Household Debt and Global Growth

Atif Mian
Princeton University and NBER

Amir Sufi
University of Chicago Booth School of Business and NBER

Emil Verner
Princeton University

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Abstract

A sustained increase in the household debt to GDP ratio over three to four years *negatively* forecasts output growth in a panel of mostly advanced economies. The increase is contemporaneously associated with a rise in the consumption share of output, a worsening of the current account balance, and a rise in the share of imported consumption goods. A rise in household debt forecasts external adjustment as net exports to GDP increase, and the increase in net exports is driven by sharp decline in imports. The external adjustment mechanism is stronger for more open economies. An increase in household debt forecasts more negative output growth in countries with a household debt cycle more correlated with the global household debt cycle. A rise in the global household debt to GDP ratio over three to four years negatively forecasts global growth, and the magnitude is large. For example, the estimated forecasting relationship using pre-2000 data can statistically "explain" the post-2007 slowdown in global growth given the large run-up in household debt during the 2000s.

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1 Introduction

There has been a rapid expansion in global credit – especially credit to the household sector – over the last many decades in advanced economies. Jordà et al. (2014a) show that bank lending to GDP *doubled* between 1980 and 2010. Data from the Bank for International Settlements shows that per capita credit to the household and non-financial corporate sectors in OECD countries grew at an average annual pace of 11.2% and 8.7%, respectively, between 1980 and 2012.[1] Is the rapid rise in global debt – particularly household debt – a point of concern, or does it simply reflect the financial development process?

Cross-sectional evidence from recent recessions in the United States and Europe using sub-regional data (see e.g. Mian and Sufi (2014a), Glick and Lansing (2010), and IMF (2012)) shows that regions or countries seeing the largest rise in household debt during the boom saw the biggest decline in economic activity during the bust. Are the negative consequences of an excessive increase in household debt limited to the most recent episode, or are they reflective of a broader phenomena across advanced economies and over time? This paper addresses these questions by exploring the link between growth and private debt in general, and between growth and household debt in particular.

Our conceptual starting point is the standard open economy macro model with a representative agent economy. This work-horse model of international macro predicts a *positive* forecasting relationship between growth in debt and subsequent growth in GDP. In particular, a rise in debt is driven either by expected future positive productivity shocks, or a transitory negative current productivity shock. In both cases, growth in debt forecasts positive growth in output.

More recent theoretical work departs from the representative agent model, and it highlights the potential dangers of debt. For example, Eggertsson and Krugman (2012) and Guerrieri and Lorenzoni (2011) 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. As we show below, one implication of these models is that rapid growth in private debt may *negatively* forecast economic

[1] Based on 26 OECD countries with household and non-financial firm credit data available from the BIS.

growth.

We build a long panel data set of 30 (mostly advanced) economies from 1960 to 2012 to test the core predictions of the standard open economy model versus the more recent heterogenous agent models. We use the recently introduced private debt series from the BIS that breaks down total private debt in each country into household debt and non-financial firm debt. Our results uncover a number of new findings that highlight the importance of household debt in forecasting a subsequent slowdown in output growth.

Our initial set of results employs panel vector-auto regressions (VARs) to explore the relation between private debt and GDP growth. The impulse response function of GDP growth to private debt shows that an increase in the private debt to GDP ratio forecasts *lower* GDP growth. This finding contradicts open economy representative agent-based macroeconomic models, and supports models with heterogeneity. The negative effect of private debt on GDP growth is driven by a short-run small negative effect of the non-financial firm debt to GDP ratio on growth and a longer-run large negative effect of the household debt to GDP ratio on growth.

The household debt forecasting power is especially strong, and we utilize the panel VARs to explore the timing of the effect in more detail. An initial shock to the household debt to GDP ratio shows medium-run persistence, boosting the household debt to GDP ratio every year for four years before dissipating. During the first three years after the initial shock, GDP growth increases slightly. From three to 10 years after the initial shock, GDP growth collapses. The panel VAR evidence suggests that an initial shock to household debt to GDP persists for three to four years, after which it stalls. Growth collapses contemporaneously with the slowdown in household debt growth.

We use the panel VAR evidence to motivate a single equation estimation strategy in which we regress GDP growth from this year to three years into the future on the increase in the household debt to GDP ratio from four years ago to last year. The timing of our single equation strategy matches the medium-run timing of the initial shock shown in the panel VAR impulse responses. In other words, our single equation strategy is meant to capture the relatively slow-moving nature of the household debt shock.

Using this single equation estimation strategy, we show a number of results to help unpackage why household debt forecasts lower growth. The negative forecasting power of private domestic debt at the medium-term horizon is entirely driven by the household debt component. Growth in non-financial firm debt has no independent forecasting power for GDP growth. The strong negative forecasting power of growth in household debt for output growth is robust to a number of different specification checks, and is not driven by either a small set of countries or a specific time period. A one standard deviation increase in the change in household debt from four years ago to last year (6.2 percentage points) is associated with 2.3% lower growth over the subsequent three years.

The growth in household debt also strongly forecasts an increase in the unemployment rate. This suggests that the GDP forecasting result reflects under-utilization after a sustained three to four year rise in household debt.

The results also show that the rise in household debt during the boom 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.

While stronger growth in household debt negatively forecasts growth in output and its main components, the net export margin adjusts in the opposite direction. In particular, a sustained increase in household debt forecasts *stronger* 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 stronger rise in exports. Moreover, the external adjustment mechanism is stronger for countries that are more reliant on international trade.

Our initial set of results focuses on the forecasting power of country-specific household debt to GDP on a country's output. However, the adjustment on the external margin suggests that growth in household debt to GDP might have even stronger forecasting power for output growth if a country's household debt cycle is more correlated with the global household debt to GDP cycle. Since the rise in household debt to GDP is followed by a fall in imports, the global household debt to GDP cycle is likely to affect all countries. We test for the forecasting power of global household debt cycle using the same medium-term horizon, and we find two main results.

First, countries with a household debt to GDP cycle that is more strongly correlated with the global cycle see increases in household debt more strongly forecast a decline in output growth. This result is driven by the fact that stronger growth in global household debt to GDP ratio forecasts negative output growth for the global economy. As before, the negative forecasting result in the medium run is only associated with household debt to GDP. Growth in global non-financial firm debt to GDP has no forecasting power for global GDP growth at the medium-term horizon.

Second, the negative forecasting strength of a rise in global household debt to GDP is extremely strong and robust. In fact, the global household debt cycle is able to completely explain the decline in global growth during and after the 2007-2009 recession. More specifically, we estimate the forecasting relationship between an increase in global household debt to GDP over three years and subsequent global growth using pre-2000 data. We then use this estimated relationship to forecast global growth after the sharp rise in global debt during the mid-2000s. This out-of-sample forecast almost perfectly matches actual growth in the Great Recession and its aftermath.

We note from the outset that our empirical strategy is designed to detect a forecasting relation between an increase in household debt and subsequent growth. We do not claim that the forecasting relation reflects causation. In our view, one can only make causal statements by taking a stand on the source of variation that drives sustained booms in household debt. We take no stand on this underlying source of variation, although we discuss some potential sources based on previous research in Section 3 and in the conclusion.

A growing body of research explores the relation between private debt and various outcomes such as recession severity, growth, and stock market returns. This includes work by Schularick and Taylor (2012), Jordà et al. (2013), Jordà et al. (2014a), Jordà et al. (2014b), Cecchetti et al. (2011), and Baron and Xiong (2014). We will first present our results, and then discuss our contribution relative to the extant literature in the conclusion.

The remainder of the paper is structured as follows. The next section presents the data and summary statistics. Section 3 presents two contrasting theories of credits expansions and growth. Section 4 presents results from panel VARs. Section 5 presents results from our single equation estimation strategy, and section 6 explores the global household debt cycle. Section 7 discusses our contribution to the literature and section 8 concludes.

2 Data and Summary Statistics

This section describes the data and presents summary statistics. The data cover an unbalanced panel of advanced and emerging economies. The countries in the sample and the years that define the main sample are summarized in the first two columns of Table 1. The data are annual and range from 1960 to 2012, providing over 900 country-years before taking differences.

2.1 Household and Non-Financial Firm Debt Series

The key variables measuring expansions in credit to households and non-financial firms are the change in household debt to GDP and non-financial firm debt to GDP, denoted by $\Delta_h(HHD/Y)_t$ and $\Delta_h(FD/Y)_t$, where $\Delta_h x_t = x_t - x_{t-h}$. The variables on credit to households and non-financial firms, HHD and FD, are from the BIS's *Long series on credit to the private non-financial sector* database. The BIS 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.[2] Credit is defined as loans and debt securities financed by domestic and foreign banks, as well as non-bank financial institutions. These data on household and non-financial firm credit are the main data constraint. Table 1 documents the availability of these series by country. Half of the 30 countries in the sample have credit data extending at least as far back at 1980.

We take annual averages of the quarterly series to obtain annual measures of household and firm credit. We then scale these variables by GDP in current prices. We scale credit by 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 credit growth instead of the change in credit-to-GDP ratio. Focusing on real credit growth has the disadvantage that episodes of large real credit growth often involve small absolute increases in credit from a low initial level, which are not likely to be important from a macroeconomic perspective.[3]

[2] 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.

[3] In robustness exercises we also verify our results using an alternative measure of credit expansions that scales the change in household and non-financial firm credit-to-GDP by initial GDP, $(\Delta_h HHD_t)/Y_{t-h}$ and $(\Delta_h FD_t)/Y_{t-h}$.

2.2 National Accounts, Trade Data, and Other Series

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 expenditure, C, gross capital formation, I, and government consumption expenditure, G. In the remainder of the paper lowercase letters will be used to the denote the natural logarithms of a variable, e.g. $\ln Y = y$. 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). This data is available for 23 of the 30 countries in the sample.[4]

Data on exports, X, and imports, Im, 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, $NX = X - Im$. We also use data on the current account, CA, from the OECD or IFS. Net exports and the current account are scaled by GDP in current prices or, in some instances, a measure of trend GDP, Y^t.

In addition to overall imports and exports, 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 ImC, we construct the share of consumption in total exports and imports, s^{XC} and s^{ImC}.

We also analyze the consequences of credit expansions for labor market slack, focusing on the unemployment rate, u. The primary unemployment rate variable is the OECD harmonized unemployment rate from OECD Labor Market Statistics. 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 (see the appendix for details). The harmonized unemployment rate is measured by applying the same definition of unemployment across OECD member

[4] 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.

countries to obtain estimates that are more internationally comparable. However, since we focus on changes in the unemployment rate, level differences in definitions that are constant over time will not bias the results.

2.3 Summary Statistics

Table 2 displays summary statistics for total private, household, and non-financial firm debt to GDP, as well as the other variables used in the empirical analysis. Our empirical analysis uses both annual changes in panel VARs, and changes over three years in a single equation estimation. Table 2 shows summary statistics for both annual and three year changes. The table reports the mean, median, standard deviation, standard deviation relative to output, correlation with output, and serial correlation for each variable. 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. To provide additional insights and ease comparison with the literature, Table 3 reports summary statistics for the same variables detrended using the Hodrick-Prescott filter with a smoothing parameter of $\lambda = 100$.[5]

Table 2 shows that total private sector debt to GDP, PD/Y, has been growing at a rate of 3.28 percentage points per year, with roughly equal contributions from household and non-financial firm credit. Despite growing at similar rates on average, non-financial firm credit is about two times as volatile as household credit. Household credit, on the other hand, is more procyclical than firm credit. For example, when we normalize the credit variables by trend GDP prior to HP filtering in Table 3, we see that HHD has a correlation of 0.32 with output, while FD has a correlation of only 0.08.[6] Finally, household and non-financial firm credit are highly persistent, both in differences or when detrended with the HP filter.

Other patterns documented in Tables 2 and 3 are consistent with the small open economy business cycle literature. Consumption expenditure is approximately as volatile as output, while investment is over three times as volatile as output. Moreover, consumption, in particular durable consumption expenditure, and investment are strongly procyclical. Imports and exports are roughly

[5] A smoothing parameter of 100 is standard for annual macroeconomic time series, see e.g. Uribe and Schmitt-Grohé (2015). The HP filter is applied to the longest possible series to minimize "end-point" problems.

[6] Table 1 reveals that HHD is more procyclical than FD in a majority of the countries in our sample.

four times more volatile than output and strongly procyclical, with imports being more procyclical than exports. The trade balance and current account are countercyclical, and the unemployment rate is also strongly countercyclical. Finally, all the components of GDP are positively serially correlated.

3 Theoretical Motivation

There has been a rapid expansion in credit the world over during the last few decades. Jordà et al. (2014a) use data from 17 advanced economies to show that bank lending relative to GDP *doubled* between 1980 and 2010. Moreover, a disproportionate share of the increase in credit was driven by lending to households as opposed to non-financial firms. How should we view the sharp increase in debt, and in particular household debt, the world over? Is the growth in debt benign and largely driven by globalization and real productivity growth? Or should we be concerned that the sharp rise in debt makes economies vulnerable to periods of low growth?

These are important but difficult questions to address. This section outlines two classes of models that differ in their view of the relationship between debt and growth. The first class of models, which we borrow from the open economy literature, views debt and growth to be linked by underlying productivity shocks. In these models, higher debt growth is a forerunner to higher GDP growth.

The second class of models posits some form of externality that makes individual borrowing decisions potentially sub-optimal from an aggregate perspective. This class of models suggest the possibility that higher debt growth will be associated with lower subsequent economic growth. This section outlines these two classes of models. The empirical sections that follow then investigate the extent to which each class of theories is supported by the data.

3.1 Debt and Growth in Standard Open Economy Models

Let us first consider the relationship between debt and growth in a standard open economy model. Formally, 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 $U(c) = -\frac{1}{2}(c - \bar{c})^2$ with $c \leq \bar{c}$, 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 permanent income y_t^p in equilibrium,

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

Plugging $c_t = y_t^p$ in (1) gives us the key relationship between debt growth and subsequent GDP growth in standard open economy models,

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

There is an intuitive forecasting relationship between debt and growth: stronger growth in debt forecasts stronger income growth on average. 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.

Equation (4) describes an *equilibrium* relationship between debt and growth, and should not be interpreted in any causal sense. We shall refer to this equation as the "growth forecasting equation." The growth forecasting equation is derived under the assumptions of quadratic utility and exogenous income process. However, the positive forecasting relationship is robust to more generic utility functions and the introduction of capital and endogenous output.[7]

In the representative-agent economy described above, gross debt is the same as net foreign debt – funds used to invest are borrowed from abroad. One could modify the representative agent framework above to have heterogeneity where some agents within a country receive a positive productivity shock and borrow from other agents. We do not fully derive such a model here, but we believe it has similar implications. Gross debt increases when there is an expectation of higher productivity as productive agents borrow from other agents. Higher productivity by some agents should boost future income, and hence an increase in gross debt should forecast stronger economic growth.

3.2 Debt and Growth in Models with Externalities

This section discusses models that make the opposite prediction to that of standard open economy models. In general, agents take on too much debt in these models because of an externality. There are two types of externalities associated with debt discussed in the models: aggregate demand externalities and pecuniary or fire sales externalities.

Aggregate demand externalities emerge from models that rely on a friction that ties aggregate real variables – such as investment or consumption – to gross private debt. Examples of possible frictions include: monetary policy rigidity as in the zero lower bound constraint of Eggertsson and

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

Krugman (2012) or frictions preventing the reallocation of factors of production from nontradable to tradable sectors as in Huo and Ríos-Rull (2013). In such an economy, if households are sufficiently levered, a shock to debt capacity or housing wealth can generate a decline in aggregate demand and employment.

Pecuniary or fire sales externalities emerge in models that rely on heterogeneity in productivity and *ex post* fire sales of assets. Examples include Shleifer and Vishny (1992), Kiyotaki and Moore (1997), and Lorenzoni (2008). For example, in Lorenzoni (2008), agents borrow too much relative to the social optimum because they do not internalize the effect on asset prices they have if a negative shock occurs and they have to sell assets. Lower *ex post* asset prices lead to more assets being held by less productive agents which lowers growth.[8]

With either type of externality, households and firms take the economy-wide level of leverage as given in equilibrium, and they do not internalize the externality when private leverage decisions are made. As a result, they take on too much debt relative to what a social planner would do taking externalities into account. Two recent studies have made this point in the context of aggregate demand externalities, showing that households take on too much debt and thereby increase the likelihood of a leverage-induced recession (Korinek and Simsek (2014) and Farhi and Werning (2015).)

We illustrate the aggregate demand externality logic by going through a simple macroeconomic model based on Korinek and Simsek (2014). Consider an infinite horizon economy ($t = 1, 2, 3, ...$) with two types of households – borrowers and lenders. Each household type $h \in (l, b)$ has the same per-period utility $u(c_t^h)$, but differs in its discount rate β^h, with $\beta^b < \beta^l$.

Households supply up to one unit of labor costlessly that translates into $\bar{y}$ units of output as long as there is sufficient demand. In particular, output per capita is given by,

$$y_t = \min(\bar{y}, \frac{(c_t^l + c_t^b)}{2}) \tag{5}$$

Equation (5) captures the Keynesian idea that output can be "demand constrained". Each household earns per capita output y_t each period. Since borrowing households are more impatient, they each borrow an amount $\frac{d_t}{(1+r_t)}$ from lenders at interest rate r_t. The difference in discount rates

[8] See Dávila (2015) for an interesting analysis of fire sales/pecuniary externalities and how they relate to collateral constraints.

also implies that borrowers will always borrow up to their borrowing limit in steady state.

Period 1 and 2 are the most important periods in this model. At $t = 2$, there is a *perfectly anticipated* shock that sets the borrowing limit to ϕ. Households enter period 1 with full knowledge of the shock that is going to hit them in period 2. However, borrowers face no borrowing constraint in period 1. We can therefore think of period 1 as a time when credit supply has expanded and lenders relax borrowing constraints. Borrowing households start period 1 with initial debt d_0 that is due right away, and must decide on the new debt amount d_1 that will be due in full at the beginning of period 2. While not modeled explicitly, we assume that there was some constraint on borrowing at $t = 0$, although not as tight as the ϕ limit imposed in period 2.

Notice in our model that there is a loosening of the borrowing constraint from $t = 0$ to $t = 1$. What is the source of this shock? This question is beyond the scope of this study, but we have existing research that examines this question. In the United States, Favilukis et al. (2015) claim that financial liberalization and an infusion of foreign capital led to a reduction in borrowing constraints during the 2000s. Rey (2015) argues that there is a global financial cycle in capital flows which can potentially drive "excess credit creation." Lópen-Salido et al. (2015) point to credit market sentiment as a driver of leverage dynamics. There is a long tradition in asset pricing of a time-varying risk premium (e.g., Cochrane (2011)), and one could argue that borrowing constraints on households are loosened when the risk premium is low. Both Rey (2015) and Jordà et al. (2014a) point to monetary policy as a potential fundamental shock that leads to higher credit flows. In our study, we take this shock and its reversion as given, and we explore how it affects the real economy through private debt dynamics.

The key question in our model is whether households make borrowing decisions in period 1 that are optimal from a macro perspective. To understand the tension between individual optimality and social optimality, we need to first solve the model in period 3 and work backwards.

The economy for $t \geq 3$ is in steady state. Borrowers borrow upto their limit ϕ and interest rate is determined by lending households Euler equation. Thus interest rate $r_t = \frac{1}{\beta^l} - 1$, output $y_t = \bar{y}$ and consumption of each household type is given by $c_t^b = \bar{y} - \phi(1 - \beta^l)$, and $c_t^l = \bar{y} + \phi(1 - \beta^l)$.

Period 2 is when the economy is hit by the fully anticipated ϕ shock, and depending on how much households borrowed in period 1, the economy may become demand constrained. To see this, let D_1 be the total household debt due at the beginning of period 2. Of course in equilibrium $D_1 = d_1$, the debt borrowed by each household individually in period 1. As we will see, output per capita y_2 may be demand-constrained in period 2 if D_1 is chosen to be too high in period 1. Consumption of borrowing households will be constrained by limit ϕ and given by, $c_2^b = y_2(D_1) - d_1 + \frac{\phi}{1+r_2}$. The interest rate in period 2 is given by lender's Euler equation, $\frac{u'(c_2^l)}{\beta^l u'(c_3^l)} = 1 + r_2$.

The key macro friction in this economy is that the interest rate cannot drop below a certain threshold. In particular, $r_2 \geq 0$, which is the usual zero lower bound constraint. Given this monetary policy constraint, consumption of lending households is bounded from above with $c_2^l \leq \bar{c}_2^l$, where $u'(\bar{c}_2^l) = \beta^l u'(\bar{y} + \phi(1-\beta))$.

The upper limit on c_2^l implies that if borrowing households are forced to cutback their consumption by a sufficiently large amount, interest rates cannot fall enough to convince lending households to absorb the full fall in spending by borrowers. In particular, if $(d_1 - \phi) > \bar{c}_2^l - \bar{y}$, the economy becomes demand constrained and dips into a recession with $y_2(D_1) = \bar{c}_2^l + \phi - d_1 < \bar{y}$.

Figure 1, panel a, summarizes the dependence of output in period 2 on total debt D_1 that the economy enters period 2 with. There is a threshold level of debt taken on in period 1, $\bar{D}_1$, such that if $D_1 > \bar{D}_1$, $y_2 < \bar{y}$. It is thus possible for the economy to become "over-levered" leading to a demand-driven recession. The fall in output in Figure 1 is driven by the fact that the cut back in spending by borrowers is not picked up by lenders, making output demand-constrained. The inability of lenders to further boost their spending is driven by the lower bound constraint on the interest rate. However, other frictions could further exacerbate the fall in output due to leverage.

For example, if borrowers and lenders tend to live in different geographical areas, then a fall in spending by borrowers will lead to a fall in the non-tradable sector employment in borrowing areas that will not respond to an increase in spending by lenders (see Mian and Sufi (2014b) for evidence). If there are frictions that make it difficult for labor to switch from non-tradable to tradable sectors, or from one region to another, then that will make it more difficult for output to revert back to full capacity (see Huo and Ríos-Rull (2013)). The zero lower bound is perhaps the easiest modeling device to see a reduction in output from a reduction in consumption by borrowers, but other frictions yield a similar result.

We now turn to the most important question of the model. Will households properly recognize the dependence of total output on debt level D_1 in period 1 and make sure the economy does not cross the threshold $\bar{D}_1$? Borrowing households enter period 1 with debt d_0 due, and decide on the new level of borrowing d_1. Households are unconstrained to borrow as much as they like in period 1, but know that they will be constrained to borrow only up to ϕ in period 2. Consumption for the two types is given by, $c_1^b = \bar{y} - d_0 + \frac{d_1}{1+r_1}$, and $c_1^l = \bar{y} + d_0 - \frac{d_1}{1+r_1}$. Since borrowing in unconstrained in period 1, both types of households will be on their first order condition:

$$\frac{u'(c_1^b)}{\beta^b u'(c_2^b)} = \frac{u'(c_1^l)}{\beta^l u'(c_2^l)} = 1 + r_1 \tag{6}$$

We can solve for d_1 and r_1 using (6) and the expressions for c_1^b, c_2^b, c_1^l and c_2^l derived earlier and get the following result as shown in Korinek and Simsek (2014): If borrowers are sufficiently impatient (i.e. β^b is low enough), then $d_1 > \bar{D}_1$ and there is recession next period. Therefore, if households are sufficiently impatient, then a credit boom induced by a relaxation in lending standards is followed by a decline in output when the credit constraint tightens.

Panel b of Figure 1 plots the growth in debt in period 1, $(d_1 - d_0)$, against β^b in a country. We can think of β^b on the x-axis as a proxy for the propensity of individuals in a country to borrow or the extent to which credit constraints are relaxed in a country.[9] Countries with lower β^b respond to period 1 with more aggressive borrowing, and for sufficiently low β^b, d_1 exceeds $\bar{D}_1$. Panel c of Figure 1 plots the predictions of this model by plotting $y_2 - y_1$ against $(d_1 - d_0)$, where the variation in the x-axis is driven by cross-country variation in β^b.

The results show a negative forecasting relationship between output growth and debt growth as debt growth exceeds a certain threshold. Credit booms or high growth in household debt forecasts *negative* output growth in short to medium run. This is exactly the opposite prediction relative to standard models discussed in the previous section.

While our focus in this section has been on models with aggregate demand externalities, there are other behavioral models that also suggest the possibility of a negative forecasting relationship between debt and growth. For example, if individuals are myopic due to hyperbolic preferences, access to financing could lead to excessive short run consumption at the expense on long run growth (Laibson (1997) and Barro (1999)). Other models with credit booms followed by output busts include models where agents suffer from "neglected risk" at times (Gennaioli et al. (2012)), or agents have strong differences in beliefs about the fundamental price of collateral.

[9]See Chen (2013) and Cronqvist and Siegel (2015) for cross-country differences in saving rates driven by "deep" parameters such as language and genetics.

4 Panel Vector Autoregressions

What is the relationship between a shock to the private debt to GDP ratio and subsequent growth? The qualitative theory presented in the previous section suggests a relationship, but it is silent on many important questions such as the time horizon of the shock and whether household debt or non-financial firm debt is more important. In this section, we present impulse response functions from panel VARs to help guide the empirical analysis. Our goal is to explore the data for answers to motivate the single equation analysis that follows. More specifically, we use a flexible VAR specification to allow the data to tell us how persistent a shock to debt is, and the time horizon over which it affects GDP.

The initial pooled panel VAR we estimate is a two variable recursive model with 5 lags where the two variables are the change in the private debt to GDP ratio in a year ($\Delta(PD/Y)_{it}$) and the change in the natural logarithm of output in a year (Δy_{it}).[10] The ordering of the variables in the recursive VAR is Δy_{it} and then $\Delta(PD/Y)_{it}$. The VAR is estimated on the pooled 30 country sample.[11] Figure 2 presents the impulse response functions of a one unit increase in the $\Delta(PD/Y)_{it}$ equation error term, holding the error term in the Δy_{it} equation fixed. To ease interpretation, we present the cumulative impulse response functions to see the evolution of private debt and GDP after the shock.

The left panel shows a high degree of persistence of the private debt shock that lasts four years. A one unit shock to $\Delta(PD/Y)_{it}$ leads to a cumulative 2.2 unit increase over four years, more than double the initial shock. After four years, the cumulative change levels off, and declines slightly over time through the tenth year after the shock. The right panel shows that a one unit increase in $\Delta(PD/Y)_{it}$ leads to an initial decline in output. The decline in the first two years after the shock is modest, but then accelerates sharply from years two through five. A one unit shock to $\Delta(PD/Y)_{it}$ leads to a 0.4 percent decline in output after five years.

The VAR evidence is more consistent with models where excessive leverage forecasts lower

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

[11]We also estimate impulse responses using the "Bayesian stochastic pooling" approach from Canova and Pappa (2007). The impulse responses from this method are depicted in Appendix Figures 11 and 12 for the two and three variable VARs, respectively. These impulse responses are computed by first estimating separate impulse responses for each of the 15 countries in the sample with sufficiently long debt to GDP time series and then constructing a weighted average of the responses, where each impulse response is weighted by its precision. The shape of the impulse responses from this method is similar to the responses from the pooled VAR.

economic growth. To explore this finding further, Figure 3 presents impulse response functions from a three variable VAR where we split out $\Delta(PD/Y)_{it}$ into its sub-components of the change in household debt to GDP ratio ($\Delta(HHD/Y)_{it}$) and the change in non-financial firm debt to GDP ratio ($\Delta(FD/Y)_{it}$).[12] 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 left panel of Figure 3 shows that the persistence of the shock is much 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. In contrast, a one unit shock to $\Delta(FD/Y)_{it}$ has a much smaller and less persistent effect on firm debt to GDP, lasting only one to two years and leading to an increase of only 1.75.

The right panel of Figure 4 shows that the short-run negative effect of private debt on economic growth is driven by non-financial firm debt. 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 0.6 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 evidence yields several important guidelines for the empirical analysis that follows. First, 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. So the period of debt expansion in the qualitative theory discussed above should be thought of as a three to four year cycle. Second, growth may contemporaneously *increase* while debt is expanding, but that pattern reverses once 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 growth stalls. We will use these facts from the VAR estimation to

[12]Household debt and non-financial firm debt sum up to total private debt extended in a country.

motivate the single equation estimation strategy in the next section.

5 Single Equation Estimation Strategy

5.1 Specification

The VAR estimation strategy in the previous section is useful as data description and motivation. However, our goal is to explore more broadly how an increase in private debt to GDP ratios affects a number of outcomes both contemporaneously and in the future. Such an analysis is more easily done within a single equation estimation framework, as described in detail by Jordà (2005). In particular, the single equation local projection methodology allows for more flexibility in the forecasting function at different horizons relative to a VAR framework.

A single equation framework requires us to take a stand on the timing of the main right hand side variable of interest: the increase in the private debt to GDP ratio. We choose as our benchmark to examine the change in the private debt to GDP ratio from four years ago to last year, which we label as $\Delta_3 \frac{PD_{it-1}}{Y_{it-1}}$. This timing is motivated by the evidence from Figures 2 and 3 that a shock to the private debt tends to persist for three to four years. Our goal in this study is to examine how a medium-run sustained increase in private debt affects subsequent growth. In robustness tests reported in the appendix, we show that the results are qualitatively unchanged if we use slight variations of this right hand side variable.

Our main single equation estimation specification is:

$$y_{it+h} - y_{it} = \alpha_i^h + \beta_{PD}^h \Delta_3 \frac{PD_{it-1}}{Y_{it-1}} + \epsilon_{it+h}, \tag{7}$$

where y_{it} is GDP for country i in year t, α_i^h are country fixed effects, Δ_3 refers to differences over three years[13], 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

[13] 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 (7) by breaking down private debt into household debt and non-financial firm debt. Formally, we estimate,

$$y_{it+h} - y_{it} = \alpha_i^h + \beta_{HH}^h \Delta_3 \frac{HHD_{it-1}}{Y_{it-1}} + \beta_F^h \Delta_3 \frac{FD_{it-1}}{Y_{it-1}} + \epsilon_{it+h}, \tag{8}$$

where HHD and FD correspond to household debt and non-financial firm debt, respectively. In some specifications, we also augment (8) to include additional control variables, including higher order lag structure in the spirit of the local projections method introduced by Jordà (2005).

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.

5.2 Domestic Private Debt and GDP Growth

Figures 4 plots the coefficient estimate on $\Delta_3 \frac{PD_{it-1}}{Y_{it-1}}$ from estimation of equation (8) at various forecasting horizons. This is related to the impulse response function shown in the right panel of Figure 2, but we are now working within the single equation framework and so we are plotting the coefficients β_{HH}^h for $h = 1, 2, ..., 5$. An increase in the private debt to GDP ratio from four years ago to last year forecasts lower subsequent GDP growth at all horizons.

Figure 5 splits out the effect of the increase in private debt into the effect of an increase in the household debt and firm debt to GDP ratio. The negative forecasting power of a rise in the medium-run of private debt to GDP is driven entirely by the rise in household debt.

We explore these patterns further in Table 4. 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 that the negative forecasting result 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 (6.18) is associated with 2.3% lower growth over the subsequent three years. The coefficient estimate is robust to inclusion of the change in net foreign liabilities and lagged GDP growth.

Panel a of Figure 6 shows the scatter plot of changes in household debt to GDP ratios and subsequent GDP growth. Ireland and Greece during the Great Recession show up in the bottom right part of the scatter plot, but 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 4, the partial correlation is negative for household debt, but flat for non-financial firm debt.

The results so far indicate the change in private debt to GDP negatively forecasts GDP growth, and this result is entirely driven by changes in household debt. The forecasting power of change in household debt to GDP is also quite large in magnitude and very significant. Figure 7 plots the country-by-country coefficient on $\Delta_3 \frac{HHD_{it-1}}{Y_{it-1}}$ from a regression with future GDP growth on the left hand side. The coefficient is negative for twenty three of the thirty countries in our sample, and none of the country coefficients are significantly positive with the exception of Japan. The forecasting power is not driven by outliers.

Table 5 conducts 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. Column 3 excludes the post-2000 period to make sure that the boom and bust cycle of the Great Recession of 2008 is not driving our results. The coefficient declines, but remains statistically significant at the 1% level. In column 4, 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 5 through 7 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 8 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 is unchanged. Column 9 breaks out the three year change in the household debt to GDP ratio and shows that all three years are negatively correlated with subsequent growth.

The qualitative theory from models with aggregate demand externalities presented in Section

3.2 suggests that the relationship 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 relationship between the increase in debt and future growth. Appendix Figure 10 explores this by including a quadratic term in $\Delta\frac{HHD_{it-1}}{Y_{it-1}}$. The quadratic term is negative and significant at the 10% level, which provides some evidence that larger increases in debt predict disproportionately lower growth.[14]

Table 6 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 6 shows, the rise in private debt to GDP ratios forecasts 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. However, the magnitude of the coefficient on change in non-financial debt is much smaller and not always significant. 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%) forecasts 0.89 percentage point higher unemployment rate, which is 0.37 times the standard deviation of 3 year change in unemployment rate.

Column 4 shows that the results are robust to adding lagged annual changes in the unemployment rate to control for any dynamic structure in change in unemployment rate. Column (5) excludes the post-2000 Great Recession period to again confirm that the forecasting result is not driven by the most recent global recession. Finally, column 6 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, showing that household debt expansions forecast higher unemployment.

A three to four year expansion in household debt strongly forecasts lower GDP growth. This finding is consistent with models in which excessive debt accumulation hurts the economy, and it is inconsistent with the standard open economy macroeconomic model in which higher debt reflects positive productivity shocks.

[14]Non-parametric smoothing methods also reveal a non-linearity.

5.3 Forecasting the Components of GDP

A change in the household debt to GDP ratio robustly forecasts negative future economic growth. Panel A of Table 7 explores what components of GDP move the most. Changes in the household debt to GDP ratio forecast consumption 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* forecast *investment* better than changes in *non-financial firm debt*. There is some statistically weak evidence that a rise in non-firm financial debt forecasts lower government spending.

Panel B of Table 7 explores how changes in debt to GDP ratios forecast external adjustment. The key result is that growth in household debt to GDP forecasts 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. Consistent with all of our earlier findings, the change in non-financial firm debt continues to have no forecasting power for the net-export margin in columns 1 through 4 of panel B.

Household debt positively forecasts a change in the net export margin, while it negatively forecasts 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 5 and 6 of panel B test for 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 forecasts 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 forecasting power. The fact that external margin is useful in cushioning a fall in GDP growth suggests that household debt may have even stronger forecasting 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 in its forecasting ability since countries will be less able to use the external margin for adjustment when more of the global economy is affected by household debt cycle. We shall test this key insight in Section 6.

5.4 Household Debt and Consumption Booms

A rise in private debt, and especially household debt, is strongly associated with subsequent lower GDP growth. This fact is less consistent with models in which changes in debt reflect productivity shocks, and is instead more broadly consistent with models discussed above in which agents may "over-borrow."

To help further discern these hypotheses, we explore what happens contemporaneously with the rise in household debt in Table 8. Changes in the household debt to GDP ratio are contemporaneously positively correlated with changes in the consumption to GDP ratio (column 1). 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 results in Table 8 are also remarkable for what they do not show. Changes in non-financial firm debt are uncorrelated with any outcome in Table 8. A likely effect of a productivity shock would be 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 as well as an increase in the consumption good share of total imports. These results are consistent with the notion that growth in household debt to GDP is associated with contemporaneous consumption boom at the expense of future GDP growth.

6 The Global Household Debt Cycle

6.1 Forecasting Global Growth

In Table 7, we show evidence that countries are able to cushion the GDP shock associated with a rise in household debt to GDP through net exports. Countries that rely more heavily on trade see net exports increase after a sustained increase in the household debt to GDP ratio. We have so far focused on variation *within* a given country but the evidence on trade 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 9, we explore whether there is a global household debt cycle that forecasts global growth. We aggregate all countries into one observation per year, and estimate the following global time series regression:

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

Table 9 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 forecasts 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) forecasts a 2.5% deceline in GDP growth over the next three years. Similar to the results in Section 5, the global debt cycle is driven by changes in household debt; non-financial firm debt has no forecasting power at the medium-run horizon we examine.

Figure 8 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 strongly forecast subsequent GDP growth.

One important pattern that emerges from both Table 9 and Figure 8 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 9 shows that a regression of subsequent GDP growth on changes in household debt to GDP produces a coefficient estimate that is almost identical to the full sample estimate. Figure 8 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 forecasting model of changes in household debt on GDP predicted accurately the collapse in global GDP growth during the 2007 to 2012 period. The Great Recession was not an outlier; instead, it followed exactly the 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 forecasts a larger decline in subsequent global GDP growth relative to how the same increase in household debt in a given country forecasts 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.

6.2 Time Fixed Effects and Loading on the Global Debt Cycle

In the regressions in Section 5, we include country fixed effects but not year fixed effects. The reasoning behind this decision is evident in Table 9 and Figure 8: 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 affects the forecasting relation 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:

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

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 9 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 10 shows this result. We run the standard forecasting 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 forecast 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 one-third compared to the specification in Table 4 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 forecast 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 forecasts 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:

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

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 forecasting power for GDP growth in country i. But the increase in the household debt to GDP ratio for country i also has forecasting 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 Relation to Extant Research

We are now in a position to discuss how the findings above are related to the existing literature. There is a large and growing body of research on the forecasting power of credit growth. The seminal work by Schularick and Taylor (2012), Jordà et al. (2013), Jordà et al. (2014a), and Jordà et al. (2014b) examines how growth in credit predicts financial crises and recession severity in a long historical panel of advanced countries. Schularick and Taylor (2012) estimate regressions showing that credit growth predicts financial crises, whereas Jordà et al. (2013) show that recessions preceded by a large run-up in credit tend to be more severe. Jordà et al. (2014b) extends the work in these previous two studies using novel data splitting credit into household and firm debt. They find that mortgage debt and real estate booms predict financial crises in the post World War II era, and they find that recessions preceded by rapid growth in mortgage debt tend to be deeper with slower recoveries.

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 use a longer window of five years because it "reduces the potential effects of cyclical movements and allows [them] to focus on the medium-term growth rate." They do not find strong evidence that the *level* of private debt forecasts growth. As they write, "For corporate and household debt, estimates are very imprecise, so we are unable to come to any real conclusions."

Baron and Xiong (2014) use the change in bank credit to GDP ratio from $t-3$ to t to predict equity returns. The right hand side variable in their study is the same as our change in private debt to GDP ratio, except their measure only includes bank credit. However, they do not examine the effect of this variable on GDP growth and they do not split out the effect of non-financial firm debt versus household debt.

Given this large body of research exploring credit growth and economic outcomes, we want to be explicit about the contribution of our results shown above. They are the following:

- Our core specification relating GDP growth to the increase in the household debt to GDP ratio and the increase in the non-financial firm debt to GDP ratio has not been estimated in the previous literature. Jorda, Schularick, and Taylor have shown a *conditional* result: conditional on a recession, recessions preceded by strong credit growth tend to be the most severe. Researchers have used credit growth to predict equity returns or financial crises, but we are unaware of anyone that has estimated the unconditional predictive power of credit growth on GDP growth.

- We are the first to use a panel VAR estimation to understand the dynamics of the relation between the increase in credit and GDP in a large sample of countries. The impulse response functions from the VAR point to a three to four year horizon for a sustained increase in private debt. While other researchers have used the same medium-term horizon to measure credit booms, we believe we are the first to show in a VAR framework why this horizon is justified. This fits nicely with cross-sectional studies by Mian and Sufi (2010) and King (1994) that utilize a four year period of rising debt in the 2000s and 1980s, respectively.

- We explicitly link data on the components of GDP and the composition of imports to credit variables, something not done in the extant literature. This allows us to flesh out the nature of the consumption boom fueled by the growth in household debt, and to detail the forecasting relation between credit growth and growth in separate components of GDP. We also estimate the relation between credit growth and the contemporaneous and subsequent trade position of a country.

- Section 6 on the global debt cycle and its interaction with country-specific debt cycles is completely new to the literature.

Our paper also contributes to the theoretical literature on the intersection of finance and macro by emphasizing the key empirical facts regarding debt and growth that should be useful in making open economy macro models more realistic. For example, 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.[15] The only emphasis in these models in net foreign debt. Our results show that we need to understand the reasons why household debt has strong negative forecasting power for output growth.

Since the seminal work of Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), a number of theoretical papers at the intersection of finance and macro have emphasized the "investment"

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

channel or firm credit for growth dynamics (see e.g. Caballero and Krishnamurthy (2003), Brunnermeier and Sannikov (2014) and Lorenzoni (2008)). Our results highlight the importance of the consumption or demand-side channel driven by household debt in understanding growth dynamics. Recent models highlight this channel, and the empirical results support many of the theoretical insights.

8 Conclusion

An increase in the household debt to GDP ratio over a three to four year period robustly forecasts lower GDP growth in a panel of 30 countries from 1960 to 2012. Non-financial firm debt forecasts lower GDP growth over a shorter horizon, but the magnitude is smaller. These results contradict the prediction of open economy macroeconomic models that an increase in debt today reflects higher future income.

Instead, the negative forecasting power of a rise in household debt is more consistent with models in which agents take on more leverage than is socially optimal. We show a number of results that are consistent with such models. Increases in debt are associated with consumption booms instead of investment booms. The consumption share of imports rises during periods when household debt rises sharply. A rise in household debt over three to four years more strongly predicts a decline in subsequent investment than a rise in non-financial firm debt.

We also find that countries are able to soften the blow of excessive household debt through the trade channel: net exports increase due to a decline in imports. This result is stronger for countries that tend to trade more with other countries.

There is also evidence of a global household debt cycle: a rise in the global household debt to GDP ratio forecasts 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 debt cycle see lower GDP growth after a rise in household debt, and this in part due to the inability to soften the blow through the net exports channel.

An open question we do not address in this study is: what is the source of large increases in household debt? The world has seen episodes of large increases in household debt: some European countries in the mid-1980s, East Asia in the mid to late 1990s, and many advanced economies in the mid-2000s. Existing research suggests monetary policy, a time-varying risk premium, or credit market sentiment as potential culprits. Regardless of the exact source of the shock, our results suggest that household debt is an important channel through which the underlying shock affects global growth.

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

Country	Years	$\rho(CA/Y^t, y)$	$\rho(HHD/Y^t, y)$	$\rho(FD/Y^t, y)$
Australia	1977-2012	-.43	.463	.58
Austria	1995-2012	.387	.676	.315
Belgium	1980-2012	-.155	.43	-.104
Canada	1969-2012	-.059	.106	-.231
Czech Republic	1995-2012	.051	.629	.328
Denmark	1994-2012	-.178	.306	.474
Finland	1970-2012	-.302	.377	-.305
France	1977-2012	-.473	.243	.44
Germany	1970-2012	-.318	-.23	.161
Greece	1994-2012	-.739	.87	.474
Hong Kong	1990-2012	.642	-.467	.467
Hungary	1989-2012	-.09	.297	.088
Indonesia	2001-2012	.25	-.732	.522
Ireland	2002-2012	-.768	.473	-.782
Italy	1960-2012	-.51	.317	-.064
Japan	1964-2012	-.148	.295	.193
Korea, Rep.	1962-2012	-.267	.332	-.321
Mexico	1994-2012	-.599	.36	-.155
Netherlands	1990-2012	-.535	.582	.458
Norway	1975-2012	-.099	-.079	.028
Poland	1995-2012	-.878	.338	.31
Portugal	1979-2012	-.504	.255	-.512
Singapore	1991-2012	.54	.262	.418
Spain	1980-2012	-.878	.723	.45
Sweden	1980-2012	.341	.46	-.113
Switzerland	1999-2012	-.737	.115	.273
Thailand	1991-2012	-.81	.496	.392
Turkey	1986-2012	-.753	.649	.033
United Kingdom	1976-2012	-.648	.413	.01
United States	1960-2012	-.587	.362	.393

Notes: Correlations are computed using HP filtered variables. CA, HHD, and NFD are scaled by trend GDP prior to HP filtering.

Table 2: Summary Statistics, Variables in Differences

	N	Mean	Median	SD	$\frac{SD}{SD(\Delta y)}$	$\rho(x, \Delta y)$	Ser. Cor.
Δy	695	2.901	3.077	2.976	1	1	.287
$\Delta_3 y$	695	8.401	8.647	6.564	2.206		.712
$\Delta(PD/Y)$	695	3.28	2.802	6.877	2.311	-.286	.496
$\Delta_3(PD/Y)$	695	8.587	7.648	15.876	5.335		.746
$\Delta(HHD/Y)$	695	1.645	1.362	2.466	.829	-.184	.548
$\Delta_3(HHD/Y)$	695	4.573	3.75	6.183	2.078		.798
$\Delta(FD/Y)$	695	1.615	1.242	5.32	1.788	-.283	.451
$\Delta_3(FD/Y)$	695	3.965	2.875	11.813	3.97		.709
Δc	678	2.813	2.899	2.84	.954	.825	.335
Δc^{dur}	389	4.104	4.725	8.062	2.709	.659	.244
Δc^{nondur}	389	1.221	1.38	1.764	.593	.557	.305
$\Delta C/Y$	688	-.056	0	1.176	.395	-.309	.048
Δi	678	2.663	3.672	10.79	3.626	.804	.148
Δg	688	2.843	2.598	2.787	.937	.298	.257
Δx	695	8.645	9.296	12.288	4.13	.529	.15
Δim	695	8.08	9.552	13.871	4.662	.645	.122
$\Delta NX/Y$	695	.144	-.006	2.115	.711	-.327	.028
$\Delta CA/Y$	648	.076	-.02	2.29	.77	-.288	-.008
Δs^{XC}	695	-.127	-.075	1.779	.598	-.112	.05
Δs^{ImC}	695	.175	.134	1.633	.549	-.133	.012
Δu	665	.078	-.042	1.078	.362	-.595	.348
$\Delta_3 u$	662	.193	-.008	2.429	.816		.672

Notes: Log changes and ratios are multiplied by 100 to report changes in percentages or percentage points. The variables $y, PD/Y, HHD/Y, NFD/Y, c, c^{dur}, c^{nondur}, C/Y, i, g, x, im, NX/Y, CA/Y, s^{XC}, s^{ImC}$, and u denote log real GDP, private non-financial credit-to-GDP, household credit-to-GDP, non-financial firm credit-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, and the unemployment rate, respectively.

Table 3: Summary Statistics, HP-Filtered Variables

	N	SD	$\frac{SD}{SD(y)}$	$\rho(x,y)$	Ser. Cor.
y	695	2.767	1	1	.545
PD/Y	695	6.995	2.528	-.153	.648
PD/Y^t	695	7.739	2.797	.192	.739
HHD/Y	695	2.56	.925	-.002	.704
HHD/Y^t	695	2.931	1.059	.318	.77
FD/Y	695	5.355	1.935	-.213	.618
FD/Y^t	695	5.628	2.034	.079	.692
c	681	2.86	1.034	.815	.611
c^{dur}	405	8.077	2.919	.751	.544
c^{nondur}	405	1.757	.635	.565	.566
C/Y	691	1.043	.377	-.335	.399
C/Y^t	681	1.985	.717	.336	.542
i	681	9.901	3.578	.848	.444
g	689	2.386	.863	.2	.58
x	695	11.391	4.117	.451	.465
im	695	13.115	4.74	.626	.46
NX/Y	695	1.853	.67	-.422	.405
NX/Y^t	695	1.987	.718	-.454	.405
CA/Y	654	1.972	.713	-.324	.394
CA/Y^t	654	2.095	.757	-.315	.403
s^{XC}	695	1.548	.56	-.053	.392
s^{ImC}	695	1.452	.525	.005	.338
u	669	1.232	.445	-.7	.59

Notes: All variables are HP filtered with a smoothing parameter of $\lambda = 100$. Variables scaled by Y^t are HP filtered after dividing by HP-trend GDP.

Table 4: Household Credit Expansion Forecasts Lower Growth

	(1) $\Delta_3 y_{it+3}$	(2) $\Delta_3 y_{it+3}$	(3) $\Delta_3 y_{it+3}$	(4) $\Delta_3 y_{it+3}$	(5) $\Delta_3 y_{it+3}$	(6) $\Delta_3 y_{it+3}$
$\Delta_3(PD/Y)_{it-1}$	-0.105**					
	(0.0293)					
$\Delta_3(HHD/Y)_{it-1}$		-0.378**		-0.377**	-0.392**	-0.368**
		(0.0711)		(0.0818)	(0.0790)	(0.0730)
$\Delta_3(FD/Y)_{it-1}$			-0.0753*	-0.000578	-0.00496	-0.0193
			(0.0364)	(0.0379)	(0.0430)	(0.0474)
$\Delta_3 NFD_{it-1}$					0.0137	0.0122
					(0.0464)	(0.0482)
Δy_{it-1}						-0.235
						(0.160)
Δy_{it-2}						-0.198+
						(0.106)
Δy_{it-3}						-0.0993
						(0.0980)
R^2	0.064	0.122	0.019	0.122	0.140	0.167
Country Fixed Effects	✓	✓	✓	✓	✓	✓
Observations	695	695	695	695	636	636

Notes: Standard errors in parentheses clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Table 5: Robustness: Household Credit Expansion Forecasts Lower Growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$
$\Delta_3(HHD/Y)_{it-1}$	-0.419**	-0.278*	-0.236**	-0.392**	-0.342**	-0.354**	-0.428**		
	(0.0992)	(0.116)	(0.0814)	(0.0880)	(0.0862)	(0.0881)	(0.0857)		
$\Delta_3(FD/Y)_{it-1}$	0.0259	-0.0521	-0.0188	-0.00432	0.000355	-0.0233	0.0200		
	(0.0372)	(0.0877)	(0.0342)	(0.0395)	(0.0487)	(0.0475)	(0.0363)		
$(\Delta_3 HHD_{it-1})/Y_{it-4}$								-0.328**	
								(0.0692)	
$(\Delta_3 FD_{it-1})/Y_{it-4}$								0.0445	
								(0.0403)	
$\Delta_1(HHD/Y)_{it-1}$									-0.264+
									(0.149)
$\Delta_1(HHD/Y)_{it-2}$									-0.304**
									(0.101)
$\Delta_1(HHD/Y)_{it-3}$									-0.548**
									(0.144)
$\Delta_1(FD/Y)_{it-1}$									-0.105+
									(0.0573)
$\Delta_1(FD/Y)_{it-2}$									-0.0196
									(0.0391)
$\Delta_1(FD/Y)_{it-3}$									0.138*
									(0.0619)
R^2	0.157	0.071	0.049	0.149	0.100	0.137	0.132	0.164	0.139
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sample	Developed	Emerging	Pre 2000	Post 1980	N.O. 1	N.O. 2	N.O. 3	Full	Full
Observations	529	166	436	617	221	233	241	695	695

Notes: Emerging market economies are the Czech Republic, Hong Kong, Hungary, Indonesia, Korea, Mexico, Poland, Singapore, Thailand, and Turkey. Developed economies are the remaining countries. Samples N.O. 1, 2, and 3 refer to the three samples of non-overlapping dependent variable observations. Standard errors in parentheses clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Table 6: Household Credit Expansion Forecasts Higher Unemployment Rate

	Full Sample				Subsamples	
	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$	$\Delta_3 u_{it+3}$
$\Delta_3(PD/Y)_{it-1}$	0.0563**					
	(0.0144)					
$\Delta_3(HHD/Y)_{it-1}$		0.143**	0.132**	0.115**	0.142*	0.173**
		(0.0382)	(0.0331)	(0.0356)	(0.0554)	(0.0503)
$\Delta_3(FD/Y)_{it-1}$		0.0235+	0.0214+	0.0328*	0.0232	0.0326+
		(0.0138)	(0.0119)	(0.0126)	(0.0223)	(0.0184)
Δu_{it-1}				-0.403**		
				(0.117)		
Δu_{it-2}				-0.262**		
				(0.0779)		
Δu_{it-3}				-0.303*		
				(0.117)		
R^2	0.095	0.128	0.365	0.206	0.095	0.169
Country Fixed Effects	✓	✓	✓	✓	✓	✓
Year Fixed Effects			✓			
Sample	Full	Full	Full	Full	Pre 2000	OECD Harm.
Observations	662	662	662	638	410	527

Notes: Standard errors in parentheses clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Table 7: Forecasting 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) $\Delta_3 g_{it+3}$
$\Delta_3(HHD/Y)_{it-1}$	-0.37**	0.041	-0.11**	-1.44**	-0.19+	-1.27**	-0.082
	(0.070)	(0.031)	(0.018)	(0.31)	(0.11)	(0.26)	(0.067)
$\Delta_3(FD/Y)_{it-1}$	0.0013	0.0038	0.013	0.030	-0.026	0.014	-0.046+
	(0.033)	(0.015)	(0.0091)	(0.13)	(0.024)	(0.11)	(0.026)
R^2	0.108	0.014	0.199	0.198	0.064	0.132	0.024
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓
Observations	679	690	425	405	405	679	687

Panel B: External Components

	(1) $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$	(2) $\Delta_3 \ln \frac{X_{it+3}}{Im_{it+3}}$	(3) $\frac{\Delta_3 X_{it+3}}{Y_{it}}$	(4) $\frac{\Delta_3 Im_{it+3}}{Y_{it}}$	(5) $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$	(6) $\frac{\Delta_3 NX_{it+3}}{Y_{it}}$
$\Delta_3(HHD/Y)_{it-1}$	0.18**	0.41**	-0.13	-0.32**	0.088	0.15*
	(0.048)	(0.14)	(0.099)	(0.11)	(0.057)	(0.060)
$\Delta_3(FD/Y)_{it-1}$	0.0024	0.052	0.0011	-0.0014	0.0086	0.0013
	(0.019)	(0.054)	(0.068)	(0.066)	(0.017)	(0.021)
$\Delta_3(HHD/Y)_{it-1} \times \text{openness}_i$					0.13**	0.099*
					(0.035)	(0.038)
R^2	0.054	0.036	0.004	0.020	0.064	0.177
Country Fixed Effects	✓	✓	✓	✓	✓	✓
Year Fixed Effects						✓
Observations	695	695	695	695	695	695

Notes: Standard errors in parentheses clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Table 8: Household Credit Expansions 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) $\Delta_1 s^{ImC}_{it}$	(5) $\Delta_1 s^{XC}_{it}$
$\Delta_1(HHD/Y)_{it}$	0.114*	-0.166+	-0.170+	0.121**	0.0384
	(0.0427)	(0.0909)	(0.0976)	(0.0271)	(0.0370)
$\Delta_1(NFD/Y)_{it}$	0.0277	0.0473	0.0332	-0.00944	-0.0210
	(0.0196)	(0.0356)	(0.0346)	(0.0181)	(0.0198)
R^2	0.077	0.025	0.021	0.023	0.003
Country Fixed Effects	✓	✓	✓	✓	✓
Observations	688	695	648	695	695

Notes: All specifications include country fixed effects. Standard errors in parentheses clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Table 9: Global Household and Firm Debt and Global Growth, Dependent Variable $\Delta_3 y_{t+3}$

	(1)	(2)	(3)	(4)	(5)	(6)
Global $\Delta_3 \frac{HHD}{Y}_{t-1}$	-1.259**		-1.302**	-1.320**	-0.963**	-1.121**
	(0.289)		(0.306)	(0.366)	(0.262)	(0.263)
Global $\Delta_3 \frac{FD}{Y}_{t-1}$		-0.0533	0.125	0.235	-0.0225	0.0726
		(0.169)	(0.150)	(0.216)	(0.0993)	(0.134)
Global Δy_{t-1}						0.257
						(0.279)
Global Δy_{t-2}						0.280
						(0.214)
Global Δy_{t-3}						0.499*
						(0.243)
Sample	Full	Full	Full	Pre 2000	Post 1980	Full
R^2	.343	.002	.352	.198	.437	.481
Observations	46	46	46	37	30	46

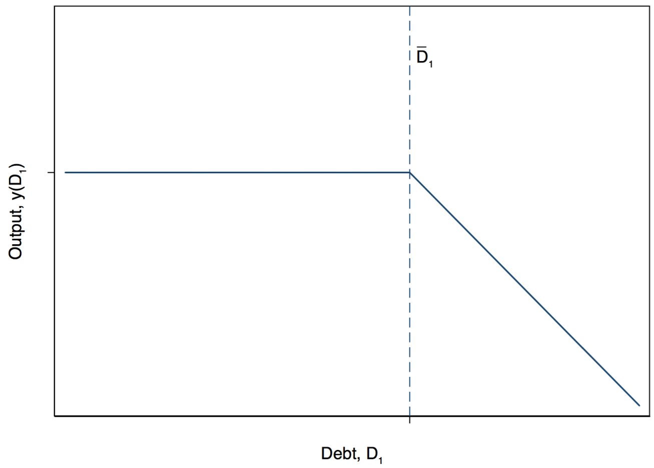
Notes: Newey-West standard errors in parentheses with 6 lags. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Table 10: Credit Expansions, Growth, and the Correlation with the Global Cycle

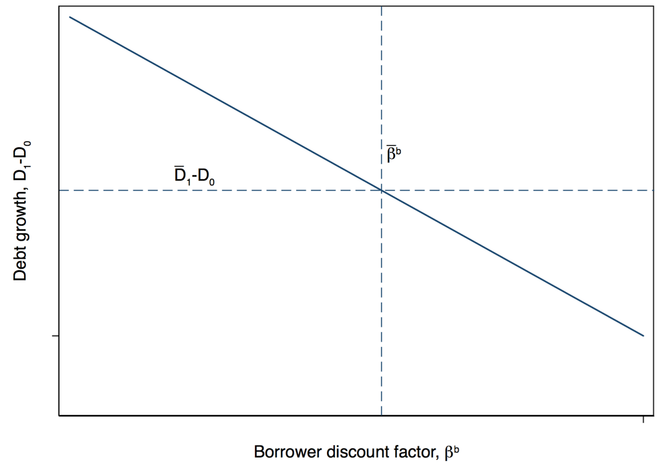
	(1) $\Delta_3 y_{it+3}$	(2) $\Delta_3 y_{it+3}$	(3) $\Delta_3 y_{it+3}$	(4) $\Delta_3 y_{it+3}$	(5) $\Delta_3 \frac{NX}{Y}_{it+3}$	(6) $\Delta_3 \frac{NX}{Y}_{it+3}$	(7) $\Delta_3 \frac{X}{Y}_{it+3}$	(8) $\Delta_3 \frac{Im}{Y}_{it+3}$
$\Delta_3(HHD/Y)_{it-1}$	-0.250*	-0.228**	-0.215*	-0.249**	0.189**	0.189**	0.267*	0.0783
	(0.0988)	(0.0717)	(0.0860)	(0.0855)	(0.0402)	(0.0423)	(0.129)	(0.119)
$\Delta_3(FD/Y)_{it-1}$	0.00302	-0.0237	-0.0228	-0.0196	0.000548	-0.00748	0.0120	0.0114
	(0.0363)	(0.0303)	(0.0319)	(0.0272)	(0.0143)	(0.0138)	(0.0358)	(0.0357)
$\Delta_3(HHD/Y)_{it-1} \times \rho_i^{Global}$	-0.377*		-0.0579	-0.0328	-0.172*	-0.0501	-0.465*	-0.293
	(0.170)		(0.161)	(0.160)	(0.0682)	(0.0651)	(0.203)	(0.188)
$\text{Global}_{-i}\Delta_3 \frac{HHD}{Y}_{it-1}$				-0.833**		-0.296*		
				(0.169)		(0.115)		
R^2	0.151	0.486	0.487	0.223	0.059	0.085	0.053	0.017
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Year Fixed Effects		✓	✓					
Observations	695	695	695	695	695	695	695	695

Notes: All specifications include country fixed effects. Standard errors in parentheses clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

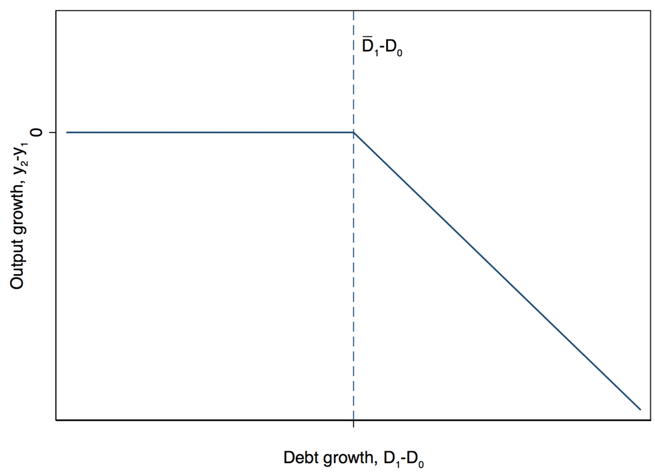
Figure 1: The Relationship between Debt and Output in Models with Financial Externalities



(a) Debt and Output

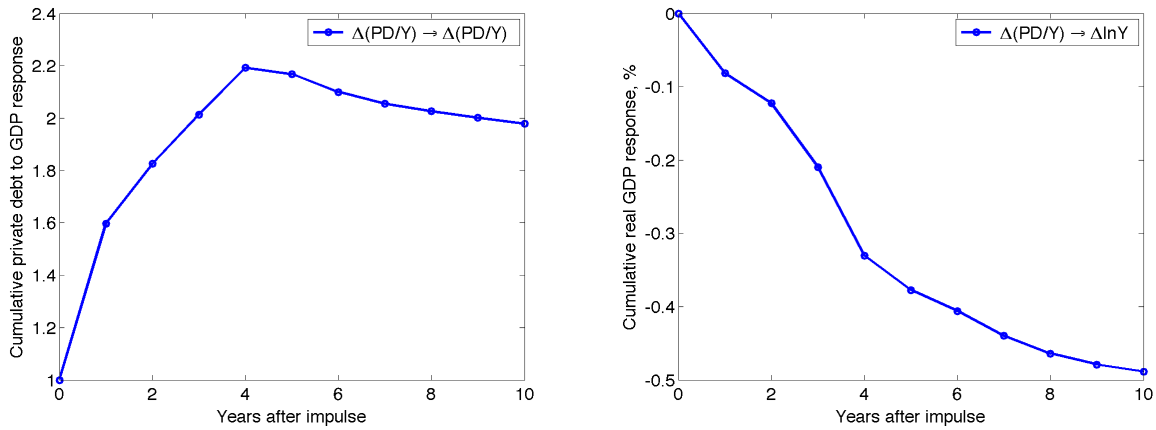


(b) Borrower Impatience and Debt Growth



(c) Debt Growth and Output Growth

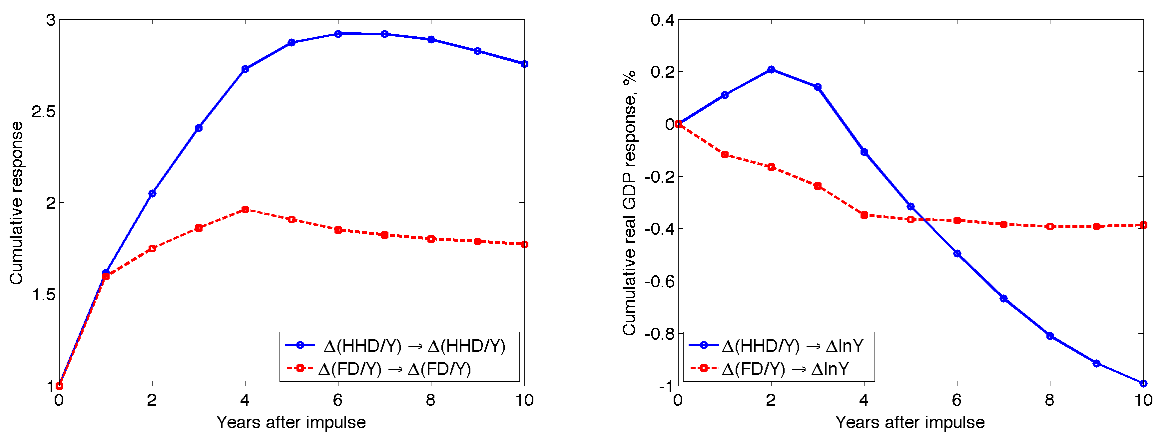
Figure 2: Responses to Private Debt to GDP Shocks in a Two Variable VAR



(a) Private debt to GDP response (b) Real GDP response

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

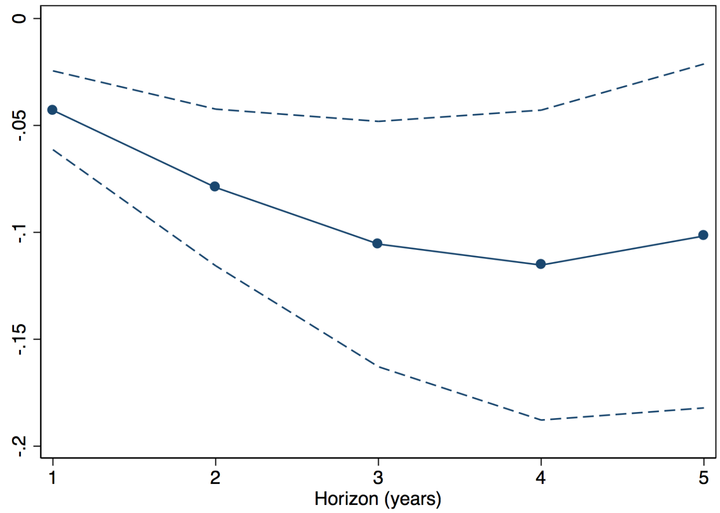
Figure 3: Responses to Household and Firm Debt to GDP Increases in a Three Variable VAR



(a) Debt to GDP response (b) Real GDP response

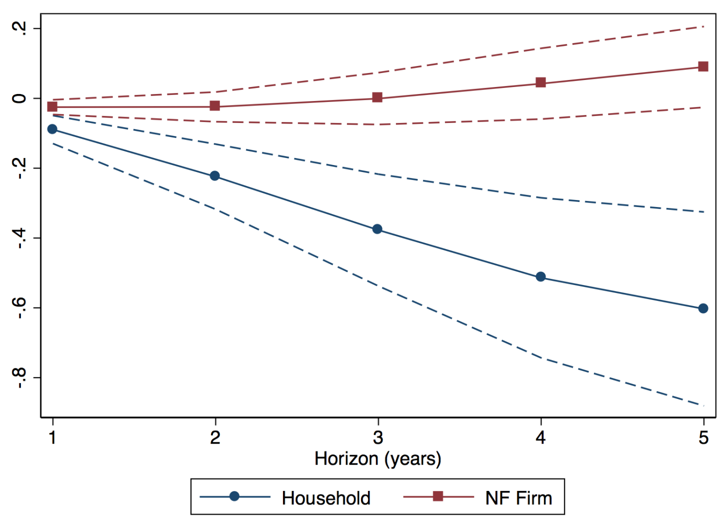
Notes: This figure shows cumulative impulse responses to household and firm debt to GDP shocks from a three variable recursive VAR in real GDP growth, the change in firm debt to GDP, and the change in household debt to GDP ,$(\Delta \ln Y_{it}, \Delta(FD/Y)_{it}, \Delta(HHD/Y)_{it})$. The impulse responses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

Figure 4: Forecasting Output Growth with Overall Private Credit Expansion



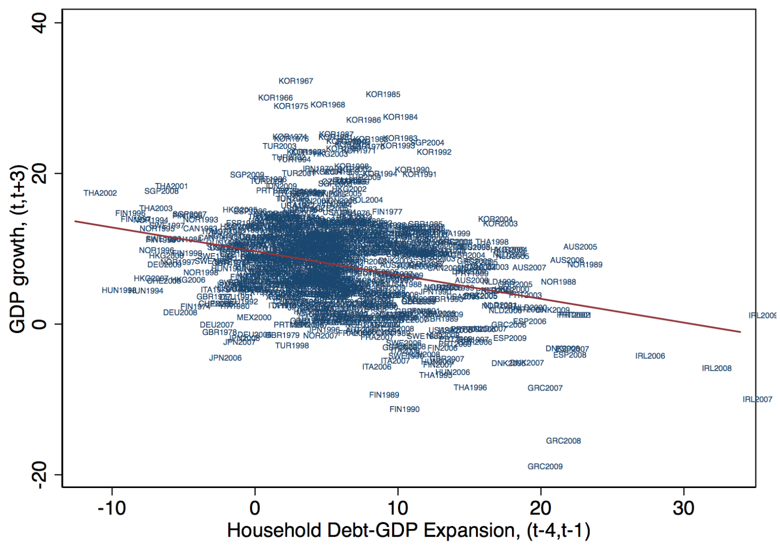
Notes: Specification at each horizon h: $y_{it+h} - y_{it} = \alpha_i^h + \beta^h \Delta_3 \frac{PD_{it-1}}{Y_{it-1}} + \epsilon_{it+h}$. In particular, each regression includes country fixed effects. The solid line plots the estimates $\{\hat{\beta}^h\}$. Dash lines represent 95% confidence intervals,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

Figure 5: Forecasting Output Growth with Household or Firm Credit Expansion

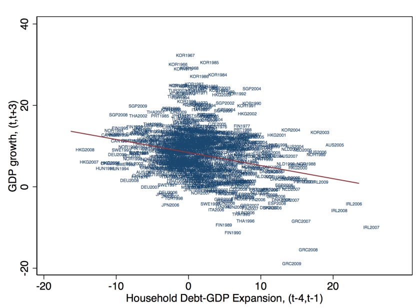


Notes: Specifications at each horizon h: $y_{it+h} - y_{it} = \alpha_i^h + \beta_{HH}^h \Delta_3 \frac{HHD_{it-1}}{Y_{it-1}} + \beta_{NF}^h \Delta_3 \frac{NFD_{it-1}}{Y_{it-1}} + \epsilon_{it+h}$. In particular, each regression includes country fixed effects. The solid circle and square lines plot the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

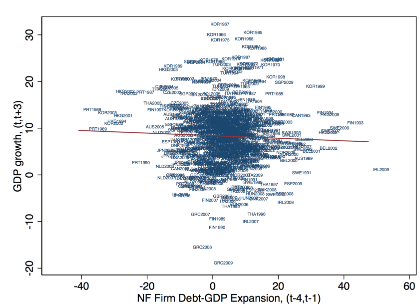
Figure 6: Household Debt-GDP Expansion and Growth



(a) Household Debt

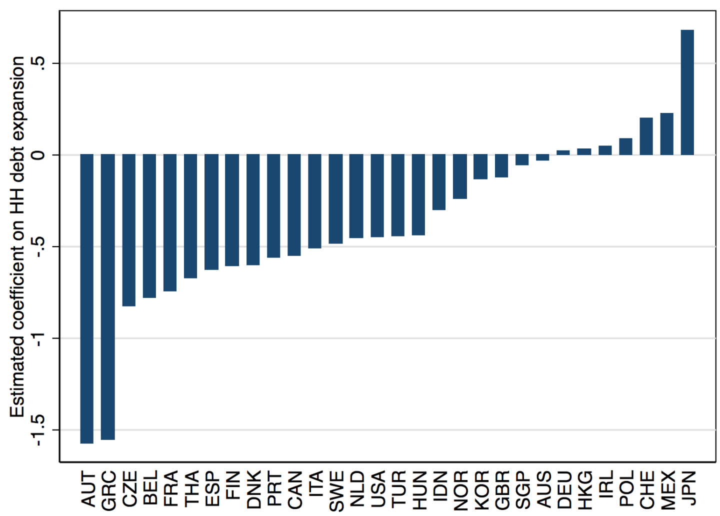


(b) Household Debt, Partial Correlation



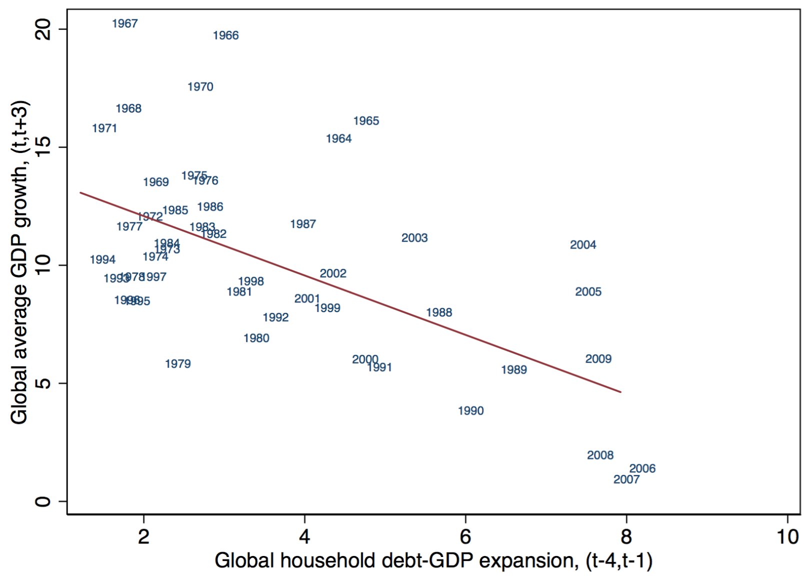
(c) NF Firm Debt, Partial Correlation

Figure 7: Estimates $\beta^3_{HH,i}$ for Each Country Individually

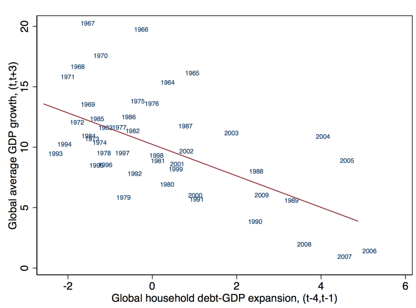


Notes: Plots $\beta^3_{HH,i}$ from the regression $y_{t+3} - y_t = \beta_0 + \beta^3_{HH,i}\Delta_3 \frac{HHD_{t-1}}{Y_{t-1}} + \epsilon_{t+h}$ for each country in the sample.

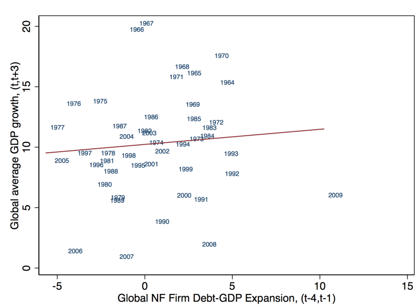
Figure 8: Global Household Debt-GDP Expansion and Global Growth



(a) Household Debt



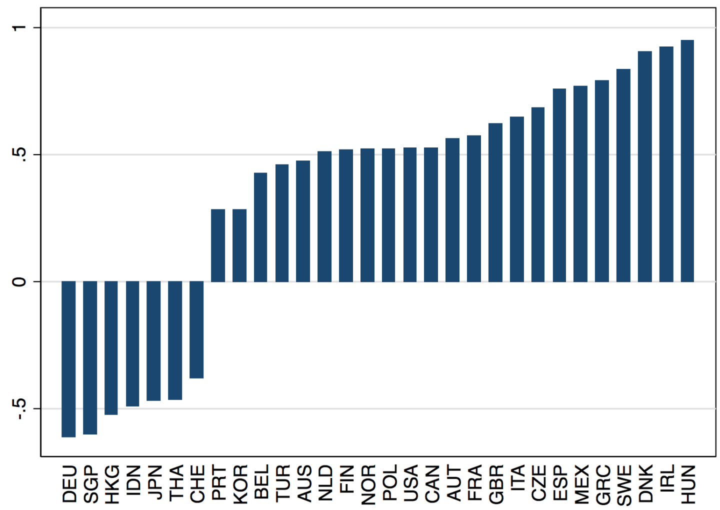
(b) Household Debt, Partial Correlation



(c) NF Firm Debt, Partial Correlation

Note: In panel (b) household debt is partialed out using NF firm debt expansion, while in panel(c) NF firm debt is partialed out with the household debt expansion variable.

Figure 9: Correlation with World Household Credit Cycle



Note: This figure shows the correlation between 3-year credit-GDP change (household or NF firm) for a given country i and the average change for all countries excluding i: corr $\left(\left(\Delta_3 \frac{HHD}{Y}\right)_{it}, \frac{1}{N-1}\sum_{j\neq i}\left(\Delta_3 \frac{HHD}{Y}\right)_{jt}\right)$.

Appendix Tables and Figures

Table 11: Household Credit Expansion Forecasts Lower Growth: Alternative RHS Windows

	(1) $\Delta_3 y_{it+3}$	(2) $\Delta_3 y_{it+3}$	(3) $\Delta_3 y_{it+3}$	(4) $\Delta_3 y_{it+3}$	(5) $\Delta_3 y_{it+3}$
$\Delta_1(HHD/Y)_{it-1}$	-0.566**				
	(0.133)				
$\Delta_1(FD/Y)_{it-1}$	-0.148**				
	(0.0530)				
$\Delta_2(HHD/Y)_{it-1}$		-0.854**			
		(0.181)			
$\Delta_2(FD/Y)_{it-1}$		-0.110			
		(0.0763)			
$\Delta_3(HHD/Y)_{it-1}$			-1.132**		
			(0.245)		
$\Delta_3(FD/Y)_{it-1}$			-0.00173		
			(0.114)		
$\Delta_4(HHD/Y)_{it-1}$				-1.374**	
				(0.318)	
$\Delta_4(FD/Y)_{it-1}$				0.140	
				(0.148)	
$\Delta_5(HHD/Y)_{it-1}$					-1.536**
					(0.395)
$\Delta_5(FD/Y)_{it-1}$					0.274
					(0.190)
R^2	0.078	0.104	0.122	0.135	0.140
Country Fixed Effects	✓	✓	✓	✓	✓
Observations	755	725	695	665	635

Notes: To allow for comparison across specifications, all dependent variables are normalized to annualized rates. Standard errors in parentheses clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Table 12: Cumulative Dynamic Multipliers

	(1) Δy_{t+1}	(2) Δy_{t+1}
LD.$\Delta\frac{HHD}{Y}$	0.0993	0.0889
	(0.0696)	(0.0739)
L2D.$\Delta\frac{HHD}{Y}$	-0.0277	-0.0443
	(0.0574)	(0.0633)
L3D.$\Delta\frac{HHD}{Y}$	-0.259**	-0.274**
	(0.0700)	(0.0677)
L4D.$\Delta\frac{HHD}{Y}$	-0.243**	-0.260**
	(0.0803)	(0.0824)
L5.$\Delta\frac{HHD}{Y}$	-0.334**	-0.453**
	(0.0866)	(0.106)
LD.$\Delta\frac{NFD}{Y}$	-0.0610*	-0.0358
	(0.0239)	(0.0241)
L2D.$\Delta\frac{NFD}{Y}$	-0.0775**	-0.0606*
	(0.0268)	(0.0290)
L3D.$\Delta\frac{NFD}{Y}$	-0.0949*	-0.0765+
	(0.0360)	(0.0377)
L4D.$\Delta\frac{NFD}{Y}$	-0.0895+	-0.0732
	(0.0500)	(0.0573)
L5.$\Delta\frac{NFD}{Y}$	-0.0132	-0.0107
	(0.0651)	(0.0727)
LD.Δy_t	0.0434	-0.0609
	(0.0425)	(0.0539)
L2D.Δy_t	0.146*	-0.0377
	(0.0686)	(0.0786)
L3D.Δy_t	0.167	-0.104
	(0.116)	(0.143)
L4D.Δy_t	0.265	-0.0744
	(0.164)	(0.169)
L5.Δy_t	0.449*	0.00473
	(0.172)	(0.200)
R^2	0.167	0.106
Country Fixed Effects		✓
Observations	695	695

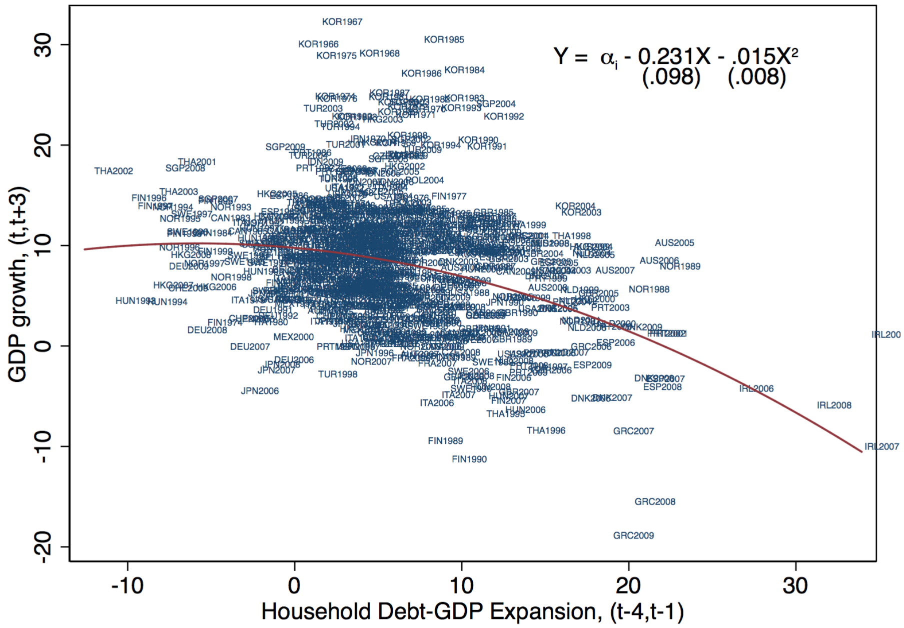
Notes: The cumulative dynamic multipliers specification is $\Delta y_{it+1} = \alpha_i + \sum_{j=1}^{4} \Delta X'_{it-j}\delta_j + X'_{it-j}\delta_5 + \epsilon_{it+1}$, where $X_{it} = \left(\Delta\frac{HHD_t}{Y_t}, \Delta\frac{NFD_t}{Y_t}, \Delta y_t\right)$. Standard errors in parentheses clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Table 13: External Adjustment (Interaction with Mean Total Trade-GDP)

	(1) $\Delta_3 y_{it+3}$	(2) $\Delta_3 y_{it+3}$	(3) $\Delta_3 \frac{NX}{Y}_{it+3}$	(4) $\Delta_3 \frac{NX}{Y}_{it+3}$
$\Delta_3(HHD/Y)_{it-1}$	-0.456**	-0.222+	0.0277	0.105*
	(0.117)	(0.113)	(0.0408)	(0.0466)
$\Delta_3(HHD/Y)_{t-1}\times$ meantrade	0.107	-0.0447	0.139**	0.0895**
	(0.0809)	(0.0791)	(0.0260)	(0.0275)
$\Delta_3(FD/Y)_{it-1}$	0.00452	-0.0230	0.00553	-0.00349
	(0.0355)	(0.0259)	(0.0140)	(0.0131)
$\text{Global}_{-i}\Delta_3 \frac{HHD}{Y}_{it-1}$		-0.873**		-0.287*
		(0.175)		(0.105)
R^2	0.126	0.223	0.062	0.092
Country Fixed Effects	✓	✓	✓	✓
Observations	695	695	695	695

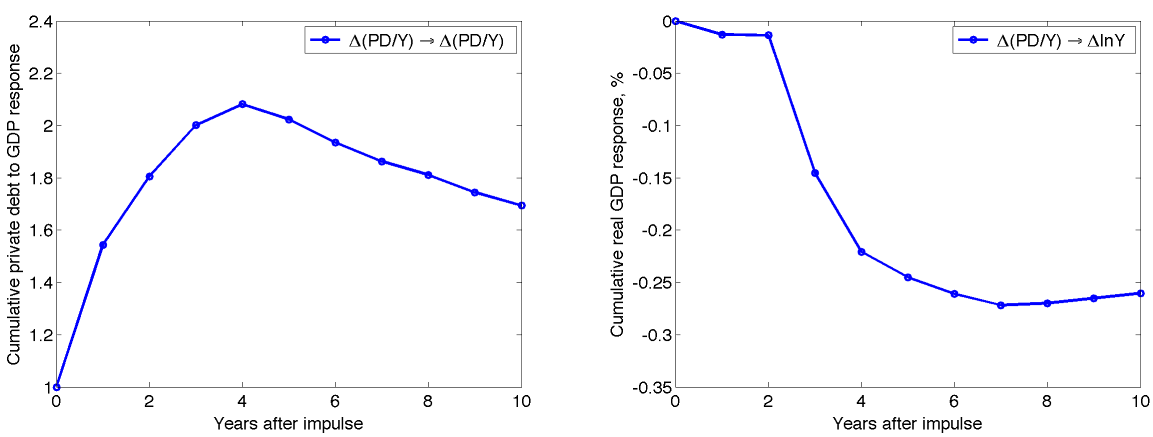
Notes: All specifications include country fixed effects. Standard errors in parentheses clustered at the country level. +,*,** indicates a significance at the 0.1, 0.05, 0.01 level, respectively.

Figure 10: Non-linearity in the Relationship Between Household Debt Expansions and Subsequent Growth



Note: This figure shows the fit of the specification that includes for a quadratic term in $\Delta_3 \frac{HHD_{it-1}}{Y_{it-1}}$. The reported estimates are from a specification that includes country fixed effects. Standard errors in parentheses are clustered at the country level.

Figure 11: Two Variable Bayesian Stochastic Pooling Panel VAR

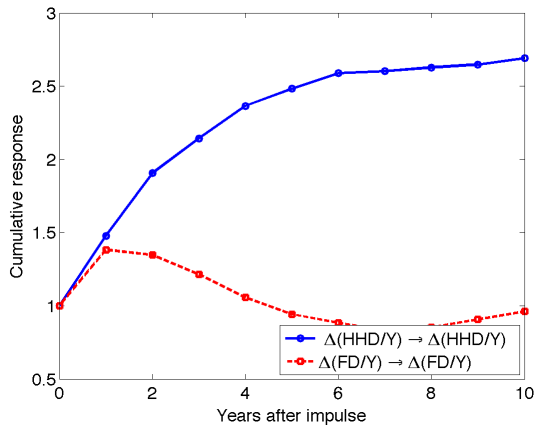


(a) Debt to GDP response

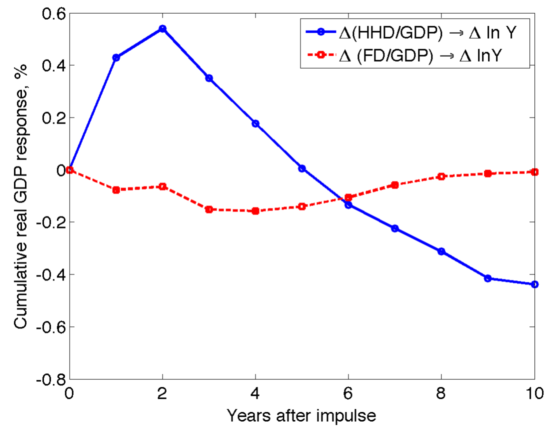
(b) Real GDP response

Notes: This figure shows cumulative impulse responses to private debt to GDP shocks from a two variable recursive VAR in real GDP growth and the change in private debt to GDP, $(\Delta y_{it}, \Delta(PD/Y)_{it})$. Impulse responses are estimated separately for each of the 15 countries in the sample with sufficiently long debt series and then averaged using the Bayesian stochastic pooling procedure from Canova and Pappa (2007).

Figure 12: Three Variable Bayesian Stochastic Pooling Panel VAR



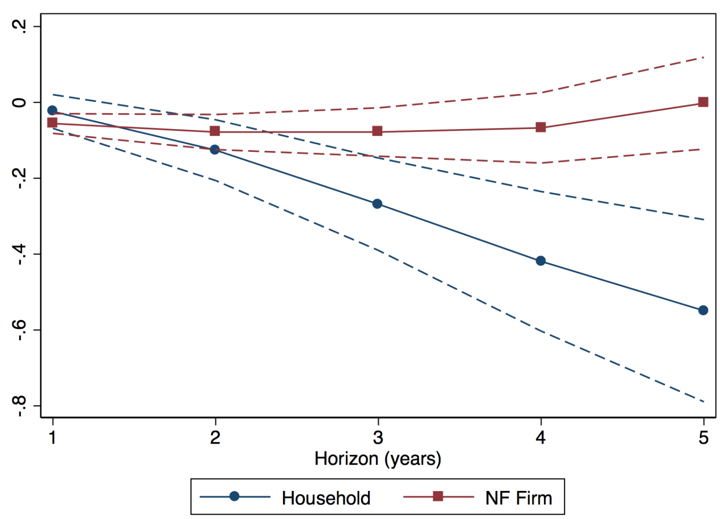
(a) Debt to GDP response



(b) Real GDP response

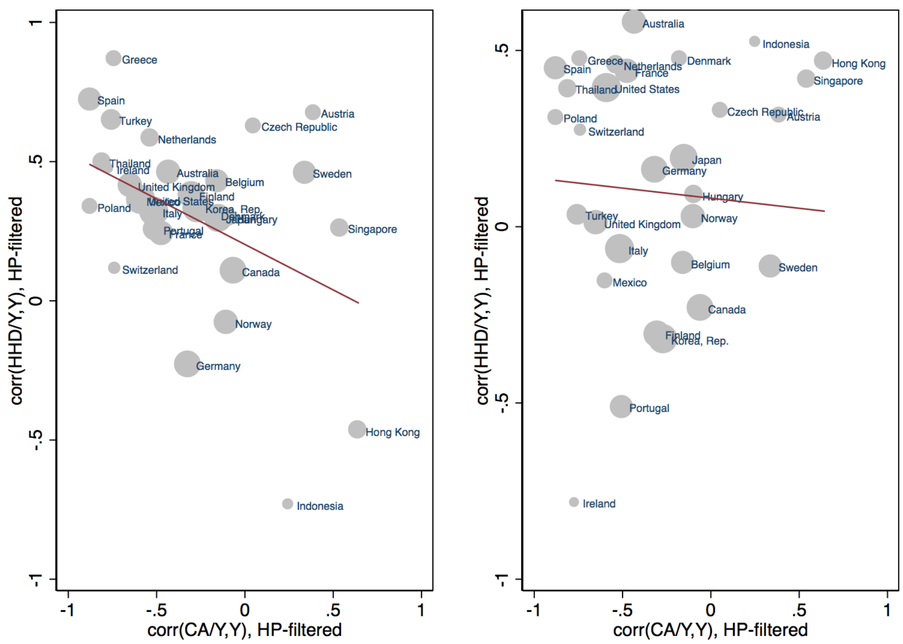
Notes: This figure shows cumulative impulse responses to household and firm debt to GDP increases from a three variable recursive VAR in real GDP growth, the change in household debt to GDP, and the change in firm debt to GDP, $(\Delta y_{it}, \Delta(FD/Y)_{it}, \Delta(HHD/Y)_{it})$. Impulse responses are estimated separately for each of the 15 countries in the sample with sufficiently long debt series and then averaged using the Bayesian stochastic pooling procedure from Canova and Pappa (2007).

Figure 13: Impulse Response Without Lagging Regressors



Note: Specifications at each horizon h: $(\ln Y_{it+h} - \ln Y_{it}) = \alpha_i^h + \beta_{HH}^h \Delta_3 \frac{HHD_{it}}{Y_{it}} + \beta_{NF}^h \Delta_3 \frac{NFD_{it}}{Y_{it}} + \epsilon_{it+h}$. The regressors are not lagged by one year. Each regression includes country fixed effects. Dash lines represent 95% confidence intervals, computed using standard errors clustered at country level.

Figure 14: Countries with More Countercyclical Current Accounts Have More Procyclical HHD but not NFD



Note: This figure shows the cross-country correlation between the cyclicality of HHD or NFD and the CA. All variables are HP-filtered, and HHD, NFD, and CA are scaled by HP-trend GDP. Observations weighted by underlying number of years in main regression.