MACROECONOMIC EFFECTS OF HOUSEHOLD DEBT: A SURVEY OF THE EMPIRICAL LITERATURE*

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Abstract

What are the macroeconomic effects of household debt? A recent empirical literature flourished after the Great Financial Crisis argues that household debt expansions have been historically followed by boom-and-bust cycles in economic activity. I survey this literature and organize it according to three main branches: panel data, cross-sectional, and vector autoregression models. I show that while different strands of literature concur that there is a significant correlation between household debt expansions and subsequent contractions in economic activity, they point to different underlying mechanisms. On the one hand, single-equation regressions favor explanations based on household financial fragility. On the other hand, vector autoregression models identify a role for monetary policy in generating the negative correlation between household debt and future economic activity.

Keywords: survey, household debt, macroeconomics

JEL codes: E32, E44, G51

1 Introduction

Since the Great Financial Crisis interest has grown in researching the links between household debt expansions and the macroeconomy. Researchers and policy makers are now more concerned about the macroeconomic consequences of household debt than they were before 2008. This concern partly mirrors the emblematic role that the accumulation of household debt had for the large imbalances that led to the Great Financial Crisis in the US.[1]

Credit cycles and financial crises, however, are not recent phenomena. Economic history records many episodes of boom-and-bust cycles in credit activity followed by deep recessions. The 1720 bubble of the South Sea Company, the 1790s credit expansion and the 1792 financial panic in Europe, the explosion of commercial papers backed by claims on the North America Western Lands and the subsequent panic in 1796-1797 are clear historical examples. In the

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[1] Along the paper I use the word "household credit" and "household debt" interchangeably. In all case I refer to households' financial liabilities such as mortgages, consumer credit, other loans.

most recent history, the late 1980s Japanese crisis, the early 1990s Scandinavian banking crises and the 2008-2011 financial crisis in Iceland provide vivid examples of business cycles induced by boom-and-bust cycles in private debt. To quote Charles P. Kindleberger, details proliferate, structure abides. Notwithstanding the post-2008 renewed interest, credit cycles were central in earlier macroeconomic theories of the real-financial interaction (Gertler, 1988). Leading authors, such as Fisher (1933), Kindleberger (1978) and Minsky (1986), formulated original theories of aggregate fluctuations driven or amplified by credit.

The growing importance of private debt reflects a long-term transformation in finance. Jordà et al. (2017) argue that as one looks at the financial history of advanced economies in the last 140 years, the *financial hockey stick* emerges as metaphor for the extraordinary acceleration in the growth of private debt-to-income ratios since the 1980s. As shown in Figure 1, the rise in total loans to the non-financial private sector accelerates starting from the 1980s. However, most of this acceleration has been driven by rising credit to household and by growing mortgage credit. The literature on the finance-growth nexus generally interprets the long-term rise of debt-to-income ratios as a growing of *financial depth* which is argued to be beneficial for economic growth (Levine, 2005; Rajan and Zingales, 1998).[2] In contrast, a recent empirical literature challenges this result and argues that episodes of large private debt expansions, especially household debt, are detrimental for growth because they are generally followed by long and deep recessions.

In this paper, I survey the recent literature on the macroeconomic effects of household debt and take a stock of its main results. Because much has been written on this topic, I narrow my attention to the post-2008 papers which explicitly address the consequences of household debt from a macroeconomic standpoint. To have a better mapping of the literature, I organize it in three branches or strands. The first strand of literature consists of papers that estimate the macroeconomic effects of household debt using cross-country panel data models. Papers in the second branch of literature employ cross-sectional regression models (generally at county/state level) to ask whether the large increase in household debt in the early 2000s was responsible for the large drop in consumption during the Great Recession in the US. The third strand of literature adopts multivariate vector autoregression (VAR) models to study the joint dynamics of credit, macroeconomic aggregates and monetary policy in the US.

[2]Recent studies on the finance-growth nexus suggest that the relationship between private debt-to-income ratios and economic growth is non-linear, namely debt becomes detrimental for growth after debt-to-income ratios reach some threshold level (Arcand et al., 2015).

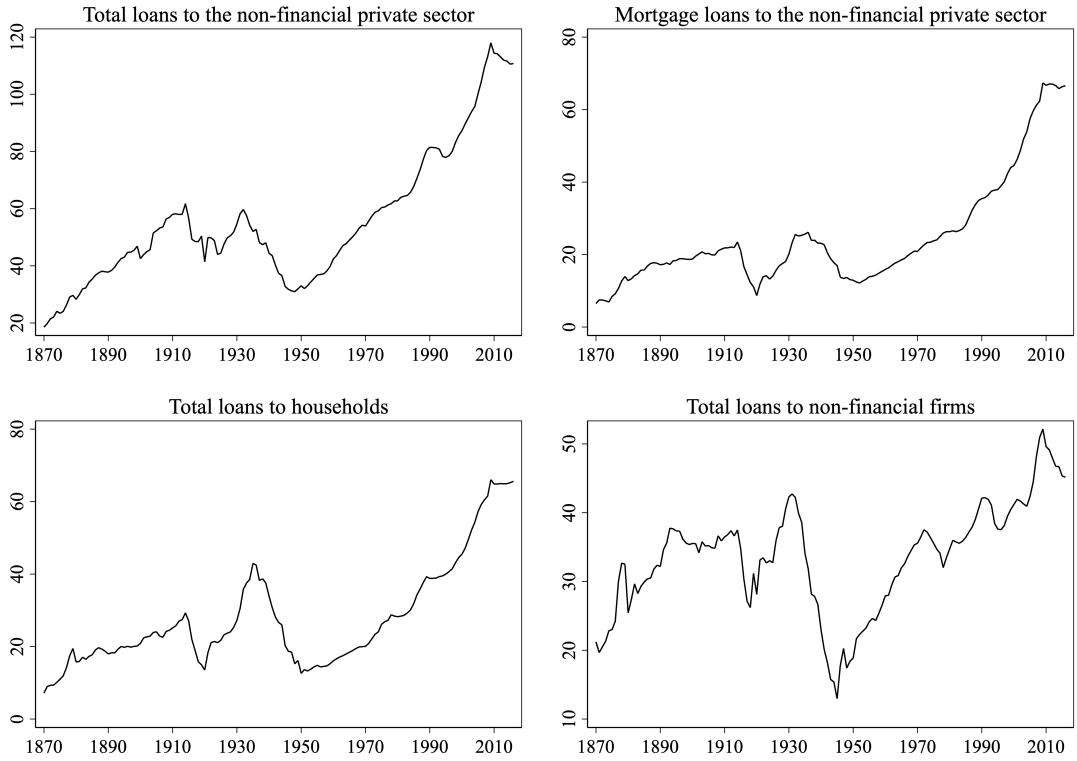

FIGURE 1: CREDIT TO NON-FINANCIAL SECTOR, 1870-2015, AVERAGE OF 17 COUNTRIES

Notes: this figure plots average debt-to-GDP ratios using annual data from the Jordà-Schularick-Taylor Macrohistory Database (Jordà et al., 2017). Both debt and GDP are nominal and in local currency. The y-axis measure debt as percentage of GDP. Country are Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

The papers included in this survey consider very diverse indicators of aggregate activity and of household debt. To fix ideas on which are the key variables, I present a series of general or nested model for each of the surveyed strands of literature. These models nest the various empirical specifications proposed in the papers that I survey. The nested models serve the purpose of allowing the reader to easily move through the literature, quickly identify empirical specifications, outcome variables, key household debt indicators and the main macroeconomic controls that have been considered.[3]

The surveyed literature suggests that household debt expansions are followed by contractions in economic activity. However, there is some disagreement on which is the economic mechanism that better explains this correlation. Single-equation regressions (panel data and cross-sectional models) suggest that large financial imbalances during the credit expansion lead

[3]The nested models are only used as conceptual framework to help the organization of the literature. To gain familiarity with this framework, I introduce an example borrowed from Brooks (2019). Suppose that two researchers are independently working on measuring the variation in some variable y. Each researcher has a different theory about which explanatory variable to choose. Alice selects the model $y = \alpha_1 + \alpha_2 x_1 + u$ while Bob selects the model $y = \beta_1 + \beta_2 x_2 + v$. Bob's model can not be viewed as a restricted version of Alice's model, and vice-versa. They are non-nested models. However, the two non-nested models can be compared by nesting them into a more general model. The nested model is $y = \gamma_0 + \gamma_1 x_1 + \gamma_2 x_2 + \varepsilon$ and contains both Bob and Alice's models as special case when γ_2 and γ_1 are restricted to zero, respectively. This is the philosophy that has inspired the construction of nested models to sum-up the literature in this survey.

to increased financial fragility and are responsible for the subsequent contraction in economic activity. The emphasis on expectations and financial innovations as endogenous forces driving the interaction between credit and real activity makes this interpretation descendant of Minsky (1986) and Kindleberger (1978). An influential version of this interpretation is the *credit-driven household demand channel* (Mian and Sufi, 2018). According to this channel, many business cycles in advanced economies are ultimately generated by an exogenous expansion in the supply of credit which, most of the time, is not motivated by prospects of future income growth. During the expansion, economic growth is driven by debt-financed household demand rather than by increases in the productive capacity of firms. The expansion ultimately leads to a contraction when aggregate demand starts to decline due to exogenous shocks or to endogenous reversal in credit sentiment. The household debt overhang and the imbalances during the credit expansion amplify the contraction in economic activity.

Multivariate (VAR) models cast doubt on the relevance of the household financial fragility hypothesis. Instead, this strand of literature favors an explanation of the negative correlation between household debt expansions and subsequent economic activity that hinges on the endogenous reaction of interest rates. Household debt expansions stimulate output growth in the short- and medium-run but they also lead to a rise in inflation. Rising inflation elicits a tightening in monetary policy and the resulting increase in interest rates slows down output growth. In other words, the VAR literature suggests that the contractions in economic activity following (inflationary) household debt expansions are caused by the automatic increase in interest rates they cause.

ROAD MAP. The paper is organized as follows. In Section 2, I survey the strand of literature that uses single-equation regressions, namely cross-country panel data and cross-sectional models. Section 3 surveys the macro-financial VAR models on the interaction between credit, macroeconomic aggregates and monetary policy in the US. In Section 4, I delve into some unresolved issues highlighted by the survey. These issues concern the choice and interpretation of the household debt indicators, the mechanisms proposed to explain the correlation between household debt and real activity, and the comparison between the macroeconomic effects of household and non-financial firm debt expansions. Section 5 concludes.

2 Evidence from single-equation regressions

I begin by surveying the evidence on the macroeconomic effects of household debt arising from single-equation regressions. I start by looking at panel-data models estimated for large cross-sections of mostly advanced economies. Then, I explore the relationship between household debt and consumption during the Great Recession in the US.

2.1 Patterns of household debt and business cycles across time and space

An influential strand of research in applied macroeconomics shows a systematic relationship between household debt expansions and future downturns in economic activity. This result is supported by a number of studies using panel data models for large cross-sections of countries.

Equation 1 combines some of the most influential empirical specifications in this literature. In particular, the panel data model in equation 1 nests the baseline models in Mian et al. (2017), Drehmann et al. (2018), Jordà et al. (2016) and Müller and Verner (2020):

$$\begin{aligned}\Delta y_{it+h} = \alpha_i^h + \beta^h D_{it}^{HH} + \mathbf{Credit}_{it}'\boldsymbol{\gamma}^h + \mathbf{Financial}_{it}'\boldsymbol{\theta}^h + \mathbf{Housing}_{it}'\boldsymbol{\delta}^h \\ + \mathbf{Real\ Activity}_{it}'\boldsymbol{\lambda}^h + \mathbf{Openness}_{it}'\boldsymbol{\psi}^h + u_{it+h}\end{aligned} \tag{1}$$

where i and t index countries and time (years or quarters), respectively. Equation 1 suggests that the macroeconomic effects of household debt can be estimated by regressing a measure of economic activity (Δy_{it+h}) on an indicator of household debt (D_{it}^{HH}). Since many other factors may influence economic activity independently of household debt, a wide set of control variables is generally included in the models. Panel A in Table 1 groups the household debt indicators, outcome variables and other information about the non-nested models. In equation 1, I add the subscript/superscript h because all non-nested models estimate the macroeconomic effects of household debt using local projections (Jordà, 2005). With local projections, the sequence of estimated coefficients $\left\{\partial \Delta y_{it+h}/\partial D_{it}^{HH} = \beta^h\right\}_{h=1}^{H}$ traces out an impulse response function, namely the impact of a unit change in D_{it}^{HH} on the dependent variable at time $t+h$.

OUTCOME. The outcome variable is generally a measure of economic activity. More specifically, the dependent variable can be the 3-year growth of log real GDP (Mian et al., 2017), the h-year growth of log real GDP (Drehmann et al., 2018), the h-year change of log real GDP per capita during the economic recovery (Jordà et al., 2016), or alternatively the change of log real GDP from $t-3+h$ to $t+h$ (Müller and Verner, 2020).

HOUSEHOLD DEBT INDICATOR. The non-nested models in equation 1 proxy household debt growth using slightly different indicators. For example, the main proxy of household debt growth in Mian et al. (2017) is the 3-year change in household debt-to-GDP in $t-1$. Their main source of data for the stock of household debt is the Bank of International Settlements (BIS) "Long series of total credit to the nonfinancial sector." In BIS data, debt is defined as total borrowing by households and nonprofit institutions serving households from banks and other non-bank lenders. Müller and Verner (2020) employ substantially the same measure of household debt growth, namely the contemporaneous 3-year change in household debt-to-GDP. The household debt indicator in Jordà et al. (2016) is mortgage debt accumulated during the expansion. The accumulation of mortgage debt is calculated at annual rate in percentage points per year and in deviations from its historical mean. They focus on the accumulation of mortgage debt before a crisis occurs and measure economic activity after each crisis. Drehmann et al. (2018) explicitly focus on the flow of household debt rather that on changes in debt-to-income ratios. Their indicator of household debt growth is new borrowing-to-GDP in $t-1$ and new borrowing is measured by the change in the stock of debt plus amortizations.

MACROECONOMIC CONTROLS. The macroeconomic controls represent factors which are likely to influence current and future economic activity, independently of household debt. Table 2 provides a detailed list of the control variables organized in blocks. The Credit block comprehends leverage measures of other sectors in the economy, e.g. non-financial firms, government, tradable and non-tradable sector. The Financial block includes factors that capture

general credit conditions in the economy, e.g. changes in interest rates on the stock of household debt, spreads and changes in loan loss provision. The Housing block includes variables that control for the value of collateral and house prices. The Real Activity block encompasses conventional macroeconomic indicators such as various measures of inflation, the unemployment rate and productivity growth. The Openness block consists of control variables related to the current account and to exchange rates. In addition, all non-nested models include country fixed effects in order to account for country-level unobserved heterogeneity.[4]

2.1.1 Household debt expansions predict negative GDP growth

In Mian et al. (2017), Drehmann et al. (2018), Jordà et al. (2016) and Müller and Verner (2020), household debt growth is positively correlated with contemporaneous and short-term GDP growth ($\beta^h > 0$ for small values of h), while the correlation turns negative as GDP growth is projected further into the future ($\beta^h < 0$ for large values of h). In other words, household debt expansions predict short-run growth but future contractions in economic activity.

It is important to highlight that this correlation does not necessarily implies that household debt expansions are *the* cause of future economic contractions. However, some studies take a number of strategies to exclude that the correlation is driven by confounding factors. For example, Mian et al. (2017) show impulse responses from a proxy-VAR in which mortgage spreads are used to instrument household debt expansions. In a two-stage least squares exercise, they use the convergence of sovereign spreads over 10-year US Treasuries to instrument household debt expansions in the euro zone. Jordà et al. (2016) provide estimates of β^h using using synthetic controls methods. Moreover, in many specifications, the household debt indicator is lagged relative to the outcome variable in order to avoid simultaneity.

The specifications included in equation 1 represent a small though rather influential subset of cross-country panel data models on the macroeconomic effects of household debt growth. Other studies find similar results using slightly different specifications, e.g. threshold models and logistic regressions. Lombardi et al. (2017) and Cecchetti et al. (2011) find that household debt may slow down economic growth when it reaches 80 to 85% of GDP. Gourinchas and Obstfeld (2012) show that domestic credit expansions together with a real currency appreciation robustly predict financial crises in both advanced and emerging economies. Anundsen et al.

[4]The nested model in equation 1 does not include time fixed effects since they are not considered by the non-nested models. Omitting time fixed effects amounts to exclude the autonomous influence that unobserved time-varying global factors may have on country-level GDP growth. In order to assess whether the exclusion of time fixed effects leads to an omitted variable problem I replicate Figure II in Mian et al. (2017, p. 1770) using their replication kit. In that figure, Mian et al. (2017) use local projections to show that household debt expansions predict significant boom-and-busts cycles in GDP. However, when I replicate their impulse responses after adding time fixed effect I find that the boom-and-bust cycles in GDP induced by household debt expansions become not significant. Moreover, time fixed effects attenuates the real effects of household debt expansions. I show and compare these results in Appendix A. Mian et al. (2017) acknowledge that time fixed effects would reduce both magnitude and significance of their estimates. At the same time, they provide an economic interpretation of time fixed effects. They argue that the global unobserved factor that matters the most for country-level GDP growth is the global change in the household debt-to-GDP ratio. This motivates their choice of excluding *generic* time dummies from their baseline models. Time fixed effects, it is argued, would lead to underestimate the effects of global household debt cycles. To the best of my knowledge, only Mian et al. (2017) discuss the implications of omitting time fixed effects for their results.

(2016) find that bubbles in house prices and high household debt are strong predictors of the probability of observing financial crises. In a sample of advanced and emerging economies, Büyükkarabacak and Valev (2010) find that household debt expansions increase the probability of banking crises without any long-term positive effect on income growth. Similarly, Alter et al. (2018) confirm the findings in Mian et al. (2017) for a larger set of countries.

2.1.2 Why do household debt expansions predict future recessions?

The model in equation 1 can be used to shed light on the different channels through which household debt expansions can influence future economic activity.

THE CREDIT-DRIVEN HOUSEHOLD DEMAND CHANNEL. Mian et al. (2017) and Mian and Sufi (2018) argue that the negative correlation between household debt expansions and future economic activity can be explained through the *credit-driven household demand channel*. This view of the business cycle conceives an outward shift in the supply of credit as the ultimate force generating expansions and contractions in economic activity. Potential drivers of the initial shift can be an influx of foreign capital in the country, financial liberalizations, or financial innovations. The credit supply shock can materialize as a relaxation of lending standards with lenders being more willing to lend to marginal borrowers as the economy starts to boom. A favorable credit market sentiment may induce an endogenous shift in the supply of credit, possibly detached from market fundamentals.[5] As the supply of credit shifts, credit spreads fall and house prices rise. Over the boom, credit-induced increases in house prices encourage the growth of the construction sector with amplification effects on aggregate demand. The crucial prediction of the *credit-driven household demand channel* is that the credit expansion spills over into the real economy by supporting household demand in contrast to business investment.[6] During household debt booms consumption-to-GDP rises, expenditure for tradable goods and services increases, imports of consumption goods grow, while business investment-to-GDP remains flat. The expansion turns into a recession when household demand contracts. The shortfall in demand may be triggered by *events* that increase the real burden of debt, e.g. unemployment or a halt in house prices growth. These *events* do not necessarily reflect exogenous shocks. Indeed, a reversal in lenders expectations or a tightening of lending standards may arise endogenously as a consequence of the credit expansion. Just like overoptimism may drive the expansion in the supply of credit and lower spreads, unexpected news may lead lenders to revise their expectations downward and to increase spreads. These swings in expectations and credit may produce credit crunches and a slowdown in aggregate demand. The household debt overhang amplifies the response of the economy to these shocks. Heterogeneous marginal propensities to consume, the zero lower bound on nominal interest rates, fixed exchange rate regimes, defaults, foreclosures, credit crunches induced by losses at financial

[5] As in Kindleberger (1978) and Minsky (1986), this view stresses that the supply of credit is pro-cyclical and that this features is among the main factors that make the financial system fragile. Pro-cyclic means that lenders and borrowers become more greedy in lending and borrowing during expansions and less when the economy contracts. It follows that waves of optimism and pessimism are pro-cyclical too.

[6] Mian et al. (2020) provide a test for this prediction using cross-country panel data and the US banking deregulation in the 1980s.

institutions make the recession following a debt expansion harsher and longer.

PRODUCTIVITY AND CAPITAL MISALLOCATION. Müller and Verner (2020) suggest that a potential reason for which household debt expansions are followed by recessions is that debt-financed household demand stimulates the growth of the non-tradable sector while leaving the productive capacity of the economy unaltered.[7] Non-tradable industries are characterized by lower productivity relative to tradable ones and household debt expansions are associated with the reallocation of resources toward low productivity sectors. This misallocation of resources from high to low productivity sectors may amplify the effects of the recession when it arrives. Moreover, household debt expansions may reduce the future level of productivity through a demand channel. For example, Bridges et al. (2017) suggest that large contractions in aggregate demand observed after household debt booms may be such that to reduce the productive capacity of the economy. In sum, the contractions in economic activity following household debt expansions may leave permanent scars on the economy.

EXTERNAL IMBALANCES. During household debt booms, the current account mirrors the reallocation of production and employment from tradable toward non-tradable industries. Mian et al. (2017) show that household debt expansions coincide with shrinking net exports and growing imports, mostly of consumption goods. However, net exports improve in the future but this improvement is driven by a drop in imports of consumption goods rather than by an increase in exports. Moreover, they find that the negative effects on output growth of household debt expansions are sharper when the country is running increasing current account deficits.

THE OTHER SIDE OF THE COIN: RISING DEBT SERVICE. Debt expansions are persistent and mortgages (the bulk of household debt) have long maturities. Hence, new borrowing, i.e. the change in the stock of debt plus amortization, entails a particular schedule for the debt service, i.e. the sum of interest payments and amortization. According to Drehmann et al. (2018), new borrowing stimulates the expansion but also pushes up the debt service on the outstanding stock of debt. As a result, the rise in debt service reduces discretionary income and depresses output growth. Drehmann et al. (2018) argue that the observed medium-run downturn can be completely attributed to the delayed increase in debt service implied by the initial boom in new borrowing.

2.2 Household debt during the Great Recession in the United States

Although the correlation between household debt and subsequent contractions in economic activity is interesting in its own right, the interpretation of this result as a causal relationship may be threatened by the existence of an omitted factor that explains changes in both debt

[7] Tradable and non-tradable are sub-sectors of the non-financial corporate sector. The tradable sector consists of firms producing goods and services that can be sold in the home economy and abroad, e.g. manufacturing. In contrast, the non-tradable sector consists of firms producing goods and services that can be only be consumed in the home economy, e.g. real estate and restaurants firms. Hence, the latter, differently from the former, is constrained by domestic demand. See also Mian and Sufi (2014) and Mian et al. (2020) on the importance of non-tradable sectors during household debt expansions.

TABLE 1: MACROECONOMIC EFFECTS OF HOUSEHOLD DEBT: SUMMING UP THE LITERATURE

	Household debt indicator, D^{HH}	**Dependent variable**	**When**	**Where**
Panel A: cross-country panel data models (equation 1)				
Mian et al. (2017)	3-year change in debt-to-GDP	3-year growth in log real GDP	1960-2012 annual data	30 advanced and emerging economies
Drehmann et al. (2018)	new borrowing -to-GDP	h-year growth in log real GDP	1980-2015 annual data	16 advanced economies
Jordà et al. (2016)	mortgage credit accumulated in the expansion	h-year cumulative change in log real GDP per capita	1870-2015 annual data	17 advanced economies
Müller and Verner (2020)	3-year change in debt-to-GDP	3-year change in log real GDP	1940-2014 annual data	116 advanced and emerging economies
Panel B: cross-sectional model of the Great Recession in the US (equation 2)				
Mian and Sufi (2010)	2002Q2-2006Q4 change in debt-to-income	2006Q4-2009Q2 change in auto sales	Great Recession, quarterly data	450 US counties
Mian et al. (2013)	2006 housing leverage ratio	2006-2009 change in auto sales	Great Recession, annual data	6,182 US ZIP codes
Dynan (2012)	2007 mortgage debt-to-assets ratio	2007-2009 change in non-housing consumption	Great Recession, two survey waves	About 8,000 households from PSID
	Household debt indicator (D^{HH})	**Identification strategy**	**Shock**	**Where and When**
Panel C: macro-financial VAR model of the US economy (equation 3)				
Brunnermeier et al. (2019)	real bank credit for real estate and consumer loans	identification -through -heteroskedasticity	shock to D^{HH}	US 1973-2015 monthly data
Guerini et al. (2018)	real mortgage debt outstanding	independent component analysis	shock to D^{HH}	US 1966-2015 quarterly data
Peersman and Wagner (2015)	mortgage and consumer loans outstanding	zero and sign restrictions	Bank lending shock: it moves outstanding, retained and securitized loans in the same direction	US 1970-2008 quarterly data
Bachmann and Rüth (2020)	mortgages loan-to-value ratio	zero (Cholesky) restrictions	shock to D^{HH}	US 1973-2008 quarterly data

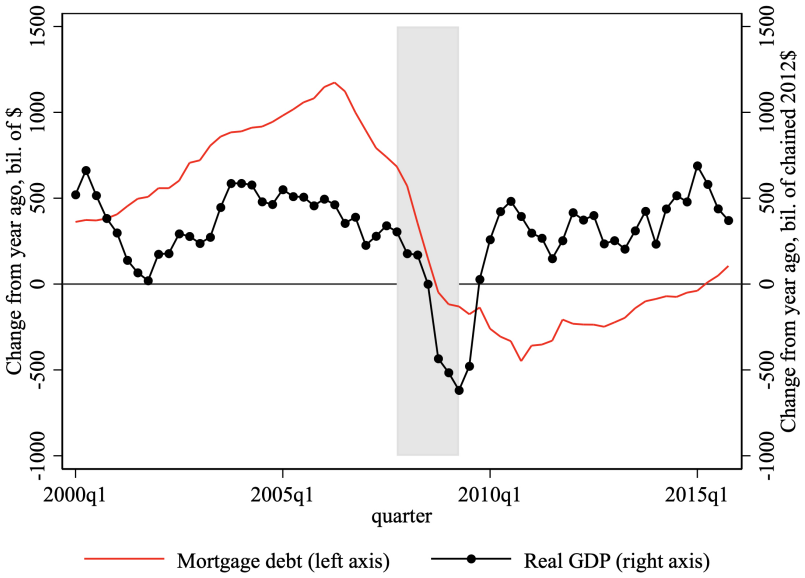

FIGURE 2: MORTGAGE DEBT AND THE GREAT RECESSION IN THE US

Notes: this figure plots the dynamics of mortgage debt and real GDP around the Great Recession in the US. Mortgage debt is the level (liability) of one-to-four-family residential mortgages. Both series are seasonally adjusted. The shaded area is the (NBER) Great Recession.

and activity. In contrast, the Great Recession provides a *natural experiment* that may be used to measure the effect of household debt expansions and explore the mechanisms at work.

From 2000 to 2009, the US experienced a dramatic boom-and-bust in household debt and the largest contraction in economic activity since the Great Depression. These credit and business cycles are clearly visible in Figure 2 which plots the year-over-year changes in mortgage debt and real GDP. The household debt expansion and the Great Recession unevenly hit the country. House prices and household debt grew more in some counties and metropolitan areas relative to other areas. Analogously, the drop in employment at the beginning of the crisis was not homogeneous across the country. Atif Mian and Amir Sufi collected a large amount of evidence on the causes and consequences of the boom-and-bust cycle in household debt in their influential book *House of Debt* (Mian and Sufi, 2015).

The cross-sectional variation in household debt growth led many researchers to employ very disaggregated datasets to identify and measure the consequences of the household debt expansion of the early 2000s. The cross-sectional units in these datasets are states, counties, metropolitan areas, ZIP-codes, or alternatively households. The effects of household debt expansions are generally estimated by regressing some proxy of economic activity (ΔC_i) observed during the crisis on a household debt indicator (D_i^{HH}) measured just before the onset of the recession. Equation 2 nests the models in Mian and Sufi (2010), Mian et al. (2013) and Dynan (2012) which may be considered among the most influential studies on the role of household debt during the Great Recession:

$$\Delta C_i = \alpha_i + \beta D_i^{HH} + \mathbf{Credit}_i'\boldsymbol{\gamma} + \mathbf{Housing}_i'\boldsymbol{\delta} + \mathbf{Real\ Activity}_i'\boldsymbol{\lambda} + u_i \tag{2}$$

The unit i can be a county (Mian and Sufi, 2010), a ZIP code (Mian et al., 2013), or alternatively a household from the Panel Study of Income Dynamics (Dynan, 2012). Additional details on the key household debt and outcome variables are provided in Panel B of Table 1.

OUTCOME. The dependent variable is a measure of spending between the beginning and the end of the Great Recession. More specifically, ΔC_i can be the change in auto sales in county i between 2006Q4 and 2009Q2 (Mian and Sufi, 2010), the change in auto sales in ZIP code i between 2006 and 2008 (Mian et al., 2013), or alternatively the change in non-housing consumption of household i between 2007 and 2009 (Dynan, 2012). Non-housing consumption is consumption for non-durable and durable non-housing goods. Mian and Sufi (2010) use a model similar to the one in equation 2 to estimate the effects of household debt expansions on household defaults, house prices, unemployment and residential investment.

HOUSEHOLD DEBT INDICATOR. The outcome variable is regressed on a measure of household debt, D_i^{HH}. Mian and Sufi (2010) focus on household debt growth and measure it as the change in the debt-to-income ratio in county i from 2002Q2 to 2006Q4. In contrast, Mian et al. (2013) use a proxy for the level of debt, namely the housing leverage ratio in 2006 at ZIP code-level. The housing leverage ratio is a stock-to-stock measure and is calculated as the sum of mortgages and home equity debt divided by home values. Hence, it is a measure of leverage akin to loan-to-value ratios. Using household-level data, Dynan (2012) measures household leverage as the ratio between mortgage debt and home value in 2007. In this context, the parameter β estimates if and to what extent the pre-2007 growth of household debt, or alternatively its level before the crisis, contributed to the slowdown in household spending during the Great Recession.

MACROECONOMIC CONTROLS. The nested model in equation 2 includes other variables which might have had an autonomous influence on household spending between 2007 and 2009. They are listed in Table 3. The controls in the Credit block capture local credit market conditions and the household-level cost of servicing debt. In fact, rising default rates or an increase in the share of income that is used for interest payments are likely to reduce consumption, independently of debt overhang problems. Analogously, the Real Activity block encompasses indicators of regional economic activity, as county- and state-level employment shares in selected sectors, unemployment rates and median income. The Housing block includes indicators of home values and wealth which might affect consumption through wealth effects.

2.2.1 Was household debt responsible for the Great Recession?

Mian and Sufi (2010), Mian et al. (2013) and Dynan (2012) estimate a negative relationship between the pre-crisis level or growth of household debt and the decline in various measures of household spending. In terms of the nested model, the parameter β is estimated to be negative and significant. In light of this, the literature suggests that the early 2000s household debt expansion, or alternatively the ex-ante level of household debt, was responsible for the downturn in spending during the Great Recession. The fact that these studies concur on the sign of the parameter β is noteworthy because they use very different data sources, definitions of leverage

and cross-sectional aggregations. According to Mian and Sufi (2010, p. 96), "a one standard deviation increase in leverage growth from 2002 to 2006 in a county was associated with a one-half standard deviation decreases in auto sales from 2006 to 2009." Similarly, Dynan (2012, p. 330) finds that "an increase in a household's mortgage loan-to-value ratio from 1 to 1.1 would have reduced its consumption growth by 0.6 percentage point over this 2 year period, or 0.3 percentage point per year." The combination between high household debt and falling house prices weakened households' balance sheet and exacerbated the slowdown in spending. Interestingly, the combination of high leverage and house prices affected spending independently of wealth effects of falling house prices. For example, Mian et al. (2013, p. 1720) report that "ZIP codes with a housing leverage ratio below 30% cut spending on autos by \$0.01 for every \$1 decline in home value. However, the same effect is three times as large for ZIP codes with a housing leverage ratio of 90% or higher."[8] The result that households in highly leveraged areas reduced spending by more than households in other areas in response to the same fall in house prices is reminiscent of the *debt-deflation theory* (Fisher, 1933).

At first sight, the non-nested models in equation 2 suffers from the same identification problems that affect the panel data specifications from the previous section. However, Mian and Sufi (2010) and Dynan (2012) provide extensive evidence that the correlation between pre-crisis debt growth and spending during the Great Recession can be interpreted as a causal effect. Mian and Sufi (2010) present estimates resulting from an instrumental variable specification in which the growth of leverage is instrumented with county-level housing supply (in)elasticity. Since 2002, a nationwide credit supply shock boosted the demand for housing. However, the response of house prices to shifts in housing demand depends on the elasticity of the local housing supply curve. In areas with less elastic housing supply curves, house prices responded more than in areas with more elastic housing supply curves to the same housing demand shock. The reason for this is that in areas with less elastic housing supply curves, natural or regulatory constraints prevented home builders to build new houses to meet the peak in demand. On the contrary, in areas with more elastic housing supply curves, supply adjusted to demand because the construction of new homes was not constrained. Therefore, in areas with less elastic housing supply curves, more expensive houses led households to take out larger mortgages and higher house prices stimulated home equity borrowing.

The nested model in equation 2 considers a limited set of contributions on household debt during the Great Recession. Mian and Sufi (2017) provide reference of other studies linking the early 2000s expansion of household debt to several measures of economic activity during

[8] A drawback of Mian et al. (2013) and Mian and Sufi (2010) is that they rely on proprietary data which are inaccessible if one wants to replicate their findings. For example, Mian et al. (2013) measure expenditure using proprietary data from Mastercard and proprietary data on auto sales. Auto sales can be though as a proxy of expenditure for durable goods. The same data on auto sales are used in Mian and Sufi (2010) although with a different time and spatial aggregation. Kaplan et al. (2020) replicate the estimates in Mian et al. (2013) using accessible county-level data on house prices and expenditure for non-durable goods. They find that the effect of leverage on expenditure is slightly softened relative to Mian et al. (2013) after controlling for the direct effect of house prices on expenditure (wealth effect). The smaller effect of leverage on expenditure in Kaplan et al. (2020) is likely to depend on the fact that they only observe spending for non-durable goods which tends to fall by less than spending for durable goods during recessions. For example, between 2007Q4 and 2008Q4 in the US, the personal consumption expenditure for durable goods fell by 15% while expenditure for non-durable goods fell *only* by 3%.

the crisis. Using a panel of US states, Albuquerque and Krustev (2018) show that the 2007-2012 decline in consumption can be explained by a combination of household deleveraging and debt overhang effects. Petach (2020) finds evidence that US states where local financial sectors rapidly expanded during the housing boom also experienced the strongest growth in household indebtedness. Other studies find a significant correlation between the country-level growth or level of private debt-to-GDP ratios before 2007 and the poor performance of output growth during the Great Recession (Berkmen et al., 2012; Bezemer and Zhang, 2019; Glick and Lansing, 2010; Lane and Milesi-Ferretti, 2011).

The evidence of a negative correlation between household debt growth and contractions in household spending during the Great Recession is not limited to the US. In a study on the effect of a currency crisis in Hungary in 2008, Verner and Gyöngyösi (2020) estimate that a currency revaluation that raised the burden of debt caused large financial distresses for households who borrowed in foreign currency and a slowdown of the local economy. Using household-level data for Denmark, Andersen et al. (2016) show that the pre-crisis growth in leverage and spending growth during the crisis are negatively correlated. However, they interpret this result as arising from a normalization of spending rather than from a debt overhang. Bunn and Rostom (2014, 2015) show a similar correlation between household debt and changes in spending using household-level data for UK. It is important to stress that both Andersen et al. (2016) and Bunn and Rostom (2014, 2015) reject the interpretation of this correlation as reflecting a causal effect of high or growing household debt on the subsequent drop in spending. More specifically, they argue that the correlation is driven by a third factor which can be debt-financed over-consumption (Andersen et al., 2016), or alternatively over-optimism (Bunn and Rostom, 2014, 2015) which caused both the rise in debt and the reduction of spending to *normal* levels.

2.2.2 Competing views on the role of household debt during the Great Recession

Was high household debt the ultimate cause of the unprecedented contraction in economic activity between 2007 and 2009? Mian and Sufi (2015, 2017) argue that the negative relationship between rising household debt during the early 2000s and the severity of the Great Recession is consistent with the *credit supply view*. This narrative (which echoes the *credit-driven household demand channel* from the previous section) interprets the Great Financial Crisis and the Great Recession as ultimately induced by an unsustainable credit expansion. The credit expansion was not backed by any economic fundamental or prospect of future income growth. Misaligned incentives in the financial sector, frauds and expectations of continuous increases in house prices contributed to the unsustainable increase in lending. The *credit supply view*, which I detail below, gained traction in the popular narrative as the main cause of the Great Financial Crisis and of the harshness of the Great Recession.

THE CREDIT SUPPLY VIEW. According to the *credit supply view*, the shock that initiated the rise in mortgage debt between 2002 and 2005 was an expansion in the supply of mortgages towards marginal borrowers, namely toward households that before 2002 would have been rationed from obtaining mortgages. The mortgage debt expansion was more pronounced in areas with high shares of subprime borrowers and it was unrelated to prospects of higher future in-

comes. The expansion of mortgages fed the house price bubble. In areas with high shares of subprime borrowers, the mortgage debt expansion boosted housing demand and pushed house prices up. At the same time, rising house prices raised the collateral value and softened credit constrains. Between 2002 and 2007, the household debt-to-GDP ratio reached unprecedented levels in the US. However, the mortgage debt expansion toward marginal borrowers accounts only for a small part of the rise in household debt. Actually, most of household debt growth was driven by existing homeowners borrowing against rising values of their homes. The bottom 80% of the credit score distribution massively borrowed against rising home equity in this period (Mian and Sufi, 2011).[9] Ultimately, the combination of *(i)* rising mortgage lending toward subprime borrowers, *(ii)* the aggressive use of home-equity borrowing by homeowners, and *(ii)* speculations and frauds in the housing sector triggered the rise in defaults between 2006 and 2007 when the growth of house prices stopped. The rise in delinquency rates was initially concentrated among subprime borrowers living in areas where swings in house prices were larger. Only in 2008 and 2009, when the fall in house prices and the Great Recession spread across the country, delinquency rates rose also for borrowers at the high end of the credit score distribution. The decline in house prices mechanically caused many mortgages to go underwater. High leverage and the high marginal propensity to consume out of housing wealth by subprime borrowers magnified the response of spending to a drop in home values. The defaults eventually caused large losses for financial institutions, distressed their balance sheets and initiated the Great Financial Crisis.[10]

OTHER VIEWS. While the *credit supply view* is consistent with other studies (see Mian and Sufi, 2017, and references therein), its focus on the role of subprime lending in the events leading to the Great Financial Crisis has been disputed by other researchers. For example, a different narrative emphasizes the role of expectations of future house price gains as *the* primary force driving the mortgage debt expansion and downplays the importance of lending to subprime borrowers relative to middle- and upper-class borrowers (Adelino et al., 2016). Moreover, this alternative view implies that credit moved passively and only in reaction to rising house prices. Therefore, this interpretation clashes with the causal mechanism from credit to house prices identified by Mian and Sufi (2017).

Recently, Bernanke (2018) proposed a different though complementary analysis on why the crisis has been particularly severe. According to this analysis, rising defaults in the household sector caused large losses for financial institutions, mostly so for those institutions which had increased their leverage in mortgage-related securities in the years preceding the crisis. This triggered a financial panic in the wholesale funding markets and induced a credit crunch. Although Bernanke (2018) recognizes the importance of the contraction in demand driven by excessively indebted households, he argues that problems related to the supply of credit that

[9] In other words, the household debt expansion affected the extensive margin, through increased borrowing by households who were traditionally denied credit, as well as the intensive margin, through increased borrowing by households who were already indebted.

[10] Cynamon and Fazzari (2016) argue for a link between rising household debt and stagnating wages in the US. Kim (2020) provides a comparative perspective on the *credit supply view*. Mason and Jayadev (2014) highlight that the rise in household debt-to-GDP ratios is more likely to reflect changes in interest rates, GDP growth, and inflation than shifts in the supply and demand for credit.

originated in wholesale funding markets were responsible for the unprecedented contraction in economic activity at the start of the Great Recession.

3 Evidence from multivariate models

The survey from the previous section suggests that household debt expansions lead to predictable boom-and-bust cycles in economic activity. This result arises from panel data studies covering large cross-section of (mostly advanced) economies and from the *natural experiment* of the Great Recession in the US. Moreover, most of the literature surveyed concurs that leverage-induced household financial fragility is the key factor driving the observed correlation. However, the consensus on the strength of this channel is more nuanced as the debate over the causes of the Great Recession in the US shows.

The robustness of the predictive content of household debt for future economic activity has been recently challenged on two fronts. First, there is some ambiguity on how one should interpret the estimated parameter associated to the household debt indicators in equations 1 and 2. The cross-country panel data models are ambiguous on whether the relationship between household debt and subsequent recessions reflects a correlation or a causal effect of debt on economic activity. Svensson (2019), building on Andersen et al. (2016) and Bunn and Rostom (2014, 2015), argues that the relationship between household debt and economic contractions does not reflect any causal effects and that solving this ambiguity is of primary importance for the design of macroprudential policies. Second, and perhaps most important, the predictive content of household debt for boom-and-bust cycles in economic activity is a result of reduced-form single-equation regressions. However, there is an established strand of literature that models credit and macroeconomic aggregates using structural multivariate models.

In this section, I survey the literature that uses VAR models to represent the joint macro-financial dynamics of the US economy with a special focus on the effects of household debt. I refer to this class of multivariate models as macro-financial VAR models. In the VAR literature, the directions of causality from credit to real activity are multiple. In addition, an important result of this literature is that many developments in credit markets respond to and influence the conduct of monetary policy. In contrast, the role of monetary policy is barely considered in the single-equation models.[11] This would suggests that the findings from the previous section on the role of household debt may be partial or biased because of an omitted variable problem.

3.1 Evidence from VAR models of the United States

Equation 3 represents a typical macro-financial (structural) VAR model of the US economy:

$$\mathbf{y}_t = \mathbf{a} + \sum_{j=1}^{p} \mathbf{A}_j \mathbf{y}_{t-j} + \mathbf{A}_0 \boldsymbol{\varepsilon}_t \tag{3}$$

[11] Among the panel data models from the previous section, Drehmann et al. (2018) argue that monetary policy responds to household debt expansions through higher money market rates. However, the rise in money market rates has quantitatively small effects on the credit cycle.

where **A** is matrix of contemporaneous relationships, namely the matrix that is generally restricted to identify the model, and **a** is a vector of constants. Equation 3 nests the VAR models in Brunnermeier et al. (2019), Guerini et al. (2018), Peersman and Wagner (2015) and Bachmann and Rüth (2020). The vector of endogenous variables is partitioned as follows: $\mathbf{y}_t = \left[D_t^{HH}, \mathbf{Credit}_t', \mathbf{Financial}_t', \mathbf{Real\ Activity}_t', \mathbf{Housing}_t', \mathbf{Policy}_t'\right]$. The Credit, Financial, Real Activity, Housing, and Policy blocks group together the macro-financial variables traditionally included in the VAR model (see Table 4).

HOUSEHOLD DEBT INDICATOR. The key household debt indicator (D_t^{HH}) can be real estate and consumer loans (Brunnermeier et al., 2019), real mortgage debt outstanding (Guerini et al., 2018), mortgage and consumer loans outstanding (Peersman and Wagner, 2015), or alternatively mortgage loan-to-value ratios (Bachmann and Rüth, 2020). I report these indicators in Panel C of Table 1 together with other information on the single specifications. There is substantial heterogeneity between the sources of data and definitions of household debt. For example, Brunnermeier et al. (2019) consider loans to household from weekly surveys of commercial banks in the US. On the contrary, Peersman and Wagner (2015) use quarterly Flow of Funds data which should provide a wider coverage of mortgages and consumer credit. Bachmann and Rüth (2020) obtain mortgage (single-family) loan-to-value ratios from the survey of the Federal Housing Finance Agency.

SHOCKS. The interpretation of shocks to household debt reflects the different identification strategies employed. The lending shock in Peersman and Wagner (2015) is a shock that raises outstanding, securitized and retained mortgage and consumer loans. This shock is interpreted as arising from changing costs of creating loans or from varying monitoring costs. A lending shock may also reflect a shift in credit demand that is independent of macroeconomic conditions. For example, an exogenous rise in home values automatically increases the collateral that households pledge when applying for a mortgage. Similarly, Bachmann and Rüth (2020) focus on shocks to mortgage loan-to-value ratios. They interpret these shocks as reflecting changes in lending standards in housing markets.[12]

In spite of the vast literature on macro-financial VAR models, I select only contributions that explicitly explore the real effects of shocks to household debt. This choice ensures that the models surveyed in this section are comparable to the single-equation models that I previously introduced. However, there is a large literature that uses VAR models to estimate the effects of financial shocks (Furlanetto et al., 2019) and credit shocks to non-financial firms using information contained in credit spreads (Gilchrist and Zakrajšek, 2012). In a similar vein, Walentin (2014) estimates the real and financial effects of a decline in mortgage spreads in the US. A different literature looks at the real effects of changing market sentiment (López-Salido et al., 2017) and credit standards (Bassett et al., 2014). However, these studies do not distinguish between households and non-financial firms. Another strand of research explores the effects of

[12] The focus of Bachmann and Rüth (2020) on lending standards would suggest that their model is not comparable to other non-nested models included in equation 3. However, taking into consideration the *credit-driven household demand channel* (Mian and Sufi, 2018), it is possible to interpret an increase in loan-to-value ratios as an instrument for mortgage expansions. In fact, according to the this channel, a rise in household debt may be induced by financial innovations or changes in beliefs which relax credit standards.

bank lending shocks but it does not distinguish between borrowing sectors (see for example Gambetti and Musso (2017) for the US and UK, and Peersman (2011) for the euro area). Last, Calza et al. (2013), Hofmann and Peersman (2017a,b), Den Haan and Sterk (2010), Alpanda and Zubairy (2019), McCarthy and Peach (2002) explore the interaction between monetary policy shocks and household debt.

3.2 Macroeconomic effects of shocks to household debt

What are the macroeconomic effects of shocks to household debt in a macro-financial VAR model? A shock to real estate and consumer loans granted by banks leads to an initial increase in industrial production, followed by a persistent decline (Brunnermeier et al., 2019). The response of consumption and real GDP to a shock to mortgage debt follows a similar path (Guerini et al., 2018). Similarly, Peersman and Wagner (2015) show that a lending shock that raises mortgage and consumer loans outstanding leads to an initial positive response of real GDP. However, GDP returns to the equilibrium level within five years. In addition, the lending shock provokes a small though not significant increase in prices.

So far, the response of real activity to shocks to household debt confirms the negative correlation between household debt expansions and subsequent economic activity. However, the interpretation provided by macro-financial VAR models for this relationship is different from the one proposed by single-equation models from the previous section.

3.2.1 A different picture on the macroeconomic effects of household debt?

In macro-financial VAR models, shocks to household debt are followed by boom-and-bust cycles in economic activity and moderate increases in inflation. However, the interpretation of this pattern downplays the role of household financial fragility. In particular, the macro-financial VAR literature argues that the downturn in economic activity observed after a shock to household debt can be completely attributed to the endogenous response of monetary policy.

The model in Brunnermeier et al. (2019) implies that a shock to household debt pushes up inflation and industrial production while leaving credit spreads unchanged. The rise in inflation induces an endogenous increase in interest rates driven by a monetary policy tightening. A counterfactual experiment shows that if the endogenous response of monetary policy is silenced, shocks to household debt lead to persistently high inflation and output. The fact that credit spreads do not move in any significant way after a household debt shock downplays the importance of household financial fragility in driving the negative correlation between debt and economic activity. On the contrary, a rise in credit spread leads to a contraction in both household and non-financial firm debt. Moreover, the predictive content of household debt expansions for future economic activity is challenged. In fact, the analysis of the forecast error variance decomposition shows that neither including credit variables nor credit spreads increases the forecasting performance of the model.

Bachmann and Rüth (2020) provide a full exploration of the systematic reaction of monetary policy to expansionary shocks in the housing market. In their model, a shock that raises mortgage loan-to-value ratios leads to a counterintuitive contraction in residential investment,

after a small and temporary increase. They show that the decline in residential investment is caused by the endogenous response of monetary policy to looser lending standards. In fact, an expansionary shock to mortgage loan-to-value ratios implies a persistent increase of the federal funds rate which, in turn, raises mortgage rates. In a nutshell, the effect of the endogenous tightening of monetary policy dominates the expansionary effect of higher loan-to-value ratios on residential investment. As in Brunnermeier et al. (2019), Bachmann and Rüth (2020) shows that in a VAR model estimated by omitting the policy function or by silencing the response of the federal funds rate, a shock that raises mortgage loan-to-value ratios implies an positive and long-lasting response of residential investment.

It is important to stress that Brunnermeier et al. (2019) and Bachmann and Rüth (2020) provide different interpretations of the endogenous response of monetary policy. On the one hand, Brunnermeier et al. (2019) argue that the Fed responds to shocks to household debt only indirectly and to the extent that these shocks are inflationary. On the other hand, Bachmann and Rüth (2020) estimate a Taylor rule with loan-to-value ratios and show that, historically, the Fed systematically responded to housing market conditions.

In sum, the macro-financial VAR models do not reject as a whole the existence of a negative relationship between household debt expansions and subsequent economic contractions. Rather, multivariate models suggest that not considering the endogenous, direct or indirect, response of monetary policy may result in an omitted variable problem.

4 Some unresolved issues

Different strands of literature suggest that there is a negative correlation between household debt and economic activity. However, single-equation regressions and multivariate models point to different, though not necessarily contrasting, interpretations of this correlation. In addition to this fundamental difference, there are other unresolved issues in the literature. I now review some of these issues which I touched upon in the previous sections. To fix ideas, I shall show some impulse responses estimated from a simple VAR model of the US economy inspired by the just reviewed literature.

4.1 Stock *vs.* flow of household debt

There is some ambiguity in the literature on whether it is debt growth (flow) or the level of household debt (stock) that poses risks for the economy (see Table 1). Although the two measures are correlated (positive flows contribute to raise the level of debt) it is useful to distinguish between stock and flow effect in order to identify the mechanisms that generate the negative correlation between household debt and future economic activity. Moreover, whether the risk factor is debt growth or high debt is important for the design of policies aiming at improving macroeconomic and financial stability.

High levels of household debt are critical for those mechanisms that focus on worsening balance sheets to explain the correlation between debt and economic activity.[13] High levels of

[13]These interpretations date back at least to Fisher (1933), Minsky (1986), Mishkin et al. (1977), Mishkin (1978),

debt may be problematic for macroeconomic stability when there are large declines in house prices. This can cause a dramatic drop in loan-to-asset ratios as home values (the main real asset in the balance sheet of households) diminish relative to the nominal value of debt. As a result, the burden of debt rises and the asset-liability imbalance worsens the sustainability of balance sheets. Similarly, a macroprudential policy that tights lending standards through higher loan-to-value or loan-to-income ratios may be detrimental for households with high levels of debt. In fact, for these households, credit constraints may suddenly become binding. Even the expectation that credit constrains may bind in the future is able to reduce consumption through precautionary saving. Moreover, lenders generally decide how much to lend to single borrowers according to loan-to-value or loan-to-income ratios. For households with high levels of debt it will be easy to reach the maximum ratios soon and this will impair further borrowing.

Another reason for which the level of debt may be problematic concerns the response of households to unemployment and income shocks. If households are hit by unemployment, their income falls and they will be forced to cut back on consumption if they decide to continue servicing the debt obligations and avoid defaulting.[14] Similarly, a rise in interest rates may increase the debt service and force households to reduce consumption with detrimental effects on aggregate demand.

The panel data studies in Section 2.1 use flow concepts as the change in debt-to-GDP ratios or new borrowing-to-GDP. Similarly, in Mian and Sufi (2010), the main explanatory variable is the change in debt-to-income from 2002 to 2006. Although the level of debt increases because of continuously positive flows, it is not clear what is the autonomous contribution of debt growth to macroeconomic (in)stability. Some studies find that in a horse race between debt levels and debt growth in predicting future contractions in GDP, debt growth wins in terms of statistical significance (Bridges et al., 2017). A possible reason for this finding is that since large build-up of debt raises the stock of household debt, fast debt growth may contribute to debt overhang problems. Andersen et al. (2016) provides another explanation for why the growth of debt may reduce subsequent consumption. They argue that the contraction in spending follows periods during which households overspend relative to their disposable income. Because overspending is financed through new borrowing and households return to *normal* level of spending in the future, overspending would explain both the expansion in borrowing and the subsequent reduction in spending.

It is important to stress that a level of debt that is excessively high from the perspective of a single household does not need to be dangerously high from the perspective of the society. In particular, to be dangerous for macroeconomic stability, it is important to understand the distribution of debt and how borrowers, at each point of the distribution, would react to shocks hitting their ability of servicing debt without reducing spending. In other words, it is important to know the distribution of debt across households and the marginal propensity to

Kindleberger (1978).

[14] As stressed by Svensson (2019), households may decide to default on their debts and keep consumption levels virtually unchanged. If defaults are widespread, financial institutions may incur into losses and restrain the supply of credit or, worse, they may become insolvent. In this case, household debt is a risk factor for financial stability rather than for macroeconomic stability.

consume of indebted households out of income and wealth. Hence, evidence from aggregate macroeconomic data may not be enough.

4.2 Household financial fragility *vs.* reaction of monetary policy: what does explain the downturn?

What does explain the downturn in economic activity following household debt expansions? Answering to this question is of primary importance not only in order to shed light on various episodes of business cycles, but also to understand which is the most appropriate set of policies to address the potential macroeconomic problems of growing household debt. This survey identified two potential sources for this correlation. On the one hand, single-equation regression models suggest that financial fragility arising in the household sector may be responsible for future contractions in GDP and consumption. On the other hand, macro-financial VAR models attribute the decline in economic activity following household debt shocks to the endogenous response of monetary policy.

In this section, I show that the two narratives can be represented using a simple VAR model of the US economy.[15] More specifically, I present a VAR model that nests the above hypothesis on the factors driving the correlation between household debt expansions and downturns in economy activity. This allows me to show how the dynamic relationship between household debt and economic activity changes if interest rates are omitted. The reduced-form model is:

$$\mathbf{y}_t = \mathbf{c} + \sum_{j=1}^{p} \mathbf{B}_j \mathbf{y}_{t-j} + \mathbf{u}_t \tag{4}$$

The model is estimated using US quarterly data from 1960Q1 to 2007Q4. The lag length p is set to 4 based on the Akaike information criteria and the structural shocks are identified using a Cholesky decomposition.

I begin by estimating a version of model in equation 4 very similar to the panel VAR model in Mian et al. (2017, pp. 1763-1764). In this case, the vector of endogenous variables is $\mathbf{y}_t = \left[y_t, \pi_t, d_t^{HH}\right]'$ where y_t is log real GDP, π_t is inflation and d_t^{HH} is household debt-to-GDP.[16] Household debt is normalized by GDP in the previous quarter as in Mian et al. (2017). I refer to this model as the *model without monetary policy*. The (black) solid lines in Figure 3 plot the median response of log real GDP (top-left panel), inflation (top-right panel) and household debt-to-GDP (bottom-left panel) to a household debt shock. The shock immediately raises the household debt-to-GDP ratio which continues to grow for roughly three years. After the peak, the household debt cycle gradually fades away. The shock to household debt temporarily

[15] A similar exercise for the role of monetary policy in shaping the response of residential investment to mortgage loan-to-value ratios shocks is presented in Bachmann and Rüth (2020). See Figure 1 at page 504 of their paper.

[16] Real GDP (y_t), is Real Gross Domestic Product, billions of dollars, seasonally adjusted annual rate (FRED code: RGDP). Inflation (π_t) is the percent change from one year ago in the Personal Consumption Expenditure price index, excluding food and energy, seasonally adjusted (FRED code: BPCCRO1Q156NBEA). Household debt (d_t^{HH}) is the sum of home mortgages (the level of one-to-four family residential mortgages on the liability side of the household sector, seasonally adjusted, FRED code: HHMSDODNS) and consumer credit (the level of consumer credit on the liability side of the household sector, seasonally adjusted, FRED code: HCCSDODNS). Nonfinancial firm debt (d_t^F) is the level of debt securities and loans on the liability side of the nonfinancial corporate business sector (FRED code: BCNSDODNS). The stock of debt is normalized by nominal GDP (FRED code: GDP) in the previous quarter.

boosts GDP which peaks roughly after one year from the impulse. Thereafter, the response of GDP turns slightly negative though not significant. The top-right panel suggests that household debt shocks are inflationary, at least in the short-run, as predicted by Brunnermeier et al. (2019). Moreover, it is interesting to note that the dynamic relationship between household debt, GDP and prices is very similar the impulse responses reported in Mian et al. (2017) from a panel-VAR estimated on annual data (see Figure 1, p. 1765, of their paper).

I now augment the model with a monetary policy equation. I estimate the same VAR model in equation 4 but with the vector of endogenous variables given by $\mathbf{y}_t = \left[y_t, \pi_t, d_t^{HH}, i_t\right]'$ where i_t is the effective federal funds rate. This order implies that monetary policy responds to contemporaneous disturbances in the household credit sector. I call this model the *model with active monetary policy*. The model with active monetary policy resembles the VAR model in Bachmann and Rüth (2020) in which monetary policy systematically responds to changes in lending standards in the housing market. However, monetary policy in the US does not necessary reacts to contemporaneous shocks to household debt. Hence, I present estimates from a model in which the effective federal funds rate is ordered just after inflation and just before household debt-to-GDP, namely $\mathbf{y}_t = \left[y_t, \pi_t, i_t, d_t^{HH}\right]'$. I refer to this model as the *model with passive monetary policy* meaning that the effective federal funds rate responds to household debt shocks with delay.

In Figure 3, the (red) lines with markers plot the median responses to a household debt shock from the model with active monetary policy. Similarly, the (green) dashed lines plot the median responses to a household debt shock from the model with passive monetary policy. The household debt expansion raises the effective federal funds rate by almost 0.2 percent at the peak (bottom-right panel). This suggests that monetary policy reacts to household debt shocks and perhaps exactly because they are inflationary (top-right panel). Interestingly, the inclusion of interest rates makes the household debt cycles slightly shorter and less persistent relative to the model without monetary policy (bottom-left panel). Allowing for the reaction of monetary policy makes the rise in GDP following a household debt shock not significant (top-left panel). However, household debt shocks now lead to a larger decline in GDP relative to the response from the model without monetary policy. These results are consistent with Brunnermeier et al. (2019) which argue that "excessive growth in household credit can forecast negative long-term real output growth [...] However, our model implies that the decline in output growth following this [household credit] shock can be entirely accounted for by the rise in interest rates it elicits. The response of the system to the credit shocks, combined with a sequence of monetary policy shock values that keep the interest rate constant, eliminates the decline in output. [...] Our interpretation is that the credit expansions generated by the credit shocks are followed with a delay by slow growth due to monetary tightening, not financial market distresses" (ibid. pp. 22-23).

4.3 The consequences of household and non-financial firm debt: are they different?

The literature on the macroeconomic effects of household debt suggests a further result on the effects of non-financial firm debt expansions. Contrary to household debt, non-financial firm debt expansions have weak (and even immediately negative) effects on future GDP growth

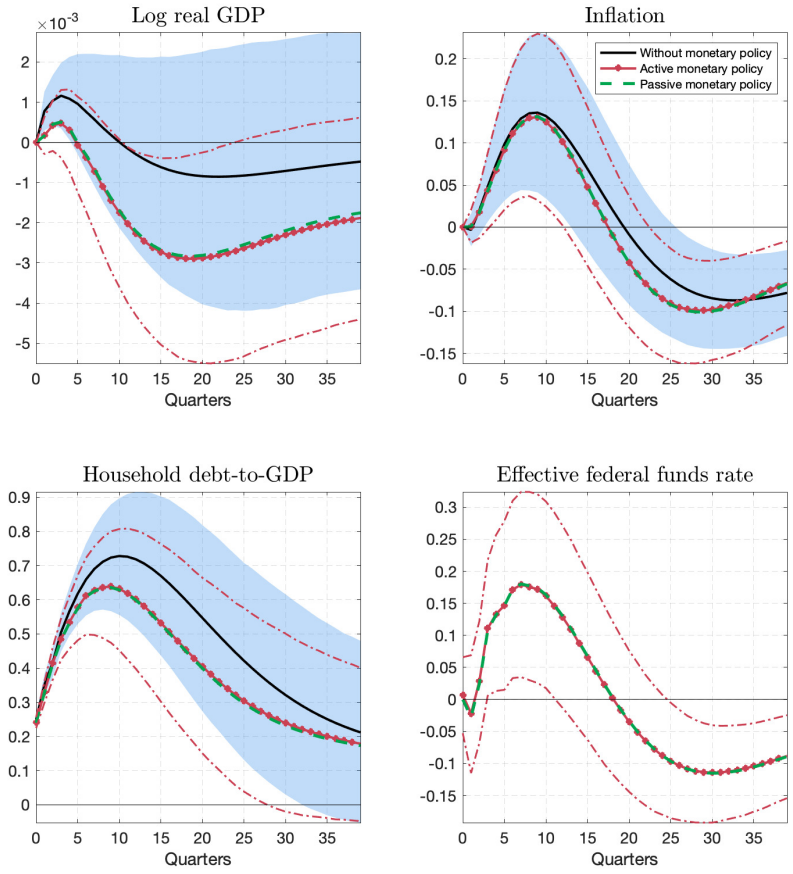

FIGURE 3: THE EFFECT OF HOUSEHOLD DEBT EXPANSIONS

Notes: this figure shows medium impulse responses of log real GDP (y_t), inflation (π_t), household debt-to-GDP (d_t^{HH}) and the effective federal funds rate (i_t) to a shock to household debt-to-GDP. For the model without monetary policy $\boldsymbol{y}_t = \left[y_t, \pi_t, d_t^{HH}\right]'$, for the model with active monetary policy $\boldsymbol{y}_t = \left[y_t, \pi_t, d_t^{HH}, i_t\right]'$, for the model with passive monetary policy $\boldsymbol{y}_t = \left[y_t, \pi_t, i_t, d_t^{HH}\right]'$. The model is estimated using OLS. The shaded areas are 68% confidence bands for the model without monetary policy. The dot-dashed lines are 68% confidence bands for the model with active monetary policy. The confidence bands for the model with passive monetary policy are not reported. Confidence bands are obtained using a sampling with replacement bootstrap algorithm (5,000 replications).

(Mian et al., 2017; Müller and Verner, 2020). Similarly, Jordà et al. (2016) show that post-crises recoveries are longer when preceded by large mortgage debt expansions which debt is predominantly a liability of households rather than of firms. In contrast, there is no evidence that non-mortgage credit booms delay the recovery.

I use the same VAR model from the previous section to show that household debt and non-financial debt expansions may have different macroeconomic effects. In particular, I obtain impulse responses by estimating the same VAR model in equation 4 but with $\mathbf{y}_t = \left[y_t, \pi_t, d_t^F, d_t^{HH}\right]'$ where d_t^F is non-financial firm debt normalized by GDP in the previous quarter. This model is equivalent to the panel-VAR model in Mian et al. (2017) apart from the fact the I include also inflation. Figure 4 compares the effects of household debt shocks (black solid line) and non-financial firm debt shocks (red line with markers) on real GDP, inflation and debt-to-GDP ratios. Non-financial firm debt shocks immediately increase the non-financial firm debt-to-GDP ratio for roughly one year (bottom-left panel). However, the non-financial firm debt cycle is short-lived and it runs out in approximately five years. On the contrary, household debt cycles are large and persistent (bottom-right panel). As it has been showed in other studies (Mian et al., 2017, Figure 1, p. 1765), shocks to household and non-financial firm debt have substantially opposite effects on real GDP (top-left panel). Household debt shocks predict a full long-lived cycle in household debt and boom-and-bust cycles in economic activity. Instead, non-financial firm debt shocks have immediately negative though only temporary effects on real GDP. Similarly, household debt shocks are more inflationary when compared to non-financial firm debt shocks (top-right panel).

Why are the effects of non-financial firm debt expansions different from those of household debt expansions? Some authors attribute this difference to the fact that non-financial firm debt has a shorter maturity relative to household debt (Drehmann et al., 2018). Jordà et al. (2020) argue that the weak correlation between non-financial firm debt expansions and persistent contractions in economic activity may be due to the fact that firm debt can be easily restructured relative to household debt. The muted or slightly negative correlation between non-financial firm debt shocks and GDP growth in the short-run is puzzling if one assumes that firms borrow to finance investment spending. Surprisingly, there is few literature on this topic.

5 Concluding remarks

The distinctiveness of the Great Recession in the US was the extraordinary rise in household debt that preceded the largest contraction in economic activity since the Great Depression. A recent literature in empirical macroeconomics argues that, historically, household debt expansions have been associated with boom-and-bust cycles in economic activity. This finding is not limited to the US macroeconomic history but it pertains to several business cycles around the world. Much of this research inherits some insights from Fisher (1933), Minsky (1986) and Kindleberger (1978).

In this paper, I surveyed this recent literature. I showed that the literature on the macroeconomic effects of household debt can be organized into three main strands. The first branch of literature estimates cross-country panel data models and it is mostly focused on advanced

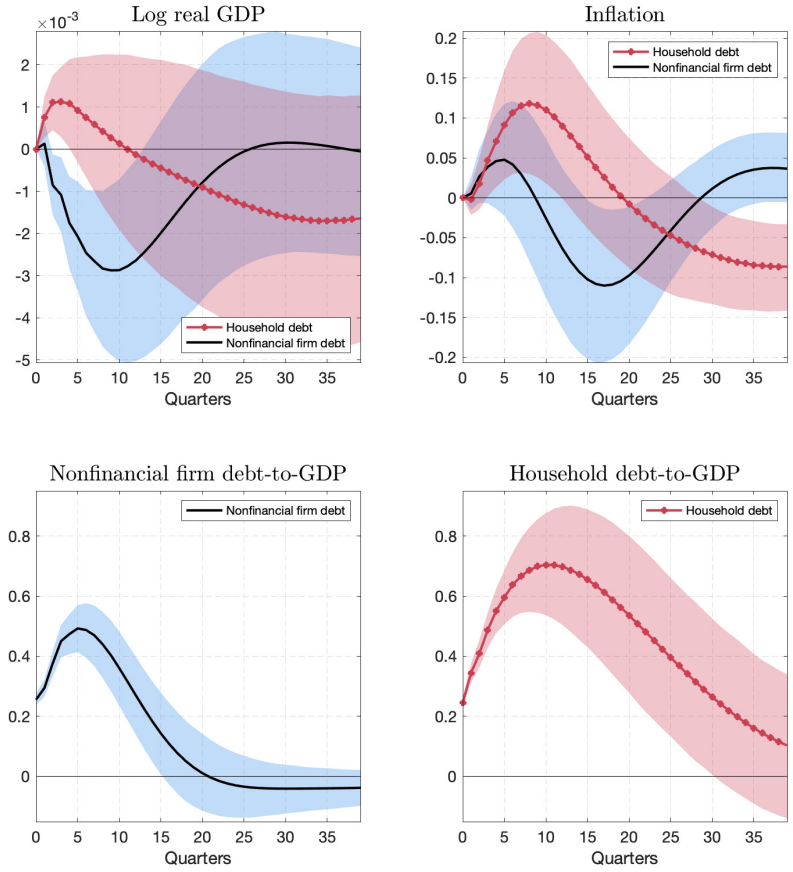

FIGURE 4: SECTORAL DEBT EXPANSIONS

Notes: this figure shows medium impulse responses of log real GDP (y_t), inflation (π_t), nonfinancial debt-to-GDP (d_t^F) and household debt-to-GDP (d_t^{HH}) to a shock to household and nonfinancial firm debt-to-GDP. The variables in the VAR are ordered as follows: $\boldsymbol{y}_t = \left[y_t, \pi_t, d_t^F, d_t^{HH}\right]'$. The model is estimated using OLS. The black solid lines are median responses to nonfinancial firm debt-to-GDP shocks. The shaded blue areas are 68% confidence bands for the responses to nonfinancial firm debt shocks. The red lines with markers are median responses to household debt-to-GDP shocks. The shaded red areas are 68% confidence bands for the responses to nonfinancial firm debt shocks. Confidence bands are obtained using a sampling with replacement bootstrap algorithm (5,000 replications).

economies. The second strand of literature explores the extent to which the large increase in household debt in the early 2000s was responsible for the drop in consumption during the Great Recession in the US. Papers in the third strand of literature estimate macro-financial VAR models of the interaction between credit, macroeconomic aggregates and monetary policy.

Although all strands of literature concur that household debt expansions are followed by contractions in economic activity, different models highlight different channels. In particular, the literature identifies two potential mechanisms that may generate the negative correlation between household debt and real activity. On the one hand, panel and cross-sectional models favor an explanation that hinges on household financial fragility. On the other hand, macro-financial VAR models challenge this view and favor an explanation according to which the negative correlation is caused by the endogenous increase in interest rates elicited by (inflationary) household debt expansions.

In the last part of the paper, I addressed some key unresolved issues. In particular, I focused on three issues. First, household and non-financial firm debt expansions have substantially different macroeconomic effects. Second, there is some ambiguity on whether contractions in economic activity are influenced by fast growth or by the ex-ante level of household debt. Third, macro-financial VAR models and single-equation regressions favor different hypotheses on the mechanism driving the correlation between household debt and economic activity. However, the former strand of literature derives this result from US macroeconomic data while the latter focuses on large cross-country datasets. In the reality, it is likely that both mechanisms - financial fragility and rising interest rates - jointly determine the observed correlation between household debt expansions and contractions in economic activity though their quantitative importance may differ. Making clear these ambiguities is important for improving our knowledge on which mechanisms drive the macroeconomic effects of household debt and for the design of macroprudential policies aimed to tame the adverse consequences of credit cycles.

TABLE 2: NESTED SINGLE-EQUATION PANEL DATA MODEL (EQUATION 1)

Dependent variable:	Real GDP growth (Δy_{it+h})			
	Mian et al. (2017)	Drehmann et al. (2018)	Jordà et al. (2016)	Müller and Verner (2020)
Credit block				
3-year change in nonfinancial firm debt-to-GDP	✓			
3-year change in government debt-to-GDP	✓			
Debt service-to-GDP[1]		✓		
Non-mortgage credit accumulated in the expansion[2]			✓	
3-year change in tradable credit-to-GDP				✓
3-year change in non-tradable credit-to-GDP				✓
Financial block				
Lending spread on mortgages[3]		✓		
Change in interest rate on household debt[4]		✓		
Change in loan loss provision		✓		
Change in corporate spreads[5]		✓		
Term spread		✓		
3-month government bonds yields			✓	
5-year government bonds yields			✓	
Housing				
Growth rate of real residential property prices		✓		
Real household net worth		✓		
Real activity block				
(lagged) 3-year change in log real GDP	✓			
Growth rate of unemployment		✓		
Change in CPI inflation rate		✓		
Growth rate of labor productivity		✓		
(lagged) growth rate of real GDP per capita			✓	
CPI inflation rate			✓	
Growth rate of real investment share per capita			✓	
Openness				
(lagged) 3-year change in foreign debt-to-GDP	✓			
Current account-to-GDP		✓	✓	
Change in the real effective exchange rate		✓		

[1] Debt service is the sum of interest payments and amortizations..

[2] Annual change in non-mortgage credit accumulated during the expansion as share of GDP and in percentage point per year, and in deviation from country-specific historical mean.

[3] Lending spread on mortgages is the difference between the prime lending rate and the 3-month money market rate.

[4] The interest rate on household debt is obtained as ratio between total interest paid by households from the National Accounts and the stock of debt.

[5] Corporate credit spreads are obtained as difference between a general corporate bond index and the weighted average og the 5- and 10-year government bond yields (Krishnamurthy and Muir, 2017).

TABLE 3: NESTED SINGLE-EQUATION MODEL OF THE GREAT RECESSION (EQUATION 2)

Dependent variable:	Household expenditure growth (ΔC_i)		
	Mian and Sufi (2010)	Mian et al. (2013)	Dynan (2012)
Credit block			
Debt-to-income ratio, 2001Q4	✓		
Default rate, 2006Q4	✓		
Default rate, 2001Q4	✓		
Fraction borrowers with credit score < 660, 2001Q4	✓		
Credit card utilization, 2006Q4	✓		
($\Delta_{2006-09}$ Home value)$\times$(Housing leverage ratio 2006)		✓	
Debt service-to-income ratio, 2007			✓
Real activity block			
Unemployment rate, 2006Q4	✓		
Unemployment rate, 2001Q4	✓		
Fraction black, 2000	✓		
Fraction with high school education or less, 2000	✓		
Fraction black, 2000	✓		
Ln(median household income), 2000	✓		
Employment share in construction, 2006Q4	✓		
Employment share in real estate, 2006Q4	✓		
Employment share in finance, 2006Q4	✓		
Employment share in retail, 2006Q4	✓		
Employment share in exports, 2006Q4	✓		
Income per household, 2006	✓		
($\Delta_{2006-09}$ Home value)$\times$(Income per household, 2006)		✓	
$\Delta_{2007-09}$ Income			✓
Income			✓
$\Delta_{2007-09}$ state unemployment rate			✓
State unemployment rate			✓
Age of household head			✓
Education level of household head			✓
Housing			
Fraction homeowners, 2000	✓		
Ln(median home value), 2000	✓		
$\Delta_{2006-09}$ Home value		✓	
Net worth, 2006		✓	
($\Delta_{2006-09}$ Home value)$\times$(Net worth, 2006)		✓	
$\Delta_{2007-09}$ Wealth			✓

TABLE 4: NESTED VAR MODEL (EQUATION 3)

Dependent variable:	VAR			
	Brunnermeier et al. (2019)	Guerini et al. (2018)	Peersman and Wagner (2015)	Bachmann and Rüth (2020)
Credit block				
Real commercial bank C&I loans	✓			
Real federal debt: total public debt		✓		
Real nonfinancial corporate business debt securities		✓		
(volume of) Retained mortgages and consumer loans			✓	
(volume of) securitized mortgages and consumer loans			✓	
Financial block				
M1 money supply	✓			
Term spread (10-year - 3-month Treasury yield)	✓			
Corporate bond spread (Gilchrist and Zakrajšek, 2012)	✓			
TED spread (3-month Eurodollars - 3-month Treasuries)	✓			
Mortgage rates				✓
Housing block				
Real residential investment				✓
Residential investment relative price inflation				✓
Real Activity				
Industrial production	✓			
PCE price index	✓			
Commodity price index	✓			
Real GDP		✓		✓
Real personal consumption expenditures		✓	✓	
GDP deflator		✓		
Inflation rate				✓
Non-residential investment relative price inflation				✓
Real non-residential investment				✓
Policy				
Federal funds rate	✓		✓	✓
3-month treasury bill: secondary market rate		✓		

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A Appendix

A.1 The role of time fixed effects

The nested panel-data model in equation 1 in does not include time fixed effects. As I argued in Section 2.1, the inclusion of time- fixed effects dramatically reduces the significance of boom-and-bust cycles in GDP induced by household debt expansions. To prove this point, in this appendix, I replicate Figure II, page 1770, in Mian et al. (2017) buy using their same specifications and dataset. Their series are annual, from the 1960s to 2012, and cover a rather heterogeneous set of 30 advanced and emerging countries.

In Panel A and Panel B in Figure A.5, I report estimates of $\beta^h_{HH,1}$ for $h = 1, \dots, 10$ from the following regression:

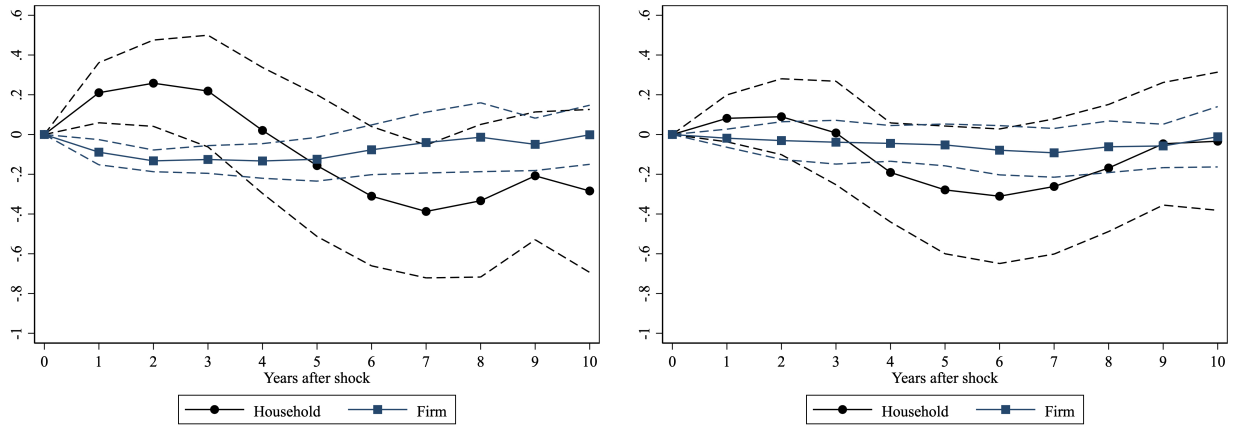
$$y_{it+h-1} = \alpha^h_i + \theta^h_t + X_{it-1}\Gamma^h + \sum_{j=1}^{5} \beta^h_{HH,j} d^{HH}_{it-j} + \sum_{j=1}^{5} \beta^h_{F,j} d^{F}_{it-j} + \sum_{j=1}^{5} \delta^h_j y_{it-j} + \varepsilon^h_{it+h-1}$$

Panel A in Figure A.5 shows that responses of log real GDP (y_{it+h-1}) to a unit change in the household debt-to-GDP ratio (d^{HH}_{it-1}) and in the non-financial firm debt-to-GDP ratio (d^{F}_{it-1}) when θ^h_t is zero, namely when there are not time fixed effects. These are the impulse responses that Mian et al. (2017) show in panel A of Figure II of their paper. When time fixed effects are excluded, household debt expansions are correlated with significant boom-and-bust cycles in economic activity. In contrast, the effects of non-financial firm debt expansions are small compared to those of household debt expansions. Moreover, non-financial firm debt booms lead to short-run through small negative effects on GDP. Panel B in Figure A.5 reports the same impulse responses obtained from a specification in which time fixed effects are included, namely when θ^h_t is not restricted to be zero. When time fixed effects are included, the correlation between non-financial firm debt expansions and the future level of log real GDP turns essentially zero and the immediate small negative effect on GDP is eliminated. For the case of household debt, the inclusion of time fixed effects make the boom-and-bust cycles dramatically smaller in size and not statistically significant for most of the forecasting horizon. Most importantly, with time fixed effects, GDP returns to the initial level after ten years from the debt expansion.

In Panel C and Panel D in Figure A.5, I report estimates of $\beta^h_{HH,1}$ for $h = 1, \dots, 10$ from the following regression:

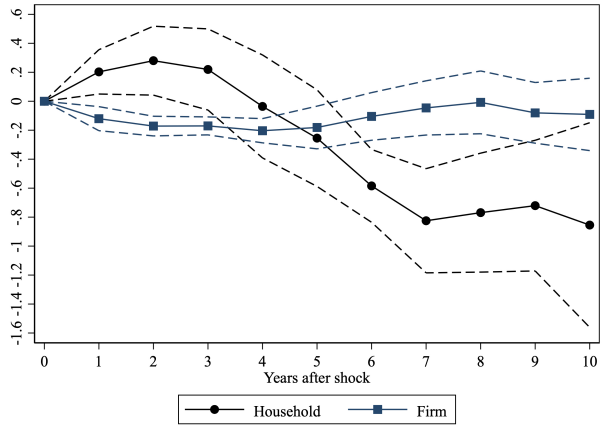
$$\Delta_h y_{it+h-1} = \alpha^h_i + \theta^h_t + X_{it-1}\Gamma^h + \sum_{j=1}^{5} \beta^h_{HH,j} \Delta d^{HH}_{it-j} + \sum_{j=1}^{5} \beta^h_{F,j} \Delta d^{F}_{it-j} + \sum_{j=1}^{5} \delta^h_j \Delta y_{it-j} + u^h_{it+h-1}$$

Panel C shows that responses of the h-year change in log real GDP ($\Delta_h y_{it+h-1}$) to a shock to the one-year change in household debt-to-GDP ratio (Δd^{HH}_{it-1}) and in the non-financial firm debt-to-GDP ratio (Δd^{F}_{it-1}) when θ^h_t is zero, namely when there are not time fixed effects. These are the impulse responses that Mian et al. (2017) show in panel B of Figure II of their paper. Panel D in Figure A.5 shows the same responses when θ^h_t is not restricted to be zero. As with the specification in levels, adding time fixed effects dramatically reduces the significance of the correlation between household debt and business cycles.

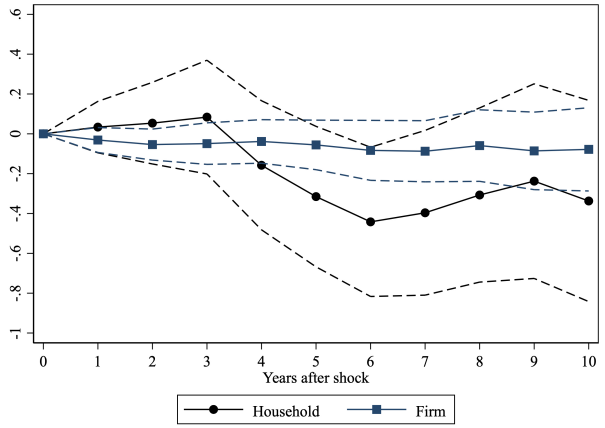


(A) *Level specification, w/o time effects*

(B) *Level specification, w/ time effects*



(C) *Difference specification, w/o time effects*



(D) *Difference specification, w/ time effects*

FIGURE A.5: THE EFFECTS OF HOUSEHOLD DEBT EXPANSIONS: THE ROLE OF TIME EFFECTS

Notes: this figure replicates Figure II, page 1770, in Mian et al. (2017) by comparing specifications with (panels B and D) and without (panel A and C) time fixed effects.