		
	(1) $\Delta_3 \frac{PD}{Y}_{it-1}$	(2) $\Delta_3 \frac{HHD}{Y}_{it-1}$	(3) $\Delta_3 \frac{HHD}{Y}_{it-1}$	(4) $\Delta_3 y^{IMF}_{t-1\|t-4}$	(5) $\Delta_3 y_{it+3}$	(6) $\Delta_3 y_{it+3}$	(7) $\Delta_3 y_{it+3}$
spr_{it-4}	-2.715**	-0.934**	-0.917**	0.00368			
	(0.696)	(0.240)	(0.218)	(0.132)			
$\Delta_3(PD/Y)_{it-1}$					-0.249**		
					(0.0791)		
$\Delta_3(HHD/Y)_{it-1}$						-0.723**	-0.746**
						(0.237)	(0.246)
R^2	0.136	0.112	0.127	0.000	0.211	0.206	0.197
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓
Distributed Lag in Δy			✓				✓
F statistic	15.2	15.2	17.6				
Observations	547	547	547	334	547	547	547

Panel B: Average U.S. high-yield share between $t-3$ to $t-1$ as an instrument for U.S. credit expansion

	OLS	First stage			IV		
	(1) $\Delta_3 y_{it+3}$	(2) $\Delta_3 \frac{PD}{Y}_{it-1}$	(3) $\Delta_3 \frac{HHD}{Y}_{it-1}$	(4) $\Delta_3 \frac{HHD}{Y}_{it-1}$	(5) $\Delta_3 y_{it+3}$	(6) $\Delta_3 y_{it+3}$	(7) $\Delta_3 y_{it+3}$
Avg HYS, t-3 to t-1		0.214**	0.167*	0.167*			
		(0.0669)	(0.0704)	(0.0729)			
$\Delta_3(PD/Y)_{it-1}$					-0.507+		
					(0.263)		
$\Delta_3(HHD/Y)_{it-1}$	-0.441**					-0.650*	-0.644+
	(0.158)					(0.310)	(0.333)
R^2	.22	.234	.26	.273	.023	.17	.217
Distributed Lag in Δy				✓			✓
F statistic		10.26	5.632	5.271			
Observations	46	46	46	46	46	46	46

Notes: Panel A reports instrumental variables regressions using the spread on 10 year government bond yields with respect to the yield on the U.S. 10 year treasury note, spr_{it-4}, as an instrument for the expansion in private or household debt to GDP between $t-4$ and $t-1$. These regression therefore exclude the United States. Column (4) shows the correlation between the $t-4$ sovereign spread and the IMF's $t-4$ forecast of GDP growth from $t-4$ to $t-1$. Columns (3) and (7) include three real GDP growth lags, $\Delta y_{it-1}, \Delta y_{it-2}$, and Δy_{it-3}, as controls. Standard errors in parentheses are clustered at the country level.
Panel B shows instrumental variables time series regressions for the United States using the average high yield share during over $t-3$ to $t-1$ as an instrument for the expansion in private or household debt to GDP between $t-4$ and $t-1$. The high yield share is from Greenwood and Hanson (2013) and is defined as the share of non-financial corporate bond issuance in each year with a high yield rating from Moody's. Columns (4) and (7) include three real GDP growth lags, $\Delta y_{it-1}, \Delta y_{it-2}$, and Δy_{it-3}, as controls. Newey-West HAC standard errors in parentheses with a truncation parameter of 6.
+,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 10: Predicting Components of GDP

Panel A: Domestic components

	(1) $\Delta_3 c_{it+3}$	(2) $\Delta_3 \frac{C}{Y}_{it+3}$	(3) $\Delta_3 s^{Cdur}_{it+3}$	(4) $\Delta_3 c^{dur}_{it+3}$	(5) $\Delta_3 c^{nondur}_{it+3}$	(6) $\Delta_3 i_{it+3}$	(7) $\Delta_3 g_{it+3}$
$\Delta_3(HHD/Y)_{it-1}$	-0.33**	0.032	-0.11**	-1.38**	-0.17+	-1.21**	-0.018
	(0.061)	(0.028)	(0.017)	(0.27)	(0.086)	(0.23)	(0.058)
$\Delta_3(FD/Y)_{it-1}$	-0.030	0.011	0.0039	-0.087	-0.032	-0.13	-0.056*
	(0.032)	(0.013)	(0.0081)	(0.12)	(0.025)	(0.099)	(0.023)
R^2	0.106	0.015	0.232	0.217	0.057	0.154	0.018
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓
Observations	679	690	405	405	405	679	687

Panel B: External components

	(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) $\Delta_3 s^{MC}_{t+3}$	(6) $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$	(7) $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$
$\Delta_3(HHD/Y)_{it-1}$	0.17**	0.43**	-0.097	-0.27*	-0.064*	0.060	0.12*
	(0.045)	(0.14)	(0.092)	(0.11)	(0.027)	(0.048)	(0.052)
$\Delta_3(FD/Y)_{it-1}$	0.018	0.088	-0.028	-0.046	0.0045	0.025+	0.017
	(0.015)	(0.053)	(0.060)	(0.058)	(0.014)	(0.012)	(0.018)
$\Delta_3(HHD/Y)_{it-1} \times \text{openness}_i$						0.16**	0.13**
						(0.030)	(0.033)
R^2	0.060	0.048	0.004	0.021	0.014	0.076	0.189
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓
Year Fixed Effects							✓
Observations	695	695	695	695	695	695	695

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 $t-1$. s^{Cdur} is the share of durable consumption in total consumption expenditure. openness_i is the average imports plus exports to GDP ratio during the sample period. See table 2 for definitions of other variables. Standard errors in parentheses are clustered at the country level. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 11: Global Household and Firm Debt and Global Growth

	Dependent variable: global average $\Delta_3 y_{t+3}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Global $\Delta_3 \frac{HHD}{Y}_{t-1}$	-1.094**		-1.097**	-0.971*	-0.797**	-0.966**
	(0.300)		(0.311)	(0.366)	(0.239)	(0.252)
Global $\Delta_3 \frac{FD}{Y}_{t-1}$		-0.103	0.00896	0.213	-0.201	-0.0756
		(0.192)	(0.177)	(0.231)	(0.122)	(0.149)
Global Δy_{t-1}						0.341
						(0.244)
Global Δy_{t-2}						0.390+
						(0.224)
Global Δy_{t-3}						0.477+
						(0.258)
Sample	Full	Full	Full	Pre 2000	Post 1980	Full
R^2	.295	.007	.295	.146	.437	.471
Observations	46	46	46	37	30	46

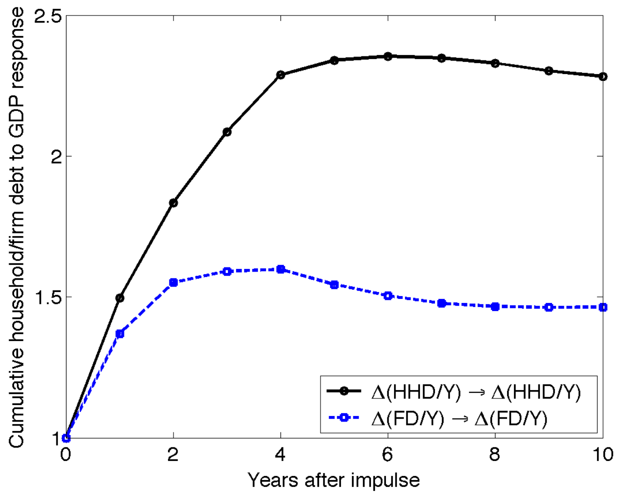
Notes: This table reports time series regressions of the sample average real GDP growth from t to $t+3$ on the sample average change in household and firm debt to GDP from $t-4$ to $t-1$. Newey-West standard errors in parentheses with 6 lags. +,*,** indicates significance at the 0.1, 0.05, 0.01 level,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

Table 12: Debt Expansions, Growth, and the Correlation with the Global Household Debt Cycle

	$\Delta_3 y_{it+3}$				$\Delta_3 \frac{NX}{Y}_{it+3}$		$\Delta_3 \frac{X}{Y}_{it+3}$	$\Delta_3 \frac{M}{Y}_{it+3}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_3(HHD/Y)_{it-1}$	-0.222*	-0.221**	-0.216*	-0.216*	0.204**	0.206**	0.261*	0.0576
	(0.0975)	(0.0693)	(0.0904)	(0.0880)	(0.0492)	(0.0522)	(0.126)	(0.118)
$\Delta_3(FD/Y)_{it-1}$	-0.0385	-0.0379	-0.0377	-0.0579*	0.0114	0.00457	-0.00116	-0.0125
	(0.0330)	(0.0298)	(0.0309)	(0.0268)	(0.0134)	(0.0131)	(0.0349)	(0.0348)
$\Delta_3(HHD/Y)_{it-1} \times \rho_i^{Global}$	-0.333+		-0.0239	-0.0333	-0.210*	-0.105	-0.512*	-0.302
	(0.179)		(0.173)	(0.171)	(0.0869)	(0.0887)	(0.203)	(0.188)
$\text{Global}_{-i}\Delta_3 \frac{HHD}{Y}_{it-1}$				-0.718**		-0.252*		
				(0.152)		(0.0950)		
R^2	0.150	0.493	0.493	0.214	0.077	0.100	0.055	0.021
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Year Fixed Effects		✓	✓					
Observations	695	695	695	695	695	695	695	695

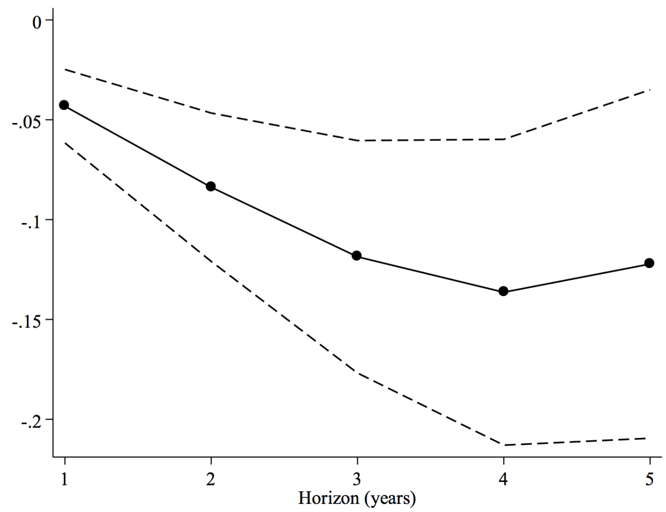
Notes: The variable ρ_i^{Global} is the correlation between country i's three-year household debt expansion and the sample average household debt expansion excluding country i given by equation (10). All specifications include country fixed effects. Standard errors in parentheses are clustered at the country level. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Figure 1: Impulse Responses of the Change in Household and Firm Debt to GDP



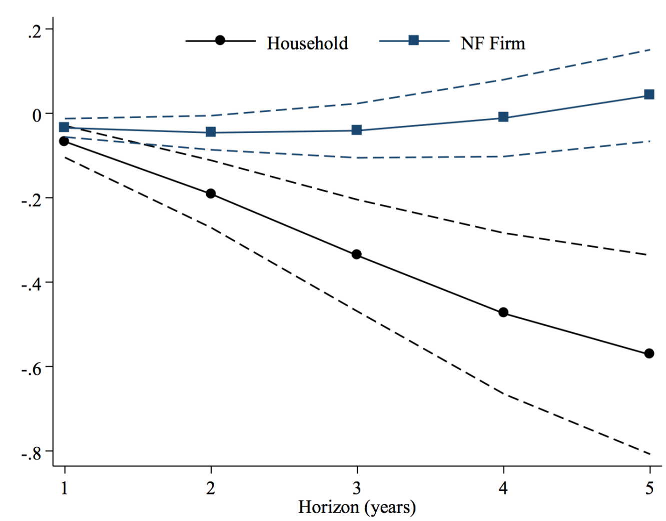
Notes: The black solid line shows the cumulative response to a one unit shock to the change in household debt to GDP from an AR(5) model with an intercept. The blue dash line shows the cumulative response for an AR(5) in the firm debt to GDP change. Both AR models are estimated in the pooled 30 country sample.

Figure 2: Three-Year Increase in Private Debt to GDP and Subsequent Growth



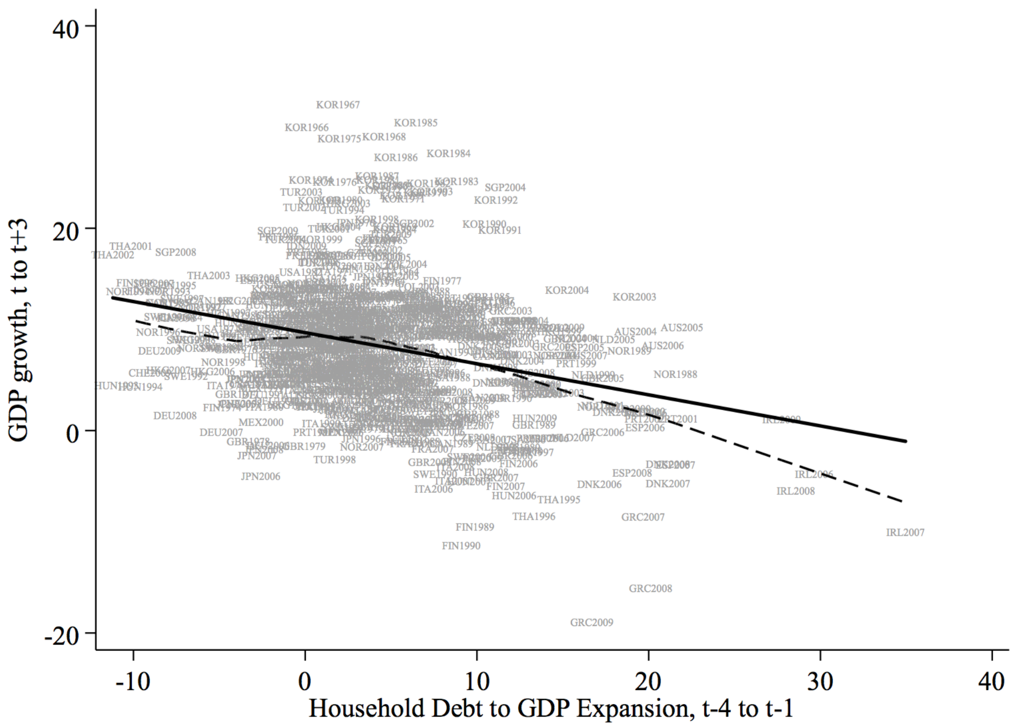
Notes: This figure plots $\{\hat{\beta}^h\}$ from the following specification estimated at each horizon h: $y_{it+h} - y_{it} = \alpha_i^h + \beta^h \Delta_3 \frac{PD_{it-1}}{Y_{it-1}} + \epsilon_{it+h}$. Each regression includes country fixed effects. The solid line plots the estimates $\{\hat{\beta}^h\}$. Dash lines represent 95% confidence intervals, computed using standard errors clustered at the country level.

Figure 3: Three-Year Increase in Household and Firm Debt to GDP and Subsequent Growth

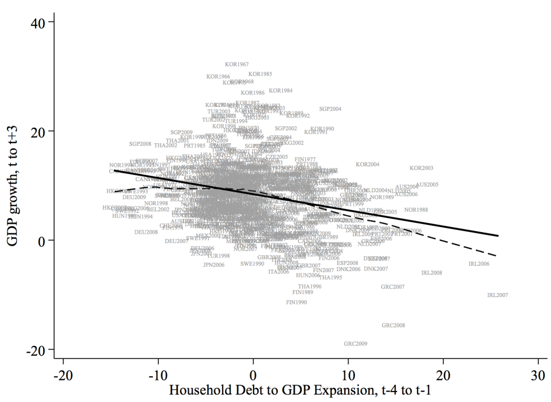


Notes: The figure plots $\{\beta_{HH}^h, \beta_F^h\}$ from the following specification estimated at each horizon h: $y_{it+h} - y_{it} = \alpha_i^h + \beta_{HH}^h \Delta_3 \frac{HHD_{it-1}}{Y_{it-1}} + \beta_F^h \Delta_3 \frac{FD_{it-1}}{Y_{it-1}} + \epsilon_{it+h}$. Each regression includes country fixed effects. The solid circle and square lines plot the estimates $\{\hat{\beta}_{HH}^h, \hat{\beta}_{NF}^h\}$. Dash lines represent 95% confidence intervals, computed using standard errors clustered at the country level.

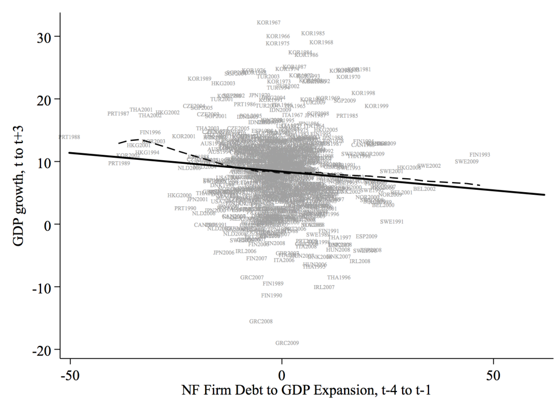
Figure 4: Household Debt to GDP Expansion and Growth



(a) Household Debt



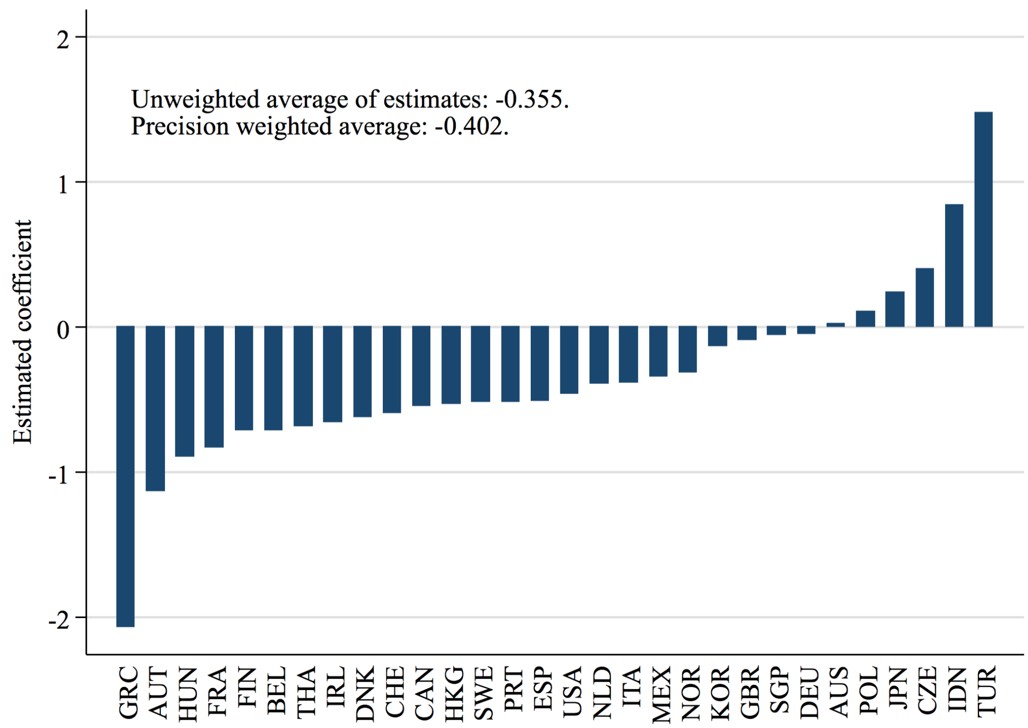
(b) Household Debt, Partial Correlation



(c) NF Firm Debt, Partial Correlation

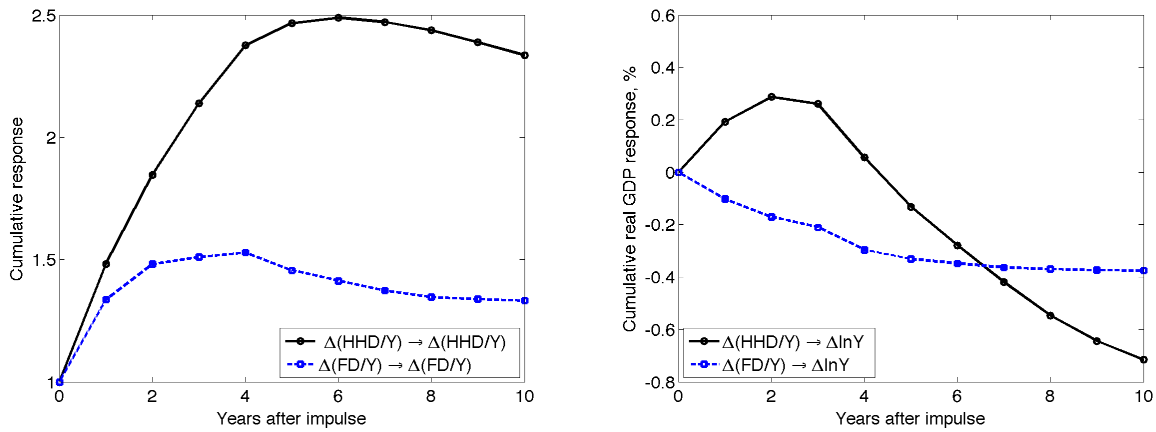
Notes: This figure plots the relationship between GDP growth from t to $t+3$ and the expansion in household and firm debt to GDP from $t-4$ to $t-1$. Each point refers to year t. The dash line is the non-parametric plot of GDP growth from t to $t+3$ against the increase in household or firm debt to GPD from $t-4$ to $t-1$. In panels (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 5: Estimates of $\beta_{HH,i}$ for Each Country Individually



Notes: This figure plots $\beta_{HH,i}$ from the time series regression, $y_{it+3} - y_{it} = \beta_0 + \beta_{HH,i}\Delta_3 \frac{HHD_{it-1}}{Y_{it-1}} + \sum_{j=1}^{3} \gamma_j \Delta y_{it-j} + \epsilon_{it+3}$, estimated separately for each country i in the sample. Regressions for Ireland (IRL) and Indonesia (IDN) control for $\Delta_3 y_{it-1}$ instead of a distributed lag in GDP growth as a consequence of the limited degrees of freedom. The unweighted average of the estimates refers to the raw average of the coefficients in the figure, and the precision weighted average is the average weighted by the inverse of the squared standard error.

Figure 6: Responses to Household and Firm Debt to GDP Increases in a Three-Variable VAR

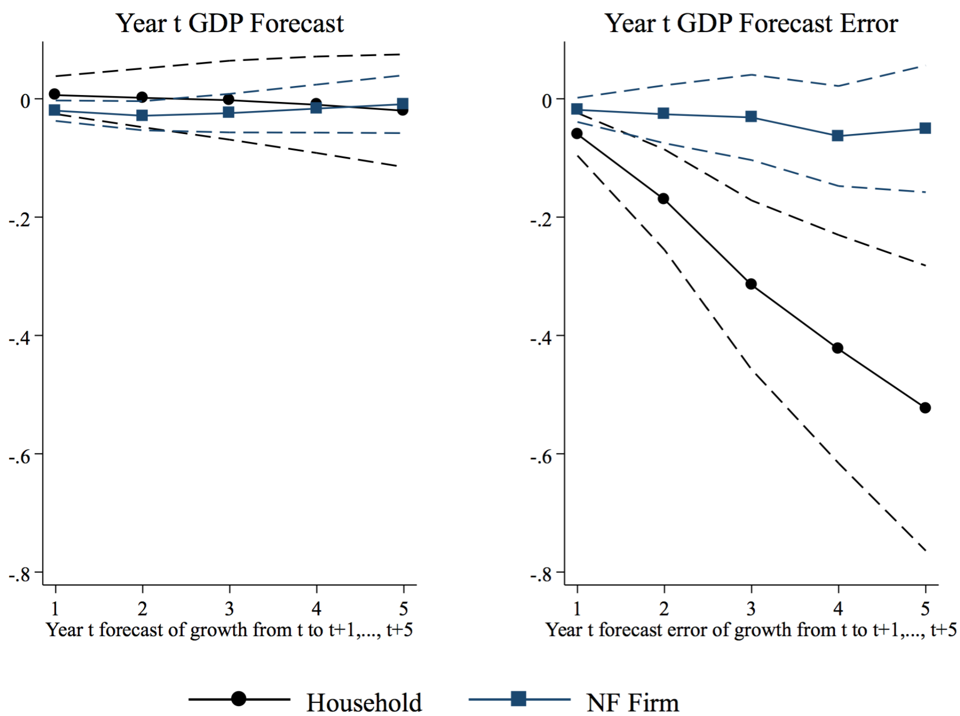


(a) Debt to GDP response

(b) Real GDP response

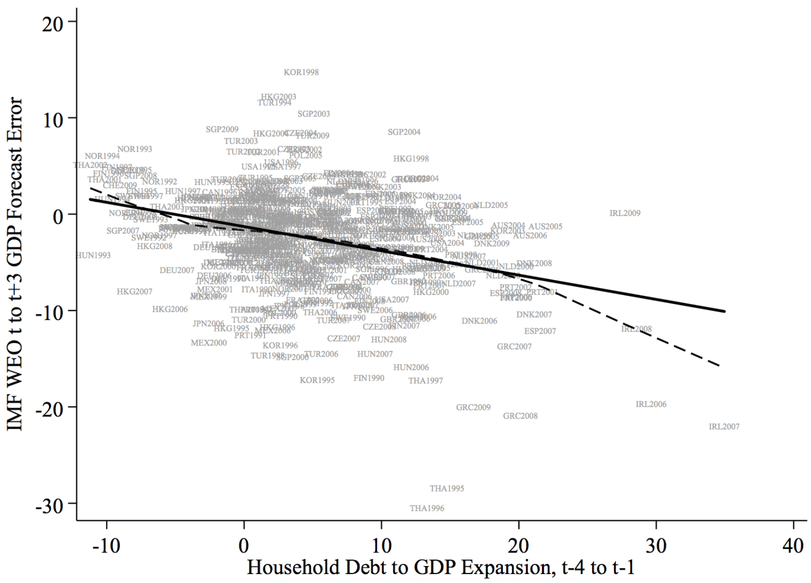
Notes: This figure shows cumulative impulse responses to household and firm debt to GDP shocks from a three variable recursive VAR in real GDP growth, the change in firm debt to GDP, and the change in household debt to GDP ,$(\Delta \ln Y_{it}, \Delta(FD/Y)_{it}, \Delta(HHD/Y)_{it})$. The impulse responses are from a VAR estimated on the pooled 30 country sample.

Figure 7: Debt Expansions and Subsequent IMF Forecasts and Forecast Errors

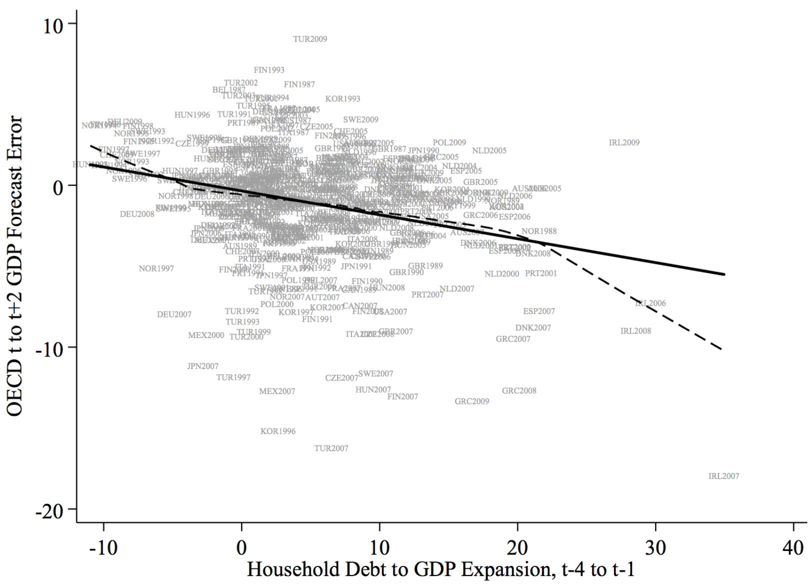


Notes: The left panel plots coefficient estimates from estimating: $\Delta_h y^{IMF}_{t+h|t} = \alpha^h_i + \beta^h_{HH}\Delta_3 \frac{HHD_{it-1}}{Y_{it-1}} + \beta^h_F \Delta_3 \frac{FD_{it-1}}{Y_{it-1}} + \epsilon_{it+h}$, where $\Delta_h y^{IMF}_{t+h|t}$ is the IMF forecast of growth from t to $t+h$ made in year t. The right panel shows estimates from the same equation where the dependent variable is the forecast error. Dash lines represent 95% confidence intervals, computed using standard errors clustered at the country level. See Table 6 for details on the IMF *World Economic Outlook* forecasts.

Figure 8: Household Debt Expansion Predicts Negative GDP Growth Forecast Errors



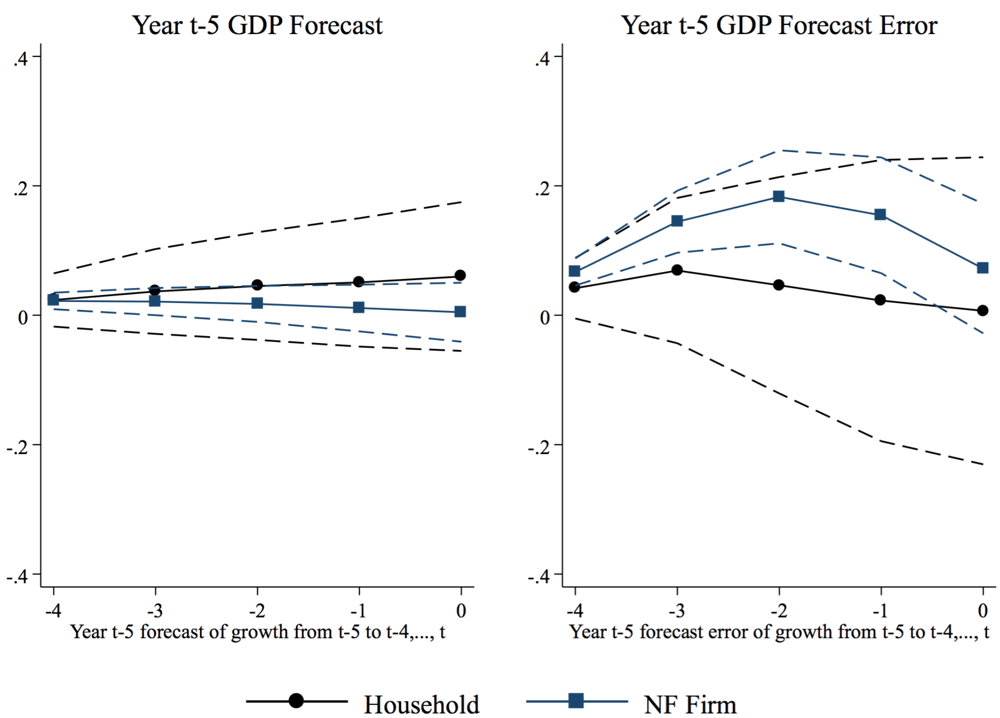
(a) IMF *World Economic Outlook* Forecast Errors



(b) *OECD Economic Outlook* Forecast Errors

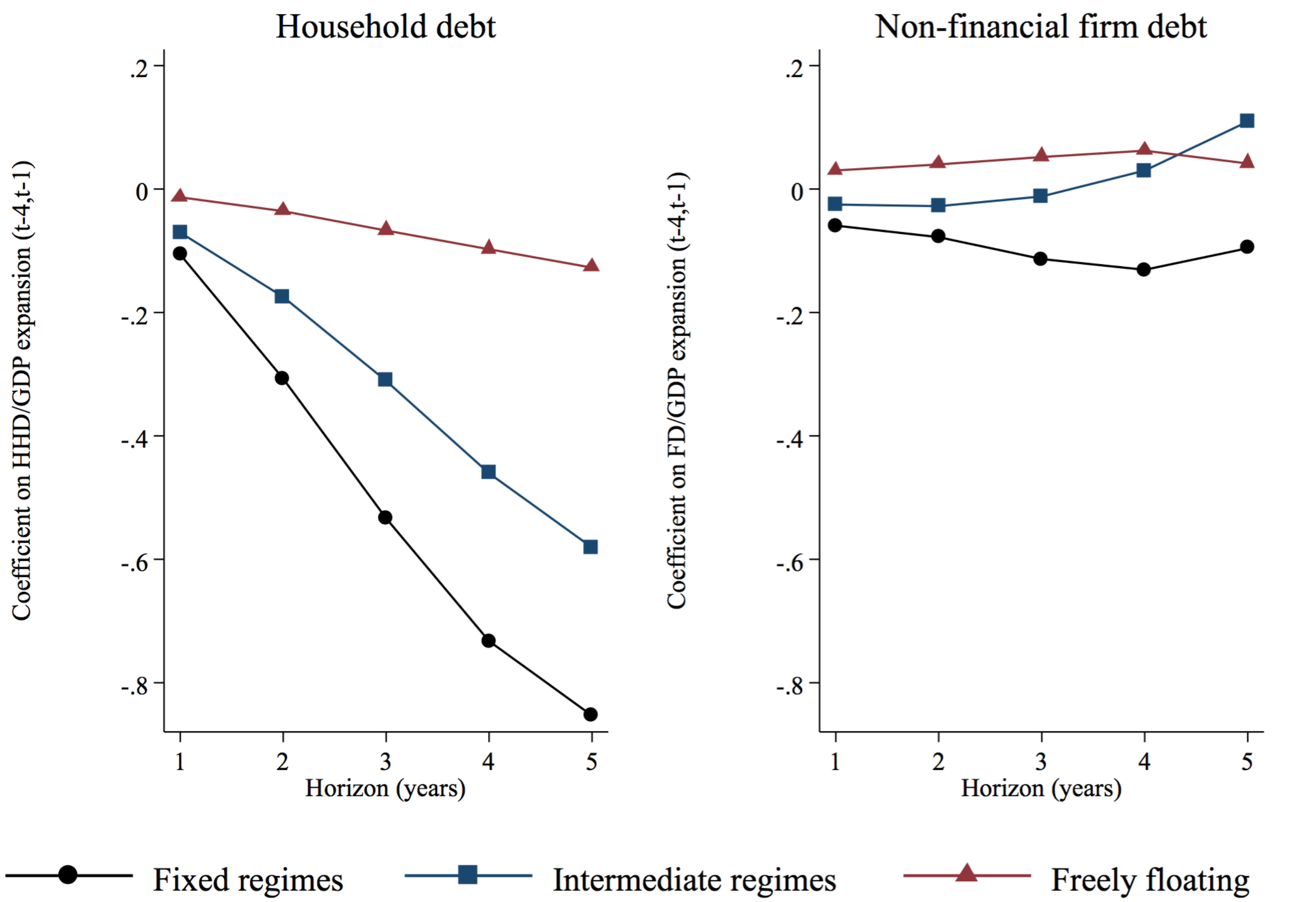
Notes: Panel (a) plots the three-year GDP forecast error from the Fall issue of the IMF *World Economic Outlook* against the change in household debt to GDP from $t-4$ to $t-1$. The sample includes years 1990-2012. Panel (b) plots the two-year GDP forecast error from the Fall *OECD Economic Outlook* against the change in household debt to GDP from $t-4$ to $t-1$. The 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 9: Debt Expansions and Preceding IMF Forecasts



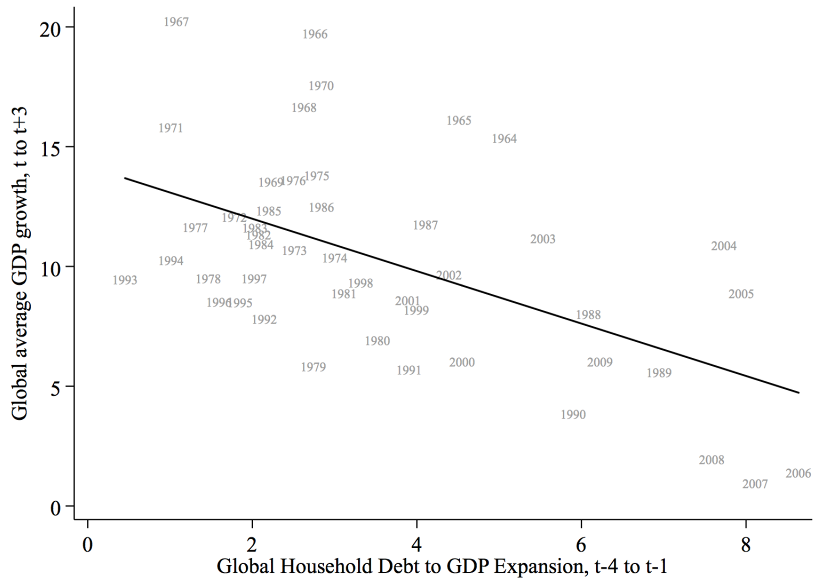
Notes: The left panel plots coefficient estimates from estimating: $\Delta_h y^{IMF}_{it-5+h|t-5} = \alpha^h_i + \beta^h_{HH}\Delta_3\frac{HHD_{it-1}}{Y_{it-1}} + \beta^h_F\Delta_3\frac{FD_{it-1}}{Y_{it-1}} + \epsilon_{it-5+h}$, where $\Delta_h y^{IMF}_{t+h-5|t-5}$ is the IMF forecast of growth from $t-5$ to $t-5+h$ made in year $t-5$. The right panel shows estimates from the same equation where the dependent variable is the forecast error. Dash lines represent 95% confidence intervals, computed using standard errors clustered at the country level. See Table 6 for details on the IMF *World Economic Outlook* forecasts.

Figure 10: Debt Expansions and Subsequent Growth Across Exchange Rate Regimes

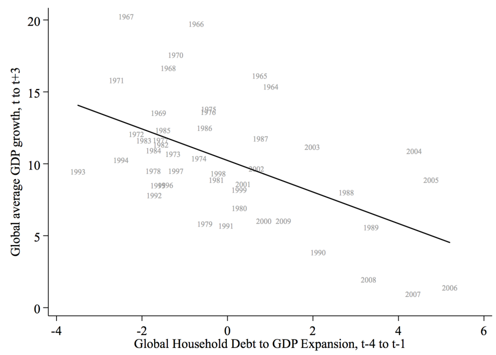


Notes: This figure reports results from estimating the following specification separately for fixed, intermediate, and floating exchange rate regimes: $\Delta_h y_{it+h} = \alpha_i^h + \beta_{HH}^h \Delta \frac{HHD_{it-1}}{Y_{it-1}} + \beta_F^h \Delta \frac{FD_{it-1}}{Y_{it-1}} + \sum_{j=1}^{3} \gamma_j^h \Delta y_{it-j} + \epsilon_{it+h}$. The left and right panels show the estimates of β_{HH}^h and β_F^h, respectively, for $h = 1, ...5$. See Table 8 for details on classifying observations by exchange rate regime.

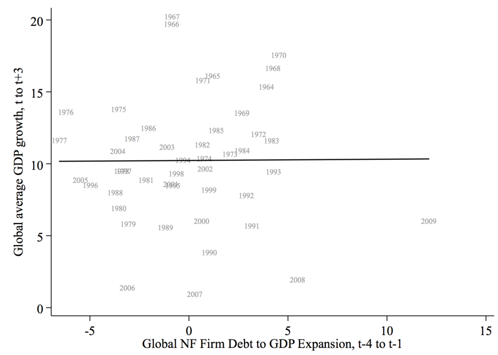
Figure 11: Global Household Debt Expansions and Global Growth



(a) Household Debt



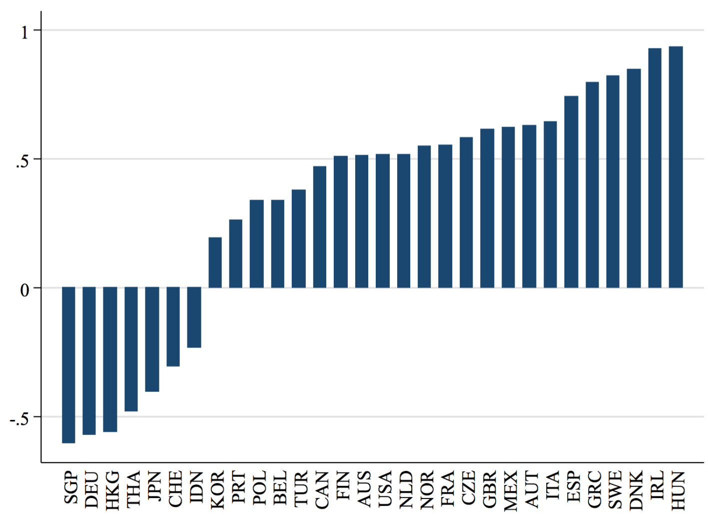
(b) Household Debt, Partial Correlation



(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.

Figure 12: Correlation with World Household Debt Cycle



Note: This figure shows the correlation between the three-year household debt to change for country i and the average change for all countries excluding i: corr $\left(\left(\Delta_3 \frac{HHD}{Y}\right)_{it}, \frac{1}{N-1} \sum_{j \neq i} \left(\Delta_3 \frac{HHD}{Y}\right)_{jt}\right)$.