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Sowing the Seeds of Financial Imbalances: The Role of Macroeconomic Performance

Elena Afanasyeva,* Sam Jerow† Seung Jung Lee‡ Michele Modugno§¶

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Abstract

The seeds of financial imbalances are sown in times of buoyant economic growth. We study the link between macroeconomic performance and financial imbalances, focusing on the experience of the United States since the 1960s. We first follow a narrative approach to review historical episodes of significant financial imbalances and find that the onset of financial disturbances typically occurs when the economy is running hot. We then look for evidence of a statistical link between measures of macroeconomic conditions and financial imbalances. In our in-sample analysis, we find that strong economic growth is followed by a build-up of financial imbalances across all dimensions of the National Financial Conditions Index. In our out-of-sample analysis, we find that the link between strong economic performance and increases in nonfinancial leverage is particularly strong and robust. Using a structural VAR identified with narrative sign restrictions, we also demonstrate that business cycle shocks are important drivers of nonfinancial leverage.

JEL classification: C32; G21; N22.

Keywords: Economic Performance; Nonfinancial Leverage; Financial Imbalances; Financial Stability; Forecasting; VARs; Sign Restrictions; Narrative.

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1 Introduction

“... I think that allowing the economy to run markedly and persistently “hot” would be risky and unwise... The combination of persistently low interest rates and strong labor market conditions could lead to undesirable increases in leverage and other financial imbalances, although such risks would likely take time to emerge...”

-Janet Yellen (2017)

Are seeds of financial imbalances sown in good times? Does high economic growth have implications for financial stability? Although profits of firms and financial intermediaries tend to grow in expansions, a buoyant economic environment can also potentially contribute to the build-up of financial imbalances, as risk tolerance decreases, expectations become optimistic, and financial constraints loosen. Some theories, including the well-known financial instability hypothesis by Minsky (1972), would explain how financial imbalances can emerge this way.¹ Much less is known about the empirical regularities underlying this causality direction from strong economic performance to financial instability. Our paper fills this gap.

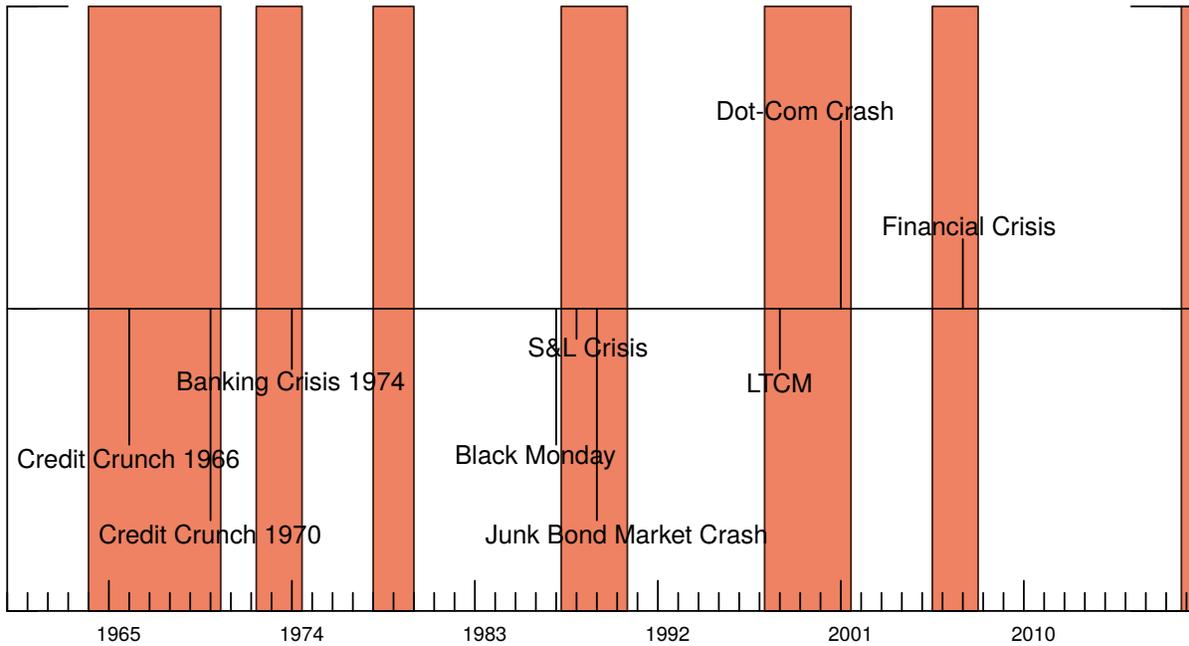
We focus on the experience of the U.S. economy from the 1960s to the present and employ a combination of narrative and quantitative tools to study the relationship between macroeconomic conditions and financial imbalances. Overall, we find a robust positive link between strong macroeconomic performance and nonfinancial sector leverage. The result is supported by historical narrative evidence, holds in the reduced-form sense (strong economic conditions predict an increase in nonfinancial leverage) and holds in the structural sense (shocks related to business cycle have a significant and sizable effect on nonfinancial leverage).

Relying on historical accounts of financial disturbances experienced by the U.S. economy since the 1960s, we find that a common denominator for these disturbances is the foregoing good health of the economy.² The connection between the health of the economy and financial disturbances is illustrated in Figure 1. Here, we plot the onset of financial disturbances against the shaded areas, which mark periods of strong economic growth as indicated by a positive output gap or negative unemployment gap. The onset of almost all financial disturbances falls within the shaded areas, indicating suggestive evidence in favor of the link. Although historical accounts point to other contributing factors, such as financial innovation, external shocks, or regulatory and monetary policy actions, a commonality across all episodes is strong economic growth.

We complement our narrative approach with quantitative analysis. In particular, we look for evidence of an in-sample and out-of-sample statistical link between macroeconomic conditions

¹Minsky (1972) argues that sustained economic growth, business cycle booms, and the accompanying financial developments generate conditions conducive to disaster for the entire economic system.

²We define financial disturbances as disruptive outcomes that materialize as a result of financial imbalances.



Notes: The shaded areas denote periods of positive output gaps and/or negative unemployment gaps.

Figure 1: **Financial Imbalances and Macroeconomic Conditions**

and financial imbalances. We measure macroeconomic conditions with output gap, unemployment gap, or the year-on-year growth rate of real GDP. The financial imbalances are captured with the National Financial Conditions Index (NFCI) of the Chicago Fed, and its subindexes. The NFCI is a suitable measure because a range of empirical evidence has linked it to financial stability risks and because it covers, via various subindexes, a variety of financial imbalances highlighted in the narrative analysis.

For the in-sample analysis, we estimate bivariate vector autoregressive models (VARs) and derive generalized impulse response functions (GIRFs) of the measures of financial imbalances to a positive impulse in the economic slack measures. All financial imbalance responses are positive, hump-shaped with a peak at a medium horizon of about 8-12 quarters, and highly statistically significant. A similar result is obtained when we test for Granger causality, i.e., economic slack measures have predictive power for the future outcome of NFCI and its components. In both exercises, the link is particularly strong for the NFCI nonfinancial leverage subindex, with the responses larger in size, more persistent, and somewhat more statistically significant when compared to the other subindexes.

Although the in-sample analysis gives us important insights regarding the relationship among these two categories of variables, we subject the strength of the relationship to an even stricter test in

several out-of-sample exercises. In particular, we compare the accuracy of forecasts produced by the bivariate VARs described above, against that of an autoregressive process estimated on the measures of financial imbalances alone. This comparison helps us to understand whether economic slack has predictive power above and beyond the one spanned by the lags of the financial imbalances alone. Our results show that economic slack is particularly helpful in predicting nonfinancial leverage, one of the categories of financial imbalances captured by the NFCI.

We also benchmark our results with those obtained with bivariate VARs where the economic slack measures are substituted with different types of financial spreads. Specifically, we consider the term spread, the TED spread (the difference between the three-month Treasury bill and the three-month LIBOR based in US dollars), and the excess bond premium from Gilchrist and Zakrajsek (2012). As we know from the literature (Brunnermeier et al. (2019) and Lopez-Salido et al. (2017), among others), these spreads can have strong predictive power for macroeconomic conditions and hence potentially also for financial imbalances. We find that the accuracy of the predictions based on economic slack is superior to the one that can be obtained with the spreads, especially at short horizons.

These results pertain to VARs estimated on the entire available sample and therefore reflect average predictive performance across both expansions and recessions. As a next step, we therefore also focus on periods of strong growth, when the economy is above potential, and test whether the information about future economic conditions one year ahead helps predict the dynamics of nonfinancial leverage. We find that both the point and density forecasts of nonfinancial leverage capture the actual evolution of nonfinancial leverage very well, providing more substantial evidence of a strong link between macroeconomic conditions and nonfinancial leverage.³

As a final step, we employ a structural approach in order to disentangle the effects of different policy shocks from the effects of macroeconomic conditions on financial imbalances. For instance, as described in the narrative analysis, loose monetary or regulatory policy can also contribute to the build-up of nonfinancial leverage during a business cycle expansion. We estimate IRFs to aggregate demand, supply as well as to monetary policy shocks in a 5-variable VAR through traditional and narrative sign restrictions, following Antolín-Díaz and Rubio-Ramírez (2018). The results show that business cycle shocks and monetary policy shocks have significant effects on leverage. In particular, leverage increases following a positive demand, negative supply shock and in response to monetary policy loosening (risk taking channel of monetary policy). Our historical variance decomposition exercise, however, illustrates that business cycle shocks are sizable and in many cases more important contributors to the build-up of leverage in periods of strong growth compared

³Our quantitative results are also robust across several other dimensions, e.g., to different measures of macroeconomic conditions and nonfinancial leverage, lag order of VARs and ARs, as well as use of real-time data vintage for the measures of real activity.

with monetary policy shocks. Hence, the strong predictive relationship between macroeconomic conditions and nonfinancial leverage appears to be rooted in factors beyond the conduct of monetary policy.

Our paper contributes to the literature on the relationship and interactions between financial and business cycles. The Global Financial Crisis (GFC) renewed a significant interest in understanding the relationship between macroeconomic performance and financial imbalances, producing a considerable body of research. Building upon seminal theoretical work such as Fisher (1933) and Bernanke and Gertler (1989), this research has mostly focused on studying channels in which imbalances in the financial sector, such as high leverage in households or at banks, exacerbate economic downturns.⁴ Our contribution is to complement these papers in providing empirical evidence on the opposite side of this link - from macroeconomic performance to financial imbalances.

On the theoretical side, a few more recent contributions highlight alternative structural channels through which macroeconomic expansions can cause a build-up in nonfinancial leverage, as our results predict. Gorton and Ordóñez (2019) stress the role of total factor productivity (TFP) as part of the channel. An innovation to TFP starts a credit boom in the economy and can potentially exacerbate the asymmetric information problem between borrowers and lenders, who grant loans against collateral and may not check its quality. This dynamic leads to a crisis. Bordalo et al. (2018) and Cao and L'Hullier (2018) focus on the perceptions or expectations about fundamentals of the real economy (such as GDP growth or TFP). For instance, the agents in Bordalo et al. (2018)'s model overweight the good news about the state of the economy during expansions, extrapolating it further into the future, which leads to mispricing of risk during a credit boom and a subsequent crisis. Our work provides empirical support for such models of financial imbalances that are rooted in good times.

The rest of the paper is organized as follows. We present our narrative analysis in Section 2. The quantitative analysis follows in Section 3, while Section 4 offers concluding remarks.

2 Narrative approach

We rely on a meta-analysis of historical accounts—based on literature summarized in Table 1—to describe the prevailing economic conditions that characterized the times in which financial disturbances materialized.

We look at the narratives of a comprehensive list of financial disturbances since 1960. The

⁴See among others Adrian and Shin (2010), Aikman et al. (2020) Borio (2014), Claessens et al. (2012), Gilchrist and Zakrajsek (2012), Brunnermeier and Sannikov (2014), Mian and Sufi (2014), Gertler and Gilchrist (2018), and Schularick and Taylor (2012).

disturbances we consider arise from periods of credit crunches, banking crises, and financial market crashes. In our historical accounts, we also include a few episodes of financial stress that emanated from abroad and carried the potential for large adverse spillovers to the United States. Figure 1 highlights the most representative episodes, while Table 1 provides a summary of all analyzed episodes. To provide more context, the shaded historical periods are when either the unemployment rate was below its U.S. Congressional Budget Office (CBO) estimate of natural rate or in which the output was above its CBO estimate of potential.⁵

We describe in chronological order the principal financial disturbance episodes in the context of the economic environment. More detailed references to the academic sources covered in our review are available in Table 1. While we take the view that financial disturbances are signs that an imbalance of some kind was building beforehand, which allows a broad consideration of financial imbalances, we do not precisely date the start of the buildup or quantify its evolution.

The Credit Crunches of 1966 and 1970

After a moderate recession, the early 1960s was a period of sustained output growth (with annual real GDP growth above 4 percent over four years) and a significant decline in the unemployment rate from levels around 7 percent in 1961 to around 4 percent in 1966. This was also a period of high credit growth that coincided with the development of the commercial paper market and negotiable certificate of deposits as new sources of short-term funding. Banks, in turn, relied on such funding to invest more in high yield bonds. In the context of these financial innovations, tightening monetary policy in response to robust economic growth, and binding Regulation Q ceilings—which imposed restrictions on the payment of interest on savings and time deposits—contributed to the two credit crunches. The Credit Crunch of 1966 forced nonbank financial intermediaries to sell long-term illiquid assets at sizable losses. The duration of the credit crunch, however, was relatively brief and, indeed, economic growth continued. Afterward, a commercial paper default by Penn Central Transportation Company in 1970 marked the beginning of another Credit Crunch concentrated in the commercial paper market. Although emergency measures by the Federal Reserve Board (such as the suspension of Regulation Q rate ceilings on negotiable CDs of less than three months, and lending banks funds that could be lent to firms) helped avert a major financial crisis, this development effectively resulted in a tightening of lending standards and reduced borrowing capacity for businesses.

1974 Banking Crisis

⁵Output gap is measured as: $100 * (\text{Real Gross Domestic Product} - \text{Real Potential Gross Domestic Product}) / \text{Real Potential Gross Domestic Product}$. Real Gross Domestic Product data is from the U.S. Bureau of Economic Analysis, and Real Potential Gross Domestic Product data is from the U.S. CBO. Real potential GDP is the CBOs estimate of the output the economy would produce with a high rate of use of its capital and labor resources. The data are adjusted to remove the effects of inflation. Also the natural rate of unemployment is produced by the CBO, available on <https://fred.stlouisfed.org/series/NROU>.

Table 1: Summary of Historical Analysis

Overheating Episode	Financial Disturbances	Date of Financial Disturbances	Literature Sources Consulted
1960-1974	Credit Crunch 1966	August - September 1966	Burger (1969); Wojnilower (1980); Bordo and Haubrich (2017)
	Credit Crunch 1970	May 1970	Wojnilower (1980); Bordo and Haubrich (2017)
1972-1974	Banking Crisis 1974	1974	Wojnilower (1980); Drehmann et al. (2012); Bordo and Haubrich (2017)
1978-1980	Latin American Debt Crisis	1982-1989	Kaminsky and Reinhart (1999); Drehmann et al. (2012); Bordo and Haubrich (2017)
1987-1990	S&L Crisis*	1988-1990	Bordo et al. (2000); Reinhart and Rogoff (2009); Romer (2013); Drehmann et al. (2012); Schularick and Taylor (2012); Laeven and Valencia (2013); Field (2017)
	Black Monday	October 1987	Romer (2013)
	Junk Bond Market Crash	October 1989	Wolfson (1994)
	Mexican Crisis (Tequila Crisis)	October 1992 / December 1994	Kaminsky and Reinhart (1999)
1997-2001	Asian Crisis, LTCM, Russia	1997 Q3 (Asian Crisis); 1998 Q3 (LTCM & Russian Crisis)	Romer (2013)
	Dot-Com Crash	Spring 2001	Romer (2013); Bordo and Haubrich (2017)
2005-2007	Financial Crisis	2007-2009	Diamond and Rajan (2009); Reinhart and Rogoff (2009); Schularick and Taylor (2012); Laeven and Valencia (2013); Bordo and Haubrich (2017)
	Euro Area Sovereign Debt Crisis	2009-2011	Lo Duca et al. (2017)

Notes: The S&L Crisis is dated to have a far wider range (1984-1991) in Reinhart and Rogoff (2009)

Real activity and credit were boosted by the commodity boom, monetary policy easing, and strong global growth in the early 1970s. During this period, real GDP growth averaged around 2 percent annually and the unemployment rate declined around 1 percentage point to levels close to 5 percent, about a half of a percentage point lower than its natural rate. As interest rates and loan volumes reached high levels, the failure of Franklin National Bank triggered a general pullback by investors that made it difficult even for the largest banks to count on rolling over their commercial paper funding. These events triggered the 1974 Banking Crisis that coincided with a severe recession with the unemployment rate climbed to almost 9 percent in June 1975.

1982 Latin American Debt Crisis

During the 1970s, large oil price shocks created significant current account surpluses among oil-exporting countries and current account deficits in many Latin American countries. Large U.S. banks served as intermediaries, providing the oil-exporting countries with a liquid place for their funds while lending those funds (in U.S. dollars) to Latin America. During the expansion of 1978-1980, real GDP growth in the United States averaged about 2.5 percent, starting from a position of already-high resource utilization, and the unemployment rate fell below 6 percent. In 1982, as interest rates were raised aggressively to fight inflation, Mexico was unable to service its outstanding debt to U.S. commercial banks and other creditors, marking the beginning of the Latin American Debt Crisis. Many Latin American countries rescheduled their public debt obligations and put strains on several of the largest banks in the United States.

The 1980s S&L Crisis, Black Monday, and the Junk Bond Market Crash

Concerns about large imbalances in the financial system started to rise during the 1980s. During the 1980s economic expansion, spurred by the development of the speculative (high-yield) bond market, corporate leverage rose significantly. Meanwhile, the unemployment rate fell from around 9 percent in early 1984 to around 5.3 percent by the end of 1988, and high interest rates continued to negatively impact the net worth of the Savings and Loan (S&L) sector as mortgages lost considerable value. Although there is a wide range of views about the dating of the onset of the S&L crisis, it is generally acknowledged that regulatory forbearance had the unintended effect of inducing S&Ls to make new and riskier loans other than residential mortgages, which expanded credit further, but subsequently led to widespread insolvencies. Despite various interventions, around 1,400 S&Ls and 1,300 banks failed between 1984 and 1991.

Long Term Capital Management and the Dot-Com Crash

The 1990s were characterized by solid economic growth amid various financial disruptions stemming from abroad, such as the Tequila Crisis, the Asian Financial Crisis, and the collapse of Long Term Capital Management. Timely coordinated policy interventions are considered to have sub-

stantially limited the imprint of these disruptions on economic activity. For over five years until the 2001 recession, real GDP growth averaged about 3.8 percent annually and the unemployment rate mostly ranged between 4 and 5.5 percent. The expansionary economic conditions contributed to the domestic boom in telecom and internet firms amid euphoria over internet-based technologies, leading to rapidly rising equity prices. Eventually, the reversal in investor sentiment led to the Dot-Com Crash, which triggered a mild recession in the early 2000s. This financial episode provides the most compelling example of how sustained economic expansion can lead to increased financial imbalances.

The Great Financial Crisis of 2007

During the period from early 2005 to the Great Recession, real GDP growth averaged about 2 percent, fueled by a rapid growth of homebuilding, mortgage credit, and house prices. However, the elevated levels of leverage, exposure to maturity transformation, and wholesale short-term funding at large financial institutions that caused the Financial Crisis of 2007-09 had already built up before this period. Aikman et al. (2017), and Lee et al. (2018) show that a comprehensive reading of imbalances in the U.S. financial system was already elevated in 2004. Although some researchers link the buildup of those systemic vulnerabilities to strong macroeconomic performance, others see those imbalances as a consequence of independent financial engineering developments. In addition, others believe that accommodative monetary policy contributed to the buildup of financial imbalances (e.g., Diamond and Rajan (2009) and Adrian and Liang (2018)). The Great Financial Crisis generated a severe recession with a subsequent sluggish recovery.

To summarize, our narrative analysis indicates that the fundamental reasons of the build up of financial imbalances has been mainly attributed to financial innovation and the development of different financial markets. Regulatory factors, policy regimes, and other external factors also appear to have played an important role in the buildup of vulnerabilities and subsequent financial disturbances. The role of economic expansions, per se, is less obvious from the narratives, though it is true that significant financial disturbances tended to occur during periods in which the economy was above potential, implying that expansions may have played a role in helping induce excesses in certain segments of the financial system, especially more recently.

3 Econometric Analysis

The previous section described the prevailing macroeconomic conditions at the times in which financial disturbances occurred in the past 60 years. In this section, we look for systematic and statistically significant patterns between business and financial cycles. We explore the link between indicators of financial imbalances and macroeconomic performance, focusing on the experience

of the United States. Our approach involves a statistical analysis of the link between measures of economic slack and financial system imbalances. In particular, we study bivariate time-series relationships between different measures of economic slack and financial imbalances, relying on conventional measures of the business and financial cycles.

Figure 2 shows the U.S. output gap computed by the Congressional Budget Office and the publicly available historical estimate of the (negative of the) unemployment gap computed by the CBO plotted against the periods of strong macroeconomic performance (shaded). Figure 2 includes the real GDP year-on-year growth that we also use throughout the paper to ensure that our results are not a byproduct of the statistical methodologies used to derive potential output and the natural rate of unemployment. The periods of ‘hot’ macroeconomic conditions correspond to quarters when either output is above potential or unemployment is lower than its natural rate.⁶ The measures of imbalances are the overall National Financial Conditions Index (NFCI) of the Chicago Fed and its subindexes, as described in Brave and Butters (2012). In particular, the NFCI is based on principal components extracted from 105 financial time series. The adjusted NFCI (ANFCI) is the version of the NFCI adjusted for macroeconomic conditions. The risk subindex captures volatility, risk appetite, funding risk. The credit subindex is composed of measures of credit conditions, e.g., lending standards. The leverage subindex consists of debt and equity measures for financial intermediaries, shadow banks, municipalities and the private sector as well as some measures of asset prices. The nonfinancial leverage subindex specifically focuses on leverage measures of households and nonfinancial firms.⁷

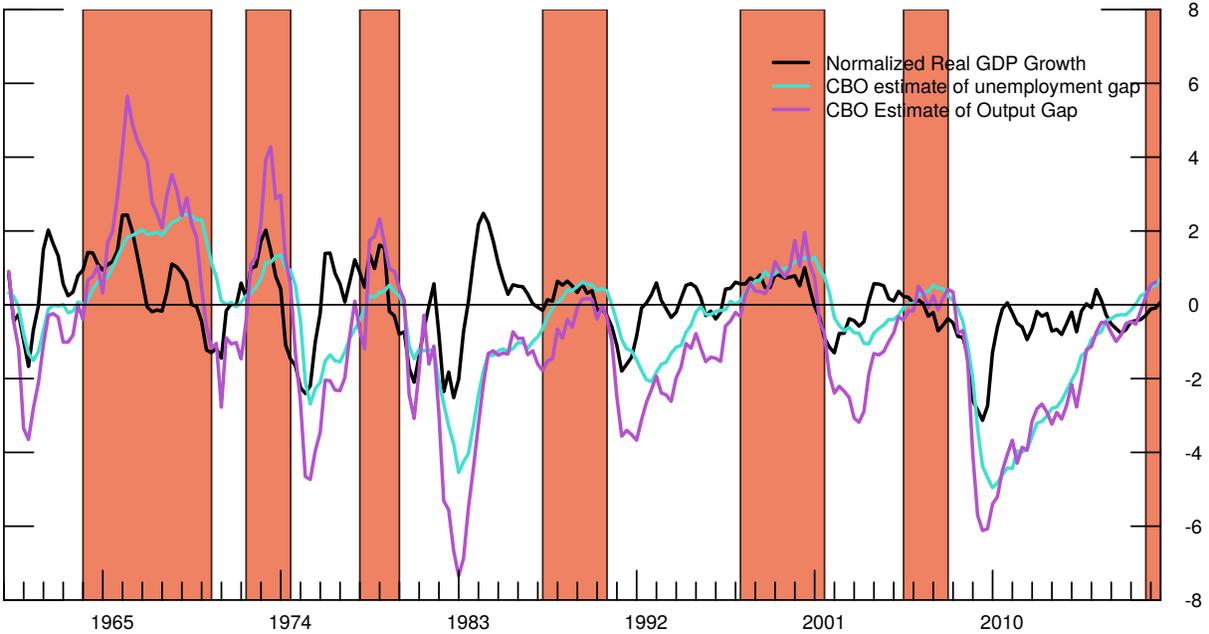
These indexes are reported in Figure 3 plotted against the periods of strong macroeconomic performance (shaded). A visual inspection reveals that the builds-up of financial imbalances tend to coincide (or follow) periods of strong macroeconomic performance. This tendency is particularly striking for nonfinancial leverage that increases and peaks during every period when the economy runs ‘hot.’

3.1 In-Sample Predictability

In this section, we rely on bivariate VARs to understand the in-sample linkages between measures of economic slack and measures of financial imbalances. In particular, we estimate 18 bivariate VARs with four lags where the two observables are the combinations of one measure of slack (output gap, unemployment gap, or year-on-year real GDP growth) and one measure of financial imbalances (NFCI, ANFCI, and all the four subcomponents, i.e., risk, credit, leverage, nonfinancial leverage), using Bayesian techniques as in Giannone et al. (2015).

⁶In order to make the comparison easier, Figure 2 reports the negative of the unemployment gap.

⁷Increasing risk, tighter credit conditions, and declining leverage are consistent with tightening financial conditions.



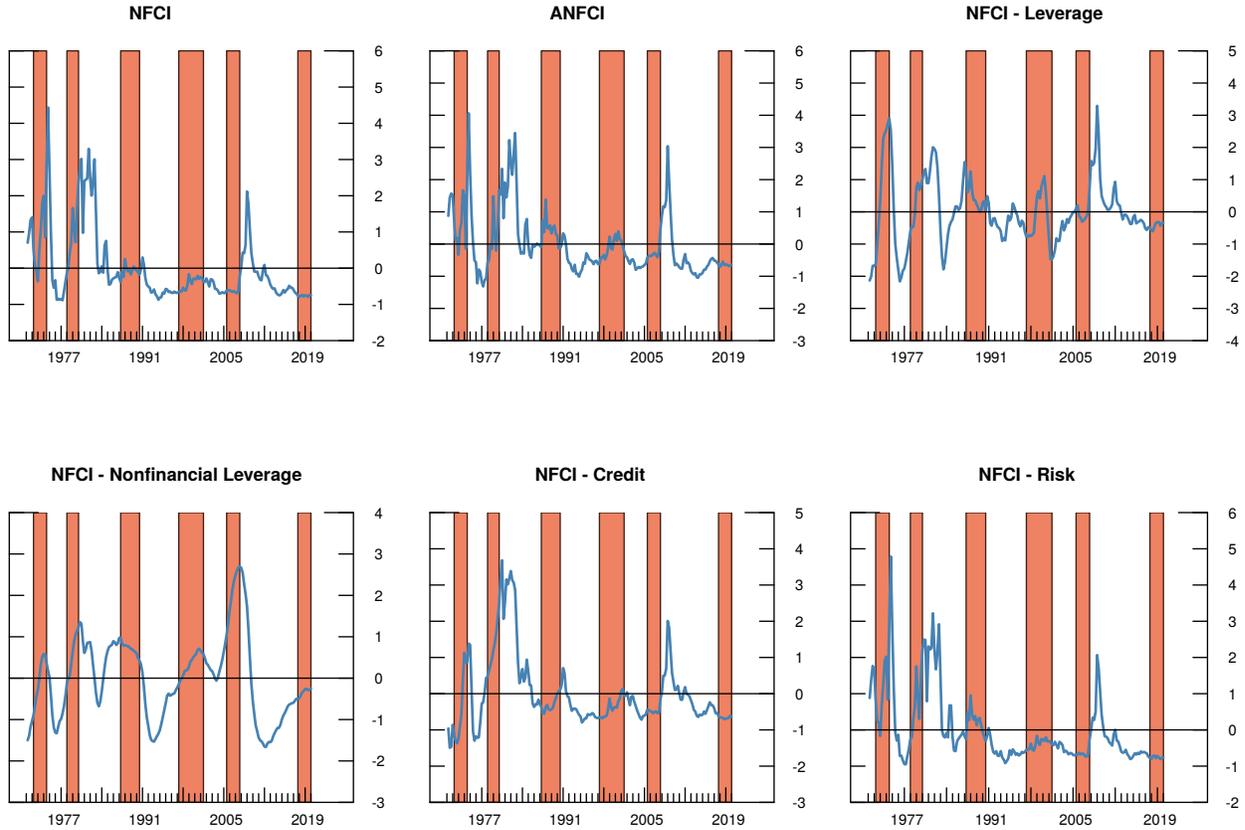
Notes: The orange shading denotes periods of positive output gaps and/or negative unemployment gaps. Real GDP Growth is the normalized year-over-year growth rate. Output gap is computed as a percent deviation of real GDP from real potential GDP. Unemployment gap is computed as negative of a deviation of the unemployment rate from the CBO NAIUR estimate.

Figure 2: Measures of Economic Slack and GDP Growth

We begin our analysis examining the dynamic relationship between economic slack and financial imbalances, and in particular whether an increase in the measure of economic slack can lead to a future increase in financial imbalances. In order to do so, we compute the generalized impulse response function (GIRF), a la Pesaran and Shin (1998). Figure 4 reports the GIRFs of the financial imbalances measures to a one-unit increase of the output gap.⁸ As we can see, an increase in the output gap is clearly associated with a future expansion of both the overall measures of financial imbalances and its subindexes. The GIRFs are substantially similar to each other except for non-financial leverage, which displays a more persistent and larger response to an increase in the output gap.

In order to understand whether this positive relationship can be useful for predicting future build-up of financial imbalances, we use the bivariate VARs to test for the presence of Granger causality and find evidence in favor of strong in-sample linkages. Table 2 shows that these conclusions largely hold across all measures of macroeconomic conditions and financial imbalances.

⁸The results for the unemployment gap and the year-on-year real GDP growth are very similar and are omitted to conserve space.

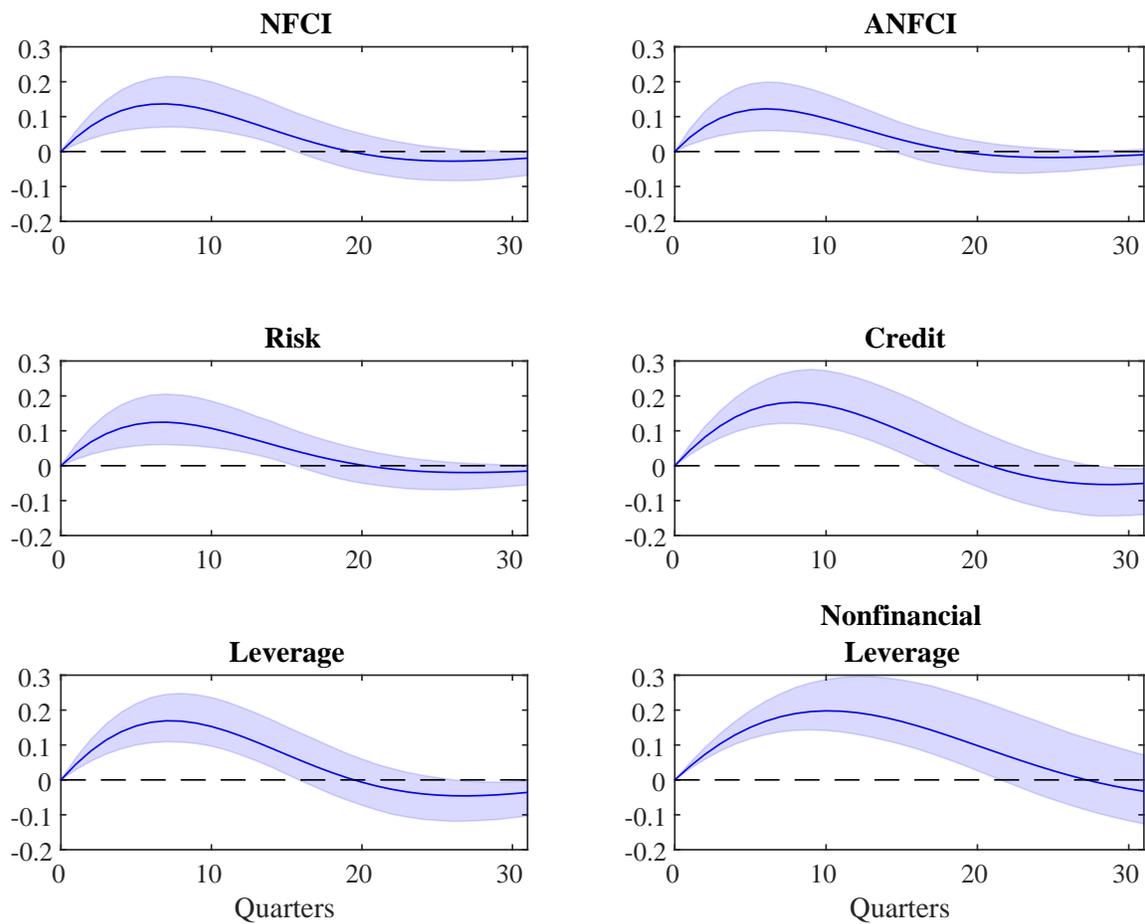


Notes: The shaded areas denote periods of positive output gaps and/or negative unemployment gaps.

Figure 3: **Financial Imbalances Measure: the National Financial Conditions Index.**

3.2 Out-of-Sample Predictability

In statistical tests of Granger causality, we found significant predictability linkages from measures of economic slack to measures of financial imbalances. However, the Granger causality test relies on all the information available when estimating the parameters - information that would have not been available if we were making the prediction at particular point in time. Moreover, the same measure of gap that we use in the Granger analysis are two-sided, i.e. they are derived using all the available information up to today. To test whether the strength of these linkages may be useful in real time, we rely on an out-of-sample forecast exercise where we substitute the measures of gap used above with one-sided or real-time measures of economic slack. We follow Stock and Watson (2019) and compute the full-utilization values as a one-sided, exponentially-weighted moving average, with a weight yielding a half-life of 15 years for the quarterly unemployment rate and for the annual growth rate of GDP. In addition, we use the year-on-year real GDP growth



Notes: Generalized impulse response functions to a one-unit increase in the output gap. Point estimate refers to the median, the bands correspond to the 2.5th and the 97.5th quantile, respectively.

Figure 4: **Generalized Impulse Response Functions**

as well. As shown in in Figure 2, the dynamics of the real GDP growth track the evolution of slack measures quite closely, but, by construction, growth rates are not subject to the limitations associated with the two-sided filtering.

Our out-of-sample exercise tests whether the business cycle helps to forecast the future evolution of the financial cycle. To this purpose, we rely again on the bivariate VARs used above. In particular, we estimate these regression models that include the overall NFCI index, its adjusted version (ANFCI), or its subindexes (Risk, Credit, Leverage, Nonfinancial Leverage) and the real time output gap, the unemployment gap, or the year-on-year real GDP growth. We estimate our models recursively starting in 1973Q1 and produce the first forecast for the observation of 1980Q1. We consider forecasts of various horizon lengths; the last forecast is produced for for 2017Q4.

Table 2: Granger Causality Results: P-Values for the Rejection of the Null (No Causality)

imbalances measure	unempl. gap	output gap	y-o-y growth
NFCI	0.002	0.000	0.007
ANFCI	0.000	0.000	0.015
Leverage	0.141	0.001	0.217
Nonfinancial Leverage	0.000	0.000	0.000
Credit	0.000	0.000	0.000
Risk	0.007	0.004	0.012

Notes: To test for Granger causality links, we examine bivariate VARs, containing one financial vulnerability and one economic slack measure. The lag order of the VAR is chosen with the AIC.

Table 3 reports the ratio of the root mean squared forecast error (RMSFE) produced by the VAR model to the RMSFE produced by the AR processes for the variables of interest. Thus, a ratio below one indicates that information stemming from the business cycle (and included as an additional observable in the VAR) is helpful to predict the financial cycle. We also test for equal forecasting performance of AR and VAR models with the Diebold-Mariano test. The table shows that there are no measurable gains from using information on the output gap to forecast the overall NFCI measure. An analogous result is evident for the unemployment gap and the year-on-year real GDP growth rate. We further apply the same procedure to the ANFCI and the subindexes of the NFCI. For the majority of these measures, the conclusions are very similar: the gains from the information on economic slack are very small when we predict these particular financial imbalances. However, the results are markedly different for the nonfinancial leverage subindex, where we detect substantial improvement in forecasting performance stemming from the use of economic slack data. We conclude that in this case, some of the in-sample predictability uncovered by the Granger causality tests is robust out-of-sample. We shed more light on this result in the next subsection.

3.3 Nonfinancial Leverage Predictability

In order to understand if the predictive content of economic slack data for nonfinancial leverage is not only superior to the predictive content included in the leverage measure, but is also superior to other possible predictor candidates, we replace economic slack measures by spreads. We focus on three spreads, the term spreads defined as the 10-year Treasury yield over the 3-month Treasury rate, the TED spreads defined as the difference between 3-month Eurodollars and 3-month Treasuries and the Excess Bond Premium of Gilchrist and Zakrajsek (2012). These spreads may have predictive power for nonfinancial leverage, as implied by the results of Brunnermeier et al. (2019) and Lopez-Salido et al. (2017).

Table 4, reports the performances of the slack measures already reported in Table 3, and the

Table 3: Comparisons of Univariate and Bivariate Pseudo-Out-of-Sample Forecasts

	NFCI			ANFCI		
horizon	y-o-y growth	output gap	unempl. gap	y-o-y growth	output gap	unempl. gap
1	1.24	1.24	1.24	1.16	1.17	1.30
	<i>0.15</i>	<i>0.14</i>	<i>0.14</i>	<i>0.26</i>	<i>0.25</i>	<i>0.06</i>
4	1.06	1.06	1.06	1.05	1.05	1.14
	<i>0.45</i>	<i>0.34</i>	<i>0.34</i>	<i>0.28</i>	<i>0.17</i>	<i>0.51</i>
8	1.13	1.14	1.14	1.07	1.07	1.43
	<i>0.42</i>	<i>0.37</i>	<i>0.37</i>	<i>0.43</i>	<i>0.38</i>	<i>0.21</i>
	Risk			Credit		
1	1.26	1.26	1.38	1.00	1.00	0.90
	<i>0.13</i>	<i>0.13</i>	<i>0.07</i>	<i>0.99</i>	<i>0.99</i>	<i>0.71</i>
4	1.07	1.07	1.10	1.39	1.41	1.95
	<i>0.10</i>	<i>0.08</i>	<i>0.65</i>	<i>0.21</i>	<i>0.18</i>	<i>0.22</i>
8	1.07	1.07	1.40	1.26	1.27	1.25
	<i>0.57</i>	<i>0.56</i>	<i>0.25</i>	<i>0.10</i>	<i>0.10</i>	<i>0.17</i>
	Leverage			Non Fin. Lev.		
1	1.06	1.06	1.05	0.65	0.65	0.74
	<i>0.26</i>	<i>0.27</i>	<i>0.30</i>	<i>0.01</i>	<i>0.01</i>	<i>0.05</i>
4	0.94	0.95	1.12	0.74	0.72	0.69
	<i>0.54</i>	<i>0.57</i>	<i>0.26</i>	<i>0.01</i>	<i>0.01</i>	<i>0.01</i>
8	1.04	1.04	1.12	0.84	0.84	0.88
	<i>0.39</i>	<i>0.41</i>	<i>0.11</i>	<i>0.04</i>	<i>0.04</i>	<i>0.02</i>

Notes: The table reports ratios of the Root Mean Squared Forecast Errors (RMSFE) from a bivariate VAR to the RMSFE for an AR process estimated on the measure of financial imbalances. The VAR includes the two variables in each panel, a measure of financial vulnerability (i.e., NFCI, ANFCI and the NFCI subcomponents Risk, Credit Leverage and Non-financial Leverage) and a measure of economic slack (year-on-year real GDP growth rate, real-time output gap, and real-time and unemployment gap). Ratios below 1 indicate that the VAR outperforms the AR process. Numbers in bold indicate a rejection of the Null Hypothesis of equal forecasting performance for the Diebold-Mariano test at the 5%-level. Numbers in italic indicates the p-value Diebold-Mariano test. We estimate our models recursively starting in Q1-1973 and producing the first forecast for the observation of Q1-1980 and ending with the forecast for the observation of Q4-2017.

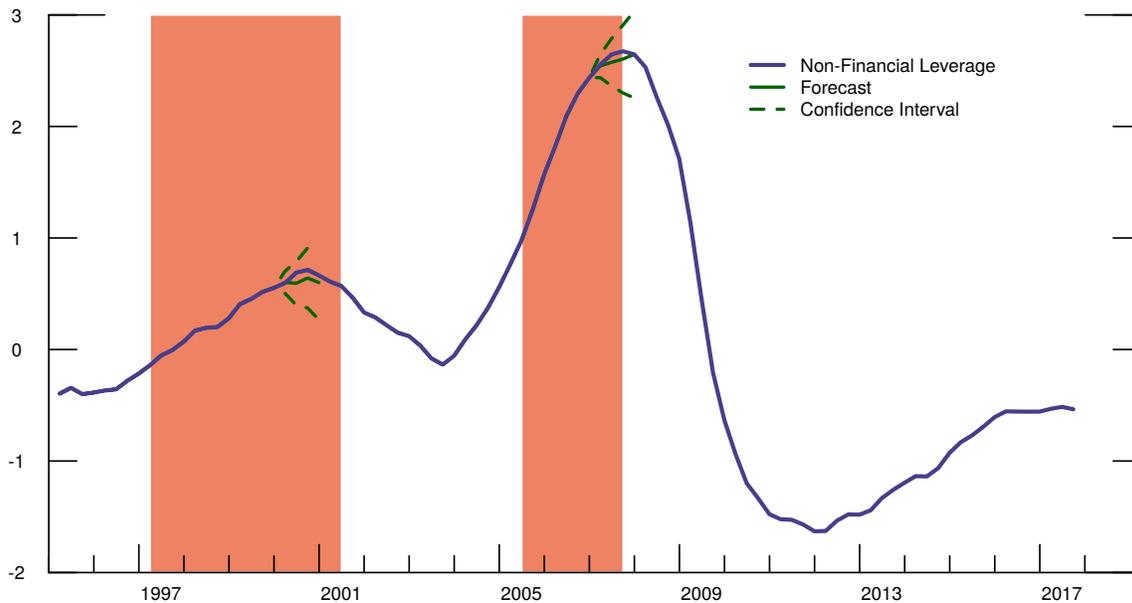
performances of the spreads. As we can see, while the EBP does not add any predictive content above and beyond the one spanned by the nonfinancial leverage per se, the term spread displays some predictability content only at a specific horizon (4-quarter ahead), while the TED spread adds some predictability content in the long run, but not in the short run, i.e., 1-quarter ahead.

In contrast with financial spreads, economic slack measures help to forecast nonfinancial leverage uniformly at all horizons, and therefore potentially constitute an important precondition for the build-up of this specific financial imbalance.

Table 4: Comparisons of Univariate and Bivariate Pseudo-Out-of-Sample Forecasts of Nonfinancial Leverage

horizon	Nonfin. Lev.					
	y-o-y growth	output gap	unempl. gap	term spread	TED	EBP
1	0.65	0.65	0.74	1.14	1.00	1.04
	<i>0.01</i>	<i>0.01</i>	<i>0.05</i>	<i>0.48</i>	<i>0.96</i>	<i>0.83</i>
4	0.74	0.72	0.69	0.75	0.80	0.84
	<i>0.01</i>	<i>0.01</i>	<i>0.01</i>	<i>0.02</i>	<i>0.01</i>	<i>0.08</i>
8	0.84	0.84	0.88	0.91	0.93	0.96
	<i>0.04</i>	<i>0.04</i>	<i>0.02</i>	<i>0.07</i>	<i>0.02</i>	<i>0.19</i>

Notes: The table reports ratios of the Root Mean Squared Forecast Errors (RMSFE) from a bivariate VAR to the RMSFE for an AR process estimated on the measure of financial imbalances. The VAR includes the two variables in each panel, the Non-Financial Leverage subcomponent of the NFCI and a measure of economic slack (year-on-year real GDP growth rate, real-time output gap, and real-time and unemployment gap) or a spread (term spread, TED or the EBP). Ratios below 1 indicate that the VAR outperforms the AR process. Numbers in bold indicate a rejection of the Null Hypothesis of equal forecasting performance for the Diebold-Mariano test at the 5%-level. Numbers in italic indicates the p-value Diebold-Mariano test. We estimate our models recursively starting in Q1-1973 and producing the first forecast for the observation of Q1-1980 and ending with the forecast for the observation of Q4-2017.



Notes: The shaded areas denote periods of positive output gaps and/or negative unemployment gaps.

Figure 5: Forecasts of the Chicago Fed National Financial Conditions Subindex 'Non-financial Leverage' Conditional on the Output Gap.

The results presented so far pertained to average predictive performance. Next, we focus on the predictability at specific points in time, i.e., during the episodes of macroeconomic slack, assuming advance knowledge of the evolution of the output gap measure (Figure 5).⁹ In particular, we focus on two specific periods at the edge of period of economic expansion. Following Bańbura et al. (2015), we produce forecasts of the NFCI nonfinancial leverage subindex assuming advanced knowledge on the evolution of the output gap into the expansion periods, up to 1-year ahead (Figure 5). Conditional forecasts of the nonfinancial leverage subindex are quite accurate in terms of point estimates, and the uncertainty range around the point forecasts is narrow. In particular, at the first overheating episode (end of the 1990s), the path of the conditional forecast displays the same shape as the actual data. At the next point (economic expansion preceding the Great Financial Crisis), the conditional forecast correctly predicts the direction, even when accounting for the uncertainty bands around the point estimates. Overall, these results corroborate our earlier findings that economic slack is helpful in predicting the nonfinancial leverage subindex of NFCI, not only on average over the entire sample, but also specifically during periods when the economy is running ‘hot. In light of this strong out-of-sample predictive relationship, it may be desirable to take this relationship into account in macroprudential policy decisions, such as, the countercyclical capital buffer.

3.4 Structural Analysis

In times of economic expansion, business cycle and macroeconomic conditions are likely to affect nonfinancial leverage. Other factors, however, could also play an important role in how leverage changes. Studies, such as those from the Riksbank (2014) and IMF (2015), consistently show that tight monetary policy decreases nonfinancial credit growth and leverage. Furthermore, leverage of nonfinancial firms has been shown to increase in response to monetary loosening shocks (see Afanasyeva and Guentner (2020)).¹⁰

In order to disentangle the effects, we analyze the relationships in a structural vector autoregression (SVAR) model. We identify shocks and parameters of interest using traditional and narrative sign restrictions.¹¹ Our restrictions are limited and largely agnostic about the relationship between real activity and policy variables so as to cleanly measure this interaction. In our model, we include a policy rate, output, price measures, and a measure of nonfinancial leverage. The series we employ are the Effective Federal Funds Rate from the Board of Governors, log-levels of Gross Domestic Product and Gross Domestic Product Implicit Price Deflator from the Bureau of Economic

⁹Similar results are obtained with the other measures of economic slack and are therefore omitted here.

¹⁰Work by Berrospide and Edge (2010) shows that tightening capital regulation also leads to a slowdown in credit growth. It is unclear whether the effects of general economic conditions or policy actions are more dominant and how they interact.

¹¹For a detailed description of this methodology, see Antolín-Díaz and Rubio-Ramírez (2018).

Analysis, the log-level of the Producer Price Index for All Commodities from the Bureau of Labor Statistics. Lastly, we also use the NFCI nonfinancial leverage subindex from the Chicago Fed. The data are quarterly and our sample ranges from 1971Q3 through 2019Q3.¹²

Our structural model appears as:

$$\mathbf{A}\mathbf{y}_t = \sum_{\ell=1}^5 \mathbf{B}_\ell \mathbf{y}_{t-\ell} + \boldsymbol{\epsilon}_t. \quad (1)$$

Here, \mathbf{y} is a vector containing our variables of interest and $\boldsymbol{\epsilon}$ is a vector of structural shocks. Matrices \mathbf{A} and \mathbf{B} contain parameters explaining the contemporaneous and lagged interactions between all variables. These parameter matrices and shocks are essential to understanding the dynamic structural relationships between the variables in the model. As these cannot be directly measured, we estimate the following reduced-form VAR:

$$\mathbf{y}_t = \sum_{\ell=1}^5 \mathbf{F}_\ell \mathbf{y}_{t-\ell} + \mathbf{u}_t, \quad (2)$$

where $\mathbf{F} = \mathbf{A}^{-1}\mathbf{B}$ and $\mathbf{u} = \mathbf{A}^{-1}\boldsymbol{\epsilon}$. It is clear that to reach estimates of our structural parameters, we must identify \mathbf{A}^{-1} ; we achieve this identification via sign restrictions. All of our traditional restrictions are at the impact period only and are summarized in Table 5. In response to a monetary policy shock, we impose that the federal funds rate has to increase while inflation and output growth both decline on impact. An increase in the federal funds rate is in line with tightening monetary policy. Intuitively, a tightening of monetary policy can increase the cost of borrowing and lending, which results in a decrease in both economic activity and measures of inflation. We do not impose any restrictions on the response of nonfinancial leverage.

In the cases of demand and cost-push (supply) shocks, we do not impose any restrictions on the response of the federal funds rate and nonfinancial leverage. As mentioned earlier, we are aiming to isolate the effects of macroeconomic conditions on these policy relevant variables, and leaving their responses unrestricted allows us to be agnostic. A demand shock refers to an unexpected increase in aggregate demand. The causes and sectoral composition of this increase could differ, but the theory as to how the economy would respond can be explained as follows. Given that the shock was unexpected, producers cannot increase supply contemporaneously resulting in higher inflation. At the same time, the new demand would stimulate additional production and we would see a positive response in output. Thus, we assume positive impact responses for both inflation and output growth.

A supply shock occurs when there is an increase in the price of production factors that results

¹²We obtain quantitatively similar results on a sample ending in 2007Q4.

in a decrease in the production of goods and services. The increase in factor prices is often passed onto consumers through higher prices, which in turn manifests itself as an increase in inflation. Additionally, higher prices will not be offset by an increase in income or demand, resulting in lower production and ultimately lower output. We therefore restrict the response of output to be negative and the response of inflation to be positive to a cost-push shock. The intuition behind our restrictions on responses to a demand shock is shown in a recent study by Leduc and Liu (2016). Furthermore, the key economic responses to a supply shock are shown in Blinder and Rudd (2013). In addition to these traditional sign restrictions, we next employ a narrative sign restriction to further strengthen our identification.

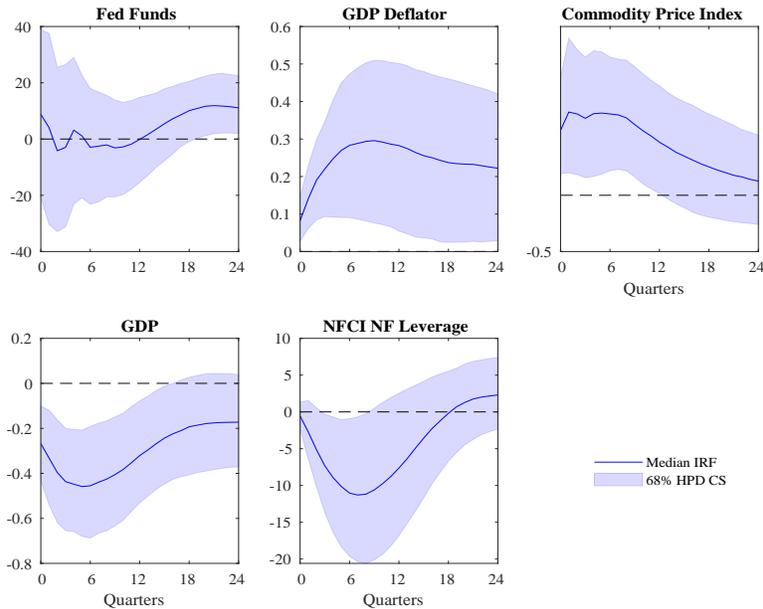
Table 5: Traditional Sign Restrictions

	Monetary Policy	Demand	Cost-Push
Federal Funds Rate	+	?	?
Log GDP Deflator	-	+	+
Log Commodity Price Index	-	+	+
Log GDP	-	+	-
NFCI Nonfinancial Leverage	?	?	?

Notes: This table reports the traditional sign restrictions we use as part of our identification strategy. These restrictions apply to the impact response of each variable only. Any cell containing a ? indicates that there is no restriction in place on that interaction.

To implement narrative restrictions on the sign of structural shocks, we compute these shocks for each of the draws accepted based on our traditional sign restrictions and compare them to our narrative restriction. Hence, our accepted draws include only those that satisfy both the traditional and narrative sign restrictions. In our baseline specification, we impose that a tightening monetary policy shock occurs in 1979Q4.

Our narrative restriction on the monetary policy shock is chosen to coincide with the Volcker Reform that was implemented during the fourth quarter of 1979. At this point, the Federal Reserve began to target nonborrowed reserves in order to more forcefully address high levels of inflation. In general, the decade was characterized by high inflation. There had been an increase in inflation of over 3 percentage points over the three years leading up to this decision. Although some degree of tightening was likely anticipated, the shift in operational goals and its public announcement were both unexpected by market participants. Indeed, it is commonly viewed that this episode was a deflationary and exogenous monetary policy shock (Romer and Romer (1989); Sims and Zha (2006); Lindsey, Orphanides, and Rasche (2013)). The choice of this narrative restriction is also consistent with Antolín-Díaz and Rubio-Ramírez (2018), who find this episode is key for identification. In line with our traditional restrictions, we again only impose narrative restrictions on impact and on the sign of the shock.



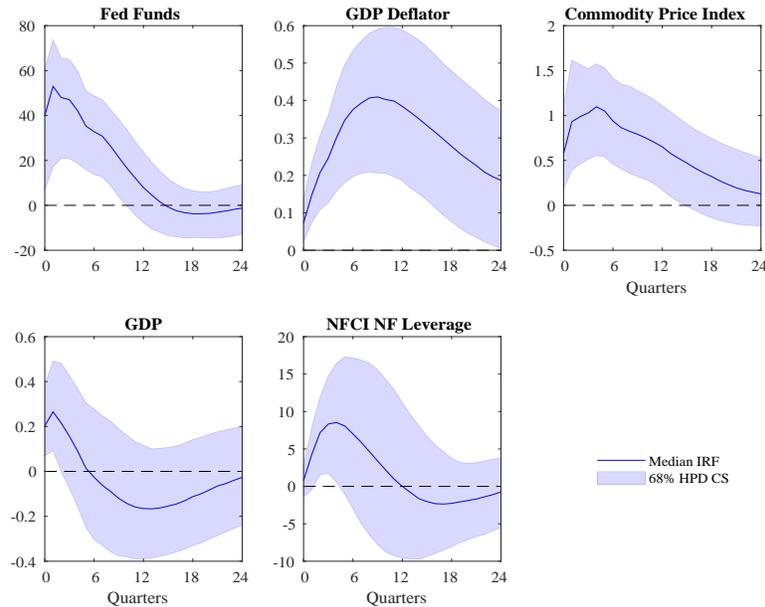
Notes: The shaded areas represent 68% credible HPD sets for the impulse response functions. The solid lines represent the median impulse response function.

Figure 6: **Impulse Responses to a Cost-Push Shock**

Based on the set of accepted draws that satisfy both types of our restrictions¹³, we next construct and plot the impulse response functions to illustrate the structural interactions between the variables in our specification. These are shown in Figures 6 to 8. To construct these, we compute the impulse response function for each of the accepted models. The solid line represents the median response, while the shaded area represents the highest posterior density (HPD) credible sets which include impulse response functions ranging from the 16th to the 84th percentiles. Hence, the credible sets around the median impulse responses reflect model uncertainty of our estimates.

We first discuss the results of a cost-push, or supply, shock, shown in Figure 6. In response to this shock, the federal funds rate does not respond on impact or over the next four years. We see that the GDP Deflator responds positively on impact and remains positive over time. The commodity price index also shows an increase on impact, but this response converges towards zero. Both output and leverage respond negatively to a supply shock. The output response is immediate and does not recover for approximately three years. The leverage response is not significant until about three quarters after a shock and then remains negative for the next six quarters. This result highlights that macroeconomic conditions stemming from aggregate supply shocks, such as cost-push shocks, do have a significant impact on nonfinancial leverage.

¹³Of 3,750,000 total draws, we accept and save 3,032 unique draws that satisfy our traditional and narrative sign restrictions.

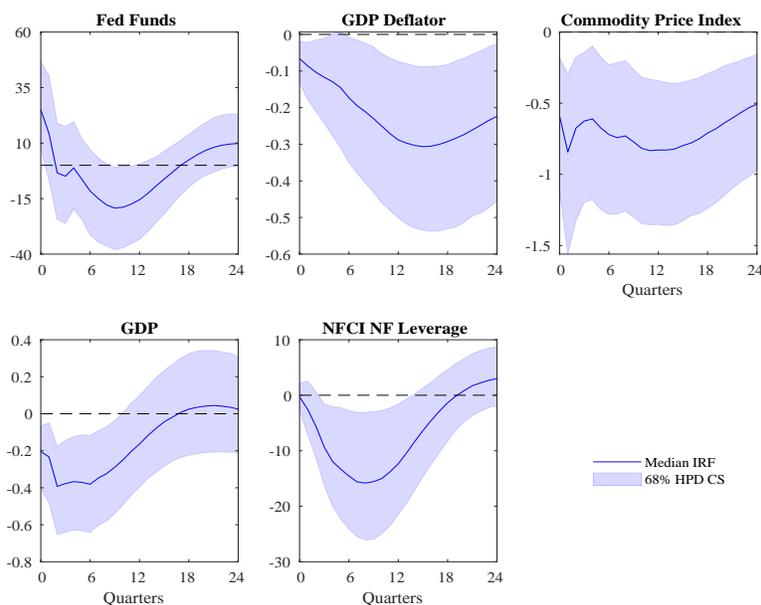


Notes: The shaded areas represent 68% credible HPD sets for the impulse response functions. The solid lines represent the median impulse response function.

Figure 7: **Impulse Responses to a Demand Shock**

In Figure 7, we show the responses of each variable to a demand shock. All of the variables have significant and positive responses to a demand shock in our specification. The GDP deflator has a small, positive initial response which becomes slightly larger over the medium term and remains significant over the considered horizon. Output and the commodity price index also show increases which become insignificant after about one and four years, respectively. The Federal Funds Rate increases on impact and remain significantly positive for about three years. Here, the NFCI nonfinancial leverage subindex responds positively shortly after impact and remains positive for about one year. Thus, macroeconomic performance can affect the buildup of nonfinancial leverage also through aggregate demand shocks.

We lastly discuss the responses to a monetary policy shock, scaled to be 250 basis points, which are shown in Figure 8. By construction, the Federal Funds Rate is positive on impact. The FFR remains positive for only a couple of quarters before converging to zero. We find that there is a significantly negative effect on output and leverage for about three years. GDP Deflator and the commodity price index both decline and remain in the negative territory over the entire horizon. The response of the nonfinancial leverage is significantly negative and persistent, staying below zero in quarters 3 through 13. This response is consistent with the literature on the risk channel of monetary policy. Nonfinancial leverage builds up in response to monetary loosening. Hence,

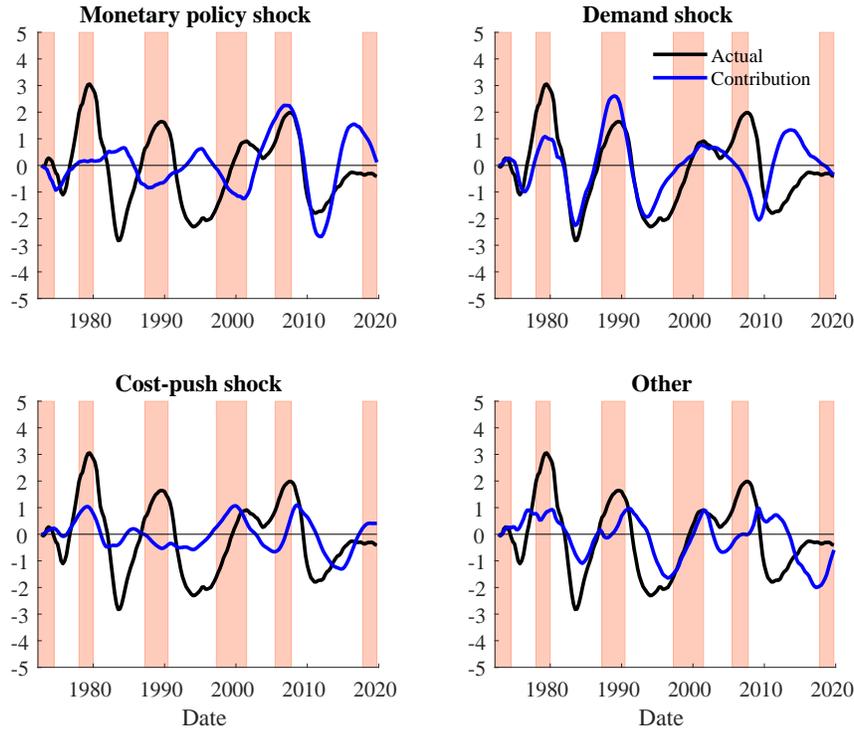


Notes: The shaded areas represent 68% credible HPD sets for the impulse response functions. The solid lines represent the median impulse response function. The responses are scaled such that there is a 250 basis point increase in the federal funds rate on impact.

Figure 8: **Impulse Responses to a Monetary Policy Shock**

monetary policy shocks are indeed additional important drivers of nonfinancial leverage apart from macroeconomic performance. In order to understand their relative importance during specific episodes, we compute the historical variance decomposition (HVD) of the nonfinancial leverage.

Figure 9 illustrates these results. Here, each panel shows the actual data and the corresponding dynamics of nonfinancial leverage attributable to a particular structural shock identified in our model. In computing the historical variance decomposition, we apply the median target method from Fry and Pagan (2011) to ensure that the shock contributions sum up to the data exactly. According to our model, monetary policy shocks were important drivers of the leverage build-up before the Great Financial Crisis, consistent with what is argued in Diamond and Rajan (2009) and Adrian and Liang (2018). They also contributed somewhat, albeit to a substantially smaller degree, to the increase in leverage during the early 1980s a period preceding the Savings and Loans crisis. In other episodes of strong macroeconomic performance, monetary policy shocks appear not to have contributed to the build-up of nonfinancial leverage. Aggregate demand shocks feature prominently in most episodes of strong economic growth as substantial drivers of leverage. They were particularly relevant for leverage build-up in the late 1980s, shortly before the S&L Crisis and during the Dot-Com years. The model assigns a smaller role to these shocks, when it comes to the period preceding the Great Recession. Supply shocks also appear to be important drivers



Notes: The shaded areas denote periods of positive output gaps and/or negative unemployment gaps. We choose the draw from the accepted set using the median target method of Fry and Pagan (2011) to construct the HVD.

Figure 9: **Nonfinancial Leverage HVD**

of increasing leverage, especially in the early 1980s, the Dot-Com period, and shortly before the Great Financial Crisis. The Dot-Com period is noteworthy because it delivered the most compelling example of how sustained economic expansion can lead to increased financial imbalances. Taken together, demand and supply shocks are crucial to explain the build-up of leverage in most episodes of strong macroeconomic performance. Monetary policy shocks left a smaller print, although they played a particularly large role in the pre-crisis episode.

4 Conclusions

Understanding the roots of financial imbalances is important for proper identification of credit cycles, their periodicity and severity, as well as for designing appropriate policy responses. We put the well-known narrative that “seeds of crises are sown in good times” to the test in this paper.

The narrative approach uncovers a common denominator to the financial disturbances observed

in the U.S. in the past 60 years. We first show that they usually occur during periods of buoyant macroeconomic conditions. Although additional factors, such as loose monetary and regulatory policy, combined with spurts in financial innovation, are attributed substantial roles to these episodes, the role of strong economic performance cannot be ignored, especially in the last half of the sample - from the late 1990s until now.

In our in-sample analysis, strong economic growth is associated with future increases in financial imbalances across all dimensions of the NFCI measure. In our out-of-sample analysis, these links are still strong and robust, particularly for nonfinancial leverage. This result is important in light of historical evidence surveyed, *inter alia*, by Brunnermeier and Schnabel (2016), who point out the particular costliness of leveraged overheating and leveraged bubbles. When growth is reverting, these episodes typically bring particularly large GDP losses, as the damage spreads throughout the entire economy via the leverage channel.

Finally, we make a step toward formal identification of policy vs. business cycle shocks and show that business cycle shocks are non-trivial drivers of nonfinancial leverage in the U.S.

Our results suggest that running the economy too “hot” can indeed be a harbinger of financial imbalances, consistent with Yellen (2017)’s conjecture. Indeed, we show that such an economic environment spurs the build-up of nonfinancial leverage and the financial system can become particularly precarious from a financial stability perspective, especially when combined with loose monetary and regulatory policies.

References

- Adrian, Tobias and Hyun Song Shin (2010). “Liquidity and Leverage.” *Journal of Financial Intermediation* 19(3): 418–437.
- Adrian, Tobias and Nellie Liang (2018). “Monetary Policy, Financial Conditions, and Financial Stability.” *Journal of Banking and Finance* 14(1): 73–131.
- Afanasyeva, Elena and Jochen Guentner (Forthcoming). “Bank Market Power and the Risk Channel of Monetary Policy.” *Journal of Monetary Economics*, in press.
- Aikman, David, Andreas Lehnert, Nellie Liang, and Michele Modugno (Forthcoming) “Credit, financial conditions, and monetary policy transmission.” *International Journal of Central Banking*.
- Aikman, David, Michael Kiley, Seung Jung Lee, Michael G. Palumbo, and Missaka Warusawitharana (2017). “Mapping heat in the U.S. financial system.” *Journal of Banking and Finance* 81: 36–64.
- Antolín-Díaz, Juan and Juan Rubio-Ramírez (2018). “Narrative Sign Restrictions for SVARs.” *American Economic Review* 108(10): 2802–2829.
- Bañbura, Marta, Domenico Giannone, and Michele Lenza (2015). “Conditional forecasts and scenario analysis with vector autoregressions for large cross-sections.” *International Journal of Forecasting* 31(3): 739–756.
- Bernanke, Ben and Mark Gertler (1989). “Agency Costs, Net Worth, and Business Fluctuations.” *The American Economic Review* 79(1): 14–31.
- Berrospide, Jose and Rochelle Edge (2010). “The effects of bank capital on lending: What do we know, and what does it mean?” *Finance and Economics Discussion Series* 2010–44.
- Blinder, Alan and Jeremy Rudd (2013). “The Supply Shock Explanation of the Great Stagflation Revisited.” *Chapter in The Great Inflation: The Birth of Modern Central Banking, NBER* 119–175.
- Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer (2018). “Diagnostic Expectations and Credit Cycles” *Journal of Finance*, in press.
- Bordo, Michael, Barry Eichengreen, Daniela Klingebiel, and Maria Soledad Martinez-Peria (2001). “Is the Crisis Problem Growing More Severe?” *Economic Policy* 16(32): 51–82.
- Bordo, Michael and Joseph. G. Haubrich (2017). “Deep Recessions, Fast Recoveries, and Financial Crises: Evidence from the American Record.” *Economic Inquiry* 1(55): 527–541.
- Borio, Claudio (2014). “The Financial Cycle and Macroeconomics: What Have we Learnt?” *Journal of Banking and Finance* 45: 182–198.
- Brunnermeier, Markus K., Darius Palia, Karthik A. Sastry, and Christopher A. Sims (2019). “Feedbacks: Financial Markets and Economic Activity.” Working paper.

- Brunnermeier, Markus K. and Yuliy Sannikov (2014). “A Macroeconomic Model with a Financial Sector” *The American Economic Review* 104(2): 379–421.
- Brunnermeier, Markus K. and Isabel Schnabel (2016). “Bubbles and Central Banks: Historical Perspectives.” In “Central Banks at a Crossroads: What Can We Learn from History?”. Cambridge University Press, Cambridge.
- Burger, Albert E. (1969). “A Historical Analysis of the Credit Crunch of the 1966” *Review* (September): 13–30.
- Cao, Dan and Jean-Paul L’Hullier (2018). “Technological Revolutions and the Three Great Slumps: A Medium-Run Analysis” *Journal of Monetary Economics* 96(C): 93–108.
- Claessens, Stijn, M. Ayhan Kose, and Marco Terrones (2012). “How Do Business and Financial Cycles Interact?” *Journal of International Economics* 87(1): 178–190.
- Diamond, Douglas W. and Raghuram Rajan (2009). “The Credit Crisis: Conjectures about Causes and Remedies.” *The American Economic Review* 99(2): 606–610.
- Drehmann, Mathias, Claudio Borio, and Kostantinos Tsatsaronis (2012). “Characterising the Financial Cycle: Don’t Lose Sight of the Medium Term!” BIS Working Paper No. 380.
- Feldberg, Greg, Douglas Elliot, and Andreas Lehnert (2013). “The history of cyclical macroprudential policy in the United States.” *Finance and Economics Discussion Series* 2013-29.
- Field, Alexander J. (2017). “The Savings and Loan Insolvencies and the Costs of Financial Crisis.” Chapter 3, pp. 65–113.
- Fisher, Irving (1933). “The Debt-Deflation Theory of Great Depressions.” *Econometrica* 1(4): 337 – 357.
- Fry, Renee and Adrian Pagan (2011). “Sign Restrictions in Structural Vector Autoregressions: A Critical Review.” *Journal of Economic Literature* 49(4): 938–960.
- Gertler, Mark and Simon Gilchrist (2018). “What Happened: Financial Factors in the Great Recession.” *Journal of Economic Perspectives* 32(3): 3 – 30.
- Gilchrist, Simon and Egon Zakrajsek (2012). “Credit Spreads and Business Cycle Fluctuations.” *The American Economic Review* 102(4): 1692 – 1720.
- Gorton, Gary and Guillermo Ordonez (2019). “Good Booms, Bad Booms.” *Journal of the European Economic Association*, in press.
- International Monetary Fund (2015). “Monetary Policy and Financial Stability”. Staff Report.
- Kaminsky, Graciela and Carmen Reinhart (1999). “The Twin Crises: The Causes of Banking and Balance-of-Payments Problems.” *The American Economic Review* 89(3): 473–500.
- Leduc, Sylvain and Zheng Liu (2016). “Uncertainty shocks are aggregate demand shocks.” *Journal of Monetary Economics* 82(C): 20–35.

- Lee, Seung Jung, Kelly E. Posenau, and Viktors Stebunovs (2018). “The anatomy of financial vulnerabilities and banking crises.” *Journal of Banking and Finance*.
- Lindsey, David, Athanasios Orphanides, and Robert Rasche (2013). “The Reform of October 1979: How it Happened and Why.” *Federal Reserve Bank of St. Louis Review* 95(6): 487–542.
- Lo Duca, Marco, Anne Koban, Maria Basten, Elias Bengtsson, Benjamin Klaus, Piotr Kusmierczyk, Jan Hannes Lang, Carsten Detken, and Tuomas A. Peltonen (2017). “A New Database for Financial Crises in European Countries.” Occasional Paper Series No. 194, European Central Bank.
- Lopez-Salido, David, Jeremy C. Stein and Egon Zakrajsek (2017). “Credit Market Sentiment and the Business Cycle.” *The Quarterly Journal of Economics* 132(3): 1373–1426.
- Mian, Atif and Amir Sufi (2014). “What Explains the 2007-2009 Drop in Employment?” *Econometrica* 82(6): 2197–2223.
- Minsky, Hyman (1972). “Financial instability revisited: the economics of disaster.” Prepared for the Steering Committee for the Fundamental Reappraisal of the Discount Mechanism appointed by the Board of Governors of the Federal Reserve System.
- Giannone Domenico , Michele Lenza and Giorgio E. Primiceri, 2015. “Prior Selection for Vector Autoregressions,” *The Review of Economics and Statistics*, MIT Press, vol. 97(2), pages 436-451, May.
- Pesaran, M. H. and Shin, Y. (1998). “Generalized Impulse Response Analysis in Linear Multivariate Models.” *Economics Letters*, 58: 17-29.
- Reinhart, Carmen M. and Kenneth S. Rogoff (2009). “This Time is Different: Eight Centuries of Financial Folly.” Princeton, New Jersey: Princeton University Press.
- Romer, David. “Preventing the Next Catastrophe: Where do we Stand?” Technical Report.
- Schularick, Moritz and Alan M. Taylor (2012). “Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises: 1870-2008” *The American Economic Review* 102(2): 1029–1061.
- Sims, Christopher and Tao Zha (2006). “Were There Regime Switches in U.S. Monetary Policy?” *American Economic Review* 96(1): 54–81.
- Stock, James H. and Mark W. Watson (2019). “Slack and Cyclically Sensitive Inflation.” NBER Working Paper No. 25987.
- Sveriges Riksbank (2015). “The effects of monetary policy on household debt.” *Monetary Policy Report* February 2014.
- Wojnilower, Albert (1980). “The Central Role of Credit Crunches in Recent Financial History” *Brooking Papers on Economic Activity* 1980(2): 277–339.
- Wolfson, Martin H. (1994). “Financial Crises: Understanding the Postwar U.S. Experience” *Taylor and Francis*.

Yellen, Janet L. (2017). “The Economic Outlook and the Conduct of Monetary Policy.” Speech at the Stanford Institute for Economic Policy Research on January 19, 2017.