NBER WORKING PAPER SERIES

FINANCE AND BUSINESS CYCLES: THE CREDIT-DRIVEN HOUSEHOLD DEMAND CHANNEL

Atif R. Mian
Amir Sufi

Working Paper 24322
http://www.nber.org/papers/w24322

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 2018

We thank Daron Acemoglu, Andrei Shleifer, Jeremy Stein, Emil Verner, and Robert Vishny for comments that substantially improved the draft. We thank Michael Varley for excellent research assistance. We also thank the Julis Rabinowitz Center for Public Policy and Finance at Princeton and the Initiative on Global Markets and the Fama-Miller Center at Chicago Booth for financial support. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Finance and Business Cycles: The Credit-Driven Household Demand Channel
Atif R. Mian and Amir Sufi
NBER Working Paper No. 24322
February 2018
JEL No. E32,E5,G01,G2,R2

ABSTRACT

Every major financial crisis leaves its unique footprint on economic thought. The early banking crises taught us the importance of financial sector liquidity and the lender of last resort. The Great Depression highlighted the devastating effects of bank failures and the need for counter-cyclical fiscal and monetary policy. The Great Recession has brought to the surface the importance of credit-driven business cycles that operate through household demand. We discuss empirical evidence accumulated over the last decade supporting this view, and we also describe accompanying theoretical work that helps define these concepts.

Atif R. Mian
Princeton University
Bendheim Center For Finance
26 Prospect Avenue
Princeton, NJ 08540
and NBER
atif@princeton.edu

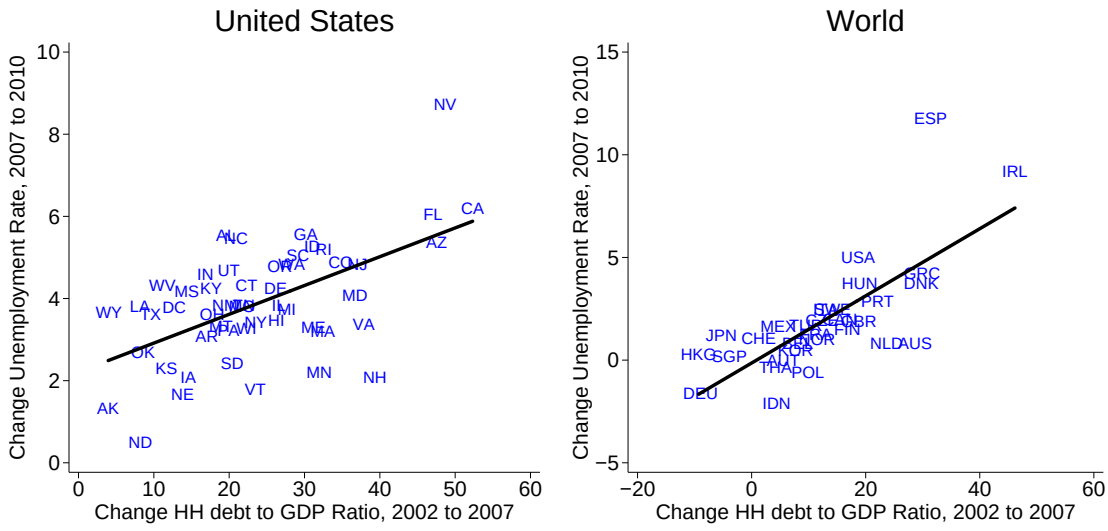
Amir Sufi
University of Chicago
Booth School of Business
5807 South Woodlawn Avenue
Chicago, IL 60637
and NBER
amir.sufi@chicagobooth.edu

1 Introduction

Every major financial crisis leaves its unique footprint on economic thought. The early banking crises taught us the importance of financial sector liquidity and the lender of last resort. The Great Depression highlighted the devastating effects of bank failures and the need for counter-cyclical fiscal and monetary policy. The Great Recession has brought to the surface the importance of credit-driven business cycles that operate through household demand. We discuss empirical evidence accumulated over the last decade supporting this view, and we also describe accompanying theoretical work that helps define these concepts.

We start with a striking empirical regularity of the Great Recession: the larger the increase in household leverage prior to the recession, the more severe the subsequent recession. Figure 1 shows that the change in household debt to GDP ratio from 2002 and 2007 is strongly correlated with the subsequent increase in unemployment rate from 2007 to 2010, both across states within the United States as well as across countries around the world.[1]

Figure 1 Household Debt and Unemployment



This relationship is broader than the Great Recession. King (1994) shows that countries with

[1]The ability of household debt expansion to predict recession severity across geographical areas during the Great Recession has been demonstrated by a number of research studies (e.g., Mian and Sufi (2010), Glick and Lansing (2010), IMF (2012), and Martin and Philippon (2017)).

the largest expansion in household debt to income ratios from 1984 to 1988 witness the largest shortfall in real GDP growth from 1989 to 1992. Mian et al. (2017a) show that states in the United States with a larger increase in household debt from 1982 to 1989 see a larger increase in unemployment and a larger decline in real GDP growth from 1989 to 1992.

Household debt expansion predicts recession severity conditional on a recession, but it also *unconditionally* predicts a decline in real GDP growth. Mian et al. (2017b) utilize a panel of 30 countries over the past 40 years, and they show that a rise in the household debt to GDP ratio in a given country systematically predicts lower subsequent growth and a rise in unemployment. More recent research by the IMF (2017) confirms the Mian et al. (2017b) result in a larger sample.

A large body of research conducted since the onset of the Great Recession explores the links between household debt, the housing market, and business cycles in order to elucidate the underlying factors generating the predictive power of household debt expansion for the real economy. Based on this emerging literature, the specific idea we put forward in this article is that expansions in credit supply, operating primarily through household demand, are an important driver of business cycles. We call this the *credit-driven household demand channel*. While scholars have modeled expansions in credit supply in different ways, our working definition is that a credit supply expansion is when lenders increase the quantity of credit or decrease the interest rate on credit for reasons unrelated to changes in income or productivity of borrowers.

The credit-driven household demand channel rests on three main pillars. First, an expansion in credit supply, as opposed to technology shocks or permanent income shocks, is a key force generating expansion and contraction in economic activity. In Section 2, we review studies showing that shifts in credit supply lead to a boom-bust cycle the real economy. This phenomena was pervasive in the 2000 to 2010 period, but it has also been a strong force in global business cycle patterns over the last five decades.

Credit supply expansions affect the real economy. But what is the precise mechanism? The second pillar of the credit-driven household demand channel is that the expansionary phase of the credit cycle affects the real economy primarily through boosting household demand as opposed to boosting productive capacity of firms in the economy. In Section 3, we describe a methodology that allows us to separate whether credit supply expansions boost household demand versus productive capacity, and we highlight a number of research studies showing that the household demand channel

appears to be dominant in recent history. Credit supply expansions can affect the real economy through business investment, and there are certainly examples in history of such an effect; however, the household demand channel appears more important in recent episodes.

What makes the contraction phase of the credit-driven business cycle so severe? The third main pillar of the credit-driven household demand channel is that the economy faces severe difficulties in "adjusting" when credit supply ultimately contracts. The contraction in credit supply, often associated with a banking crisis, precipitates a sharp drop in spending by indebted households. The economy experiences an aggregate demand shortfall as savers do not sufficiently boost spending even as short-term interest rates fall to zero. On the supply side, employment cannot easily switch from the non-tradable to tradable sector. Nominal rigidities, banking sector disruptions, and legacy distortions also help explain why recessions can be severe following credit booms. We discuss these factors in more detail in Section 4.

Our emphasis on both the expansion and contraction phase of the credit cycle is consistent with the perspective taken by earlier scholars such as Charles P. Kindleberger and Hyman Minsky. In particular, financial crises and a sudden contraction in credit supply are not exogenous events hitting a stable economy. Instead, the crash should be viewed at least partially as the result of preceding excesses associated with credit supply expansions. In short, credit supply expansions often sow the seeds of their own destruction, and so we must understand the boom to make sense of the bust. We discuss how the presence of behavioral biases and aggregate demand externalities may be able to generate such endogenous boom-bust credit cycles in Section 5.

What causes a sudden increase in credit supply? This is an open question for which existing research has less definitive answers. In Section 6, we explore potential sources and conclude that the fundamental shock appears to be most closely related to financial excesses. More specifically, we see from historical episodes that a shock that leads to a rapid influx of capital into the financial system often triggers an expansion in credit supply. Recent manifestations of such a shock are the rise in income inequality in the United States (Kumhof et al. (2015)) and the rapid rise in savings by many emerging markets (i.e., the "global savings glut" as articulated by Bernanke (2005)).

While we focus on business cycles, we believe the ideas presented in Section 6 may help us answer longer-run questions. There is a long term secular rise in private credit to GDP ratios, especially household credit to GDP ratios (Jordà et al. (2016)). This has been accompanied by a

related decline in long term real rates, and a rise in within-country inequality and across-country "savings gluts." There may be a connection between these longer term trends and what we uncover at the business cycle frequency. We discuss these issues in the conclusion.

The credit-driven household demand channel we propose is distinct from traditional financial accelerator models linking business cycles to the financial sector (e.g., Bernanke and Gertler (1989), Kiyotaki and Moore (1997), and Bernanke et al. (1999)). In particular, the credit-driven household demand view places more importance on the expansion phase of the credit cycle, and it views the subsequent contraction in credit as an outcome of the initial credit expansion. There is room in the financial accelerator view for the financial sector to amplify the real effects of positive technology shocks or monetary policy shocks. However, most of the applications of financial accelerator models have focused on the contraction phase of the credit cycle. In many of these applications, a contraction in credit occurs exogenously, pushing the economy into a recession from a previously stable steady state. In our view, most contractionary shocks emanating from the financial sector are preceded by credit and housing booms; the economy does not appear to be stable prior to the negative shock.

Another important difference is the emphasis on aggregate demand versus aggregate supply. As the term implies, the credit-driven household demand channel emphasizes fluctuations in household demand driven by credit supply expansions. Borrowing by households is critical. In contrast, financial accelerator models operate primarily by amplifying movements in business investment. The empirical evidence supports the view that the household demand channel has been more prominent in recent history.

Finally, the credit-driven household demand view admits an important role for systematic flaws in expectations formation. We highlight a large body of evidence that suggests that flawed expectations formation is a critical explanation for the boom and bust cycles in credit availability. In contrast, Bernanke (1983) highlights the lack of behavioral biases as an advantage of the financial accelerator view.[2] In the traditional financial accelerator models, behavioral biases are not central.

[2] "... it does have the virtues that, first, it seems capable (in a way existing theories are not) of explaining the unusual length and depth of the depression; and second, it can do this without assuming markedly irrational behavior by private economic agents" Bernanke (1983).

2 Credit Supply Expansion and Business Cycles

2.1 Credit cycles and business cycles

A robust empirical finding in the literature is the existence of predictable credit cycles that generate fluctuations in real economic activity. López-Salido et al. (2017) present evidence on the predictability of the credit cycle; they use evidence from the United States since the 1920s to show that a narrow spread between mid-grade corporate bonds and U.S. Treasuries predicts a subsequent widening of credit spreads. Krishnamurthy and Muir (2017) use a sample of 19 countries (with data going back to the 19th century for 14 countries) to show that a period of low credit spreads precedes a sudden widening of credit spreads. The notion of a predictable cycle in credit is also highlighted by Borio (2014), who reviews a substantial body of research from the Bank of International Settlements supporting this view.

This predictable cycle has important effects on the household debt cycle. Using a sample of 30 mostly advanced countries over the last 40 years, Mian et al. (2017b) estimate a VAR in the level of household debt to lagged GDP, nonfinancial firm debt to lagged GDP, and log real GDP.[3] The left panel of Figure 2 shows the impulse response function of household debt to a shock to household debt. As it shows, a sudden increase in the household debt to GDP ratio in a given country leads to a three year increase in the household debt to GDP ratio followed by a sharp fall over the subsequent seven years. There is a predictable decline in household debt following a positive shock to household debt in a country, which reflects the importance of the predictable cycle in credit spreads.

The credit cycle is closely connected to the business cycle. The right panel of Figure 2 shows the impulse response function of log real GDP to a shock to the household debt to lagged GDP ratio from Mian et al. (2017b). As it shows, a shock to household debt generates a boom-bust cycle in the real economy that is similar to the credit cycle. Growth increases for two to three years, and then falls significantly.

The IMF (2017) estimates similar specifications using a significantly larger sample of 80 countries, with some data going back to the 1950s. They confirm the boom-bust pattern associated

[3]The specification includes country fixed effects and lags of five years in the specification. Identification of the structural shocks come through Cholesky decomposition with real log GDP ordered first, followed by nonfinancial debt to lagged GDP, and household debt to lagged GDP. See Mian et al. (2017b) for more details.

with sudden increases in the household debt to GDP ratio. They conclude based on their findings that "an increase in household debt boosts growth in the short-term but may give rise to macroeconomic and financial stability risks in the medium term." Their sample includes substantially more emerging economies, and they are able to show that the same pattern is present in emerging economies, but it is less pronounced. Drehmann et al. (2017) also confirm this pattern in a panel of 17 advanced economies from 1980 to 2015. They emphasize the importance of rising debt service burdens in explaining the subsequent drop in GDP.

The boom-bust cycle in the right panel of Figure 2 represents a large and robust pattern in the data. The pattern is strong enough that a rise in household debt systematically predicts a decline in subsequent GDP growth. Figure 3 shows the correlation between the growth in household debt from four years ago to last year on subsequent real GDP growth from this year to three years later in the Mian et al. (2017b) sample. There is a robust negative relationship.

2.2 Identification of credit supply expansion in aggregate data

Why does household debt increase all of a sudden? Why might such a rise generate a boom-bust cycle in real economic activity? An initial approach to answer this question focuses on whether debt expansion is due to credit demand shocks versus credit supply shocks. By credit demand shocks, we mean changes in household permanent income, demographics, or beliefs holding fixed credit supply. By credit supply shocks, we mean an increased willingness of lenders to provide credit that is independent of the borrower's income position.[4]

There are two approaches used in the literature to distinguish whether credit supply versus credit demand shocks are responsible for the relationship between credit growth and output growth. The first focuses on aggregate country-level analysis in data sets that cover a long time series and many macroeconomic cycles. The second approach examines specific macroeconomic episodes and uses cross-sectional data across countries or regions to isolate whether credit demand or credit supply shocks are the driver of economic activity.

Focusing on longer time series data sets covering many episodes, the most direct empirical

[4]We note from the outset that the negative relationship between a rise in household debt and subsequent growth shown in Mian et al. (2017b) casts doubt on the role of credit demand shocks coming from changes in permanent income. A rise in household debt driven by a positive permanent income shock should predict an increase in subsequent growth, at least in models with rational expectations. The opposite pattern is found in the data.

method for separating credit supply versus credit demand shocks is an examination of interest rates and credit spreads during household debt expansions. Such evidence favors the credit supply expansion view. For example, using the same sample mentioned above, Mian et al. (2017b) show that large three to four year increases in household debt are associated with low mortgage credit to sovereign credit spreads. To isolate increases in credit supply, they use low mortgage credit spread episodes as an instrument for the rise in household debt, and they show that such credit supply-driven increases in household debt predict subsequent economic downturns.[5]

Jordà et al. (2015) use pegged currencies and monetary policy shocks to isolate variation in credit supply. Countries with fixed exchange rates see changes in short-term interest rates unrelated to home economic conditions when monetary policy shifts in the pegged country. They show that monetary policy shocks that lower the short-term interest rate are associated with an increase in household debt and house prices. Further, the rise in household debt and house prices heightens the risk of a financial crisis.

Krishnamurthy and Muir (2017) find similar results when examining growth in private sector credit. In their sample of 19 countries going back to the 19th century, they show that credit spreads between lower and higher grade bonds within a country tend to fall in the period of credit growth that occurs before a financial crisis. They conclude based on the evidence that the "behavior of both prices and quantities suggests that credit supply expansions are a precursor to crises."

2.3 Identification of credit supply expansion in specific episodes

The large sample historical evidence points to the importance of credit supply expansion in explaining a sudden rise in household debt. Scholars have also focused on specific episodes which allow for a cleaner identification of credit supply shocks.

Europe from 1996 to 2010

Mian et al. (2017b) treat the introduction of the euro currency in the late 1990s as a shock that increased credit supply by lowering currency and other risk premia, especially in peripheral

[5]More specifically, they present the impulse response function of log real GDP to an increase in household debt from a proxy-SVAR specification in which low credit spread episodes are used as an instrument for a credit-supply driven increase in household debt. The proxy structural vector auto regression approach is based on Mertens and Ravn (2013). See Mian et al. (2017b) for details. The impulse response function from this specification shows a similar boom and bust in real economic activity coming from a credit-supply driven increase in household debt.

European countries. The decline in risk premia for a given country can be most easily seen in the spread between interest rates on sovereign bonds in the country versus U.S. bonds. For example, Denmark, Finland, Ireland, and Greece all witnessed substantial declines in their borrowing costs on sovereign debt relative to U.S. Treasury rates.

The left panel of Figure 4 shows that countries with the largest decline in the sovereign spread from 1996 to 1999 experienced the largest increase in household debt from 2002 to 2007. The middle panel shows that countries seeing the biggest drop in the sovereign spread also see the strongest GDP growth from 2002 to 2007. The right panel of Figure 4 shows that these same countries experienced the worse economic downturn from 2007 to 2010. We interpret this evidence as showing how a credit supply expansion induced by an institutional change led to a boom in household debt and the real economy followed by a more severe economic downturn.

An alternative measure of shifts in credit supply are credit standards as reported by loan officers at banks (e.g., Favilukis et al. (2012)). In the left panel of Figure 5, we present evidence from the European Central Bank on credit standards on loans for house purchase from 2003 to 2007 across the Euro area.[6] The vertical axis represents the net percentage of loan officers reporting a tightening of credit standards on loans for house purchase. As it shows, the credit expansion period of 2003 to 2007 was associated with a substantial loosening of credit standards by loan officers on house purchase loans, especially in late 2004 and 2005.

United States prior to Great Recession

The rapid increase in household debt in the United States from 2000 to 2007 has been studied extensively, and the culmination of the evidence on interest rates also points to an expansion in credit supply as the key factor. For example, risk spreads on mortgage credit fell sharply from 2000 to 2005 (e.g., Chomsisengphet and Pennington-Cross (2007); Demyanyk and Van Hemert (2011)). Justiniano et al. (2017) point to a "mortgage rate conundrum" in the summer of 2003 when mortgage credit spreads relative to U.S. Treasuries fell 80 basis points, and then continued to fall through 2005.

Evidence on credit standards in the United States points the same direction. The middle panel of Figure 5 shows the net percentage of senior loan officers reporting tighter credit standards on

[6]The exact question is: "Over the past three months, how have your bank's credit standards as applied to the approval of loans to households changed?" The data series begins in 2003.

mortgages from the Federal Reserve Board Senior Loan Officer Opinion Survey.[7] The loosening of credit standards on mortgages in the United States from 2003 to 2005 is remarkably similar to the pattern shown in Europe. The right panel provides additional evidence that credit supply as opposed to credit demand was the driving force behind the rise in household debt. As it shows, the net percentage of loan officers reporting stronger demand for mortgages actually fell from 2003 to 2005.

The shift in credit supply can also be seen in the dramatic changes in mortgage markets during the late 1990s and early 2000s. Levitin and Wachter (2012) conduct a detailed analysis of the rise of the private label securitization (PLS) market. While securitization was certainly not new, Levitin and Wachter (2012) argue that the nature of PLS was fundamentally different than previous forms of securitization. The PLS market increased from about 20% of all mortgage-backed securities issued by dollar volume to over 50% in 2004 and 2005.

An extensive body of research shows how the rise of the PLS market, and subprime mortgages in particular, represented a positive credit supply shock to marginal borrowers who were previously denied credit (e.g., Mayer (2011); Mian and Sufi (2009); Demyanyk and Van Hemert (2011)). Scholars have carefully documented how subprime mortgages reduced the incentives of financial intermediaries to carefully screen borrowers, thereby helping to explain why default rates on these mortgages were so high (Keys et al. (2010)). Fraud was rampant in the PLS market during the height of the mortgage credit boom (Piskorski et al. (2015); Griffin and Maturana (2016b); Mian and Sufi (2017a)), and such fraudulent activity likely helped fuel house price growth in some areas of the country (Griffin and Maturana (2016a)).

This is not to say that the subprime mortgage market alone can explain the sharp rise in household debt in the United States from 2000 to 2007. Borrowing by existing homeowners was the most important driver of aggregate household debt, and such borrowing occurred even among higher credit score borrowers (e.g., Mian and Sufi (2011); Mian et al. (2017a)). Further, credit supply expansion was broader than the subprime mortgage market. For example, Anenberg et al. (2017) use a frontier estimation strategy to show a significant expansion in credit supply from 2001 to 2005 across the credit score distribution.

[7] We only include the answers to this survey question through the first quarter of 2007. Beginning in the second quarter of 2007, the survey split questions on credit standards for mortgages into prime and subprime segments. As a result, there is no consistent series available from before and after the second quarter of 2007.

Banking Deregulation

Perhaps the cleanest identification of credit supply shocks in recent literature comes from the evaluation of banking deregulation episodes. Di Maggio and Kermani (2017) focus on the federal preemption of state laws against predatory lending for national banks in 2004. Eighteen states in the United States as of January 1, 2004 had anti-predatory lending rules that applied to all banks doing business in the state. However, on January 7, 2004, the Office of the Comptroller of the Currency adopted sweeping regulations preempting these state laws from applying to national banks. Di Maggio and Kermani (2017) show that the states where anti-predatory lending rules were preempted witnessed a surge in mortgage credit provided by national banks in 2005 and 2006, which corresponded to a sudden increase in house prices and employment in the non-tradable sector. The same states then witnessed a larger decline in house prices, mortgage availability, and employment in the non-tradable sector from 2006 to 2010. As the title of the article puts it, the preemption of anti-predatory lending laws induced a credit supply-driven boom and bust.

Mian et al. (2017a) focus on banking deregulation in the United States in the 1980s. They document an aggregate positive credit supply shock in the United States from 1983 to 1989. Their state-level empirical strategy relies on the fact that states with a more deregulated banking sector as of 1983 witnessed a stronger expansion in credit supply from 1983 to 1989. More specifically, they classify a state as more deregulated as of 1983 if the state was early to remove restrictions on inter- and intra-state bank branching restrictions (e.g., Jayaratne and Strahan (1996) and Kroszner and Strahan (2014)).

Figure 6 replicates some of the patterns from Mian et al. (2017a). States that deregulated their banking system earlier witnessed a larger rise in bank credit from 1983 to 1989 relative to states that deregulated their banking system later. This is one measure of the stronger credit supply shock in early deregulation states (left panel). During the expansion period, the unemployment rate fell by more (middle panel) and house price growth was significantly stronger (right panel) in early deregulation states. When the recession hits, early deregulation states see a relative rise in the unemployment rate and a relative decline in house prices. States with a stronger credit supply shock from 1983 to 1989 experience a significantly amplified business cycle.

While these two studies on bank regulation take the aggregate credit cycle as given, they both

show a precise source of variation in bank regulation to generate differential credit supply expansion across states. They find similar results: stronger credit supply expansion due to a different bank regulatory environment generates stronger growth in debt in the short-run and a more severe recession in the medium run.

2.4 Credit supply expansion and house prices

Increases in household debt are often associated with an increase in house prices (Mian et al. (2017b)). Both quantitative macroeconomic models (e.g., Favilukis et al. (2017), Justiniano et al. (2015), Landvoigt (2016)) and microeconomic studies (e.g., Mian and Sufi (2009), Adelino et al. (2014), Landvoigt et al. (2015), and Favara and Imbs (2015)) show that an increase in credit supply boosts house prices. In addition, the rise in house prices is an important amplification mechanism for the real economy because households often borrow aggressively against the rising value of their home (Mian and Sufi (2011)). Further, a positive credit supply shock tends to boost new residential construction, which is another channel for effects on the real economy (e.g., Mian et al. (2017a)).

The important role of house prices in credit supply expansions has led to the question of whether the increase in house prices is the initial shock and the rise in household debt is a response (e.g., Laibson and Mollerstrom (2010), Foote et al. (2012), Adelino et al. (2017)). There are no doubt feedback effects between house prices and credit supply expansions. An initial expansion in credit supply may lead to a rise in house prices, thereby encouraging lenders to provide even more credit because they expect house prices to rise further.

However, our view is that the weight of the empirical evidence suggests that house prices are more likely to be a *response* to credit supply expansion rather than a *cause*. For example, using the sample of 30 countries over the past 40 years, Mian et al. (2017b) run a bivariate recursive VAR to examine the dynamic relationship between increases in household debt and house prices. The impulse response functions show that a shock to household debt leads to a large and immediate increase in house prices, followed by substantial mean reversion four years after the initial shock. In contrast, a shock to house price growth leads to a gradual rise in household debt to a permanently higher level. There are no boom and bust dynamics associated with a shock to house price growth.

Favilukis et al. (2012) use credit standards data for the 2002 to 2010 period for 11 countries. They show that changes in credit standards have strong marginal explanatory power for house

price movements. This is true both within the United States, and in a broader panel of European countries. They conclude based on the evidence that "... a stark shift in bank lending practices ... was at the root of the housing crisis." Further, as mentioned above, there are several micro-economic studies that suggest the direction of causality runs from credit supply expansion to house price growth instead of vice versa. Di Maggio and Kermani (2017) and Mian et al. (2017a) use variation in banking regulation as an instrument for credit supply expansion, and they both show a strong response of house prices.[8]

While there is a debate in the literature on the exact source of the rise in house prices, there is consensus on the real effects. The rise in house prices boosts construction activity, retail employment, and consumption. Many of these real effects help explain the severity of the subsequent downturn, and we return to these issues in Section 4.

2.5 The importance of behavioral biases

Behavioral biases are a critical component of credit expansions. As mentioned above, in the United States, López-Salido et al. (2017) show evidence of predictable mean reversion in credit-market conditions. Low credit spreads predict a widening of credit spreads, and the widening of credit spreads is closely tied to contraction of economic activity. Further, this phenomenon of reversal is present in credit markets but not in the stock market. For example, high price to earnings ratios for stocks predict lower stock returns going forward, but they do not predict real economic activity. Greenwood and Hanson (2013) use the share of total new firm debt issues by low credit quality firms as a measure of credit market overheating, and they show this measure predicts lower bond returns.

The examination of bank stock prices by Baron and Xiong (2017) also highlights the importance of behavioral biases. The compile a data set of bank equity prices for 20 developed economies from 1920 to 2012. The change in the bank credit to GDP ratio over the last three years robustly predicts a crash in bank equity prices within the next one, two, or three years, where a crash is defined to be a -30% return in any quarter. In addition to the heightened crash risk, the expansion in bank credit also predicts lower mean returns on bank equity. The ability of credit expansion to predict

[8]For further discussion of the relative importance of credit supply expansion versus a rise in house prices, please see Mian and Sufi (2017b).

lower returns is robust to the inclusion of measures of equity valuations such as the price-dividend ratio. The expansion in credit predicts returns on bank equity beyond standard measures used in the stock return predictability literature.

Fahlenbrach et al. (2017) follow a similar methodology to show the same result at the bank level within the United States. They examine a panel of banks form 1973 to 2014, and they sort banks into quartiles based on loan growth in the past three years. They find that banks with the largest loan growth over the past three years have lower stock returns over the next year, two years, and three years. They also show that analysts over-predict stock returns for banks with high loan growth in the past. As they write, "the evidence is consistent with banks, analysts, and investors being overoptimistic about the risk of loans extended during bank-level periods of high loan growth."

A large and rapid increase in the household debt to GDP ratio predicts lower growth in a country, and yet professional economic forecasters do not take this into account adequately. Mian et al. (2017b) examine output growth forecasts by the IMF and the OECD, which are available for almost all of the countries in their sample after 1990 and advanced economies back to 1973. For a given year t, the rise in the household debt to GDP ratio from $t-4$ to $t-1$, which is known to economic forecasters at time t, predicts GDP growth forecasting errors from t to $t+1$, from t to $t+2$, and from t to $t+3$. The ability to predict forecasting errors is present even in the pre-2006 sample, and yet economic forecasters still significantly over-forecasted GDP growth after 2007. The rise in household debt from $t-4$ to $t-1$ can even predict the revisions forecasters make between t and $t+1$ of growth from $t+2$ to $t+3$. Forecasters play catch up once the economy turns, even though their forecasts should have predicted lower growth at time t. The ability to predict forecasting errors is unique to a rise in the household debt to GDP ratio; the rise in the firm debt to GDP ratio has no predictive power once household debt is taken into account.

3 The Household Demand Channel

Credit supply expansions generate a boom-bust cycle in real economic activity. But what is the precise channel? An expansion in credit supply could affect the supply side of the economy by boosting firm investment or employment. Alternatively, it could boost aggregate demand by en-

abling households to increase consumption. From the outset, we want to emphasize that this is an empirical question; there are good theoretical arguments for why credit supply could operate through the firm or household channel. While there are certainly episodes in history where credit supply boosted the economy through the firm sector, recent evidence suggests the household demand channel is more prominent. This can be seen in both country-level analysis of long-run time series data, or in specific episodes.

Over the past 40 years, the boom-bust business cycle generated by a rise in debt is unique to household debt; increases in firm debt or government debt do not produce the same pattern (Mian et al. (2017b)). For example, the increase in the household debt to GDP ratio over the past four years predicts lower growth over the next four years, but the rise in firm debt or government debt has no predictive power once the rise in household debt is taken into account.

Further, periods of rising household debt are associated with a rise in the consumption to GDP ratio, an increase in imports of consumption goods, and no change in the investment to GDP ratio. In advanced economies, a rise in household debt generates a consumption boom-bust cycle that is significantly more severe than the real GDP boom-bust cycle (IMF (2017)). Household debt appears to be crucial in generating these cycles; for example, a rise in the consumption to GDP ratio by itself does not predict subsequently lower growth. But a rise in consumption to GDP ratios concurrent with a large rise in household debt does predict lower growth (Mian et al. (2017b)).

Household debt also appears to be important in predicting financial crises. Jordà et al. (2016) use their disaggregated bank credit data set to estimate the relationship between bank credit and subsequent financial crises in 17 advanced economies since 1870. Since World War II, elevated mortgage credit to GDP ratios predict financial crises to the same degree as non-mortgage credit to GDP ratios. Further, in predicting recession severity since World War II, the mortgage credit to GDP ratio at the beginning of the recession plays an especially important role.

The prominence of household debt is also found in emerging economies. Bahadir and Gumus (2016) focus on Argentina, Brazil, Chile, Korea, Mexico, South Africa, Thailand, and Turkey; and they show that household debt to GDP ratios in almost all of these countries have risen substantially since the early 1990s. In contrast, business credit to GDP ratios have been relatively stable. They also show significant comovement between household credit and real economic outcomes such as output, consumption, and investment. Increases in household credit are also associated with

substantial real exchange rate appreciations. In contrast, changes in business credit have weaker correlations with other real economic outcomes.

They use these stylized facts to build a model to distinguish whether shocks to household credit or business credit are driving the real economy. One insight from the model is that household credit shocks are unique from business credit shocks in their tendency to simultaneously boost the real exchange rate and increase employment in the non-tradable sector. Mian et al. (2017a) build on this model to show that a credit expansion to businesses that boosts productivity is inconsistent with a simultaneous increase in the price of non-tradable goods and employment growth concentrated in the non-tradable sector.

Mian et al. (2017a) test these predictions in their evaluation of bank deregulation in the 1980s. As mentioned above, states with a more deregulated banking system as of 1983 experience a more amplified business cycle from 1983 to 1992. Mian et al. (2017a) show that the relative increase in employment in early deregulation states during the expansionary period is concentrated in the non-tradable and construction sectors. Figure 7 replicates this result. Further, early deregulation states see no relative increase in employment in the tradable sector, even among small firms where bank credit is particularly important. The employment patterns are more supportive of credit supply expansion operating through household demand than an expansion in productive capacity by businesses.

The evidence on nominal prices and wages also points to the critical role of household demand. Mian et al. (2017a) show that early deregulation states experience a rise in consumer prices driven by the price of non-tradable goods from 1983 to 1989. At the same time, nominal wage growth is substantially stronger in early deregulation states. Figure 8 replicates these patterns. Stronger growth in nominal prices in the non-tradable sector and stronger growth in construction and non-tradable employment are indicative of a boost in household demand.

Mian et al. (2017a) also show a similar pattern among peripheral European countries during the credit expansion period of 2002 to 2007. Countries in the eurozone with the largest decline in real interest rates experienced employment growth from 2002 to 2007 in the non-tradable and construction sectors of 12 to 14%, while employment in the tradable sector actually fell 7%. Inflation rates were higher in these peripheral countries during this time period, as was nominal wage growth.

Kalantzis (2015) uses a sample of 40 countries from 1970 to 2010. The study isolates 47

episodes of large capital inflows; many are associated with well known financial or capital account liberalizations such as Latin America in the 1970s and 1990s, Nordic countries in the 1980s, and Asian countries in the 1990s. He finds that large capital inflows predict a shift of resources from the tradable to non-tradable sector. The size of the non-tradable sector relative to the tradable sector increases on average by 4% relative to normal times. This pattern is consistent with the view that credit supply expansions fuel household demand as opposed to firm productivity.

4 Explaining the Severity of the Bust

4.1 Debt and the initial drop in demand

What makes recessions following expansions in household debt so severe? The initial culprit appears to be a significant drop in household demand. In the Great Recession, for example, Mian and Sufi (2010) show that household spending fell substantially even before the heart of the financial crisis in September 2008. A substantial drop in consumption is one of the defining characteristics of the aftermath of household debt expansions, as shown by the IMF (2017) . Further, conditional on a recession, the drop in consumption is stronger in areas where household debt rose the most prior to the recession (e.g., Mian and Sufi (2010), Glick and Lansing (2010), IMF (2012)). Researchers have used individual level data in a variety of settings to show the same result: individuals taking on the most debt during the expansion phase of the credit cycle cut spending the most during the ensuing economic downturn.[9]

A key reason for the fall in demand is high household leverage itself. This channel was first articulated as the *debt deflation hypothesis* by Irving Fisher, who pointed out that a slowdown in economic activity would raise the real burden of debt, which in turn would further slow down the economy through a reduction in aggregate demand. Fisher's debt deflation cycle could make recessions much worse in the presence of high household leverage. Isolating this channel is challenging because other factors that may also interact with economic shocks are often correlated with household leverage. However, a compelling case in favor of Fisher's debt deflation hypothesis is presented by Verner and Gyongyosi (2017) who investigate the consequences of the increase in the

[9]See Bunn and Rostom (2015) for evidence from the United Kingdom; Andersen et al. (2014) for evidence from Denmark; and the IMF (2017) for evidence from a broad sample of households in Europe.

real household debt burden in Hungary due to the large and sudden appreciation of the Swiss Franc in 2008.

Verner and Gyongyosi (2017) show that some Hungarian households borrowed in Hungarian forint during the 2000's while others borrowed in Swiss francs. This choice of borrowing currency was partly dictated by bank branching networks and is uncorrelated with pre-2008 levels of leverage or growth in house prices, unemployment, or consumption. The sudden appreciation of the Swiss franc in 2008 by over thirty percentage points greatly increased the real burden of debt for a significant fraction of Hungarian households. This sudden rise in the real debt burden generates a sharp decline in household spending.

The effect of debt burdens on consumption during an economic downturn can also be seen in research evaluating a relief in debt payments during the Great Recession in the United States. Di Maggio et al. (2017) exploit variation in the timing of resets on adjustable rate mortgages to show that a 50% reduction in mortgage payments boosts spending on autos by 35%. They also find evidence of MPC heterogeneity: households with low income and low housing wealth see the strongest consumption response to the decline in mortgage payments.

Agarwal et al. (2017a) evaluate the Home Affordable Modification Program. Their empirical stategy exploits regional variation in the intensity of program implementation by intermediaries, and they show that lower mortgage payments associated with the program increased spending on durable goods. Agarwal et al. (2017a) examine the Home Affordable Refinancing Program, also exploiting geographic variation in exposure to the program. They find that borrowers who were eligible for HARP reduced their mortgage payments per year by $3500, and this reduction spurred an increase in both non-durable and durable spending. Further, the spending response was stronger among more indebted borrowers.

The evidence from the literature using careful identification in microeconomic data sets reveals an important clue for why the drop in aggregate consumption is so large after debt expansion: debtors have a higher marginal propensity to consume out of wealth and income shocks than those without debt. Mian et al. (2013) show this result explicitly: during the 2006 to 2009 period, households living in zip codes with higher leverage cut back spending on autos by more for the same decline in house prices. Baker (2018) shows that individuals with higher debt burdens cut spending by substantially more in response to the same decline in income during the Great Recession in

the United States. In our view, the higher MPC among debtors is a crucial feature in explaining the severity of recessions following household debt expansions. Debtors cut back on spending dramatically, while those with less leverage may not increase spending sufficiently. We explore this idea further in the next subsection.

4.2 Frictions leading to a decline in aggregate demand

The fact that leveraged households cut spending dramatically after a debt expansion does not, by itself, explain the large drop in aggregate consumption nor the decline in growth. For example, the decline in demand by indebted households could by offset by higher demand from less-indebted households through lower interest rates. Or net exports could be boosted through exchange rate depreciation. However, as we discuss in this section, there are a variety of frictions that prevent such adjustments from offsetting the initial drop in demand.

One set of frictions is related to rigidities in prices and interest rates. Many countries find themselves at the zero lower bound on nominal interest rates in the aftermath of large expansions in household debt. As illustrated by Hall (2011) and Eggertsson and Krugman (2012), an economy that hits the zero lower bound during the period in which leveraged households cut demand is plagued with a real interest rate that is "too high." As a result, less leveraged households do not boost spending sufficiently to offset the decline in demand coming from leveraged households.

This friction is aggravated by the fact that consumption of less leveraged households may in general be less sensitive to credit conditions and interest rates (e.g., Sufi (2015), Agarwal et al. (2017b)). Households that in normal times have the highest sensitivity of consumption to interest rates and credit availability find themselves either unwilling or unable to borrow in the midst of the downturn that follows credit booms.

Price rigidities in general appear to play an important role. For example, the negative effect of household debt expansion on subsequent growth is larger in countries with less flexible exchange rate regimes (Mian et al. (2017b), IMF (2017)). Further, the effect of a change in household debt on subsequent growth is non-linear: a large decline in household debt does not predict subsequently stronger growth, but a large increase in household debt predicts subsequently weaker growth (Mian et al. (2017b)). Both of these results suggest that the inability of prices to fall after a debt expansion is one reason the recession is severe.

4.3 Labor market frictions

The aggregate decline in demand quickly spills over into the labor market. Downward nominal wage rigidity is an important reason. For example, Schmitt-Grohé and Uribe (2016) examine the nominal labor cost index for peripheral European countries from 2000 to 2011. Nominal labor costs rise dramatically from 2000 to 2008, but then stay high from 2008 to 2011 as the unemployment rate jumps from six percent to 14 percent.

There is also evidence of significant downward wage rigidity at the state level in the aftermath of the 1980s credit supply expansion in the United States. As mentioned in Section 3, states that deregulated their banking sector earlier witnessed substantial relative nominal wage growth during the credit supply expansion from 1982 to 1989. However, when these same states experienced a relative rise in unemployment from 1989 to 1992, nominal wages adjusted downward only slowly. Even by 1995, nominal wages remained relatively higher in early deregulation states (Mian et al. (2017a)). The nominal wage pattern within the United States during the 1980s and early 1990s mimics the pattern shown by Schmitt-Grohé and Uribe (2016) among peripheral European countries from 2000 to 2011.

County-level analysis within the United States after the Great Recession also shows the importance of such rigidities. In counties with the largest decline in housing net worth and consumer demand, job losses in the non-tradable sector (e.g., retail and restaurant jobs) were severe. However, there was no relative expansion in employment in the tradable sector in these same counties. At least some of the lack of expansion in tradable employment in these counties appears to be related to wage rigidity (Mian and Sufi (2014)).[10] Verner and Gyongyosi (2017) find similar evidence in Hungary after the depreciation of the local currency in 2008. Areas that experienced a sudden rise in debt burdens see a sharp decline in employment catering to local demand. But wages decline only modestly, and there is no increase in employment among firms operating in the tradable sector.

More generally, recent research suggests that any shock that leads to a large rise in unemployment in the short-term may have large and persistent effects on the labor force and large spillovers onto local economic activity (e.g., Acemoglu et al. (2016); Yagan (2017); Acemoglu and Restrepo

[10] Beraja et al. (2017) show that wages declined more in states where employment fell by the most during the Great Recession, and they argue the data are consistent with only a "modest degree of wage stickiness."

(2017)). The most comprehensive research by Yagan (2017) suggests that long-term consequences for labor market participation among those laid off in recessions is due to human capital decay and persistently low labor demand. If a large drop in household demand generates a substantial rise in unemployment, we should expect the consequences to be large and long-lived.

4.4 A collapse in asset prices

Debt also depresses economic activity during the bust because of forced asset sales such as residential foreclosures. The negative consequences of foreclosures on house prices and economic activity is well established in the empirical literature. For example, Mian et al. (2015) use variation across states in judicial requirements for foreclosures, which they show has a strong effect on foreclosure propensity. They show that this variation is uncorrelated with the propensity of households to default on their mortgages, and uncorrelated with a number of other observable variables. They then show that higher foreclosure propensity in non-judicial foreclosure states is associated with a decline in house prices, residential investment, and durable goods spending.

Anenberg and Kung (2014) use an identification strategy based on the precise timing of a listing of a foreclosed property. They show that nearby sellers lower their prices in the exact week that the foreclosed property is listed, thereby causing lower house prices for transactions. Gupta (2016) isolates exogenous variation in foreclosures using shocks to interest rates resulting from details in adjustable rate mortgage contracts. He finds that a foreclosure leads to further foreclosures and lower house prices in the surrounding area. Further, a foreclosure leads to difficulty in refinancing mortgages into lower rates for those living close to the foreclosed property, as banks tend to use the depressed foreclosure price as a comparison. Guren and McQuade (2015) construct a quantitative model of the housing market to assess the impact of foreclosures on house prices. They find that foreclosures during the Great Recession in the United States exacerbated aggregate price declines by 62% and non-foreclosure price declines by 28%. Verner and Gyongyosi (2017) find similar effects in Hungary.

4.5 Banking crises

Another reason for the severity of the recessions following an expansion in credit supply is the presence of a banking crisis. Such a crisis leads to a severe tightening of credit supply which

may affect all households and businesses. This important factor follows more closely the financial accelerator view of Bernanke and Gertler (1989) and Kiyotaki and Moore (1997).

Evidence from the United States during the Great Recession shows that households living in zip codes with high housing leverage and a decline in house prices faced a particularly acute contraction in credit supply. Home equity limits and credit card limits fell significantly more in these zip codes relative to the rest of the country (Mian et al. (2013)). First-time home buying contracted more severely for low credit score versus high credit score individuals after the Great Recession even controlling for standard factors such as age and income, which also suggests a tightening of credit supply (Bhutta (2015)).

In addition, the banking crisis in the United States led to a decline in employment and consumption that spread beyond leveraged households. For example, Chodorow-Reich (2014) shows that firms borrowing from banks that were most exposed to the banking crisis witnessed a larger decline in employment during the Great Recession. Giroud and Mueller (2017) confirm that employment losses in the non-tradable sector were particularly large in counties with a large drop in demand. However, they show that these employment losses were concentrated among firms with weak balance sheets who were likely most exposed to the adverse credit conditions during the Great Recession. On the consumption side, Benmelech et al. (2017) show that the collapse in the asset-backed commercial paper market led to a collapse in the availability of non-bank auto loan financing. As a result, counties that traditionally relied on non-bank auto loan financing witnessed a substantial decline in auto purchases.

A banking crisis disrupts economic activity for a variety of reasons, as pointed out in Bernanke (1983). However, banking crises should not be viewed independently from the expansion in household debt that often precedes them. As mentioned above, Jordà et al. (2016) show that a rise in mortgage credit to GDP ratios predicts banking crises. Further, they show that recessions associated with high mortgage debt growth *and* a banking crisis are the most severe.

4.6 Longer-term distortions

Recent research suggests that recessions after large expansions in credit supply are likely severe and protracted because of distortions in the real economy during the boom. One such distortion is the large increase in employment in the retail and construction sectors that typically occurs during

credit supply expansions. Charles et al. (2015) show evidence that areas of the United States with substantial housing booms experienced substantial improvement in labor market opportunities for young men and women. As a result, these areas witnessed lower college enrollment, especially at two-year colleges. After the bust, many of these individuals did not return to college, "suggesting that reduced educational attainment is an enduring effect of the recent housing cycle."

Borio et al. (2016) examine across-sector labor reallocation during periods of rapid private credit growth, and they find that workers systematically move into low productivity growth sectors. Further, the movement of workers into lower productivity sectors during the credit expansion lowers productivity growth after the recession, and this is especially prevalent in recessions associated with financial crises. Gopinath et al. (2016) show how credit supply expansion lowered productivity growth among Spanish manufacturing firms between 1999 and 2012 by directing funds toward higher net worth firms that were not necessarily more productive.

5 Theoretical Foundations

What existing models help us to understand the credit-driven household demand channel? In this section, we first discuss how existing theoretical research models a credit supply expansion, and then we turn to theoretical models that can explain how credit supply expansion leads to predictable boom-bust cycles.

5.1 Modeling a credit supply expansion

Much of the existing theoretical research treats credit supply expansion as an exogenous shock. For example, Schmitt-Grohé and Uribe (2016) examine the case of a small open economy with a pegged exchange rate. In one of the exercises in their study, they assume an exogenous decline in the country interest rate, which then reverses subsequently. In the model of Justiniano et al. (2015), total lending by savers is limited exogenously. A credit supply expansion in their model is a relaxation of this lending constraint. This leads to higher levels of household debt, lower interest rates, and an increase in house prices.

Favilukis et al. (2017) consider two shocks which together produce a rise in household debt and a housing boom. One is a financial market liberalization, which consists of a loosening of a loan-

to-value (LTV) constraint on mortgages and lower transactions costs associated with obtaining a mortgage. The other is an influx of foreign funds into the domestic risk-free bond market. The authors argue that the combination of both shocks is necessary to generate an increase in household debt, an increase in house prices, and a steady or declining risk-free rate. Greenwald (2016) models a credit supply expansion as a simultaneous loosening of a payment-to-income (PTI) constraint on mortgages and a decline in the real interest rate. He argues that both forces are necessary to generate the observed patterns in housing markets during the 2000 to 2007 period in the United States. Garriga et al. (2017) build a model where there are exogenous changes in both LTV ratios and mortgage interest rates. They conclude that a decline in mortgage interest rates is the more important quantitative force leading to house price appreciation, but that the interaction of the two forces can amplify the effect of mortgage rates on home values.

While a relaxation of LTV or PTI constraints is an important component of debt booms, there are a few drawbacks in treating these as the main force driving credit supply expansions. As Justiniano et al. (2015) point out, a relaxation of an LTV constraint by itself actually leads to an increase in mortgage interest rates which is counter-factual for most episodes. Further, Kiyotaki et al. (2011) and Kaplan et al. (2017) argue that a relaxation of LTV constraints alone cannot explain the rise in house prices that is typical of these credit booms. This explains why models that rely on relaxation of these constraints typically also contain a second force which is necessary to fit the facts.

Another important point is that credit supply expansions manifest themselves far beyond a higher allowed LTV or PTI ratio. We concur with Favilukis et al. (2012) who write: "the behavior of combined loan-to-value ratios in the boom and bust does not do full justice to several aspects of increased availability of mortgage credit." As they point out, the 2000 to 2007 mortgage credit expansion in the United States was associated with previously rationed borrowers receiving credit, new mortgage contracts, and reduced asset and income verification by lenders. A narrow focus on LTV and PTI ratios misses many dimensions of credit supply expansion episodes.

5.2 Rational expectations and credit-driven externalities

What models can help us explain the predictable boom-bust episode generated by an expansion in credit supply? One class of models relies on credit-driven externalities where households are

rational with common beliefs. There is a temporary positive shock to credit supply that everyone understands will revert at some time in the future. However, despite rational expectations and the transient nature of credit expansion, there is "over borrowing" from a macro-prudential perspective that results in a boom-bust cycle in both credit and the real economy. The key reason for this outcome is the presence of aggregate demand and pecuniary externalities.

Consider a small open economy that faces a temporary positive credit supply shock in period t that reverses at $t+1$. Schmitt-Grohé and Uribe (2016) model the credit shock as a reduction in the interest rate that lasts only one period. Following Korinek and Simsek (2016), we model the credit supply shock by assuming that households become completely unconstrained in their borrowing at t, but can only borrow up to an exogenous amount ϕ at $t+1$.

The economy features an underlying friction that makes it susceptible to the $t+1$ negative credit supply shock if households borrow too much at time t and are subsequently forced to delever. The friction could be downward wage rigidity as in Schmitt-Grohé and Uribe (2016), a monetary policy constraint such as the zero lower bound as in Korinek and Simsek (2016) and Eggertsson and Krugman (2012), or difficulty in reallocating production from consumption (non-tradable sector) to net exports (tradable sector) as in Huo and Ríos-Rull (2016). A key result in these models is that a higher amount of debt carried over from t is harmful for GDP at $t+1$ when the negative expected credit supply shock hits. The negative credit shock forces households to delever by cutting back on spending which in turn reduces GDP due to the underlying friction. This result can be summarized by writing output in $t+1$ as a function of total debt D_t accumulated at t,

$$y_{t+1} = \bar{y} - f(D_t, \Phi) \tag{1}$$

where $\bar{y}$ is potential output. The function $f(.)$ is non-linear, zero if debt is below some threshold $\bar{D}$, and increases after this point with $f_D > 0$. The non-linearity results from constraints that only bind in one direction, such as the zero lower bound or downward wage rigidity. The condition $f_D > 0$ reflects depressed aggregate demand after a tightening of financial conditions due to macro frictions such as nominal rigidity or a monetary policy constraint. These frictions are captured by Φ, with $f_{D\Phi} > 0$; more binding frictions, such as fixed versus floating exchange rate regime, will

lead to a greater reduction in aggregate demand when financial conditions tighten.[11]

What is the intuition for the fall in aggregate demand with higher household leverage (i.e. $f_D > 0$)? Households with high leverage are forced to cut consumption when financial conditions tighten; this cut in consumption leads to depressed aggregate demand. The economy tries to adjust by reducing interest rates to boost local demand and by reducing nominal wages to increase production of tradable goods catering to external demand. However, a combination of downward wage rigidity and restricted monetary policy prevents real wages and interest rates from falling sufficiently. The lack of full adjustment results in increased unemployment and decline in total output summarized in (1).

Given that a high level of household debt is costly for the economy at $t+1$, will households prudently choose a safe debt level in period t? To answer this question, let us assume that there is a measure one of households with each household earning full potential output $\bar{y}$ in period t and expecting to earn y_{t+1} according to (1) next period, i.e., household income next period depends partly on the total level of debt accumulated by households. There are no borrowing constraints in period t and with rational expectations everyone is fully aware of the tightening credit conditions next period. Households choose consumption c_t, c_{t+1}, and debt d_t to maximize utility $u(c_t) + \beta u(c_{t+1})$, subject to budget constraints $\bar{y} = c_t - \frac{d_t}{1+r_t}$ and $y_{t+1}(D_t) = c_{t+1} + d_t - \phi$. The term $(d_t - \phi)$ reflects the extent to which the economy has to delever next period. Given identical households, $d_t = D_t$ in equilibrium, but each individual takes expected D_t as given when setting their own choice of d_t.

The private Euler equation for each household can be written as,

$$\frac{u'(c_t)}{u'(c_{t+1})} = \beta(1 + r_t) \tag{2}$$

The key point to notice is that households do not take into account the impact of their choice d_t on the economy next year as each household is infinitesimally small relative to the population. This gives rise to an "aggregate demand externality" which can be seen by comparing the private Euler equation (2) with the social planner's Euler equation that internalizes the impact of d_t on output next period,

[11] A further increase in precautionary savings when financial conditions tighten, as in Guerrieri and Lorenzoni (2017), make such frictions more binding as well.

$$\frac{u'(c_t)}{u'(c_{t+1})} = \beta(1+r_t)(1+f_D) \tag{3}$$

Since $f_D > 0$, it follows that the household's period t consumption in (2) is too high relative to the constrained-best level of consumption in (3). The aggregate demand externality leads to over-borrowing and a subsequent recession. Farhi and Werning (2015) show that the aggregate demand externality exists in a more general setting with complete markets whenever there are nominal rigidities and monetary policy constraints.

A second reason for over-borrowing is the presence of pecuniary externalities due to fire sales as discussed in papers including Caballero and Krishnamurthy (2001), Lorenzoni (2008), Bianchi (2011), Shleifer and Vishny (1992), Kiyotaki and Moore (1997) and Dávila (2015). Suppose that there is an asset, such as a house, that is used as collateral for borrowing, and the $t+1$ borrowing constraint depends on the price of this asset. A lower collateral price will tighten the borrowing constraint further, pushing the economy further into contraction. The squeeze on the collateral price in $t+1$ is itself a function of how much households borrowed in the preceding period. If households borrowed too much, they will be forced to delever by fire-selling the collateral which reduces the price of collateral and hence further tightens the borrowing constraint. In the context of our example, we can illustrate this asset price feedback with a higher Φ. Given that $f_{D\Phi} > 0$, the collateral price channel adds to the gap between the household's and social planner's Euler equation.

5.3 Heterogeneous beliefs and behavioral biases

The rational expectations framework with a temporary, self-reverting credit shock is successful in explaining why an expansion in credit supply leads to a boom-bust cycle. However, an explanation based on rational expectations and externalities has one major problem: it predicts that households during the credit boom in period t anticipate a slowdown in the economy. As already shown in section 2.5, this prediction is counterfactual. During credit booms, economic forecasters systematically over-predict future GDP growth. Further, there is substantial evidence that market participants fail to see the correction in asset prices that typically occurs in the aftermath of credit

booms.

For these reasons, the rational expectations model with common beliefs is unlikely to explain the predictable boom-bust cycles we witness in the data. One direction is to move away from the assumption of common beliefs. Geanakoplos (2010) builds a theory of endogenous leverage cycles based on heterogeneous beliefs where households agree to disagree. Households differ in their view about the economy, with some having more optimistic views relative to others. Greater availability of credit in such an environment enables optimists to leverage, buy more of the collateralized asset, and therefore raise asset prices. A positive credit supply shock results in giving the optimists' expectations greater weight in market prices. As a result, credit, asset prices, and market expectations rise collectively.

However, the economy with heterogeneous beliefs is fragile in the sense that a small negative shock can lead to a much larger negative swing in credit and asset prices. Even a small negative shock bankrupts the optimists who are highly leveraged because of their exuberant beliefs. Consequently optimists are forced to dump the asset in the market and the only households with positive net worth who can buy these assets are the pessimists. Asset prices fall which further reinforces the original wave of fire sales and credit contraction. This endogenous boom-bust leverage cycle may interact with frictions in the macroeconomy such as those behind equation (1), thereby generating a boom-bust cycle in the real economy.

Another approach is reliance on behavioral biases. Such an approach has the advantage of being consistent with empirically-observed errors in expectations and being able to endogenously generate credit cycles. Such behavioral biases have been emphasized at least since Minsky (2008) and Kindleberger (1978), and they are formally modeled in a number of recent studies. For example, in Gennaioli et al. (2012), investors neglect tail risks which leads to aggressive lending by the financial sector via debt contracts. In Landvoigt (2016), the lending boom is instigated when creditors underestimate the true default risk of mortgages. In Greenwood et al. (2016), exuberant credit market sentiment boosts lending because lenders mistakenly extrapolate previously low defaults when granting new loans. Bordalo et al. (2017) provide micro-foundations for such mistakes by lenders, which they refer to as "diagnostic expectations."

These behavioral biases can be viewed as the cause of the reduced form credit supply expansions in the models discussed above. For example, perhaps lenders begin lending to lower credit quality

borrowers because they mistakenly believe that the probability of default for such borrowers is lower. Or perhaps mortgage credit spreads fall because lenders become more optimistic about house price growth, as in Kaplan et al. (2017).

A further advantage of the behavioral models is that they may be able to generate endogenously a reversal in credit supply after an expansion driven by behavioral biases. For example, Bordalo et al. (2017) generate predictable reversals in credit supply given the biased expectations formed by investors. As they note, "following this period of narrow credit spreads, these spreads predictably rise on average ... while investment and output decline ...". While the exact timing of the reversal is not known, a rise in credit supply driven by lender optimism eventually reverts as lenders become pessimistic.

6 What Drives Credit Supply Expansion?

Much of the theoretical and empirical work on the credit-driven household demand channel takes the credit supply expansion as given. But what is the shock that leads to an expansion in credit supply? We should admit up front that we have now entered the more speculative part of this essay. The evidence currently available is less conclusive on this question.

In our view, credit supply expansion is likely due to an initial shock that creates an excess of savings relative to investment demand in some part of the global financial system, what we call a financial excess. Such a financial excess is the initial shock, and then behavioral biases, financial innovation, and malfeasance within the financial sector act as crucial amplification mechanisms.

Perhaps the most popular version of such a financial excess is the "global savings glut" hypothesis articulated in Bernanke (2005), who focuses on the "metamorphosis of the developing world from a net user to a net supplier of funds to international capital markets." In response to financial crises in the late 1990s and early 2000s, governments in emerging markets began to accumulate foreign reserves, which in turn led to declining global interest rates, the rise of dollar-denominated assets, and current account deficits in many advanced economies. Alpert (2013) and Wolf (2014) both place high importance on the global savings glut as a reason for the boom and bust in economic activity from 2000 to 2010 in many advanced economies.

We can look back further in history for another example: the Latin American debt crisis of the

early 1980s. Bernal (1982) focuses on external debt of non-oil developing countries from 1973 to 1982, which increased from $97 billion to $505 billion. He shows that syndicated bank loan interest spreads over LIBOR on loans to these countries fell from 1.6% to 0.7% during the credit expansion. This evidence is confirmed in Devlin (1989), who focuses on bank loans to Latin American countries during the late 1970s. As he writes, "by 1977 not only did loan volume continue to rise but the terms of lending softened as the situation moved back into a so-called borrowers' market ... beginning in 1977 spreads came down sharply and maturities were commonly awarded in excess of five years. The trend toward lower spreads and longer maturities became sharply accentuated in 1978 to 1980."

What was the source of this expansion in credit supply? Pettis (2017) points to financial excesses created by OPEC countries: "in the early 1970s, for example, as a newly assertive OPEC drove up oil prices and deposited their massive surplus earnings in international banks, these banks were forced to find borrowers to whom they could recycle these flows. They turned to a group of middle-income developing countries, including much of Latin America." Devlin (1989) also points to the dramatic increase in oil prices in 1973 and 1974 as a source of credit supply expansion. As he points out, a large fraction of the surplus dollars earned by oil-producing countries entered the international private banking system. In response, "banks become much more active lenders, and the scope of their operations expanded enormously." Similarly, Folkerts-Landau (1985) writes that "the international payments imbalances generated by the oil price increase of 1973 provided an unprecedented opportunity for the international credit markets to expand."

In both of the examples above, a set of countries experiences an expansion in credit supply because of financial excesses created in the international financial system. The reasons that these excesses make it into any given country may be due to the level of financial development, the regulation of the banking system, or even cultural attitudes toward borrowing. However, examples of a shock leading to financial excesses in a closed-economy setting are less common.

One such example proposed by Kumhof et al. (2015) is a rise in income inequality. They are motivated by the large increases in income inequality that took place prior to both the Great Depression and Great Recession. In both episodes, there was a simultaneous large increase in debt to income ratios among lower- and middle-income households. In their model, a rise in income inequality leads to more funds entering the financial system as high income households have a preference for wealth accumulation and therefore a high marginal propensity to save. As they put

it, "... top earners ... use a larger share of [their income] to accumulate financial wealth in the form of loans to bottom earners." A rise in income equality acts as a credit supply expansion to middle and lower income households, and the main channel is a "push" factor coming from the financial sector. The model also predicts a decline in the interest rate on household borrowing, which is consistent with the empirical evidence.

Scholars have also pointed to financial liberalization and financial deregulation as a source of credit supply expansions, especially for smaller open economies. For example, Kindelberger and Aliber (2005) write that "a particular recent form of displacement that shocks the system has been financial liberalization or deregulation in Japan, the Scandinavian countries, some of the Asian countries, Mexico, and Russia. Deregulation has led to monetary expansion, foreign borrowing, and speculative investment." Two studies mentioned above exploit variation across the United States in banking deregulation: Di Maggio and Kermani (2017) and Mian et al. (2017a). Both show that states that experience more deregulation see a bigger increase in credit supply during aggregate credit expansion episodes.

The Latin American debt crisis of the early 1980s was preceded by a round of deregulation that many scholars point to as a source of the rapid expansion in debt (e.g., Diaz-Alejandro (1985)). As Ronald McKinnon noted in 1985, "... the case of the Southern Cone in the 1970s and early 1980s is hardly very pure; in this period virtually all less developed countries over-borrowed, and then got themselves into a debt crisis. This era was complicated by a recycling from the oil shock on the one hand, and then what I consider to be a major breakdown in the public regulation of risk-taking Western banks on the other. The result was gross overlending by banks in the world economy at large and to the Third World in particular."

Scholars focused on the Scandinavian banking crises of the late 1980s and early 1990s come to a similar conclusion. In his overview of the banking crises in Norway, Finland, and Sweden, Englund (1999) concludes that "newly deregulated credit markets after 1985 stimulated a competitive process between financial institutions where expansion was given priority." Jonung et al. (2008) focus on the banking crises in Sweden and Finland. As they write, "the boom-bust process starts with a deregulation of financial markets leading to a rapid inflow of capital to finance domestic investments and consumption."

From the perspective of a given country or state, deregulation of the financial sector may lead

to capital inflows and a credit supply expansion. In this sense, deregulation is the shock that leads to an expansion in credit supply from the perspective of the country or state. This tells us where credit lands, but it still leaves open the question of why so much credit is looking for a place to land in the first place. It is for this reason we give the financial excesses view more importance as the initial shock starting the expansion process. But the level of regulation or efforts at deregulation will help determine where credit is directed during credit supply expansions.

7 Directions for Future Research

The credit-driven household demand channel is the idea that credit supply expansions, operating through household demand, are an important source of business cycles. The Great Recession is the most prominent example, but this phenomenon is present in many episodes the world has witnessed over the past 50 years.

In this article, we have shown evidence supporting the three main pillars of the credit-driven household demand channel. First, credit supply expansions lead to a boom-bust cycle in household debt and real economic activity. Second, expansions tend to affect the real economy through a boost to household demand as opposed to an increase in productive capacity of firms. And third, the downturn is driven initially by a decline in aggregate demand which is further amplified by nominal rigidities, constraints on monetary policy, banking sector disruptions, and legacy distortions from the boom. Perhaps most importantly, financial crises should not be viewed as exogenous shocks affecting an otherwise stable economy. Instead, they are a product of excesses that take place before the crash.

There are a number of open questions requiring more research. Perhaps the most important open question is the fundamental source of credit supply expansions. What causes lenders to suddenly increase credit availability? How should we model such a force? Another important question surrounds the turning point of the cycle. Why do some credit booms end in a crash while others may not? What is the precise shock that initiates the crisis stage?

And what about policy implications? Should regulators impose macro-prudential limits on household debt? Should monetary policy-makers "lean against the wind" during credit supply expansions? Should the government encourage the use of debt contracts? During the bust, what

is the most effective policy at limiting the damage coming from the collapse in aggregate demand? We have addressed these questions elsewhere (Mian and Sufi (2015), Mian and Sufi (2017c)), but definitive answers require more investigation on both the theoretical and empirical fronts.

Finally, while we have emphasized the business cycle implications of the credit-driven household demand channel, we believe the analysis presented here is relevant for longer-run growth considerations. Since 1980, advanced economies of the world have experienced four key trends. Most advanced economies have seen a substantial rise in wealth and income inequality. Borrowing costs have fallen dramatically, especially on risk-free debt. Household debt to GDP ratios have increased substantially, and most of bank lending is now done via mortgages (Jordà et al. (2016)). Finally, the financial sector has grown as a fraction of GDP.

Are these four patterns linked? Can they help explain why global growth for advanced economies has been so weak since the onset of the Great Recession in 2007 (e.g., Summers (2014))? One preliminary idea is that there is a global excess supply of savings coming from both the rise in income inequality in advanced economies and the tendency of some emerging economies to export capital to advanced economies. This excess savings leads to growth in the financial sector, a decline in interest rates, and a rise in household debt burdens of households in advanced economies outside the very top of the income distribution. The connection to growth is still an open question, and we look forward to future research addressing it.

References

Acemoglu, Daron and Pascual Restrepo, "Robots and jobs: Evidence from US labor markets," 2017.

_ , David Autor, David Dorn, and Gordon H Hanson, "Import Competition and the Great US Employment Sag of the 2000s," *Journal of Labor Economics*, 2016, *34* (1), 141–98.

Adelino, Manuel, Antoinette Schoar, and Felipe Severino, "Credit supply and house prices: Evidence from mortgage market segmentation," *Available at SSRN 1787252*, 2014.

_ , _ , and _ , "Dynamics of Housing Debt in the Recent Boom and Bust," in "NBER Macroeconomics Annual 2017, volume 32," University of Chicago Press, 2017.

Agarwal, Sumit, Gene Amromin, Itzhak Ben-David, Souphala Chomsisengphet, Tomasz Piskorski, and Amit Seru, "Policy Intervention in Debt Renegotiation: Evidence from the Home Affordable Modification Program," *Journal of Political Economy*, 2017, *125* (3).

_ , Souphala Chomsisengphet, Neale Mahoney, and Johannes Stroebel, "Do Banks Pass Through Credit Expansions to Consumers Who Want To Borrow? Evidence from Credit Cards," *forthcoming, Quarterly Journal of Economics*, 2017.

Alpert, Daniel, *The Age of Oversupply: Overcoming the Greatest Challenge to the Global Economy*, Portfolio, 2013.

Andersen, Asger L., Charlotte Duus, and Thais L. Jensen, "Household Debt and Consumption During the Financial Crisis: Evidence from Danish Micro Data," 2014. Working Paper.

Anenberg, Elliot and Edward Kung, "Estimates of the Size and Source of Price Declines Due to Nearby Foreclosures," *The American Economic Review*, 2014, *104* (8), 2527–51.

_ , Aurel Hizmo, Edward Kung, and Raven Molloy, "Measuring Mortgage Credit Availability: A Frontier Estimation Approach," 2017. Working Paper.

Bahadir, Berrak and Inci Gumus, "Credit decomposition and business cycles in emerging market economies," *Journal of International Economics*, 2016, *103*, 250–262.

Baker, Scott R, "Debt and the Response to Household Income Shocks: Validation and Application of Linked Financial Account Data," *Journal of Political Economy*, 2018.

Baron, Matthew and Wei Xiong, "Credit expansion and neglected crash risk," *Quarterly Journal of Economics*, 2017, pp. 713–64.

Benmelech, Efraim, Ralf Meisenzahl, and Rodney Ramcharan, "The Real Effects of Liquidity During the Financial Crisis: Evidence from Automobiles," *The Quarterly Journal of Economics*, 2017, *132* (1), 317–65.

Beraja, Martin, Andreas Fuster, Erik Hurst, and Joseph Vavra, "Regional Heterogeneity and Monetary Policy," Working Paper 23270, National Bureau of Economic Research August 2017.

Bernal, Richard, "Transnational Banks, the International Monetary Fund and External Debt of Developing Countries," *Social and Economic Studies*, 1982, *31* (4), 71–101.

Bernanke, Ben, "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression," *American Economic Review*, June 1983, *73* (3), 257–76.

_ , "The Global Saving Glut and the U.S. Current Account Deficit," March 2005. Speech at the Sandridge Lecture, Virginia Association of Economists, Richmond, Virginia.

_ **and Mark Gertler**, "Agency Costs, Net Worth, and Business Fluctuations," *American Economic Review*, 1989, *79* (1), 14–31.

Bernanke, Ben S, Mark Gertler, and Simon Gilchrist, "The financial accelerator in a quantitative business cycle framework," *Handbook of macroeconomics*, 1999, *1*, 1341–1393.

Bhutta, Neil, "The ins and outs of mortgage debt during the housing boom and bust," *Journal of Monetary Economics*, 2015, *76*, 284–98.

Bianchi, Javier, "Overborrowing and Systemic Externalities in the Business Cycle," *American Economic Review*, 2011, *101* (7), 3400–3426.

Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer, "Diagnostic Expectations and Credit Cycles," *Journal of Finance*, 2017.

Borio, Claudio, "The financial cycle and macroeconomics: What have we learnt?," *Journal of Banking & Finance*, 2014, *45*, 182–198.

_ **, Enisse Kharroubi, Christian Upper, and Fabrizio Zampolli**, "Labour reallocation and productivity dynamics: financial causes, real consequences," 2016. BIS Working Paper.

Bunn, Philip and May Rostom, "Household Debt and Spending in the United Kingdom," 2015. Bank of England Working Paper.

Caballero, Ricardo J. and Arvind Krishnamurthy, "International and domestic collateral constraints in a model of emerging market crises," *Journal of Monetary Economics*, 2001, *48 (3)* (2), 513–548.

Charles, Kerwin Kofi, Erik Hurst, and Matthew J Notowidigdo, "Housing booms and busts, labor market opportunities, and college attendance," *National Bureau of Economic Research*, 2015.

Chodorow-Reich, Gabriel, "The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis," *The Quarterly Journal of Economics*, 2014, *129* (1), 1–59.

Chomsisengphet, Souphala and Anthony Pennington-Cross, "Subprime Refinancing: Equity Extraction and Mortgage Termination," *Real Estate Economics*, 2007, *35*, 233–63.

Dávila, Eduardo, "Dissecting Fire Sales Externalities," 2015. Working Paper.

Demyanyk, Yuliya and Otto Van Hemert, "Understanding the subprime mortgage crisis," *Review of financial Studies*, 2011, *24* (6), 1848–1880.

Devlin, Robert, *Debt and Crisis in Latina America: The Supply Side of the Story*, Princeton University Press: Princeton, 1989.

Diaz-Alejandro, Carlos, "Good-Bye Financial Repression, Hello Financial Crash," *Journal of Development Economics*, 1985, *19* (1-2), 1–24.

Drehmann, Mathias, Mikael Juselius, and Anton Korinek, "Accounting for debt service: the painful legacy of credit booms," BIS Working Papers No 645 June 2017.

Eggertsson, Gauti B. and Paul Krugman, "Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach," *Quarterly Journal of Economics*, 2012, *127* (3), 1469–1513.

Englund, Peter, "The Swedish banking crisis: roots and consequences," *Oxford review of economic policy*, 1999, *15* (3), 80–97.

Fahlenbrach, Rüdiger, Robert Prilmeier, and René M Stulz, "Why Does Fast Loan Growth Predict Poor Performance for Banks?," *Review of Financial Studies, forthcoming*, 2017.

Farhi, Emmanuel and Iván Werning, "A Theory of Macroprudential Policies in the Presence of Nominal Rigidities," 2015. Working Paper.

Favara, Giovanni and Jean Imbs, "Credit supply and the price of housing," *The American Economic Review*, 2015, *105* (3), 958–992.

Favilukis, Jack, David Kohn, Sydney C Ludvigson, and Stijn Van Nieuwerburgh, "International capital flows and house prices: Theory and evidence," in "Housing and the Financial Crisis," University of Chicago Press, 2012, pp. 235–299.

_ , Sydney C. Ludvigsson, and Stijn Van Nieuwerburgh, "The Macroeconomic Effects of Housing Wealth, Housing Finance, and Limited Risk-Sharing in General Equilibrium," *The Journal of Political Economy*, 2017, *125* (1), 140–223.

Folkerts-Landau, David, "The Changing Role of International Bank Lending in Development Finance," *IMF Staff Papers*, 1985, *32* (2), 317–63.

Foote, Christopher L, Kristopher S Gerardi, and Paul S Willen, "Why did so many people make so many ex post bad decisions? The causes of the foreclosure crisis," Technical Report, National Bureau of Economic Research 2012.

Garriga, Carlos, Rodolfo Manuelli, and Adrian Peralta-Alva, "A macroeconomic model of price swings in the housing market," *Federal Reserve Bank of Saint Louis Working Paper*, 2017.

Geanakoplos, John, "The Leverage Cycle," *NBER Macroeconomics Annual 2009, Volume 24*, April 2010, pp. 1–65.

Gennaioli, Nicola, Andrei Shleifer, and Robert Vishny, "Neglected risks, financial innovation, and financial fragility," *Journal of Financial Economics*, 2012, *104* (3), 452–468.

Giroud, Xavier and Holger M. Mueller, "Firm Leverage, Consumer Demand, and Unemployment during the Great Recession," *Quarterly Journal of Economics, forthcoming*, 2017.

Glick, Reuven and Kevin J. Lansing, "Global household leverage, house prices, and consumption," *FRBSF Economic Letter*, 2010, (11).

Gopinath, Gita, Sebnem Kalemli-Ozcan, Loukas Karabarbounis, and Carolina Villegas-Sanchez, "Capital Allocation and Productivity in South Europe," Working Paper 21453, National Bureau of Economic Research August 2016.

Greenwald, Daniel L, "The Mortgage Credit Channel of Macroeconomic Transmission," *Available at SSRN 2735491*, 2016.

Greenwood, Robin and Samuel G. Hanson, "Issuer Quality and Corporate Bond Returns," *Review of Financial Studies*, 2013, *26* (6), 1483–1525.

_ , Samuel G Hanson, and Lawrence J Jin, "A Model of Credit Market Sentiment," 2016.

Griffin, John M. and Gonzalo Maturana, "Did Dubious Mortgage Origination Practices Distort House Prices?," *The Review of Financial Studies*, 2016, *29*, 1671–1708.

_ and _ , "Who Facilitated Misreporting in Securitized Loans?," *The Review of Financial Studies*, 2016, *29*, 384–419.

Guerrieri, Veronica and Guido Lorenzoni, "Credit crises, precautionary savings, and the liquidity trap," *The Quarterly Journal of Economics*, 2017, *132* (3), 1427–1467.

Gupta, Arpit, "Foreclosure contagion and the neighborhood spillover effects of mortgage defaults," 2016.

Guren, Adam and Tim McQuade, *How do foreclosures exacerbate housing downturns?*, Joint Center for Housing Studies, Harvard University, 2015.

Hall, Robert E, "The Long Slump," *American Economic Review*, 2011, *101*, 431–469.

Huo, Zhen and Josè-Víctor Ríos-Rull, "Financial Frictions, Asset Prices, and the Great Recession," 2016. Working Paper.

IMF, "Dealing with Household Debt," in "World Economic Outlook, April" April 2012.

_ , "Household Debt and Financial Stability," in "Global Financial Stability Report, October" October 2017.

Jayaratne, Jith and Philip E Strahan, "The finance-growth nexus: Evidence from bank branch deregulation," *The Quarterly Journal of Economics*, 1996, pp. 639–670.

Jonung, Lars, Jaakko Kiander, and Vartia Pentti, "How costly was the crisis of the 1990s? A comparative analysis of the deepest crises in Finland and Sweden over the last 130 years," Technical Report 367, European Economy: Economic Papers 2008.

Jordà, Òscar, Moritz Schularick, and Alan M Taylor, "Betting the house," *Journal of International Economics*, 2015, *96*, S2–S18.

_ , _ , and _ , "The great mortgaging: housing finance, crises and business cycles," *Economic Policy*, 2016, *31* (85), 107–152.

Justiniano, Alejandro, Giorgio E. Primiceri, and Andrea Tambalotti, "Credit Supply and the Housing Boom," Working Paper 20874, National Bureau of Economic Research January 2015.

_ , _ , and _ , "The Mortgage Rate Conundrum," 2017. Working Paper.

Kalantzis, Yannick, "Financial fragility in small open economies: firm balance sheets and the sectoral structure," *The Review of Economic Studies*, 2015, *82* (3), 1194–1222.

Kaplan, Greg, Kurt Mitman, and Giovanni L Violante, "The Housing Boom and Bust: Model Meets Evidence," Technical Report, National Bureau of Economic Research 2017.

Keys, Benjamin J, Tanmoy Mukherjee, Amit Seru, and Vikrant Vig, "Did securitization lead to lax screening? Evidence from subprime loans," *The Quarterly journal of economics*, 2010, *125* (1), 307–362.

Kindelberger, Charles P and Robert Z Aliber, *Manias, panics and crashes: A history of financial crises*, Palgrave Macmillan, 2005.

Kindleberger, Charles, *Manias, Panics and Crashes: A history of financial crises*, New York, Basic Books, 1978.

King, Mervyn, "Debt deflation: Theory and evidence," *European Economic Review*, 1994, *38*, 419–445.

Kiyotaki, Nobuhiro, Alexander Michaelides, and Kalin Nikolov, "Winners and losers in housing markets," *Journal of Money, Credit and Banking*, 2011, *43* (2-3), 255–296.

_ **and John Moore**, "Credit Cycles," *The Journal of Political Economy*, 1997, *105* (2), 211–248.

Korinek, Anton and Alp Simsek, "Liquidity trap and excessive leverage," *The American Economic Review*, 2016, *106* (3), 699–738.

Krishnamurthy, Arvind and Tyler Muir, "How credit cycles across a financial crisis," *Working paper*, 2017.

Kroszner, Randall S. and Philip E. Strahan, *Regulation and Deregulation of the U.S. Banking Industry: Causes, Consequences, and Implications for the Future*, University of Chicago Press, 2014.

Kumhof, Michael, Romain Ranciere, and Pablo Winant, "Inequality, Leverage, and Crises," *American Economic Review*, 2015, *105*, 1217–1245.

Laibson, David and Johanna Mollerstrom, "Capital flows, consumption booms and asset bubbles: A behavioural alternative to the savings glut hypothesis," *The Economic Journal*, 2010, *120* (544), 354–374.

Landvoigt, Tim, "Financial Intermediation, Credit Risk, and Credit Supply during the Housing Boom," *Unpublished Paper, UT Austin, McCombs School of Business*, 2016.

_ **, Monika Piazzesi, and Martin Schneider**, "The housing market(s) of San Diego," *The American Economic Review*, 2015, *105* (4), 1371–1407.

Levitin, Adam J. and Susan M. Wachter, "Explaining the Housing Bubble," 2012. Working Paper.

López-Salido, David, Jeremy C Stein, and Egon Zakrajšek, "Credit-market sentiment and the business cycle," *The Quarterly Journal of Economics*, 2017, p. qjx014.

Lorenzoni, Guido, "Inefficient Credit Booms," *The Review of Economic Studies*, 2008, *75* (3), 809–833.

Maggio, Marco Di, Amir Kermani, Benjamin J. Keys, Tomasz Piskorski, Ramcharan Rodney, Amit Seru, and Vincent Yao, "Interest Rate Pass-Through: Mortgage Rates, Household Consumption, and Voluntary Deleveraging," *American Economic Review, forthcoming*, 2017.

_ **and** _ , "Credit-induced boom and bust," *The Review of Financial Studies*, November 2017, *30* (11), 3711–58.

Martin, Philippe and Thomas Philippon, "Inspecting the Mechanism: Leverage and the Great Recession in the Eurozone," *American Economic Review*, July 2017, *107* (7), 1904–37. Working Paper.

Mayer, Christopher, "Housing Bubbles: A Survey," *Annual Review of Economics*, 2011, *3*, 559–77.

Mertens, Karel and Morten O. Ravn, "The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States," *American Economic Review*, June 2013, *103* (4), 1212–47.

Mian, Atif, Amir Sufi, and Francesco Trebbi, "Foreclosures, house prices, and the real economy," *The Journal of Finance*, 2015, *70* (6), 2587–2634.

_ **and** _ , "The Consequences of Mortgage Credit Expansion: Evidence from the U.S. Mortgage Default Crisis," *The Quarterly Journal of Economics*, 2009, *124* (4), pp. 1449–1496.

_ **and** _ , "Household Leverage and the Recession of 2007-09," *IMF Economic Review*, 2010, *58* (1), 74–117.

_ **and** _ , "House prices, home equity–based borrowing, and the us household leverage crisis," *The American Economic Review*, 2011, *101* (5), 2132–2156.

_ **and** _ , "What Explains the 2007–2009 Drop in Employment?," *Econometrica*, 2014, *82* (6), 2197–2223.

_ **and** _ , *House of debt: How they (and you) caused the Great Recession, and how we can prevent it from happening again*, University of Chicago Press, 2015.

_ **and** _ , "Fraudulent income overstatement on mortgage applications during the credit expansion of 2002 to 2005," *The Review of Financial Studies*, 2017, *30* (6), 1832–1864.

_ **, Kamalesh Rao, and Amir Sufi**, "Household Balance Sheets, Consumption, and the Economic Slump," *The Quarterly Journal of Economics*, 2013, *128* (4), 1687–1726.

Mian, Atif R, Amir Sufi, and Emil Verner, "Credit Supply and Business Cycle Ampli cation: Evidence from Banking Deregulation in the 1980s," 2017.

_ **,** _ **, and** _ , "Household debt and business cycles worldwide," *forthcoming, Quarterly Journal of Economics*, 2017.

_ **and** _ , "Household Debt and Defaults from 2000 to 2010: The Credit Supply View," *Evidence and Innovation in Housing Law and Policy*, 2017.

_ **and** _ , "The Macroeconomic Advantages of Softening Debt Contracts," *Harvard Law and Policy Review*, 2017.

Minsky, Hyman P, *Stabilizing an unstable economy*, Vol. 1, McGraw-Hill New York, 2008.

Pettis, Michael, "Is Peter Navarro Wrong on Trade?," February 2017.

Piskorski, Tomasz, Amit Seru, and James Witkin, "Asset quality misrepresentation by financial intermediaries: evidence from the RMBS market," *The Journal of Finance*, 2015, *70* (6), 2635–2678.

Schmitt-Grohé, Stephanie and Martín Uribe, "Downward Nominal Wage Rigidity, Currency Pegs, and Involuntary Unemployment," *Journal of Political Economy*, 2016.

Shleifer, Andrei and Robert W. Vishny, "Liquidation Values and Debt Capacity: A Market Equilibrium Approach," *The Journal of Finance*, 1992, *47* (4), 1343–1366.

Sufi, Amir, "Out of many, one? Household debt, redistribution and monetary policy during the economic slump," *Andrew Crockett Memorial Lecture, BIS*, 2015.

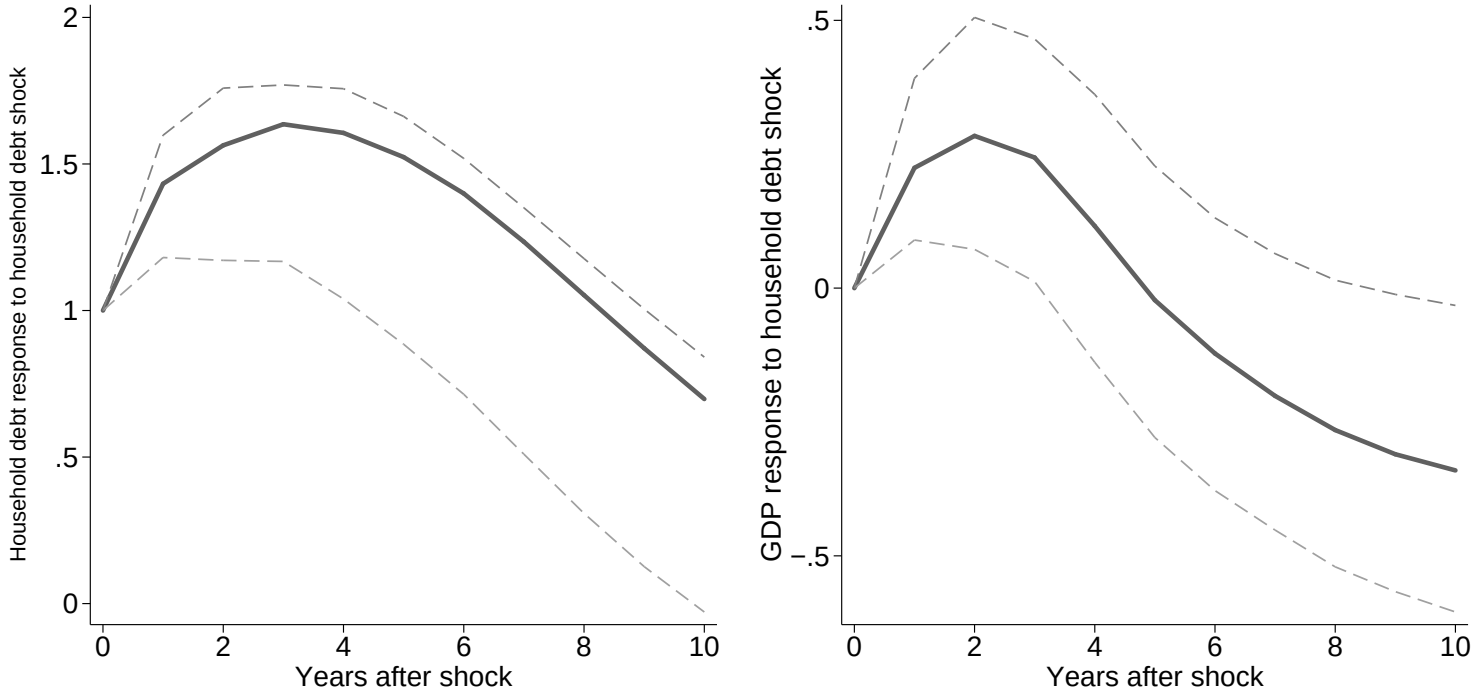
Summers, Lawrence H, "US economic prospects: Secular stagnation, hysteresis, and the zero lower bound," *Business Economics*, 2014, *49* (2), 65–73.

Verner, Emil and Gyozo Gyongyosi, "Household Debt Revaluation and the Real Economy: Evidence from a Foreign Currency Debt Crisis," 2017.

Wolf, Martin, *The Shifts and the Shocks: What We've Learned–and Have Still to Learn–from the Financial Crisis*, Penguin Books, 2014.

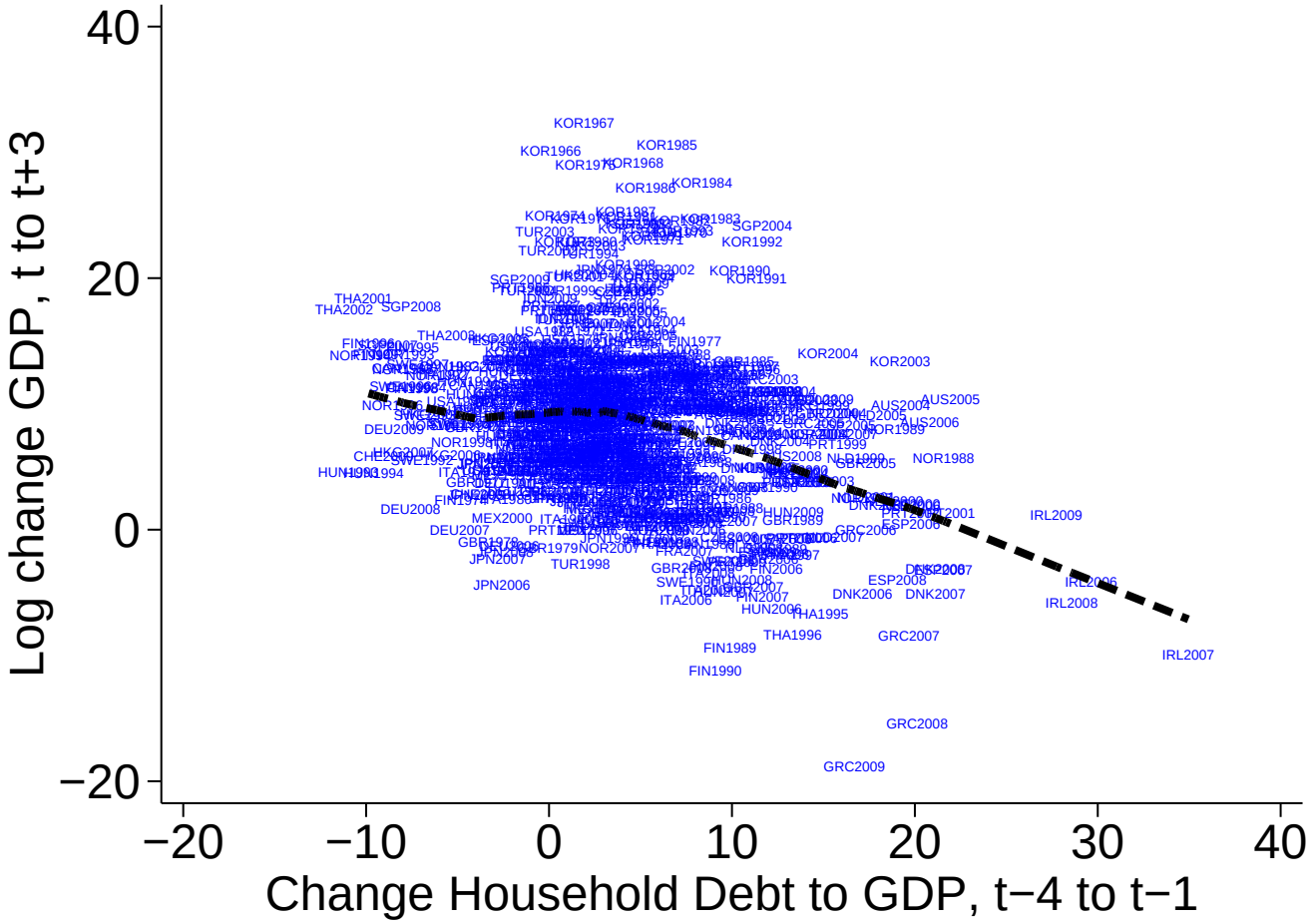
Yagan, Danny, "Employment Hysteresis from the Great Recession," Technical Report, National Bureau of Economic Research 2017.

Figure 2 Household Credit Cycle and Business Cycle



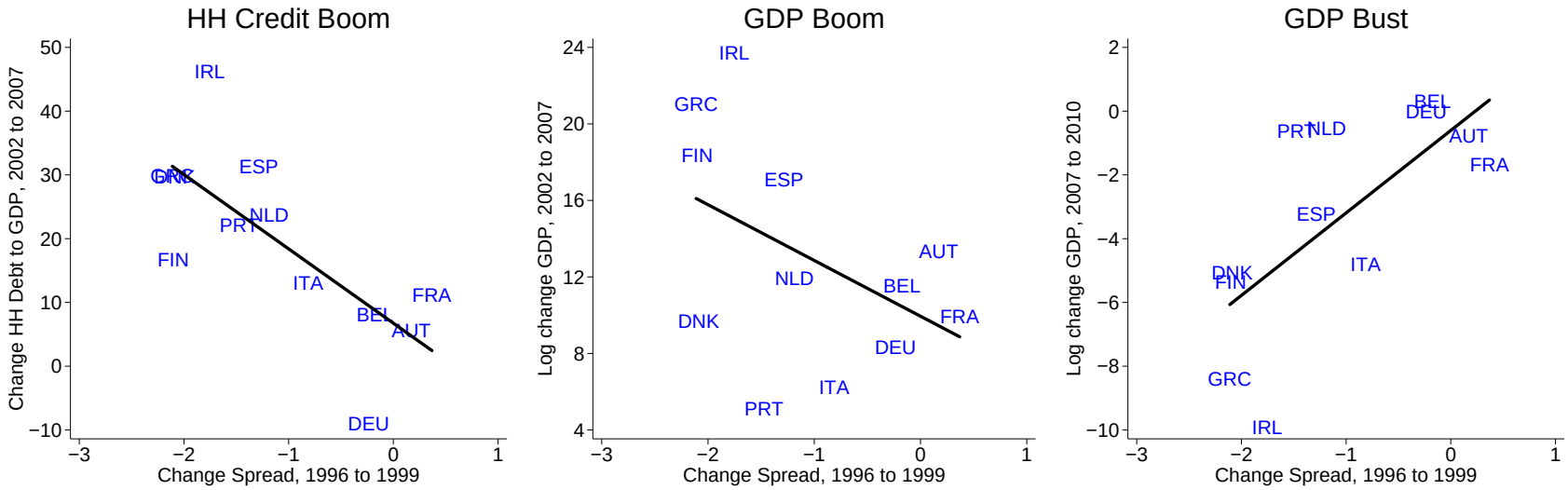
Notes: This figure plots the impulse response function of the household debt to lagged GDP ratio (left panel) and log real GDP (right panel) to a shock to the household debt to lagged GDP ratio from a vector auto-regression. Please see Mian et al. (2017b) for more details.

Figure 3 Rise in Household Debt Predicts Lower GDP Growth



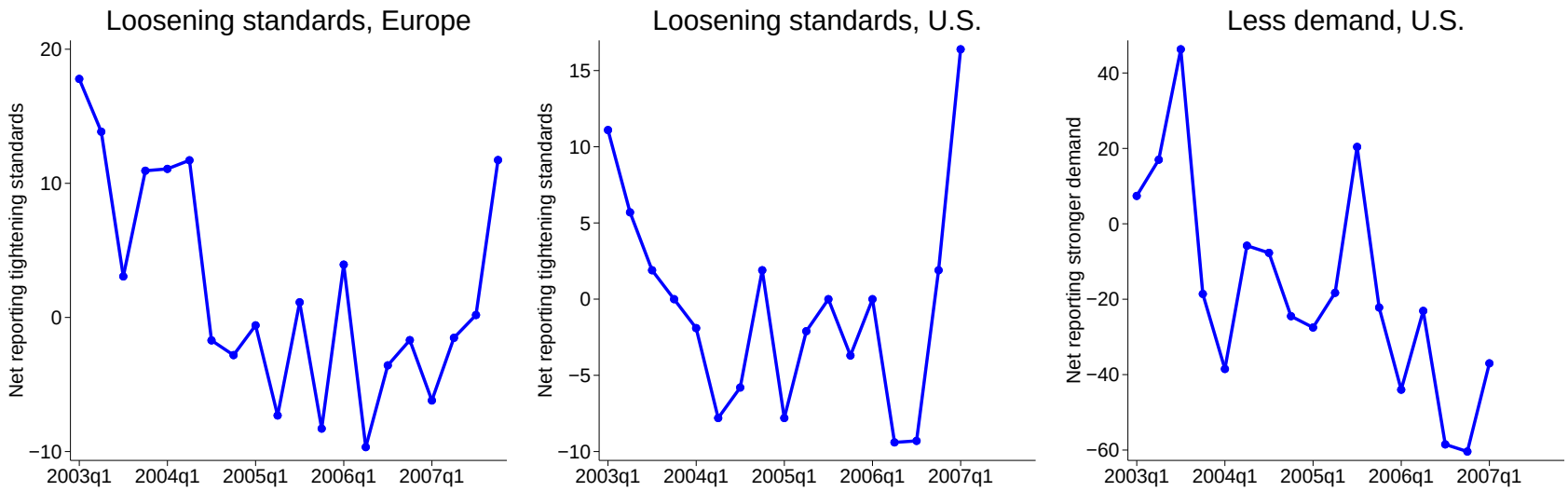
Notes: This figure plots real GDP growth from year t to $t+3$ against the rise in the household debt to GDP ratio from year $t-4$ to year $t-1$. Please see Mian et al. (2017b) for more details.

Figure 4 Eurozone Experiment



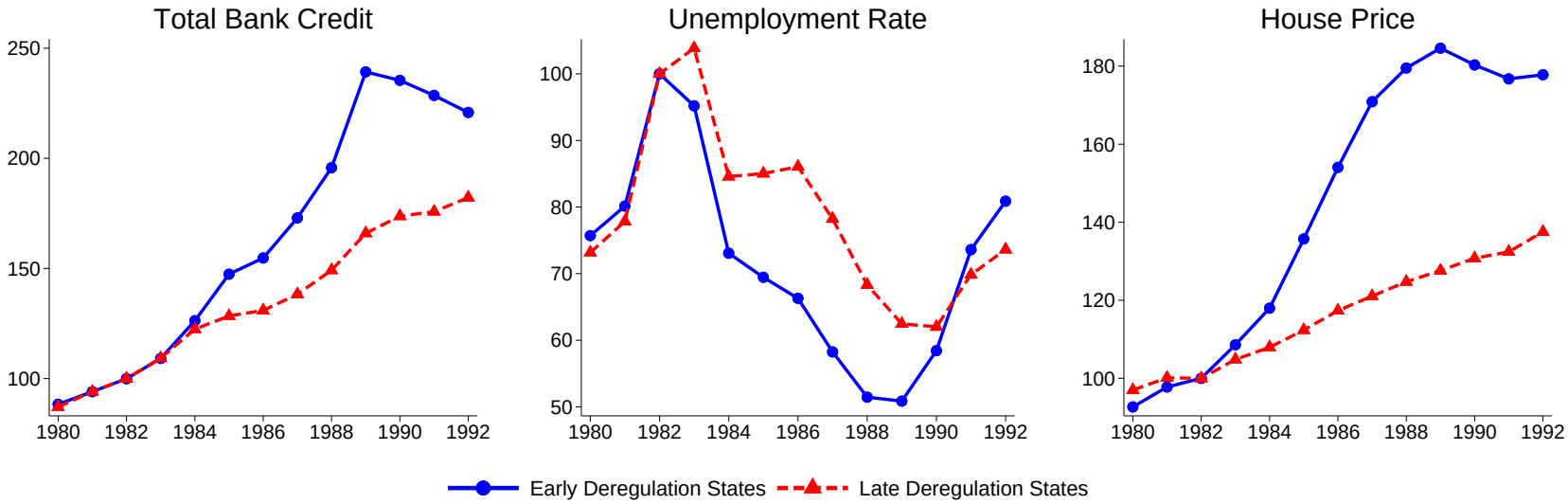
Notes: This figure plots various outcomes agains the change in the sovereign interest spread from 1996 to 1999 in countries that joined the euro currency zone. The sovereign interest spread is the interest rate on the 10-year government bond of the given country relative to the interest rate on the 10-year government bond of the United States. Please see Mian et al. (2017b) for more details.

Figure 5 Lending Standards



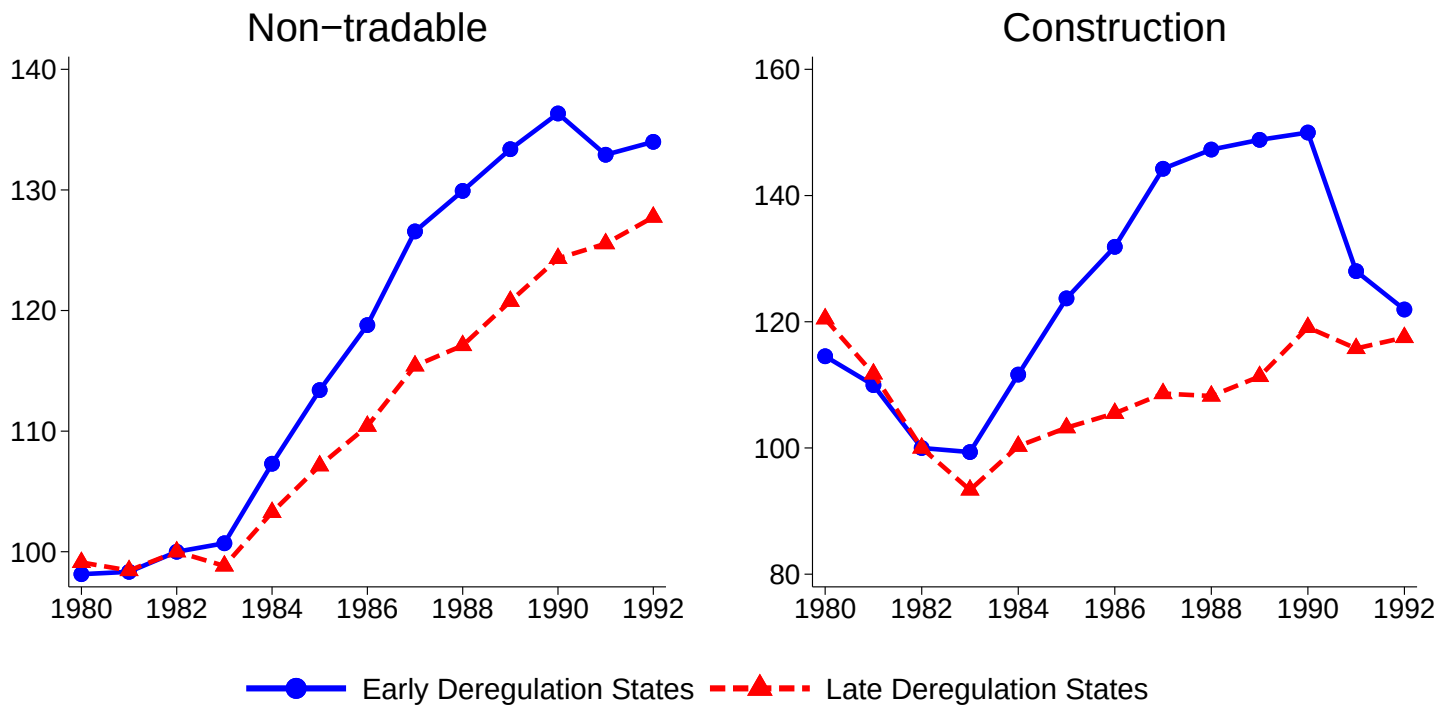
Notes: The left and middle panels of this figure plot lending standards according to loan officers in Europe and the United States, respectively. The right panel plots demand strength for mortgages as reported by loan officers in the United States. For more information, see Favilukis et al. (2012).

Figure 6 U.S. Deregulation Experiment



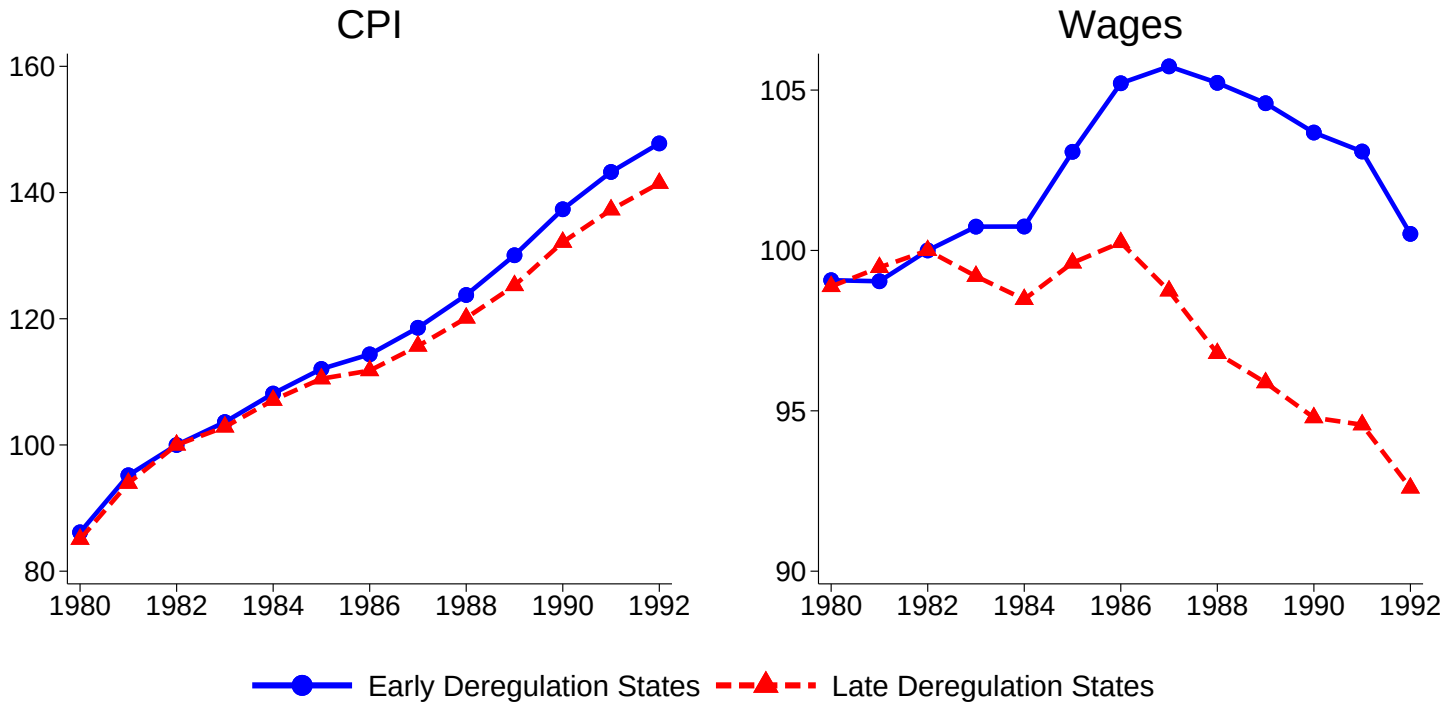
Notes: This figure plots outcomes for states in the United States that deregulated restrictions on inter- and intra-state branching early versus late in the 1970s and 1980s. For more information, see Mian et al. (2017a).

Figure 7 U.S. Deregulation Experiment: Demand



Notes: This figure plots outcomes for states in the United States that deregulated restrictions on inter- and intra-state branching early versus late in the 1970s and 1980s. For more information, see Mian et al. (2017a).

Figure 8 U.S. Deregulation Experiment: CPI/Wages



Notes: This figure plots outcomes for states in the United States that deregulated restrictions on inter- and intra-state branching early versus late in the 1970s and 1980s. For more information, see Mian et al. (2017a).