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Understanding the Macro-Financial Effects of Household Debt: A Global Perspective

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Abstract

We confirm the negative relationship between household debt and future GDP growth documented in Mian, Sufi, and Verner (2017) for a wider set of countries over the period 1950–2016. Three mutually reinforcing mechanisms help explain this relationship. First, debt overhang impairs household consumption when negative shocks hit. Second, increases in household debt heighten the probability of future banking crises, which significantly disrupts financial intermediation. Third, crash risk may be systematically neglected due to investors' overoptimistic expectations associated with household debt booms. In addition, several institutional factors such as flexible exchange rates, higher financial development and inclusion are found to mitigate this impact. Finally, the tradeoff between financial inclusion and stability nuances downside risks to growth.

JEL Classification Numbers: E17, E2, E21, E32, E44, G01, G21

Keywords: Household debt; financial crises; neglected crash risk; leverage; macro-financial stability

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I. INTRODUCTION

Recent academic studies suggest that increases in household debt are associated with lower output growth, higher unemployment, and greater probability of future banking crises (Mian, Sufi, and Verner, 2017; Jordà, Schularick, and Taylor, 2016).[2] These relationships were noticeable in the aftermath of the global financial crisis, where overborrowing by subprime households led to a rise in defaults and foreclosures, and triggered the collapse of the U.S. housing market and the subsequent large recession (Sanders, 2008; Mian and Sufi, 2009, 2014a, 2014b). Theoretically, this relationship can be explained by the presence of aggregate demand externalities associated with high household debt, which may lead to a supply-constrained economy during recessions (see, e.g., Eggertsson and Krugman, 2012; Korinek and Simsek, 2016). In addition, behavioral factors and heterogenous beliefs may also play an important role. Investors and households may exhibit over-optimism, especially during periods of housing booms (e.g., Cheng, Raina, and Xiong, 2014). Despite significant risks associated with household debt, investors may also neglect crash risks due to over-optimism (Baron and Xiong, 2017).

The renewed increase in household debt worldwide may be additional cause for concern. The IMF's Fall 2017 Global Financial Stability Report (GFSR) found that since 2008, household debt has continued to grow significantly in a sample of 80 countries. Among advanced economies, the median debt ratio rose from 52 percent of gross domestic product (GDP) in 2008 to 63 percent in 2016. Among emerging market economies, it increased from 15 percent of GDP to 21 percent over the same period. Hence, the global financial crisis does not seem to have deterred households from taking on more debt. While this may be optimal in a low interest rate environment, this may eventually come back to hurt households when they face a rising debt service once interest rates start rising and the credit boom ends (Drehman, Juselius, and Korinek, 2017).

Conversely, higher household borrowing could also improve economic efficiency and enhance macro-financial stability. Households may borrow to smooth fluctuations in consumption.[3] In addition, households may also borrow to invest in financial (e.g., stocks and bonds) and non-financial (e.g., housing and education) assets. Channeled through financial intermediaries, higher borrowing by these households with access to better investment opportunities can be an important source of economic growth. Thus, in the long term, higher household borrowing today may also be associated with higher future GDP growth (Beck and Levine, 2004; Beck, Levine, and Loayza, 2000; Levine 1998, among others). However, the long-term positive effects on output growth start fading once private sector debt reaches a certain threshold, due to rising financial stability risks and misallocation of resources (Arcand, Berkes, and Panizza, 2015; Sahay et al., 2015).

[2] Monetary policy may also play a role. See Brunnermeier and others (2017) for U.S. evidence.

[3] The permanent income hypothesis (PIH) indicates that an individual's consumption is determined by his or her expected future income. Households may increase borrowing to smooth consumption if they anticipate their expected future income rises (Friedman, 1957; Hall, 1978).

This paper takes a deeper look at these issues and confirms a time-varying relationship between household debt and growth for a very broad sample of countries, and explores several mechanisms of propagation favoring this relationship. In particular, it addresses the following questions: (1) Can the negative relationship between household debt and macroeconomic outcomes over the business cycle be generalized to a broad set of countries, including both advanced and emerging market economies? (2) What are the channels and factors which could explain this relationship? (3) What role, if any, do institutional factors play in this relationship?

The main findings are as follows. First, the negative relationship between household debt growth and future GDP growth, documented in Mian, Sufi and Verner (2017) for 30 countries, is generalized to a much larger set of 80 advanced and emerging market economies. Second, this negative relationship seems to be explained by three complementary mechanisms: (i) the macro effect of a debt overhang situation, the magnitude of which depends on differences in marginal propensities to consume across households; (ii) household credit booms being reflected in a higher future probability of banking crises; and (iii) sentiment driven by rapid increases in household debt being associated with a neglect of crash risks. Third, the effects of household debt, conditional on individual household level debt and country characteristics, are associated with different downside sensitivities across countries.

The rest of this paper is structured as follows. Section II reviews the role of household and corporate debt in macro-financial models. Section III presents the empirical analysis and the main results. This section is divided into five parts. Part A confirms the negative relationship between household debt and future output growth for a large panel data set. Part B examines the role of various institutional factors and distributional (micro-household level) characteristics. Part C provides evidence on the effects of household debt on the probability of banking crises. Part D explores the link between household debt and neglected downside risks. In Part E, the impact of debt overhang on household consumption is studied. For robustness, an alternative approach, which employs panel vector autoregression (VAR) techniques is applied in Section IV. Finally, Section V concludes.

II. The Role of Debt in Macro-Financial Models

The impact of shocks on the macroeconomy can be amplified by financial frictions. Much of the existing literature focuses on the implications of productivity shocks on the supply side of the economy (e.g., Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Caballero and Krishnamurthy, 2003; Brunnermeier and Sannikov, 2014). In these theoretical models, nonfinancial corporates face financial frictions, such as collateral constraints. Positive productivity or monetary policy shocks that relax these constraints lead to increased borrowing and investment and higher asset prices which may further relax the constraints. As a result, such shocks can amplify the business cycle dynamics.

A recent strand of literature has emphasized the debt-driven demand channel of credit supply shocks for the business cycle. While the underlying borrowing constraint mechanism is the same as in earlier models, when credit supply tightens after a credit boom, nominal rigidities, monetary policy constraints, and other frictions can exacerbate the downward pressure on

growth (e.g., Eggertsson and Krugman, 2012; Korinek and Simsek, Farhi and Werning, 2016). In these models, households increase borrowing to finance consumption when credit constraints are relaxed. However, when credit constraints later tighten, borrowers have to delever by cutting back consumption. While the borrowing decisions are optimal from the individual household perspective, they are excessive relative to the social optimal level as monetary policy is unable to stimulate demand from the savers due to monetary policy constraints and/or nominal rigidities. For example, these constraints can include a fixed exchange rate regime as opposed to a floating regime where the former imposes more limitations on monetary policy in stimulating demand during economic downturns.

In the cases described above, a positive shock to the credit constraint of borrowers would have amplified implications for the macroeconomy. In the aggregate, we would see a decline in economic growth after household credit booms. Mian, Sufi, and Verner (2017) are among the first to document the household debt cycle at the global level. In their study, they emphasize the debt-driven "consumption" channel in which households may rationally borrow more than the socially optimal level when their credit constraints are relaxed. They argue that the channel is a distinct one that has implications for policies, particularly macroprudential policies.

In other strands of the literature, households are shown to borrow also because of behavioral biases. These behavioral biases may originate from household consumption patterns or mispricing of risk by the financial market. For example, the present-bias of consumption and/or extrapolative expectations by households may lead to excessive borrowing when positive credit shocks hit but significant drop in consumption when credit constraints tighten (Laibson, 1997; Cheng, Raina, and Xiong, 2014). Heterogeneous beliefs and/or the underestimation of risks associated with household debt can also lead to more pronounced leverage cycles and more volatile asset prices (Geanakoplos, 2010; Baron and Xiong, 2017). Empirically, Jorda and others (2016) and Dell'Ariccia and others (2012) emphasize the role of mortgages in the macroeconomy. Brunnermeier and others (2017) examine the relation among household credit expansion, financial market stress and other macroeconomic aggregates. They find monetary policy to be an important driver of these dynamics.

More recently, several studies have shown that demographics and the distribution of income and debt matter. Younger households that anticipate future income growth would borrow more against their future income (Blundell, Browning, and Meghir 1994). Rajan (2010) and Kumhof, Rancière, and Winant (2015) have argued that increased income and wealth inequality led to the rapid growth of household debt in the United States and eventually to the financial crisis in 2008. Coibion and others (2017) find that, over the period 2001–2012, income inequality may have indirectly operated as a screening device for banks, given that they lend less to low-income households in high-inequality regions in the United States.

III. Empirical Analysis and Results

A. Household Debt and Output Growth in 80 Countries

In this section, we document the relationship between current increases in household debt and future GDP growth in a large sample of 80 countries (see Table 1 in Appendix I for a description of countries and data sources). Among these 80 countries, there are 39 advanced economies and 41 emerging market economies. The large size of the sample allows us to confirm the findings in the academic literature and explore more the cross-country differences. Following Mian, Sufi, and Verner (2017), we first study:

$$\Delta_3 y_{i,t+k} = \alpha_i + \beta^h \Delta_3 hhd_{i,t-1} + \beta^f \Delta_3 fd_{i,t-1} + \gamma X_{i,t} + \epsilon_{i,t+k}$$

where $\Delta_3 y_{i,t+k} \equiv \log\left(\frac{y_{i,t+k}}{y_{i,t+k-3}}\right)$, y is real GDP, $\Delta_3 hhd_{i,t-1} \equiv \left(\frac{HHDebt}{GDP}\right)_{i,t-1} - \left(\frac{HHDebt}{GDP}\right)_{i,t-4}$ is the past three-year change in the household debt ratio, $\Delta_3 fd_{i,t-1} \equiv \left(\frac{FirmDebt}{GDP}\right)_{i,t-1} - \left(\frac{FirmDebt}{GDP}\right)_{i,t-4}$ is the past three-year change in corporate debt ratio, and X includes control variables such as lagged GDP growth for the proceeding two years and the past three-year change in the government debt to GDP ratio.

This forecasting equation examines the relationship between current changes in the household debt to GDP ratio and future real income growth, controlling for current changes in the non-financial corporate debt to GDP ratio, country and time fixed effects, and other variables such as the past level of household debt to GDP ratio. Tables 2 and 3 in Appendix I. contain a full description of all variables in this paper and the data sources. The equation is estimated as an unbalanced panel regression, with standard errors clustered both by year and country.

In the regression above, a negative estimate for β^h would indicate that household debt growth forecasts *lower* future income growth; a positive estimate for β^h would indicate the opposite. Country and year fixed effects are included to absorb the level effects of each country and year. Standard errors are dually clustered at the country-year level. We repeat this forecasting equation for varying horizons k from the current year ($k = 0$) to six years ahead ($k = 6$).

Table 1 provides summary statistics on household debt and the main variables used in this paper. The mean household debt to GDP ratio across the sample stood at 35 percent and the mean annual increase was about 1 percentage point. This compares to 60 percent for firm debt to GDP, increasing by slightly less than 1 percentage point per year, and the public debt-GDP ratio of 52 percent on average, rising by 2 percentage points per year. The data also exhibit considerable heterogeneity, with household debt-GDP ratios at the tenth and ninetieth percentile, for example, ranging between 6 percent and 72 percent.

Table 2 reports the regression results. Columns (1)–(7) show the regression results for forecasting horizons from zero years (current year) to six years later and the coefficients on the household debt to GDP ratio are strongly negative.[4] In other words, current growth in household debt relative to GDP is associated with *lower* future income growth. Regression results are statistically significant at the 1 percent level. Among different forecasting horizons, the negative effect is the strongest at the three to four-year horizon and diminishes as the horizon increases. Additional results (not reported here) show that the effects remain significant when the sample is split in several ways (before/after the year 2000, before/after the global financial crisis).

The effect is also economically significant. The three-year change in household debt to GDP ratio has a standard deviation of 5.89 percentage points, and a one standard deviation increase in the household debt ratio is associated with 1.2 percentage points lower GDP growth over a three-year horizon. Compared to the effect of corporate debt, household debt has a stronger negative effect on future GDP growth, and the effect lasts for much longer than corporate debt. The standard deviation for three-year change in the corporate debt to GDP ratio is 18.97 percentage points, three-times that for household debt. However, the coefficients on corporate debt are more than three-times smaller than those for household debt. Moreover, negative and significant effects of corporate debt on future income are absent at forecasting horizons beyond four to five years.

These results based on 80 countries are thus broadly consistent with the findings in Mian, Sufi, and Verner (2017) who study a sample of 30, mostly advanced, economies. We also verify this relationship using a panel vector auto-regression (VAR) approach, as discussed in Section III.[5]

In Table 2b, we further split the sample into advanced economies and emerging markets. Columns (1)–(4) present the results for the sample of 39 advanced economies.
The correlation between past growth in household debt and future income growth is negative and statistically significant with a forecasting horizon of one to five years. The negative effect diminishes at the seven-year horizon. Columns (5)–(8) present the same regression results for emerging markets. The negative correlation is still present, although statistical significance is weak at the three- and five-year horizons due to the shorter data span for many emerging market economies.

What drives this negative relationship? The negative effect of debt overhang of households on the macroeconomy has been examined in the literature using micro-level data. However, empirical analysis using micro-level data can only be performed for a few advanced economies, especially the United States, where data quality permits such in-depth treatment (e.g., Mian and Sufi 2014a). Many of these papers focus on the deleverage episode after a

[4] All regressions include lagged GDP growth for the preceding two years as controls. Results remain the same when including the past three-year change in the government debt to GDP ratio (not reported here).

[5] For 27 countries where quarterly data of household debt and GDP are available between 1998 and 2015, the relationship between innovations in household debt and future GDP growth is analyzed. In addition, this analysis controls for corporate debt, house prices, and short-term interest rates. Results are very similar as the OLS regressions.

large negative shock (such as a house price shock) and examine how households with different leverage ratios respond. These studies may provide well-designed identification strategies but often suffer from external validity problems. Section E provides complementary evidence of such micro-macro analysis using European data.

In our analysis, the cross-country setting provides a natural dimension of variation across countries and can potentially overcome external validity issues when thinking about macrofinancial policies at the country level or across countries. In the next section, we study a selection of institutional factors that likely matter the most in the context of household debt.

B. Institutional Factors and Distributional Characteristics

The large size of the sample allows us to go beyond the existing literature by exploiting cross-country differences. In this section, we examine the sensitivity of the household debt-GDP relationship to country-level variations in institutional factors and distributional characteristics of debt. We are particularly interested in the exchange rate regime, financial development, mortgage participation rates of low-income households, and the average debt-to-income (DTI) ratio of low-income households.

Specifically, we conduct the following regression analysis:

$$\Delta_3 y_{i,t+5} = \alpha_i + \beta_1 \Delta_3 hhd_{i,t-1} + \beta_2 \cdot \Delta_3 hhd_{i,t-1} \times IF_i + \beta_3 X_{i,t-1} + \delta_t + u_{i,t+k}$$

where IF_i is an indicator for an institutional factor or distributional characteristic of household debt. The forecasting horizon is fixed at five years for illustration purposes. Qualitatively similar results (not reported here) are obtained if one uses other forecasting horizons at three or seven years. The coefficient of interest is β_2. We are interested in examining whether certain institutional factors and distributional characteristics of household debt can mitigate or reinforce the effect of household debt. In Section III, we use an alternative panel VAR methodology to verify these results. The results obtained here are qualitatively similar to those reported in the Fall 2017 GFSR.[6]

B.1. Exchange Rate Regime and Capital Account Openness

An increase in household debt corresponds to a transfer of funds from households that save to households that borrow. These household borrowers increase their leverage and pay down their debt over time. In such a situation, a negative credit constraint shock to borrowers would lead to forced deleveraging by the borrowers by cutting back consumptions (e.g., Eggertsson and Krugman 2012). When this happens, and to avoid an aggregate decline in consumption, optimal monetary policy should lower interest rates to encourage consumption

[6] The Fall 2017 GFSR used continuous variables, whereas this paper relies on discrete measures. The GFSR estimation was multivariate, using a general-to-specific estimation approach, whereas this paper is confined to bivariate analysis. However, both sets of results yield qualitatively similar conclusions.

by the savers in the economy.[7] Failure to raise consumption by the savers would result in a decline in aggregate demand and economic recession.

Flexibility in monetary policy is essential in this situation. Constraints to monetary policy, such as the zero lower bound, can prevent the rise in consumption by the savers to fully offset the consumption drop by the borrowers. Similarly, at the country level, a fixed exchange rate regime would impose limitations to monetary policy. When monetary policy faces such constraints, one would expect that the negative effects of household debt growth on future income growth are stronger.

We use the IMF classification of exchange rate regimes for all 80 countries in our sample. The classification has six categories including fixed exchange rate regime, freely floating exchange rate regime, and categories that are in between. We generate an indicator variable for fixed exchange rate regime. The indicator takes value 1 if the country is classified as having a fixed exchange rate regime, and 0 otherwise. We substitute IF in the regression above with this indicator.

Regression results are reported in the first two columns of Table 3. Column (1) shows the results controlling for firm debt and lagged GDP growth. We find that the interaction term between past household debt growth and the indicator for fixed exchange rate regime is negative and highly significant, while household debt growth by itself becomes insignificant. This indicates that having a fixed exchange rate regime, which limits monetary policy flexibility, compounds the negative effect of household debt on future income, which is consistent with our hypothesis.[8] These results are further confirmed in Figure 5, using a panel VAR approach (see Section III).

Columns (2) and (3) include the consideration of the impact of high capital account openness. High capital account openness is defined as having a capital account openness index above the median. Column (2) suggests that a higher reliance on external funding may amplify the negative effect of household debt on future GDP growth. The results for fixed exchange rate regime and high capital account openness remain when both variables are included in the regression (Column (3)). In both cases, there is a very significant interaction of these institutional factors with household debt growth, while household debt growth by itself is insignificant.

B.2. Financial Development, Transparency, and Financial Risk Index

Similarly, if a country has a better developed financial system, more transparent credit information about borrowers, and a better financial risk index, the rise in household debt is associated with a less negative impact on future growth. We use the Financial Development Index to capture how well the financial system can allocate credit in general. An indicator is generated for having high Financial Development Index, which takes value 1 if the Financial

[7] Assuming the total supply of goods in the economy is determined by the total demand.

[8] We further confirm that this result is not driven by euro-area countries alone. Regression results remain statistically significant at the 10 percent level when the interaction of past household debt growth and the euro area dummy is also included as an additional control.

Development Index is within the top quartile of all countries in the sample as of 2014, and 0 otherwise. We also use the Transparency index and Financial Risk Index to capture the degree of credit information transparency and financial risk, respectively.

Regression results are reported in Columns (4)–(6) of Table 3. In Column (4), we find that when the Financial Development Index is high, i.e., the indicator takes value 1, the negative effect of household debt is mitigated significantly. The magnitude of the coefficient on the interaction term is the same as the coefficient on the household debt term, suggesting that the negative effects are concentrated in countries where the Financial Development Index is low. Similar effects are found for better transparency and better financial risk (Columns (5) and (6)), although the coefficient on the interaction term is smaller in magnitude.

These results suggest that better and more efficient financial markets and institutions can help overcome the negative medium-term macro-financial effects associated with rising household debt. This may reflect the fact that credit growth is less risky in more financially developed countries because their financial systems are, on average, better able to assess credit risk and allocate credit, and to deal with the consequences.

B.3. Distributional Characteristics of Household Debt: Participation Rate vs. DTI

To further distinguish the effect of debt overhang, we explore the distributional characteristics of household debt. Distributional characteristics of household debt can contain valuable information.[9] In the theoretical framework of Korinek and Simsek (2016), differences in marginal propensities to consume (MPCs) between borrowers and savers can generate negative aggregate effects stemming from debt overhang on consumption. In other words, aggregate debt that is concentrated in low-income households would likely have very different implications on the macroeconomy compared to the same level of aggregate household debt that is uniformly allocated across all income groups, because the average MPCs of borrowers and savers in these two cases are very different.

Also empirically, the cross-section characteristics of household debt holders are shown to be extremely important when analyzing the role of household debt. For example, Mian and Sufi (2009) show convincingly that a key driver of the U.S. subprime crisis is the fast accumulation of household debt in U.S. zip codes that had the lowest income growth. Mian and Sufi (2014a) contrast the negative outcomes during the Great Recession in U.S. counties that had high household leverage with those that had low leverage. These studies highlight the importance of looking at distributional characteristics of household debt in addition to the information contained in the aggregate household debt level.[10]

In this paper, two distributional characteristics of household debt are considered: (1) the mortgage participation rate of low-income households (i.e., bottom two quintiles in income

[9] For a discussion of the distributional aspects of household assets and liabilities in the international context see also Badarinza, Campbell, and Ramadorai (2016); Badarinza, Balasubramaniam, and Ramadorai (2016).

[10] For a different perspective regarding the distributional aspects of household debt, see also Foote, Loewenstein, and Willen (2016) and Albanesi, De Giorgi, and Nosal (2017).

distribution); and (2) the (weighted) average debt-to-income ratio of low-income households. We generate these measures based on the latest available micro-level data for 30 countries.

The mortgage participation rate of low-income households is an indicator for the degree of financial development in an economy. A higher mortgage participation rate for low-income households is likely associated with a banking sector that can efficiently screen borrowers based on relatively transparent information and determine their credit risk. In countries where mortgage participation rate is low for low-income households, such financial intermediation is likely less efficient.

We rank all countries by the mortgage participation rate for low-income (bottom two quintiles in income distribution) households, and generate an indicator *LowIncPart*. This indicator takes value 1 if the mortgage participation rate for the bottom 40 percent of households in the income distribution ranks highly (within the top quartile of countries; roughly above 20 percent), and 0 otherwise. Column (7) of Table 3 shows the regression results. The results show that a high mortgage participation rate for low-income households mitigates the negative effects of household debt on future income growth. Qualitatively and quantitatively, this result is similar to the that for the Financial Development Index, although the latter has a larger sample of 80 countries. Both results show that financial development, including inclusive financial services, mitigates the negative impact of household debt overhang on the real economy.

Now we turn to the other indicator, *LowDTI*. This indicator is designed to capture the average debt-to-income ratio of low-income (bottom 40 percent of income distribution) households weighted by the share of debt held by these households as a percent of total outstanding household debt in the economy. We rank all countries by this measure where such data are available at the micro level. *LowDTI* takes value 1 if the weighted DTI for these households is low (within the quartile of all countries), and 0 otherwise.

Columns (8)–(9) of Table 3 report the regression results and suggest that having a low average DTI for low-income households seems to reduce the negative impact of aggregate household debt on the economy, although statistical significance is weaker. This result remains when the interaction with emerging market (*EM)* indicator is controlled for (Column 9). In other words, high indebtedness of low-income borrowers would likely worsen the negative impact. This is consistent with the intuition in the theoretical models such as Korinek and Simsek (2016) and empirical evidence by Mian and Sufi (2014a).
Hence, debt participation and average DTI capture two distinct aspects of financial access by low-income households. The former is more related to financial inclusion and financial development, while the latter points the potential danger of over-indebtedness of low-income households. They appear to have different implications for macroeconomic growth.
These results are further confirmed in Figures 5 and 6 where an alternative panel VAR approach is used (see Section III).

C. Systemic Banking Crises

Previous work by Schularick and Taylor (2012) finds that total private credit helps predict financial crises. In the same vein, while using a larger set of countries, we ask the following related questions: Do household and corporate credit growth matter for financial crises? What role does the level of debt play? Is there a threshold effect?

To answer these questions, we use a basic forecasting framework and estimate the following probabilistic model of systemic banking crisis event in country *i*, and year *t*:

$$log\frac{P[S_{it}=1|X_{it}]}{P[S_{it}=0|X_{it}]} = \Psi_{0i} + \Psi_1 X_{it} + \Psi_2 X_{it} \text{ x I(Hi Debt)}_{it} + \epsilon_{it},$$

where the dependent variable is the log of the odds ratio, X_{it} refers to a vector of lagged changes and levels of household and corporate debt (scaled by GDP) ratios while the third term of the regression refers to interactions between *X* and an indicator function I (Hi Debt). The latter takes value one if country *i* experiences household or sovereign debt exceeding various thresholds.[11] Finally, Ψ_{0i} are country fixed effects (FE), to control for time-invariant country-specific characteristics.[12]

Household debt appears to be a good early warning indicator for banking crises.[13] Using a logit panel estimation covering 34 countries over 1970–2015 period, both household and corporate debt-to-GDP ratios are found to be positively associated with a greater probability of systemic banking crises in the future (Table 4). Moreover, *changes* in household debt are found more important than *levels* (Column 3) while the effects of household debt seem to dominate those of corporate debt (Column 4).[14]

The relation between increasing household debt and financial crises is more pronounced when the household debt level exceeds 65 percent of GDP (Column 5). This suggests that a given increase in debt of already highly-indebted households is likely to result in a debt overhang. In such situations, households must either drastically reduce consumption or default on their debt. Similarly, the probability of a banking crisis is larger when levels of

[11] For instance, the threshold for HI household debt is considered 65 percent of GDP which represents the top quintile of the country-time distribution of the set of countries included in the regression, and HI sovereign debt indicator takes value 1 when it exceeds 60 percent of GDP, which corresponds to the top 1/3 of the distribution.

[12] The average change in household credit-to-GDP ratio is about 1 percentage point while the standard deviation is around 2.5 percentage points in our regression sample. Up to four lags for both household and corporate credit changes were considered. However, only the significant lags were included in the baseline specification of Table 4. Robustness checks are provided in Table 5a and 5b. Various methods such as Firth logit, Poisson, and Panel logit point to similarly robust estimates for the effect of household debt changes on the probability of banking crises.

[13] Previous research looking at the relationship between bank credit and financial crises include Gourinchas, and Obstfeld (2012); Drehmann and Tastaronis (2014); Jordà, Schularick, and Taylor (2016).

[14] Given that we use models with country fixed effects, these results should be interpreted as deviations from the country averages.

sovereign debt are high (above 60 percent of GDP), suggesting that the probability of a systemic banking crisis increases when the government capacity to support banks is more constrained (Column 6).

The average marginal effect of changes in household debt is about 1 percentage point, almost double the effect of firm debt increases. When household debt level is high, the probability of systemic banking crises is boosted by another 80 basis points. In economic terms, these are significant and relevant effects, given that the unconditional crisis probability is about 3.5 percent for the countries considered in this analysis.[15]

Another way to look at these relationships is to compare crisis predictability power, using the Area Under Curve (AUC) metric.[16] We compare four models: (1) where only country FE are considered (*xb0*); (2) where country FE and the level of household debt are considered (*xb1*); (3) where country FE and changes in household debt are considered (*xb2*); and (4) where country FE and both levels and changes of household and corporate debt are considered, jointly with interactions of household debt with high household debt and high sovereign debt levels (*xb3*). The performance of the *xb3* model with AUC at about 0.87 dominates the second (*xb1*) and the third model (*xb2*) which in turn do a better job than the uninformative null hypothesis where AUC equals 0.5 (reference) and the model with country FE only (*xb0*) where AUC equals 0.57.

D. Neglected Downside Risk

In this section, we investigate whether investors systematically neglect the downside risk to asset returns and economic outcomes during the buildup of household leverage. This behavioral bias may result in overborrowing and reinforces the previous mechanisms documented in this paper.[17] For example, households and professional investors may have extrapolative expectations about future house prices. Cheng, Raina, and Xiong (2014) show that during the 2000s housing boom in the U.S., professionals in the mortgage securitization industry, who were supposed to understand the underlying risks of the housing market the best, were among the most aggressive buyers of second homes in the run-up to the subprime crisis. Systematic mispricing of risks can happen when investors have a tendency to think that "this time is different" (Reinhart and Rogoff, 2009). Investor sentiment, often a mean-reverting process, also explains fluctuations in economic activities (López-Salido, Stein and Zakrajšek, 2017).

To empirically test this, we examine whether past growth in household debt is systematically associated with future lower banking equity returns as banks are especially exposed to

[15] However, the negative effects of household debt on the real economy through systemic banking crises might depend on, and be reinforced by, other mechanisms documented in this paper.

[16] AUC is a test statistic which measures the predictability accuracy. For more details see Jorda and Taylor (2011).

[17] While we do not directly measure the behavioral bias of household borrowers, Cheng, Raina and Xiong (2014) show that such bias is prevalent even for experienced real estate investors.

household debt. A negative correlation between past household credit growth and future equity returns would indicate that investors in financial markets are on average overly optimistic during household credit booms.

The analysis in this section has two key contributions to the literature. First, we place an emphasis on the role of household debt (as opposed to *total* debt) in mispricing of risk. While the literature has found that investors tend to neglect downside risk during periods of high *total* credit growth, we examine whether household debt itself has an independent impact. Second, we test whether household debt can predict both bank stock excess returns as well as abnormal returns. The latter may tell whether, compared to the overall market, banking stocks are particularly affected by the neglect of crash risk associated with household credit.

This exercise has important policy relevance because mispricing of risk in the banking sector would suggest that the banking sector overall should require a larger capital buffer to sustain large negative shocks than implied by market prices and corresponding risk measures (e.g., those derived from value-at-risk models). Therefore, it provides the rationale for regulators to implement macroprudential policies, which by definition are not based on current market prices but on systemic events including a sudden drop in asset prices.

D1. Predictability of Bank Stock Returns

Following Baron and Xiong (2017), we run the regression below:

$$r_{i,t+h} - r^f_{i,t+h} = \alpha_i + \beta \cdot \Delta_k \left(\frac{HHD}{GDP}\right)_{i,t-k} + \gamma \cdot X_{it} + \delta_t + \epsilon_{i,t+h}$$

where $r_{i,t+h} - r^f_{i,t+h}$ is the *h*-year ahead excess return (relative to the risk-free rate) for country *i*'s banking sector index, $\Delta_k \left(\frac{HHD}{GDP}\right)_{i,t-k} \equiv \left(\frac{HHD}{GDP}\right)_{i,t} - \left(\frac{HHD}{GDP}\right)_{i,t-k}$ is the past *k*-year growth in the household debt to GDP ratio, and X_{it} includes a list of controls, such as, importantly, the past *k*-year growth in the corporate debt to GDP ratio. The sample covers 70 countries between 1973 and 2016, where data on bank equity returns are available. Both country- and year-fixed effects are included in the regressions. To address the potential issue that the growth rate in the household debt ratio may differ across emerging and advanced economies, we follow Baron and Xiong (2017) and normalize the variable by the standard deviation of the annual changes in the ratio for each country. Thus, the coefficient β can be easily interpreted as the predicted *h*-year ahead excess return for each standard deviation increase in the household debt ratio. In the main specification, we choose *h*=1, 3, 5 and *k*=3. Standard errors are clustered at the country level. Results are very similar if standard errors are two-way clustered at the country-year level or bootstrapped.

Note that in the regression above, the regressors are all variables known at time *t* whereas the dependent variable measures the innovation in the equity index from time *t* to *t+h*. Predictability would suggest the existence of mispricing in the stock market, possibly a neglect of crash risk. We examine this relationship in a broad sample of countries, both

emerging and advanced economies, and over a relatively long time, both including and excluding the period of the Global Financial Crisis.

Regression results are reported in Table 6. Columns (1)–(2) show the regression coefficients for the forecasting horizon of k=1 year. The findings suggest that the past three-year change in the household debt ratio is negatively associated with one-year ahead bank equity returns. The relationship remains statistically significant after controlling for the past changes in the corporate debt ratio as well as the past levels of the household debt and corporate debt ratios. In terms of magnitudes, the coefficient suggests that one standard deviation increase in the annual growth of the household debt ratio is associated with a lower equity return of 2 percent to 2.7 percent one year later.

Columns (3)–(4) and (5)–(6) report the regression results that extend the forecasting horizons to three and five years, respectively. These results show that the relationship between past growth in the household debt ratio and future bank equity returns becomes strongly significant. This relationship is unchanged by including past growth in the corporate debt ratio, which by itself also has statistically significant predictive power for (lower) future equity returns. In terms of the magnitude, a one standard deviation increase in the annual growth rate of the household debt ratio is associated with lower equity returns of 12 percent to 15 percent at the three- and five-year horizons.
Note that these negative correlations between past household debt ratio and future bank stock returns only consider the deviations from their country averages since country fixed effects are included in all regressions. The correct interpretation of the result is that, for countries that have similar average growth in stock prices and other conditions, the ones experiencing higher household credit growth on average have lower future equity returns than the other countries.

D2. Probability of Bank Stock Crashes

Another related exercise is to examine the relationship between past household debt growth and the probability of bank equity crashes using a probit model. Compared to the OLS regressions above which study the mean stock returns, probit analysis in this section investigates the lower tail of the distribution of stock returns. We consider:

$$Prob\left(Bank\ Equity\ Crashes_{t,t+k}|X_{i,t}\right) = \Phi^{-1}\left(\alpha_{i,k} + \beta_1\Delta_3\left(\frac{HHD}{GDP}\right)_t + \beta_2\Delta_3\left(\frac{NFCD}{GDP}\right)_t\right)$$

where $Bank\ Equity\ Crashes_{t,t+k}$ is an indicator variable for having at least one occurrence of having an annual return below -30 percent (as in Baron and Xiong (2017)) in the next k years. Φ is the CDF of the standard normal distribution.

Columns (7)–(9) of Table 6 report the regression results where marginal effects are reported. Note also that the independent variables including the household debt and corporate debt ratios are normalized by the (annual) standard deviation. Therefore, the coefficients represent how one standard deviation increase in the variables correspond to increases in the

probability of banking crashes. Columns (8) and (9) show that past increases in the household debt ratio are associated with significantly higher probability of bank equity crashes three to five years later. A one standard deviation increase in the growth rate of the household debt ratio is associated with 8 percent higher probability of having a bank equity crash within the next five years.

D3. Abnormal Returns of Bank Stocks

Is the neglect of crash risk particularly a banking sector phenomenon? In this section, we conduct the analysis in two stages to test whether household debt may be associated with the performance of the banking sector relative to the market. In the first stage, we estimate the relative performance of banking sector stocks to the overall market. In the second stage, we examine whether past growth in household credit is associated with the abnormal bank equity returns.

Stage 1

To measure the relative performance of banking sector stocks, we compute the abnormal bank equity returns relative to the overall stock market. Specifically, we estimate the market beta of the banking sector in each country according to the Capital Asset Pricing Model (CAPM). We treat the residuals from the CAPM regressions, i.e., the abnormal returns, to be measuring the relative performance to the market. We consider:

$$r^e_{ib,t} = \alpha_i + \beta_i \cdot r^e_{im,t} + \epsilon_{i,t}$$

where $r^e_{ib,t}$ is the banking sector excess return (relative to the risk-free rate) for country i, $r^e_{im,t}$ is the excess return of the stock index for country i, and β_i measures the banking sector beta. Regressions are run at the quarterly frequency for each country and are repeated for each quarter using stock price data before that quarter. We require at least data of past 20 quarters in each estimation regression to forecast one- to three-year ahead abnormal returns, which limits the number of countries to 30 countries in our analysis. By estimating a series of banking sector betas, we utilize the most available information while not using any information that is not known at that time. For each country and for each quarter, the abnormal returns are computed as the actual banking sector return minus the market return for that quarter times the estimated beta. By estimating market betas using rolling windows, we also do not need to assume a constant market beta for banking stocks over time.

Stage 2

In the second stage, we relate past three-year growth in household credit to the abnormal returns of banking sector stocks. We repeat the forecasting equations in the last section and replace the one- to three-year ahead equity returns with banking sector abnormal returns. Since the market risk factor has already been controlled for, we drop the time fixed effects in our regressions. We restrict the sample to the 30 countries where quarterly stock price data have the longest history since the 1990s so that market betas are more accurately estimated.

Table 7 reports the regression results of Stage 2. Forecasting horizon *k* ranges from one year to three years. The results indicate that past three-year growth in the household debt ratio is associated with negative future abnormal returns for the banking sector. The relationship is statistically significant at the two- to three-year horizons. In Columns (4) and (6), the past three-year change in the corporate debt ratio is included as a control variable, and the results remain unaltered. Note that the sample of our analysis is restricted to 30 countries only due to data availability. In this subsample of countries, the corporate debt ratio is also negatively (and slightly more strongly) correlated with future banking sector abnormal returns.

E. Debt Overhang: Micro-level Evidence

Aggregate private consumption fell more in the aftermath of the crisis, in countries which experienced a steeper increase in household debt before the Global Financial Crisis (GFC), while in countries with moderate household credit growth, consumption increased modestly (Figure 2). A similar picture is found in micro-level data (Figure 3).

To test whether household indebtedness plays a role in explaining the drop-in consumption, besides micro household characteristics, we estimate the following cross-sectional regression at the household level with changes in household food consumption (percent of income) as dependent variable:

$$\Delta C_{i,2014} = \alpha_c + \beta_1 DTI_{i,2010} + \gamma Controls + \epsilon_i$$

where debt-to-income ratio ($DTI_{i,2010}$) is a proxy for past household indebtedness; household characteristics (such as size of household main residence, employment, education, and age of the reference person) are considered as *Controls.* In addition, the model includes country fixed effects (α_c) and errors are clustered at the country level.[18]

The main finding in Table 8 is that higher indebtedness, proxied by debt-to-income or loan-to-value ratios, makes households more vulnerable to income shocks. This analysis takes into consideration the level of household indebtedness in 2010, right before the European sovereign debt crisis. The negative effects of an exogenous shock on household consumption are intensified when the level of indebtedness exceeds a certain threshold (i.e., total debt in excess of 300 percent of household disposable income). In other words, consumption declined more for the most indebted households, which is perceived as more financially constrained. In terms of economic magnitude, a 100 percentage point increase DTI ratio translates into a 4 percentage points drop in consumption. However, this magnitude is much larger (about 7 percentage points) for households with total debt in excess of 300 percent of disposable income. Consistent with Mian, Rao, and Sufi (2013), these results confirm the debt overhang channel for the European households in this analysis and support the macro-level results presented above.

[18] Micro-level longitudinal data for five euro area countries (Belgium, Cyprus, Germany, Malta, the Netherlands) for two consecutive waves (2010 and 2014) with panel dimension is utilized. There are about 3000 households with borrowing and consumption information. Population weights were considered.

Robustness checks reinforce our findings. Even when controlling for household characteristics such as age, size, education, employment and net wealth, and time-invariant country features these results hold.

IV. ROBUSTNESS: PANEL VAR ANALYSIS

To complement the results obtained with panel fixed effects models, we also estimate a five-variable recursive panel VAR model with 5 lags, using quarterly data for 27 countries over 1998Q1–2015Q4.[19] The variables included in the VAR are real GDP, corporate debt, household debt, house prices, and short-term interest rates. The model includes country and time fixed effects. Compared to the estimations in section II, this specification allows for richer interactions of the debt variables with house prices, interest rates and GDP, and allows us to test whether household and corporate debt growth remain significant, for a smaller set of countries, but at a higher frequency. As such, it may prove that the relationship between household debt and GDP growth is not specific to one method or one particular set of variables.

Following Canova and Cicarelli (2013) and Calza et al (2013), the structure of the panel VAR follows:

$$Y_{it} = A_{0i}(t) + A_i(l)Y_{it-1} + F_i(l)W_{t-1} + u_{it}$$

where Y_{it} is a vector of endogenous variables. Shocks are identified from a Cholesky decomposition with the following order: log real GDP, log real corporate debt, log real household debt, log real house prices, and short-term interest rates.[20] The model includes country fixed effects which, together with constants, are bundled into A_{0i}. $A(l)$ is a polynomial lag operator and error terms (u_{it}) are identically and independently distributed (0, $\sum_u$). For estimation purposes, the procedure developed by Cagala and Glogowsky (2014) is employed, where a multivariate panel regression using the least squares dummy variable estimator (LSDV) is fitted for each dependent variable (Bun and Kiviet 2006).[21]

The dynamic panel VAR analysis confirms short-term positive and significant effects of household debt on real house prices and output. Household debt leads to higher house prices and more debt in the future, likely through reinforcing feedback effects (see also Lombardi, Mohanty, and Shim, 2017). A one standard deviation shock to household debt initially leads

[19] In this analysis, 27 countries with available quarterly data for all variables starting in 1998 are included: Australia, Belgium, Canada, Colombia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, Israel, Italy, Japan, Korea, Lithuania, the Netherlands, Norway, New Zealand, Portugal, Singapore, Spain, Sweden, Thailand, the United Kingdom, and the United States.

[20] Robustness checks include different orderings and specifications (different number of lags; first differences instead of levels).

[21] Since quarterly data are utilized, small T (Nickell, 1981) is not issue in our sample estimation (T=68). In addition, robustness checks using the GMM-style estimator by Abrigo and Love (2015), which addresses the Nickel bias, are employed. In addition, analysis using mean group estimator, where a VAR for each individual country is considered and impulse responses are averaged across countries, confirms the baseline result.

to higher real house prices and output, but over the medium term (after about two to five years) results in a declining pattern (Figures 4 panels 1.3 and 4.3). After six to seven years, the cumulative economic impact equals about 0.2 (quarterly) log points of real output, which offsets the short-term positive effects.[22] Likewise, higher house prices are positively associated with output in the short term (first four to six quarters), but negatively in the medium term (Figures 4 panel 1.4). In response to a positive shock to house prices, household debt increases steadily over the short- and medium-term, while reverting to its long-term mean afterwards (Figures 4, panel 3.4). In contrast to household debt, an increase in real non-financial credit does not seem to have a positive and significant effect on real output in the short term. However, the economic impact of a standard deviation increase in corporate debt translates into an output loss of about 0.25 quarterly log points after five to six years. Intuitively, interest rate shocks affect negatively real output, both corporate and household debt, and real house prices. The cumulative negative effects on real GDP appear to be the highest in this case, reaching almost 0.4 log (quarterly) points.

A. Exchange Rate Regime

The interactions between institutional factors and household debt (Table 3) showed an amplification of the negative effects on output in countries with less flexible exchange rates, hinting to the role of nominal rigidities and constrained monetary policy. In Figure 5, we split countries into two groups based on their sample average exchange rate flexibility: high and low FX flexibility.[23] In the short term the positive effects seem similar in magnitude and shape for both groups (Figure 5, panel 1.3). However, the negative effects for low FX flexibility countries are four times larger than for high FX flexibility in the medium term. Another intuitive result is the impact of interest rates on real output which is traditionally negative through lower credit channeled to the economy, consistent with credit supply shock models. However, higher interest rates in in more flexible exchange regime countries attract more capital inflows and investment which translates into a dampening effect on real output. The negative effects in countries with fixed exchange rates are almost double in magnitude over the medium term.

B. Distributional Characteristics of Household Debt

The distribution of debt and income plays an important role for macroeconomic dynamics (see Section III.B.2). Low-income households (bottom 40 percent) have typically much less access to credit markets and their riskiness is higher. Poorer borrowers are associated with higher debt-to-income ratios a proxy for riskiness, while at the same time, participation rates are much lower. Given that marginal propensities to consume (MPC) are higher for poorer

[22] This magnitude might not be directly comparable with those in previous sections due to differences in sample, frequency, and methodology.

[23] To divide countries, we calculate sample averages for each country using the de facto classification of exchange rate regimes by Ilzetzki, Reinhart, and Rogoff (2010). Countries above the median and included in the "Hi FX" flexibility group: AUS, CAN, COL, GBR, JPN, KOR, NOR, NZL, SGP, SWE, THA, and USA. Countries included in the "Low FX" flexibility group: BEL, CZE, DEU, DNK, ESP, FIN, FRA, GRC, HKG, HUN, ISR, ITA, LTU, NLD, and PRT.

borrowers, highly indebted low-income households reduce sharply consumption when unexpected income shocks hit.

To examine differences in macroeconomic dynamics, we first split countries into two groups by the credit participation rate for the low-income households, a concept close to financial inclusion and development (Figure 6). In terms of impact on output, financial inclusion is found to dampen the negative effects associated with household debt (Figure 7). These results reinforce our findings in Table 3. Second, we divide countries based on the debt share of the low-income households which could be a proxy for banking sector risk. In Figure 8, we compare the results for each group of countries: high vs low debt share. Focusing on the effects of household debt on real output, countries with higher debt share held by the low-income borrowers are found to be impacted more negatively than countries with lower debt share. This signals the importance of debt overhang or over-indebtedness in the context of low-income higher MPC borrowers. Combining the messages from these two sensitivity analyses, we conclude that both financial inclusion and riskiness of low-income borrowers matter for future output growth and have opposite effects.

V. CONCLUSIONS

This paper presents evidence which suggests that, over the business cycle, high growth in household borrowing is negatively associated over the medium term with economic growth. These results are in line with Mian, Sufi and Verner (2017), which first documented such relationship for 30 advanced economies. This paper expands their analysis to a sample of 80 advanced and emerging market economies, spanning 65 years (1950–2016). In terms of the magnitude, a one standard deviation increase in the household debt ratio is, on average, associated with a 1.2 percentage points lower output growth over the following three years. This effect appears stronger for advanced economies than for emerging markets.

The paper also shows that country characteristics such as flexible exchange rates, and higher financial development help mitigate the risks associated with increasing household debt. The broad sample coverage of 80 countries allows for this in-depth analysis of the role played by institutional factors, relative to earlier studies mentioned before that used smaller and more homogeneous country samples. In a smaller sample, the macro effects of household debt are studied, conditional on micro-household level and country characteristics, finding that higher participation by low-income households, suggestive of greater financial inclusion, appears to reduce the negative effect of household debt on medium-term GDP growth, while a higher debt share, potentially reflecting a potential debt overhang effect, is associated with a more negative effect.

Finally, three complementary aspects of the mechanism through which household indebtedness causes growth to decline in the future are discussed and presented in a quantitative fashion. These three mechanisms are related and can mutually reinforce each other, as well as the contractionary effect of binding borrowing constraints. More specifically:

- Household debt increases the probability of banking crises and the effect is twice as large as for non-financial corporate debt. This result is even stronger when the level of household debt is above 65 percent of GDP. This is in line with previous studies, showing that economic costs associated with financial crises are higher than in normal downturns and increases in private debt raise the probability of systemic banking crises (Jordà, Schularick, and Taylor 2011). While existing studies have focused on private sector credit as a whole, our findings suggest that the adverse effect on banking crises is twice as large for household debt than for non-financial corporate debt.

- Sentiment-driven behavior is associated with neglected crash risk and abnormal bank stock returns. This paper analyzed the stock price performance of bank stocks in 70 countries over the past 40 years. It found that household credit growth systematically predicts lower bank stock returns, both excess stock returns and market-adjusted abnormal returns, as well as bank stock crashes, in the next two to three years. This predictability suggests the existence of neglected crash risks associated with growth in household credit. Price corrections originated from such mispricing generally trigger sharp declines in asset prices, increases in risk premiums, and significant reallocation of resources in the economy.

- Distributional characteristics of household debt matter. Marginal propensities to consume differ across indebted households, and a higher financial leverage by the borrowing households will subject the latter more to negative shocks to income or tighten their credit constraint more severely. In particular, micro-level results for Europe point to a higher sensitivity to shocks when households are more indebted. A 100-percentage point increase in the debt-to-income ratio translates into a 4 percentage point drop in household consumption between 2010 and 2014.

APPENDIX I. DATA DESCRIPTION AND METHODOLOGY

This appendix provides further details on the data and variables used in the analysis. A description of the explanatory variables and their sources is presented in Appendix I Table 1.

Household and non-financial corporate debt (macro level)

These data are collected from BIS, Jorda-Schularick-Taylor (2016), and IMF's Monetary and Financial Statistics. Country coverage and time span varies across countries, with most of the advanced economies starting in 1950s and emerging markets in 1990s.[24]

Household debt (micro level)

From a broader euro area household finance and consumption survey of 15 to 20 countries for two waves (2010 and 2014), data for Belgium, Cyprus, Germany, Malta, and the Netherlands allow for a panel dimension, where consumption and debt data is reported for the same households in both waves.

Summary statistics are detailed in Appendix I Table 1.

[24] Country coverage and data sources are presented in Appendix I Table 2.

Appendix I: Table 1. Description of Explanatory Variables

Variables	Description	Source
Macro-level Variables		
Nominal GDP	Gross domestic product, current prices in national currency	WEO; JST; Penn World Table
Current Account Balance (current price)	Current account balance, in billions, national currency	WEO
Private Consumption (current price)	Private final consumption, current prices, in billions, national currency	WEO
Public Consumption (current price)	Public final consumption, current prices, in billions, national currency	WEO
Government Revenue (current price)	General government revenue, in billions, national currency	WEO
Government Total Expenditure (current price)	General government expense, in billions, national currency	WEO
Investment (current price)	Gross fixed capital formation, in billions, current prices in national	WEO
Nominal Disposable Income	Gross household disposable income; or gross national disposable income	Haver Analytics; CEIC; Thomson Reuters
Real GDP	Gross domestic product, constant prices in national currency	WEO
Real Private Consumption	Private final consumption, constant prices, in billions, national currency	WEO
Real Public Consumption	Public final consumption, constant prices, in billions, national currency	WEO
Real Imports	Imports of goods and services, constant prices, in billions, national	WEO
Real Exports	Exports of goods and services, constant prices, in billions, mational	WEO
Real Investment	Gross fixed capital formation, in billions, constant prices in national	WEO
Consumer Price Index	Consumer price index, all items	IFS
Population	Population, millions of persons	WEO
Unemployment	Unemployment rate (percent)	WEO
Interest Rate	Three-month treasury bill rate; money market rate; interbank market rate (percent)	IFS; Thomson Reuters Datastream; Bloomberg Finance L.P.
Bank Equity Index	Equity price index of the banking sector (or financial sector if banking sector price index not available)	Thomson Reuters Datastream; Bloomberg
Stock Market Index	General stock price index	IMF, GDS database; Thomson Reuters Datastream; Bloomberg Finance L.P.
Banking Crisis	Systemic banking crisis defined as: 1) Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations); 2) Significant banking policy intervention measures in response to significant losses in the banking	Laeven and Valencia (2012)
Real House Price Index	House price index deflated by CPI	OECD, Global Property Guide, and IMF staff
Exchange Rate	National currency per U.S. dollar	Thomson Reuters
Real Effective Exchange Rate	Real effective exchange rate, based on consumer price index (percent)	IMF, Monetary and Financial Statistics Database
Exchange Rate Regime	Foreign exchange regime	IMF, Ilzetzki, Reinhart and Rogoff (2008)
Institutional Variables		
Financial Risk Index	Measure of a country's ability to pay its way by financing its official, commercial, and trade debt obligations; index ranges from 50 (least risk)	PRS Group, International Country Risk Guide (ICRG)
Financial Development Index	Overall financial development index	Svirydzenka (2016)
Financial Openness Index (Chinn-Ito Index)	An index measuring a country's degree of capital account openness	Chinn, Menzie D. and Hiro Ito (2008)
Official Supervisory Power	Whether the supervisory authorities have the authority to take specific actions to prevent and correct problems; index ranges from 0 no powers)	Barth, Caprio and Levine (2013)
Overall Capital Stringency	Whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital before minimum capital adequacy is determined; index ranges from 0 (least stringent) to 7 (most	Barth, Caprio and Levine (2013)
Income Share held by Highest 20 Percent	Percentage share of income or consumption is the share that accrues to subgroups of the population indicated by deciles or quintiles.	World Bank, World Development Indicators
Income Share held by Lowest 20 Percent	Percentage share of income or consumption is the share that accrues to subgroups of the population indicated by deciles or quintiles.	World Bank, World Development Indicators

Note: BIS = Bank for International Settlements; CEIC = CEIC Data Co. Ltd.; CPI = consumer price index; GDS = Global Data Source; HPDD = Historical Public Debt Database; IFS = IMF, International Financial Statistics database; JST = Jordà-Schularick-Taylor Macrohistory Database; OECD = Organisation for Economic Co-operation and Development; WEO = World Economic Outlook database.

Appendix I: Table 2. Household Debt Data Sources

Country	Source	Start Year
Advanced Economies		
Australia	BIS; JST	1952
Austria	BIS	1995
Belgium	BIS; JST	1950
Canada	BIS; JST	1956
Cyprus	CEIC	1995
Czech Republic	BIS	1995
Denmark	BIS; JST	1951
Estonia	Haver; Bank of Estonia	1993
Finland	BIS; JST	1950
France	BIS; JST	1958
Germany	BIS; JST	1950
Greece	Haver	1980
Hong Kong SAR	CEIC	1982
Iceland	Haver; IMF, MFS	1995
Ireland	ECRI	1998
Israel	BIS	1992
Italy	BIS	1950
Japan	BIS; JST	1950
Korea	BIS	1962
Latvia	Haver	2003
Lithuania	Haver	1993
Luxembourg	Haver	1992
Malta	ECRI	1995
Netherlands	BIS	1990
New Zealand	BIS	1990
Norway	BIS	1975
Portugal	BIS	1979
Singapore	BIS	1991
Slovak Republic	National Bank of Slovakia	1993
Slovenia	Haver; IMF, MFS	2004
Spain	BIS; JST	1950
Sweden	BIS; JST	1975
Switzerland	BIS; JST	1950
United Kingdom	BIS; JST	1950
United States	BIS; JST; CEIC	1950

Country	Source	Start Year
Emerging Markets Economies		
Argentina	BIS	1994
Bangladesh	Haver	2004
Bolivia	Central Bank of Bolivia	1992
Brazil	BIS	1994
Bulgaria	ECRI	1995
Chile	BIS; Central Bank of Chile	1983
China	BIS	2006
Colombia	BIS	1996
Costa Rica	Central Bank of Costa Rica	1997
Croatia	Croatian National Bank	1993
Egypt	Central Bank of Egypt	2002
FYR Macedonia	National Bank of the Republic of Macedonia	1995
Georgia	IMF, MFS	2001
Hungary	BIS	1989
India	CEIC	1998
Indonesia	BIS	2001
Jordan	Central Bank of Jordan	1993
Kazakhstan	Haver	1996
Kuwait	CEIC	1997
Malaysia	IMF, MFS	2001
Mexico	BIS	1994
Mongolia	IMF, MFS	2001
Montenegro	ECRI	1995
Morocco	IMF, MFS	2001
Pakistan	IMF, MFS	2006
Panama	IMF, MFS	2002
Paraguay	Central Bank of Paraguay; IMF, MFS	1990
Philippines	Central Bank of the Philippines	1999
Poland	BIS	1995
Romania	ECRI	1996
Russia	BIS	1995
Saudi Arabia	BIS; CEIC	1995
Serbia	IMF, MFS	2003
South Africa	Haver	1969
Thailand	BIS	1991
Turkey	BIS	1986
Ukraine	IMF, MFS	2001
Uruguay	BIS	2001
Venezuela	BIS	2001
Kenya	IMF, MFS	2001
Botswana	IMF, MFS	2001
Nigeria	IMF, MFS	2001
Ghana	IMF Bridge Data; IMF, MFS	2001
Mauritius	IMF, MFS	2001
Namibia	IMF, MFS	2001

Note: BIS = Bank for International Settlements; CEIC = CEIC Data Co. Ltd.; ECRI = Economic Cycle Research Institute; Haver = Haver Analytics; IMF, MFS = IMF, Monetary and Financial Statistics database; JST = Jordà-Schularick-Taylor Macrohistory Database.

Appendix I: Table 3. Nonfinancial Corporate Debt Data Sources

Country	Source	Start Year	Country	Source	Start Year
Advanced Economies (AEs)			**Emerging Markets Economies (EMs)**		
Australia	BIS; JST	1952	Argentina	BIS	1994
Austria	BIS	1995	Bangladesh	IMF, MFS	2001
Belgium	BIS; JST	1950	Botswana	IMF, MFS	2001
Canada*	BIS; JST	1956	Bolivia	IMF, MFS	2001
Cyprus	BIS	2001	Brazil	BIS	1994
Czech Republic	BIS	1995	Bulgaria	ECRI	1995
Denmark	BIS; JST	1951	Chile*	BIS; IMF, MFS	1983
Estonia	BIS; Haver	1993	China	BIS	2006
Finland	BIS; JST	1950	Colombia	BIS	1996
France	BIS; JST	1958	Costa Rica	Central Bank of Costa Rica	1997
Germany	BIS; JST	1950	Croatia	Croatian National Bank	1993
Greece*	BIS	1994	Egypt	IMF, MFS	2004
Hong Kong SAR	BIS	1990	FYR Macedonia	National Bank of the Republic of Macedonia	1995
Iceland	BIS; IMF, MFS	2003	Georgia	IMF, MFS	2001
Ireland*	BIS; IMF, MFS	1998	Ghana	IMF Bridge Data	2001
Israel	BIS	1992	Hungary	BIS	1989
Italy	BIS	1950	India*	BIS	1998
Japan	BIS; JST	1950	Indonesia	BIS	2001
Korea	BIS	1962	Jordan	Central Bank of Jordan	1993
Latvia	Haver	2003	Kazakhstan	Haver	1996
Luxembourg	BIS; IMF, MFS	2001	Kenya	IMF, MFS	2001
Malta	ECRI	1995	Kuwait*	CEIC	1997
Netherlands	BIS	1990	Lithuania	Haver	2003
New Zealand*	BIS	1990	Malaysia	BIS; IMF, MFS	2001
Norway	BIS	1975	Mauritius	IMF, MFS	2001
Portugal	BIS	1979	Mexico	BIS	1994
Singapore	BIS	1991	Mongolia	IMF, MFS	2001
Slovak Republic	National Bank of Slovakia	1993	Montenegro	ECRI	1995
Slovenia	Haver	2004	Morocco	IMF, MFS	2001
Spain	BIS; JST	1950	Namibia	IMF, MFS	2002
Sweden	BIS; JST	1975	Nigeria	IMF, MFS	2001
Switzerland	BIS; JST	1950	Pakistan	IMF, MFS	2001
United Kingdom	BIS; JST	1950	Panama	IMF, MFS	2002
United States	BIS; JST	1950	Paraguay	IMF, MFS	2001
			Philippines	Central Bank of the Philippines	1999
			Poland	BIS	1995
			Romania	ECRI	1996
			Russia	BIS; Haver	1998
			Saudi Arabia	ECRI	1995
			Serbia	IMF, MFS	2003
			South Africa*	IMF, MFS	1969
			Thailand	BIS	1991
			Turkey	BIS	1986
			Ukraine	IMF, MFS	2001
			Uruguay	IMF, MFS	2001
			Venezuela	IMF, MFS	2001

Note: BIS = Bank for International Settlements; CEIC = CEIC Data Co. Ltd.; ECRI = Economic Cycle Research Institute; Haver = Haver Analytics; IMF, MFS = IMF, Monetary and Financial Statistics database; JST = Jordà-Schularick-Taylor Macrohistory Database.
* denotes countries where part of the corporate debt series was either derived from, or the ratio spliced, by subtracing household debt from total private sector debt

APPENDIX II. TABLES AND FIGURES

A. Tables

Table 1. Summary Statistics

This table presents the summary statistics of the variables used in this paper. Log changes and ratios are multiplied by 100 to report changes in percentages or percentage points. Δ and Δ3 denote to one-year and three-year changes, respectively. The variables HHD/GDP, CD/GDP, PD/GDP, GD/GDP, RGDP, RPVC, PVC/GDP, RHP, INT, KA OPEN, FIN DEV, FIN RISK, TRANSPAR, INC HIGH 20, INC LOW 20, BNK CRISIS, BNK RET 1YR, BNK RET 3YR, BNK RET 5YR and AB RET 3YR denote household debt to GDP, non-financial firm debt to GDP, government debt to GDP, real gdp, real private consumption, private consumption to GDP, real house prices, short-term interest rates, capital account openness, financial development, financial risk index, credit bureau availability, income share of the richest 20 percent, income share of the poorest 20 percent, systemic bank crisis dummy, bank stock return one year ahead, bank stock return three years ahead, bank stock return five years ahead, and abnormal return three years ahead, respectively. N = number of observations; p10, p25, p75, p90 = 10th, 25th, 75th, 90th percentile, respectively; p50 = median.

	N	Mean	SD	p10	p25	p50	p75	p90
HHD/GDP	2299	35.39	27.39	6.02	13.37	30.01	51.02	72.43
Δ (HHD/GDP)	2184	1.02	2.56	-1.39	-0.22	0.84	2.19	3.94
Δ_3 (HHD/GDP)	2024	3.22	5.89	-2.75	0.01	2.76	6.13	10.45
CD/GDP	2257	60.81	48.84	16.65	28.36	53.88	81.02	109.00
Δ (CD/GDP)	2142	0.97	9.51	-4.15	-1.20	0.75	3.00	5.96
Δ_3 (CD/GDP)	1982	2.98	18.97	-7.46	-2.06	2.43	7.04	13.15
PD/GDP	2247	96.41	66.56	25.79	47.27	84.94	130.60	177.20
Δ (PD/GDP)	2167	1.99	10.22	-4.71	-0.99	1.77	4.53	8.79
GD/GDP	2807	51.94	90.67	14.98	26.76	42.06	65.12	89.44
Δ (GD/GDP)	2727	0.15	5.85	-5.90	-2.27	-0.04	2.65	6.19
Δ ln(RGDP)	4190	3.66	5.00	-0.75	1.83	3.96	6.12	8.39
Δ_3 ln(RGDP)	4030	11.19	11.09	0.87	6.27	11.53	16.98	22.58
Δ ln(RPVC)	3347	3.42	6.39	-1.78	1.13	3.40	6.09	9.50
Δ (PVC/GDP)	3413	-0.48	9.14	-2.37	-0.97	-0.04	0.76	2.14
Δ ln (RHP)	1629	1.78	9.68	-8.08	-2.28	1.83	6.02	11.62
INT	2501	15.70	54.63	4.21	6.08	9.20	14.81	25.80
KA OPEN	2983	0.47	1.58	-1.38	-1.19	0.13	2.39	2.39
FIN DEV	2755	0.39	0.24	0.11	0.21	0.35	0.55	0.74
FIN RISK	2455	35.91	10.24	25.5	33	38	42	46
TRANSPAR	127	0.8189	0.3866	0	1	1	1	1
INC HIGH 20	811	45.57	8.389	36.5	39.17	42.54	51.4	58.88
INC LOW 20	811	6.399	2.318	3.17	4.52	6.7	8.3	9.28
BNK CRISIS	5360	0.016	0.126	0	0	0	0	0
BNK RET 1YR	1768	6.20	43.82	-37.06	-12.65	6.13	27.43	49.66
BNK RET 3YR	1630	19.78	75.36	-56.56	-13.85	18.48	57.94	100.12
BNK RET 5 YR	1492	32.05	101.29	-63.42	-12.40	34.55	81.38	134.11
AB RET 3YR	4095	-3.99	51.20	-57.47	-23.99	-0.33	22.52	48.16

Table 2a. Household Debt and Future GDP Growth

This table presents results from estimating $\Delta_3 y_{i,t+k} = \alpha_i + \beta_1 \Delta_3 hhd_{i,t-1} + \beta_2 \Delta_3 fd_{i,t-1} + \delta_t + u_{i,t+k}$ for $k = 0, \ldots, 6$. All regressions control for country and time fixed effects, and lagged GDP growth for the preceding two years. Standard errors are dually clustered on country and year. ***, **, *, indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels.

	Dependent Variable					
	$\Delta_3 y_{i,t+1}$	$\Delta_3 y_{i,t+2}$	$\Delta_3 y_{i,t+3}$	$\Delta_3 y_{i,t+4}$	$\Delta_3 y_{i,t+5}$	$\Delta_3 y_{i,t+6}$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3 hhd_{i,t-1}$	-0.112***	-0.180***	-0.211***	-0.185***	-0.146***	-0.122***
	(0.039)	(0.053)	(0.058)	(0.055)	(0.045)	(0.044)
$\Delta_3 fd_{i,t-1}$	0.021***	-0.030***	-0.026***	-0.012	0.014	0.051*
	(0.004)	(0.007)	(0.008)	(0.011)	(0.018)	(0.026)
N	1,823	1,743	1,663	1,583	1,503	1,421
Number of Countries	80	80	80	80	80	78
Country Fixed Effects	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y
R^2	0.65	0.42	0.41	0.40	0.41	0.42

Table 2b. Household Debt and Future GDP Growth: AEs and EMs

This table presents results from estimating $\Delta_3 y_{i,t+k} = \alpha_i + \beta_1 \Delta_3 hhd_{i,t-1} + \beta_2 \Delta_3 fd_{i,t-1} + \delta_t + u_{i,t+k}$ for $k = 0, \ldots, 6$. All regressions control for country and time fixed effects, and lagged GDP growth for the preceding two years. Columns (1)–(4) show the regression results for advanced economies (AEs) and Columns (5)-(8) show results for emerging markets (EMs). Standard errors are dually clustered on country and year. ***, **, *, indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels.

	Dependent Variable							
	Advanced Economies				Emerging Markets			
	$\Delta_3 y_{i,t+1}$	$\Delta_3 y_{i,t+3}$	$\Delta_3 y_{i,t+5}$	$\Delta_3 y_{i,t+7}$	$\Delta_3 y_{i,t+1}$	$\Delta_3 y_{i,t+3}$	$\Delta_3 y_{i,t+5}$	$\Delta_3 y_{i,t+7}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_3 hhd_{i,t-1}$	-0.081**	-0.207***	-0.146***	-0.037	-0.156*	-0.111	-0.024	-0.249**
	(0.036)	(0.064)	(0.054)	(0.047)	(0.085)	(0.138)	(0.093)	(0.100)
$\Delta_3 fd_{i,t-1}$	-0.021***	-0.020***	0.026^{+}	0.054**	-0.087**	-0.064	-0.062	0.048
	(0.003)	(0.007)	(0.017)	(0.023)	(0.038)	(0.045)	(0.053)	(0.064)
N	1,203	1,125	1,047	969	620	538	456	374
Number of Countries	39	39	39	39	41	41	41	39
Country Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
R^2	0.71	0.49	0.47	0.47	0.62	0.41	0.43	0.48

Table 3. The Role of Institutional Factors, Policies, and Household-level Debt Characteristics

This table presents results from estimating $\Delta_3 y_{i,t+5} = \alpha_i + \beta_1 \Delta_3 hhd_{i,t-1} + \beta_2 \cdot \Delta_3 hhd_{i,t-1} \times IF_i + \beta_3 X_{i,t-1} + \delta_t + u_{i,t+k}$ where IF_i is the dummy variable for institutional factors including fixed exchange rate regime (*FIXED*), high capital account openness (*KAOPEN*), high financial development (*FINDEV*), transparency of consumer credit (*Transparency*), high low-income households mortgage participation (*LowIncPart*), low financial risk (*FINRISK*), low debt-to-income of low-income households (*LowDTI*), and emerging market economies (*EM*). *FIXED* takes value 1 if the country has a fixed exchange rate regime. *KAOPEN* takes value 1 if financial openness index is higher than the median. *FINDEV* takes value 1 if the Financial Development Index is within the top 25 percent of countries as of 2014. *Transparency* takes value 1 if consumer credit transparency index is 1. *LowIncPart* takes value 1 if the mortgage participation rate for the bottom 4 percent of households in the income distribution is within the top 25 percent of countries in the most recent year where data are available. *FINRISK* takes value 1 if financial risk rating is above the median (higher rating indicates less risk). *LowDTI* takes value 1 if the weighted debt-to-income ratio for the bottom 40 percent of households (mortgage borrowers) in the income distribution is within the lower 25 percent of countries in the most recent year where data are available. In the regressions for *FIXED* and *KAOPEN*, the indicator itself is also included as a control variable as the indicator for each country can vary over time. In all regressions, control variables include past growth in non-financial corporate debt ($\Delta_3 fd_{i,t-1}$), country and time fixed effects, and lagged GDP growth for the preceding two years. Standard errors are dually clustered on country and year. ***, **, *, + indicate statistical significance at the 1 percent, 5 percent, 10 percent, and 15 percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Institutional Factors and Policies						Household-level Debt Characteristics		
$\Delta_3 hhd_{i,t-1}$	-0.058	0.029	0.056	-0.289***	-0.261*	-0.273***	-0.303***	-0.258**	-0.251**
	(0.043)	(0.073)	(0.076)	(0.074)	(0.150)	(0.067)	(0.088)	(0.106)	(0.117)
$\Delta_3 hhd_{i,t-1} \times FIXED$	-0.247**		-0.223**						
	(0.100)		(0.104)						
$\Delta_3 hhd_{i,t-1} \times KAOPEN$		-0.250**	-0.184*						
		(0.108)	(0.108)						
$\Delta_3 hhd_{i,t-1} \times FINDEV$				0.243**					
				(0.101)					
$\Delta_3 hhd_{i,t-1} \times TRANSPAR$					0.158^{+}				
					(0.102)				
$\Delta_3 hhd_{i,t-1} \times FINRISK$						0.122*			
						(0.074)			
$\Delta_3 hhd_{i,t-1} \times LowIncPart$							0.272***		
							(0.106)		
$\Delta_3 hhd_{i,t-1} \times LowDTI$								0.222^{+}	0.216^{+}
								(0.143)	(0.147)
$\Delta_3 hhd_{i,t-1} \times EM$									-0.086
									(0.170)
N	1,503	1,333	1,333	1,503	1,285	1,126	835	784	784
Number of Countries	80	77	77	80	68	76	30	25	25
Country and Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
$\Delta_3 fd_{i,t-1}$, Lagged GDP Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
R^2	0.42	0.36	0.37	0.42	0.42	0.37	0.53	0.54	0.54

Table 4. Probability of Systemic Banking Crisis

This table presents results from estimating a logit panel as follows: $log\frac{P[S_{it}=1|X_{it}]}{P[S_{it}=0|X_{it}]} = \Psi_{0i} + \Psi_1 X_{it} + \Psi_2 X_{it}$ x I(Hi Debt)$_{it} + \epsilon_{it}$; where S_{it} is the banking crisis dummy variable. *hhd* and Δhhd are level and first difference in household debt-to-gdp ratio. *fd* and Δfd are level and first difference in non-financial corporate debt-to-gdp ratio. High household debt I(*Hi hhd*) is a dummy variable which takes value 1 if level of household debt exceeds 65 percent of GDP, representing the top quintile of the distribution. High government debt I(*Hi Gov Debt*) is a dummy variable with threshold set at 60 percent of GDP, representing the top third of the distribution. All independent variables are lagged. The third lag of household debt change is utilized, based on explanatory power and robustness presented in Table 5a. Banking crises are taken from the updated database by Laeven and Valencia (2013). AUC stands for area under curve. Country fixed effects (COU FE) are considered. Errors are clustered at the country level. ***, **, *, indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:				Systemic Banking Crises			
hhd	4.037***		2.501***	1.270	1.727	2.091	2.479
	(0.783)		(0.925)	(1.276)	(1.384)	(1.716)	(1.760)
Δhhd		40.05***	35.01***	35.60***	31.25***	30.86***	26.47***
		(6.482)	(6.334)	(7.161)	(7.310)	(8.451)	(8.726)
fd				0.879	0.974	0.536	0.647
				(0.761)	(0.690)	(0.743)	(0.689)
Δfd				13.13***	12.64***	15.62***	15.33***
				(3.954)	(3.706)	(4.220)	(3.900)
Δhhd x I(*Hi Gov Debt*)					22.62*		24.12*
					(12.49)		(12.44)
I(*Hi Gov Debt*)					-0.644		-0.739
					(0.602)		(0.669)
Δhhd x I(*Hi hhd)*						24.41*	25.93*
						(14.11)	(13.43)
I(*Hi hhd*)						-1.355	-1.346
						(0.896)	(0.832)
Constant	-5.949***	-3.741***	-5.465***	-5.224***	-5.517***	-5.253***	-5.534***
	(0.594)	(0.150)	(0.681)	(0.732)	(0.800)	(0.902)	(0.944)
N	1,223	1,033	1,033	1,020	1,020	1,020	1,020
COU Cluster	Y	Y	Y	Y	Y	Y	Y
COU FE	Y	Y	Y	Y	Y	Y	Y
AUC	0.700	0.791	0.806	0.840	0.845	0.850	0.856
No of Crises	46	37	37	37	37	37	37
Countries	40	34	34	34	34	34	34
Preudo R^2	0.0612	0.142	0.153	0.204	0.212	0.218	0.228

Table 5a. Probability of Systemic Banking Crisis: Robustness–Lags

This table presents results of the robustness exercises for the logit panel estimations reported in Table 4. l1, l2, l3, and l4 refer to first, second, third, and forth lag, respectively. *hhd* and Δ*hhd* are level and first difference in household debt-to-gdp ratio. *fd* and Δ*fd* are level and first difference in non-financial corporate debt-to-gdp ratio. I(*Hi hhd*) is a dummy variable which takes value 1 if level of household debt exceeds 65 percent of GDP. Country fixed effects (COU FE) are considered. Errors are clustered at the country level. Banking crises are taken from the updated database by Laeven and Valencia (2013). ***, **, *, indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels.

	(1)	(2)	(3)
Dependent Variable:	Systemic Banking Crisis		
Corporate Debt (l1)	1.442	1.405	0.516
	(1.355)	(1.420)	(1.069)
hhd (l1)	0.792	0.869	1.553
	(1.715)	(2.137)	(2.033)
Δ Corporate Debt (l1)	9.528**	11.48***	13.94***
	(3.926)	(4.204)	(3.814)
Δ Corporate Debt (l2)	4.023	4.843	
	(3.971)	(4.150)	
Δ Corporate Debt (l3)	-3.501	-4.198	
	(3.555)	(3.600)	
Δ Corporate Debt (l4)	-4.971	-6.075	
	(4.164)	(4.262)	
Δ*hhd* (l1)	0.380	4.965	
	(7.396)	(9.019)	
Δ*hhd* (l2)	0.506	4.344	
	(8.251)	(10.25)	
Δ*hhd* (l3)	32.93***	29.89***	26.99***
	(8.410)	(9.966)	(8.723)
Δ*hhd* (l4)	1.367	-2.537	
	(9.654)	(10.81)	
Δ*hhd* x I(*Hi hhd*) (l1)		-13.12	
		(17.09)	
Δ*hhd* x I(*Hi hhd*) (l2)		0.759	
		(16.07)	
Δ*hhd* x I(*Hi hhd*) (l3)		13.26	
		(14.21)	
Δ*hhd* x I(*Hi hhd*) (l4)		24.24*	22.27*
		(14.72)	(12.72)
I(*Hi hhd*)		-1.211	-1.152
		(0.992)	(0.841)
N	938	938	972
Countries	33	33	34
Country Cluster	Y	Y	Y
Country FE	Y	Y	Y

Table 5b. Probability of Systemic Banking Crisis: Robustness–Methods

This table presents results robustness exercises for the logit panel estimations reported in Table 4 . *hhd* and Δ*hhd* are level and first difference in household debt-to-gdp ratio. *fd* and Δ*fd* are level and first difference in non-financial corporate debt-to-gdp ratio. All independent variables are lagged. The third lag of household debt change is utilized. Country fixed effects (COU FE) are considered. Errors are clustered at the country level. Banking crises are taken from the updated database by Laeven and Valencia (2013). ***, **, *, indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels.

	(1)	(2)	(3)	(4)
Dependent Variable	Systemic Banking Crisis			
Method	Logit FE	Panel logit	Firth logit	Panel Poisson
fd	0.257	0.169	-0.753	0.152
	(1.008)	(1.278)	(0.617)	(1.342)
hhd	1.433	1.458	0.562	1.354
	(1.894)	(2.392)	(0.798)	(2.023)
Δ*fd*	6.413**	5.675	3.136	5.527*
	(3.248)	(3.996)	(2.105)	(3.040)
Δ*hhd*	34.19***	30.73***	24.61***	29.57***
	(8.127)	(8.171)	(5.268)	(7.462)
Observations	786	786	786	786
Errors	Clustered	Bootstrap	PMLE	Bootstrap
Country FE	YES	YES	YES	YES
Number of Crises	35	35	35	35
Number of Countries	32	32	32	32

Table 6. Bank Equity Returns and Crashes

This table presents the relationship between past household debt growth and future bank stock returns and the probability of crashes. Equity crashes are defined as having an annual return of below -30 percent, as in Baron and Xiong (2017). Forecasting horizons vary from one year to five years. Standard errors are clustered at the country level. Marginal effects are reported for the probability of future equity crashes. ***, **, *, indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent Variable: Future Bank Stock Returns $r_{i,t+k}$						Probability of Future Equity Crashes		
	$k = 1$		$k = 3$		$k = 5$		$k = 1$	$k = 3$	$k = 5$
$\Delta_3\left(\frac{HHD}{GDP}\right)_{c,t}$	-0.020*	-0.027**	-0.120**	-0.113**	-0.159**	-0.123**	-0.011	0.035**	0.080***
	(0.011)	(0.013)	(0.032)	(0.037)	(0.050)	(0.055)	(0.010)	(0.015)	(0.017)
$\Delta_3\left(\frac{NFCD}{GDP}\right)_{c}$		-0.029		-0.106*		-0.183**	0.053***	0.099***	0.057***
		(0.021)		(0.053)		(0.071)	(0.011)	(0.017)	(0.020)
$\left(\frac{HHD}{GDP}\right)_{c,t-3}$		-0.398**		-0.695		-0.640			
		(0.189)		(0.433)		(0.669)			
$\left(\frac{NFCD}{GDP}\right)_{c,t-3}$		-0.010		-0.117		-0.234			
		(0.092)		(0.233)		(0.355)			
Country FEs	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y	Y	Y	N	N	N
N	1,488	1,319	1,348	1,319	1,208	1,179	1,680	1,680	1,668
Countries	70	70	70	70	70	70	70	70	70
R^2	0.27	0.36	0.34	0.36	0.36	0.37	0.11	0.15	0.14

Table 7. Abnormal Returns for Bank Stocks

This table presents the relationship between past household debt growth and future abnormal returns for bank stocks. Abnormal returns are defined as the Capital Asset Pricing Model (CAPM) residuals. Market betas are estimated for each country in each year based on past quarterly stock price data to avoid using unknown information at the time. Forecasting horizons vary from one year to three years. Standard errors are clustered at the country level. ***, **, *, indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)
	$k = 1$		$k = 2$		$k = 3$	
$\Delta_3\left(\frac{HHD}{GDP}\right)_{c,t}$	-0.049	0.003	-0.228***	-0.145*	-0.289*	-0.289***
	(0.063)	(0.069)	(0.079)	(0.083)	(0.090)	(0.097)
$\Delta_3\left(\frac{NFCD}{GDP}\right)_{c,t}$		-0.198**		-0.401***		-0.479***
		(0.081)		(0.098)		(0.114)
$\left(\frac{HHD}{GDP}\right)_{c,t-3}$		-0.081		-0.503***		-0.723***
		(0.112)		(0.134)		(0.161)
$\left(\frac{NFCD}{GDP}\right)_{c,t-3}$		-0.130		-0.187		-0.239
		(0.104)		(0.125)		(0.151)
Country FEs	Y	Y	Y	Y	Y	Y
N	723	723	722	722	693	693
Countries	30	30	30	30	30	30
R^2	0.00	0.02	0.02	0.08	0.04	0.11

Table 8. Euro Area: Household Debt Overhang

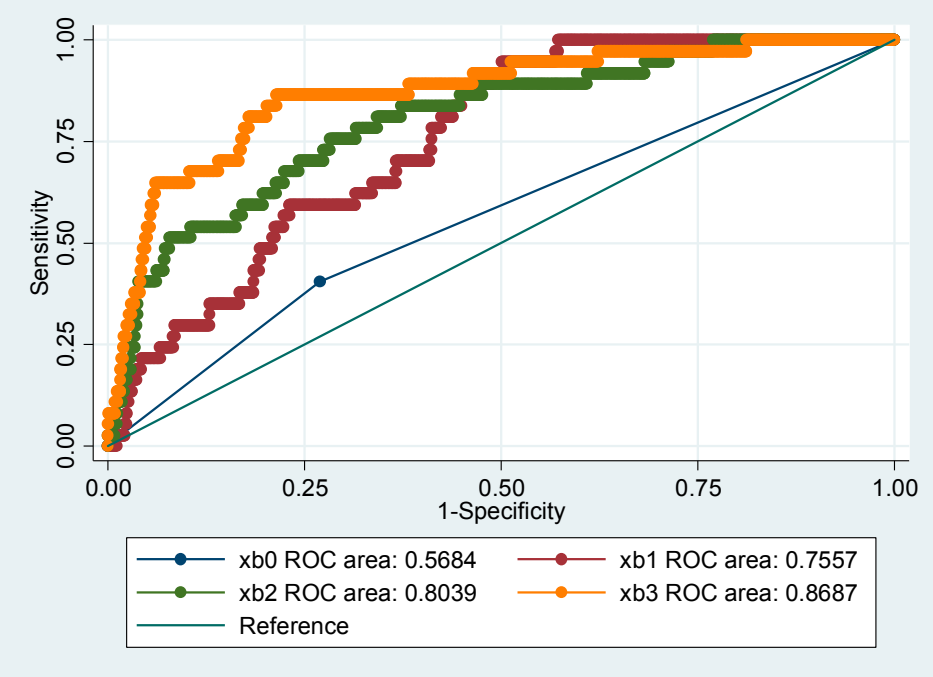
This table presents the relationship between past household indebtedness and changes in consumption to income ratio in a cross-section of euro area households. DTI = debt-to-income ratio; LTV = loan-to-value ratio; I(DTI>300) is a dummy variable which takes value 1 if DTI exceeds 300 percent, and 0 otherwise. All regressions include country fixed effects and household net wealth dummies. Country-clustered robust errors in parentheses. ***, **, *, indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels.

	Dependent Variable: Change in Consumption to Income Ratio						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DTI (lag)	-0.0396***		-0.0404***		-0.0401***		-0.0152*
	(0.00235)		(0.00183)		(0.00226)		(0.00619)
LTV (mortgages, lag)		-0.123***		-0.128**		-0.131***	
		(0.0218)		(0.0302)		(0.0154)	
DTI x I(DTI>300) (lag)							-0.0537***
							(0.00816)
I(DTI>300) (lag)							26.32***
							(2.010)
Size of household main residence					0.0294**	-0.0506*	0.0200*
					(0.00694)	(0.0173)	(0.00779)
Education of reference person					0.986***	0.557	0.721***
					(0.0584)	(2.923)	(0.108)
Age of reference person					0.110	0.116	0.132**
					(0.0469)	(0.0720)	(0.0264)
Unemployment					-4.096	10.59	-3.451
					(3.693)	(8.163)	(3.114)
Constant	0.840*	-3.417***	0.348	25.44**	-11.54**	21.59**	-13.32**
	(0.333)	(0.377)	(1.429)	(6.631)	(3.487)	(4.775)	(2.627)
N	2,925	699	2,925	699	2,744	656	2,744
R^2	0.102	0.059	0.103	0.113	0.109	0.133	0.142
Country FE	Y	Y	Y	Y	Y	Y	Y
Net Wealth FE	Y	Y	Y	Y	Y	Y	Y
Cluster Country	Y	Y	Y	Y	Y	Y	Y

B. Figures

Figure 1. Systemic Banking Crises: Area Under Curve (AUC)

This figure depicts the AUC from 5 models: reference - uninformative model; xb0 – model with country FE only; xb1 – model with country FE+ household debt (level); xb2 – model with country FE + Household debt (change); xb3 – model with country FE + household debt (level and change) + Corporate Debt (level and change) + interactions between household debt (change) and high household debt and high sovereign debt.



Source: IMF staff computations.

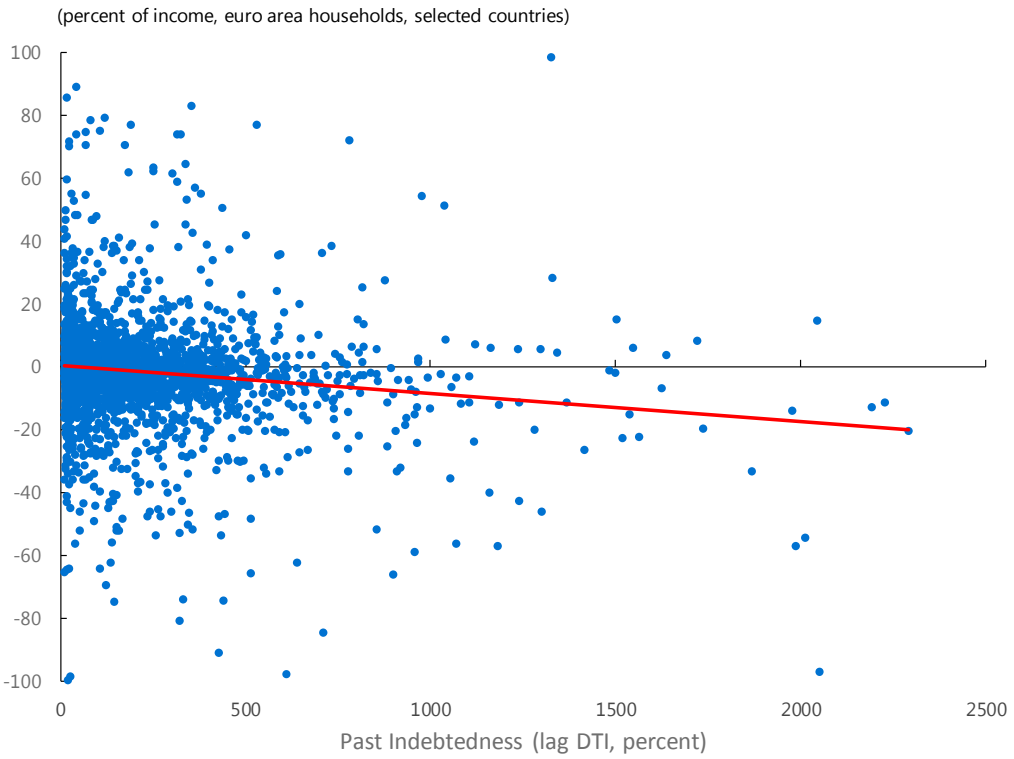
Figure 2. Europe: Debt Overhang and Consumption (Macro-level)

This figure depicts the country-level relationship between change in real private consumption after the crisis (2008–2013) and change in household debt (percent of GDP) before the crisis (2001–2007.)

Source: IMF staff computations.

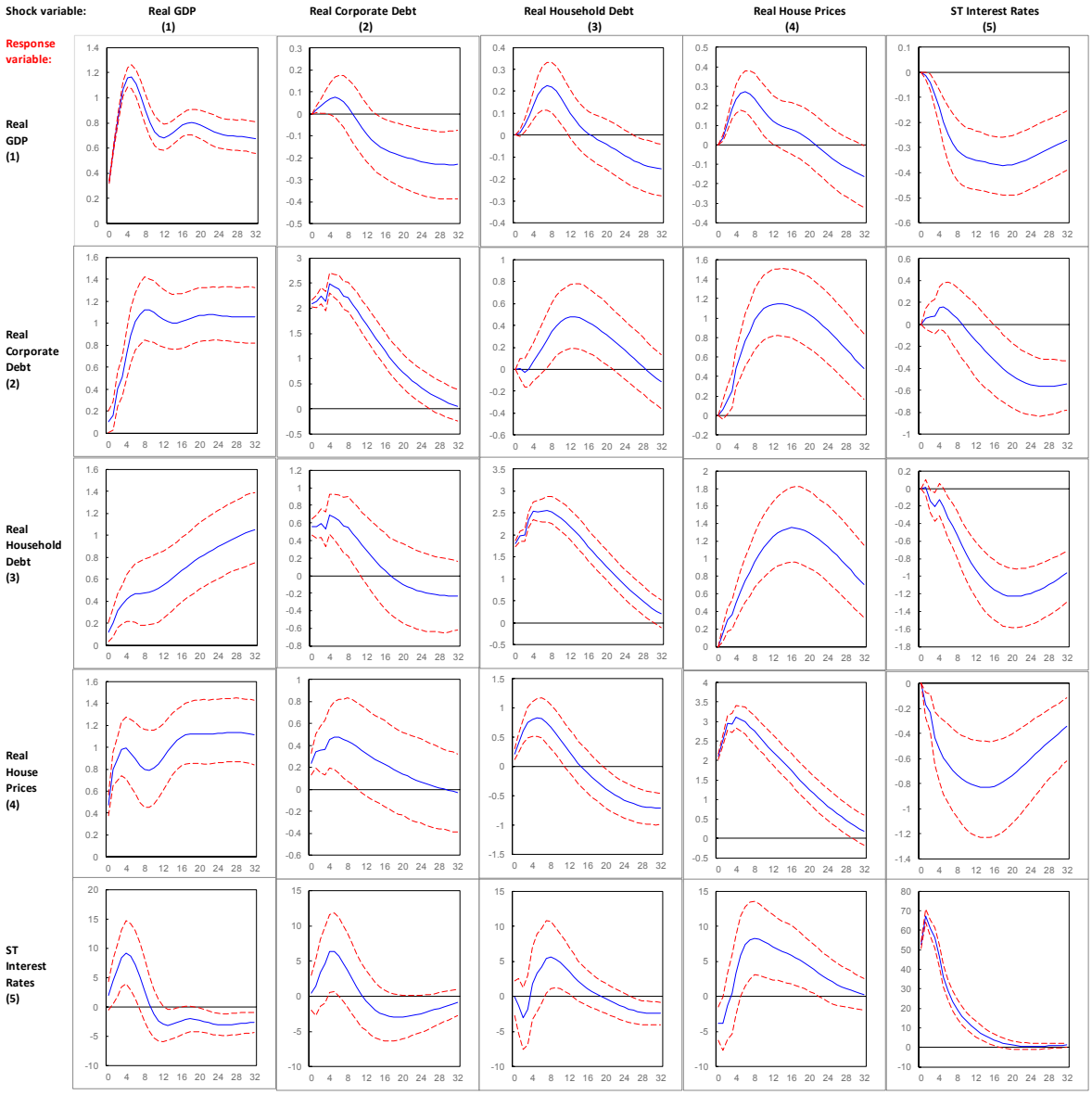
Figure 3. Euro Area Households: Debt Overhang and Consumption (Micro-level)

This figure depicts the relationship between change in household consumption-to-income ratio and past indebtedness (DTI). Household survey data from euro area countries with a panel dimension (Belgium, Cyprus, Germany, Malta, the Netherlands) are considered. The change in consumption-to-income ratio is computed over 2010–2014. DTI = debt-to-income ratio.



Source: IMF staff computations.

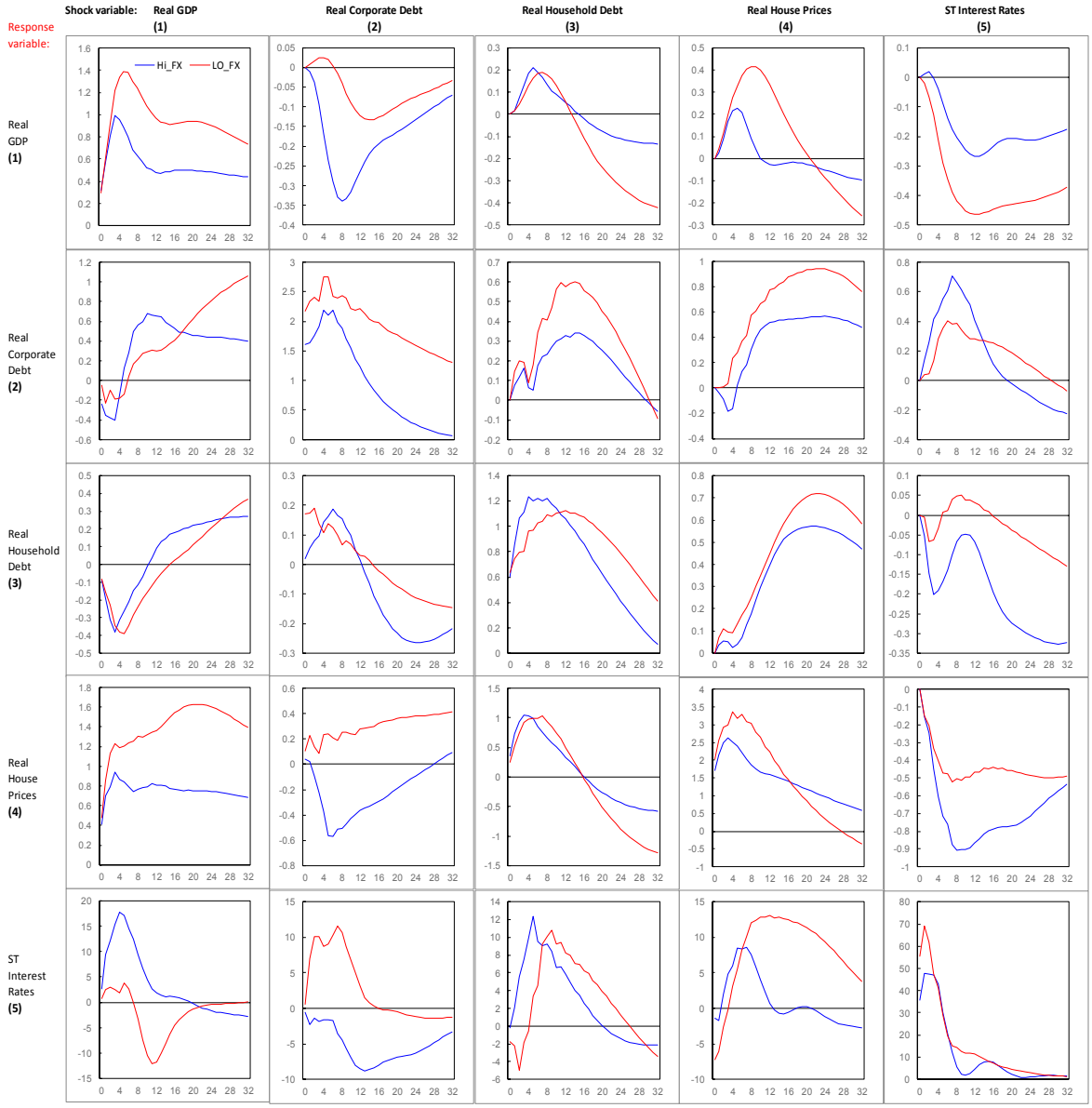
Figure 4. Panel VAR Analysis: Baseline



Source: IMF staff computations.

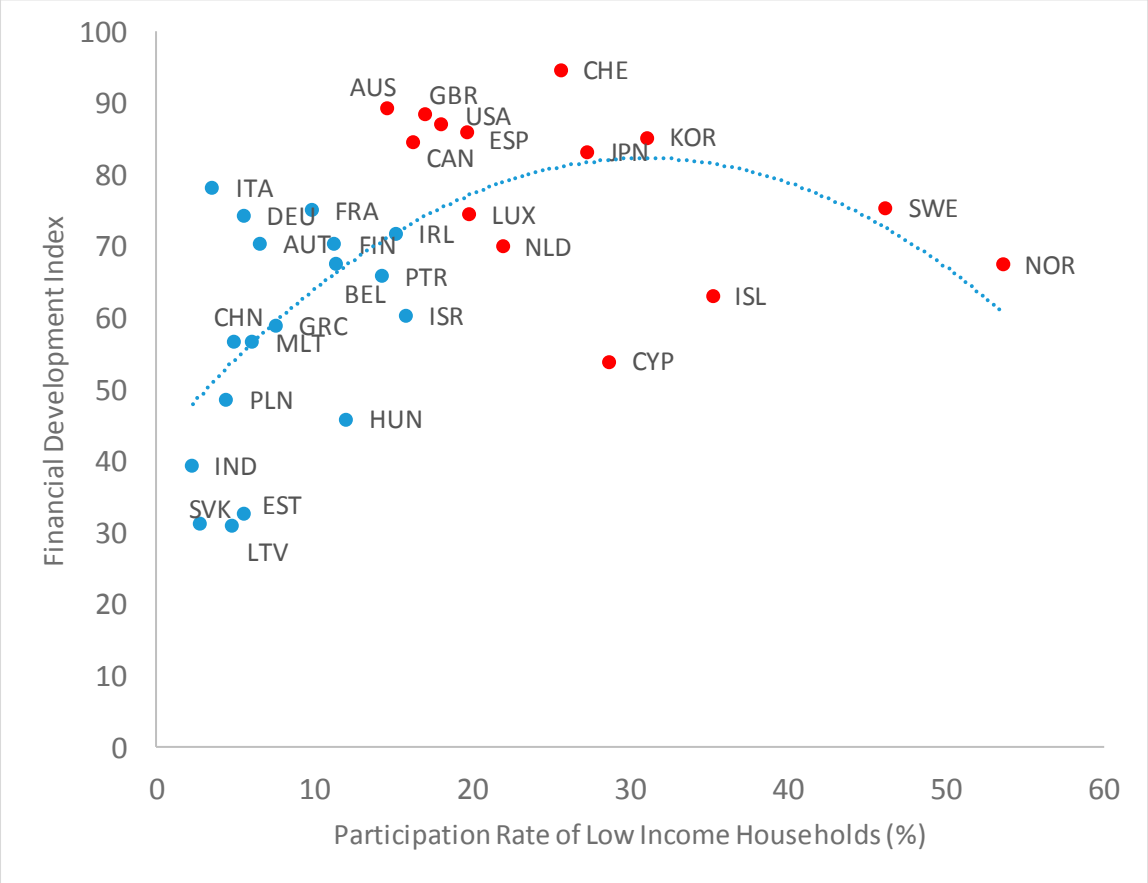
Note: Shock variables are on columns, while response variables on rows. Countries included in this analysis are: AUS, BEL, CAN, COL, CZE, DEU, DNK, ESP, FIN, FRA, GBR, GRC, HKG, HUN, ISR, ITA, JPN, KOR, LTU, NLD, NOR, NZL, PRT" SGP, SWE, THA, and USA. Forecast horizon is 32 quarters. Estimation period 1998:Q1–2015:Q4. Shocks are identified using Cholesky decomposition with the following order: log real GDP, log real corporate debt, log real household debt, log real house prices, and short-term interest rates. Dashed lines represent 95 percent confidence intervals which were computed using 1000 Monte Carlo simulations.

Figure 5. Panel VAR Analysis: High vs Low Exchange Rate Flexibility



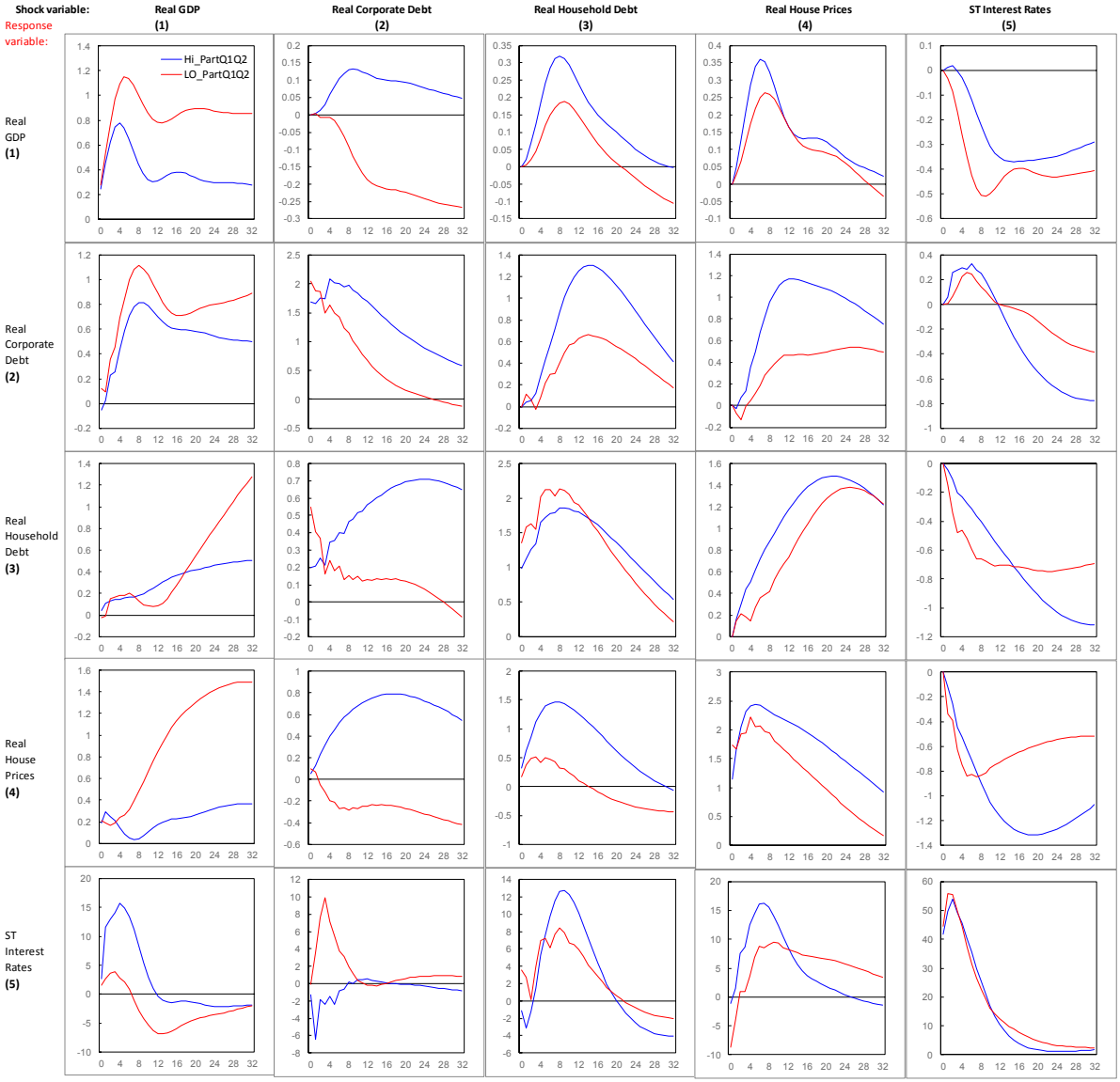
Source: IMF staff computations.
Note: Shock variables are on columns, while response variables on rows. Dotted lines depict 90 percent confidence bands. Countries included in the "Hi FX" flexibility group: AUS, CAN, COL, GBR, JPN, KOR, NOR, NZL, SGP, SWE, THA, and USA. Countries included in the "Low FX" flexibility: BEL, CZE, DEU, DNK, ESP, FIN, FRA, GRC, HKG, HUN, ISR, ITA, LTU, NLD, and PRT. Forecast horizon is 32 quarters. Estimation period 1998:Q1–2015:Q4.

Figure 6. Panel VAR Analysis: Participation Rate of Low-income Households and Financial Development



Source: IMF staff computations.
Note: Participation for the low-income borrowers refers to those mortgages in the bottom 40 percent of the income distribution, using country-specific household level data. "High" and "Low" mortgage participation countries are reported in red and blue, respectively. Micro-level data refers to most recent wave available in each case, 2011–2013.

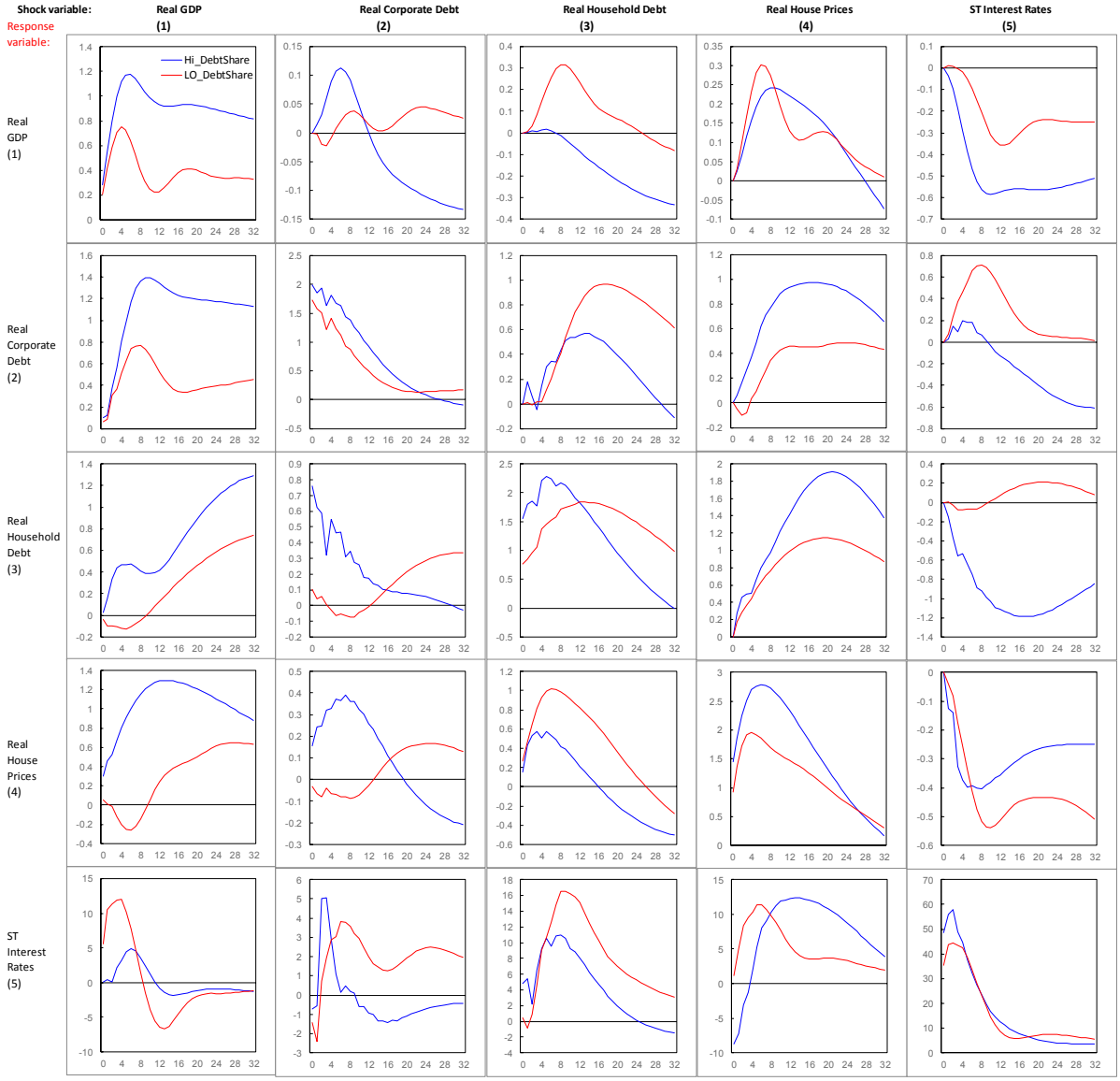
Figure 7. Panel VAR Analysis: High vs Low Participation for Low Income Borrowers



Source: IMF staff computations.

Note: Shock variables are on columns, while response variables on rows. Dotted lines depict 90 percent confidence bands. Countries included in the "Low Participation" group: PRT, HUN, BEL, FIN, FRA, GRC, DEU, ITA, and ISR. Countries included in the "High Participation" group: NOR, SWE, KOR, JPN, NLD, ESP, USA, GBR, AUS, and CAN. Forecast horizon is 32 quarters. Estimation period 1998Q1-2015Q4. Participation for the low-income borrowers refers to those mortgages in the bottom 40 percent of the income distribution, using country-specific household level data.

Figure 8. Panel VAR Analysis: High vs Low Debt Share for Low-income Borrowers



Source: IMF staff computations.

Note: Shock variables are on columns, while response variables on rows. Dotted lines depict 90 percent confidence bands. Countries included in the "High Debt Share" group: AUS, ESP, GRC, HUN, ITA, JPN, KOR, and NLD. Countries included in the "Low Debt Share" flexibility: BEL, CAN, DEU, FIN, FRA, GBR, PRT, and USA. Forecast horizon is 32 quarters. Estimation period 1998:Q1-2015:Q4. Debt share of low income borrowers is computed as the share of mortgage debt held by households in the bottom 40 percent of the income distribution, using country-specific household level data.

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