Macroeconomic Overheating and Financial Vulnerability

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Presentation Overview

- Motivation
  - Literature on financial vulnerability $\longrightarrow$ output
  - Financial disturbances usually comes after/during macro overheating
- Narrative Investigation
- Econometric Analysis
  - Introduce NFCI
  - Cross-correlograms
  - Out-of-sample predictability
  - Testing for nonlinearities
- Conclusion
  - Weak link between macroeconomic overheating and aggregate financial vulnerability
  - Stronger link between macroeconomic overheating and nonfinancial leverage

Literature

- Literature has focused on studying channels in which vulnerabilities and stretched balance sheets exacerbate economic downturns
    - Fisher (1933), Bernanke and Gertler (1989), Adrian and Shin (2010), Gilchrist and Zakrajsek (2012), Brunnermeier and Sannikov (2014), Mian and Sufi (2014), Gertler and Gilchrist (2018)
- Literature on the relationship between business and financial/credit cycles has also focused on the bust phases
    - Claessens et al. (2012), Schularick and Taylor (2012), Borio (2014)
- We focus on the boom phases
    - During expansionary booms and low measures of risk, funding constraints are looser and intermediaries can build up leverage and maturity mismatch (Adrian et al. (2015))

Periods of Macroeconomic Overheating

Economic Slack Measures
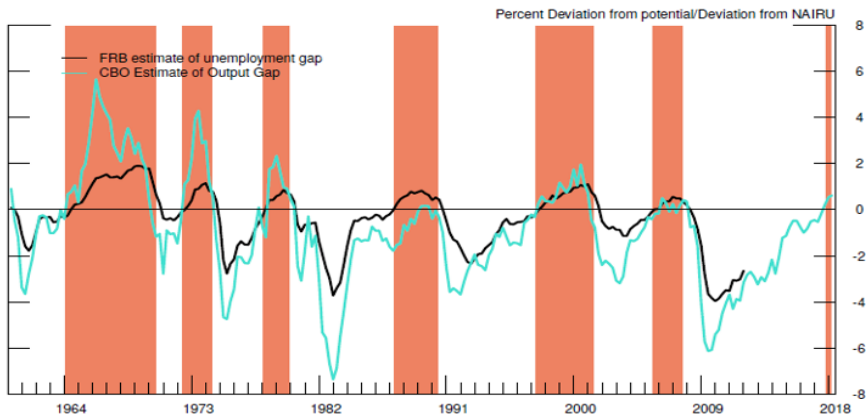
The orange shading denotes periods of economic overheating. Output gap is computed as a percent deviation of real GDP from real potential GDP. Unemployment gap is computed as negative of a deviation of the unemployment rate from the FRB NAIRU estimate.

Motivation

Economic Overheating and Selected Financial Disturbances
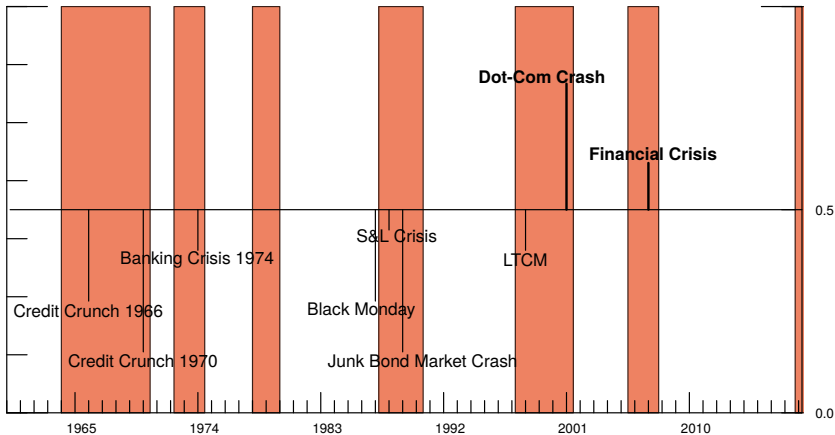
Disturbances with stronger linkages to overheating are highlighted in bold.

Narrative Context

Categories/Sectors of Vulnerabilities, Adrian et al. (2015)

- Categories
  - Price of risk, leverage, maturity and liquidity transformation, interconnectedness
- Sectors
  - Asset markets, financial sector (banking and nonbank), nonfinancial sector
- Available for limited time series
  - Aikman et al. (2017) and Lee et al. (2018)

Narrative Investigation I

Vulnerabilities

|	Price of risk	Leverage	Maturity and liquidity transformation	Interconnectedness and complexity
Asset Markets	Black Monday 1987 Junk Bond Crash 1989 Dot-com Crash 2001 Financial Crisis 2007			
Financial Sector	Latin Debt Crisis 1982 S&L Crisis 1988 Financial Crisis 2007	Banking Crisis 1974 S&L Crisis 1988 LTCM Crash 1998 Financial Crisis 2007	Credit Crunch 1966 Credit Crunch 1970 Banking Crisis 1974 Financial Crisis 2007	Latin Debt Crisis 1982 Financial Crisis 2007
Nonfinancial Sector	Financial Crisis 2007	S&L Crisis 1988 Dot-com Crash 2001 Financial Crisis 2007	Credit Crunch 1970	

Narrative Investigation II

Other factors and triggers

Financial Episodes	Regulation	Financial Innovation	Overheating	Trigger
Credit Crunch 1966	√	√		Monetary Policy
Credit Crunch 1970	√	√		CP default by Penn Central
Banking Crisis 1974	√			Failure of Franklin National Bank
Latin Debt Crisis 1982				Bank loan default by Mexico
Black Monday 1987		√		Legislation
S&L Crisis 1988	√	√		Large earnings losses
Junk Bond Crash 1989		√		Collapse of UAL buyout
LTCM Crash 1998				Bond default by Russia
Dot-com Crash 2001		√	√	Problems at internet firms
Financial Crisis 2007	√	√	√	Subprime mortgage defaults

Chicago National Financial Conditions Index

- NFCI - Brave and Butters (2012) and Brave and Kelly (2017)
- Calculates principal components of 105 indicators for the following:
    - Risk–funding premiums and volatility, coincident indicators of financial stress
    - Credit–credit conditions such as tightening of credit standards, lagging indicators of financial stress
    - Leverage / nonfinancial leverage–debt levels, leading indicators of financial stress
- Adjusted NFCI is adjusted for macroeconomic conditions
- Available since 1971
- Useful for forecasting financial stress, growth in GDP, and business investment two to four quarters ahead
- Used for GDP-at-risk (Adrian et al. (2019))

National Financial Conditions
Index (NFCI)
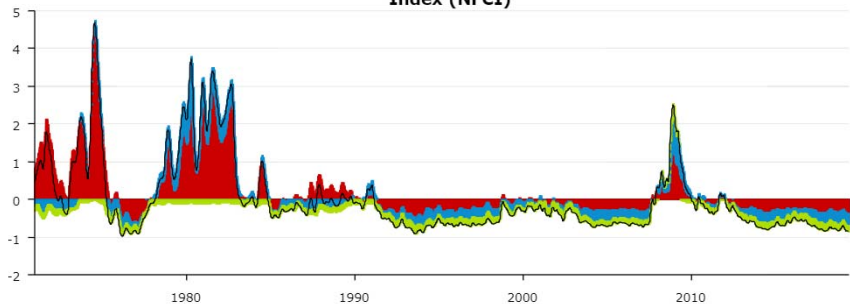
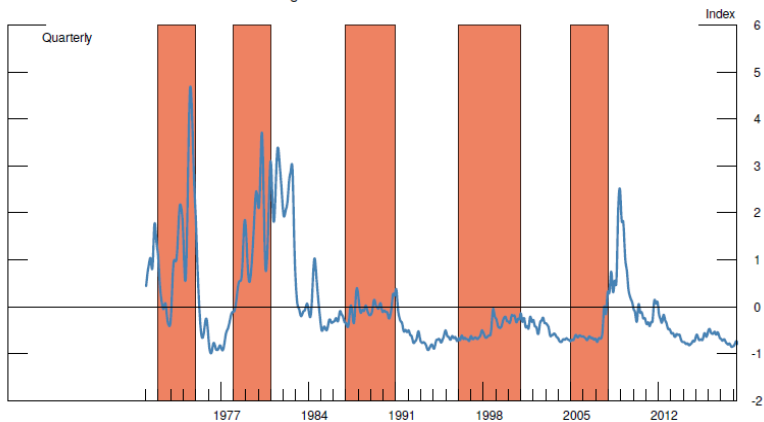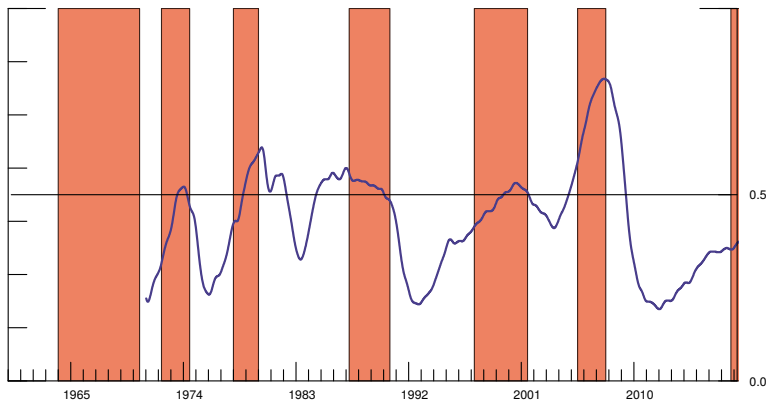NFCI and Periods of Economic Overheating

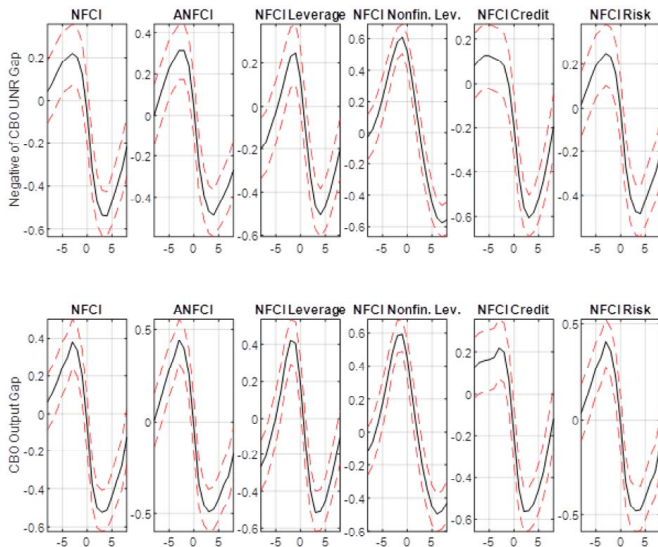The orange shading denotes periods of economic overheating.

NFCI Nonfinancial Leverage and Overheating

NFCI Nonfinancial Leverage Subindex

Econometric Analysis: Cross-correlograms

Overheating positively associated with future NFCI, esp. nonfin. lev.

Econometric Analysis: Out-of-sample Predictability I

Does business cycle help forecast the financial cycle?

- Estimate bivariate auto-regressions (VARs) with output gap and NFCI (and subindexes)
- Compare pseudo out-of-sample (1980:Q1 - 2015:Q4) root mean square forecasting error (RMSFE) generated by an autoregressive process (AR) estimated on the NFCI (and subindexes) with the same number of lags as the VAR
- Estimation is recursive for each forecast horizon (1 to 8 quarters)
- Calculate the following RMSFE ratio

$$RMSFE\ ratio = \frac{RMSFE(VAR)}{RMSFE(AR)}$$

- If RMSFE ratio < 1, then average predictive performance for NFCI (and subindexes) is enhanced by the addition of output gap

Table: Comparisons of Bivariate to Univariate Pseudo-Out-of-Sample
Forecasts for the NFCI: **RMSFE Ratio VAR/AR**

Horizon	NFCI & Output Gap		NFCI & UNR Gap	
	VAR(1)	VAR(4)	VAR(1)	VAR(4)
1	1.09	1.35	1.25	1.24
2	1.24	1.46	1.57	1.45
4	0.90	0.91	1.04	0.97
8	0.75	0.77	0.73	0.96

Notes: The table reports ratios of the Root Mean Squared Forecast Errors (RMSFE) from a
bivariate VAR to the RMSFE for an AR process. The VAR includes the two variables in each
panel. Ratios below 1 indicate that the VAR outperforms the AR process. For instance, value
1.09 under the heading "NFCI" indicates that forecasts from a bivariate VAR(1) including the
NFCI and the output gap are less accurate than forecasts from an AR(1) process for the NFCI.
Numbers in bold indicate a rejection of the Null Hypothesis of equal forecasting performance
for the Diebold-Mariano test at the 5%-level.

Table: Comparisons of Bivariate to Univariate Pseudo-Out-of-Sample Forecasts for the ANFCI: **RMSFE Ratio VAR/AR**

Horizon	ANFCI & Output Gap		ANFCI & UNR Gap	
	VAR(1)	VAR(4)	VAR(1)	VAR(4)
1	1.02	1.29	1.12	1.25
2	1.05	1.25	1.24	1.26
4	0.89	0.93	0.95	0.97
8	0.85	0.87	0.82	0.99

Notes: The table reports ratios of the Root Mean Squared Forecast Errors (RMSFE) from a bivariate VAR to the RMSFE for an AR process. The VAR includes the two variables in each panel. 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.

Table: Comparisons of Bivariate to Univariate Pseudo-Out-of-Sample Forecasts for the NFCI-Risk: **RMSFE Ratio VAR/AR**

Horizon	NFCI-Risk & Output Gap		NFCI-Risk & UNR Gap	
	VAR(1)	VAR(4)	VAR(1)	VAR(4)
1	1.10	1.38	1.23	1.28
2	1.21	1.50	1.47	1.48
4	0.92	0.92	1.03	0.95
8	0.78	0.78	0.75	0.91

Notes: The table reports ratios of the Root Mean Squared Forecast Errors (RMSFE) from a bivariate VAR to the RMSFE for an AR process. The VAR includes the two variables in each panel. 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.

Out-of-sample Predictability: NFCI-Credit

Table: Comparisons of Bivariate to Univariate Pseudo-Out-of-Sample
Forecasts for the NFCI-Credit: **RMSFE Ratio VAR/AR**

Horizon	NFCI-Credit & Output Gap		NFCI-Credit & UNR Gap	
	VAR(1)	VAR(4)	VAR(1)	VAR(4)
1	0.87	0.86	0.95	0.86
2	0.87	0.75	1.00	0.77
4	0.71	0.92	0.80	1.28
8	**0.73**	1.01	0.75	1.13

Notes: The table reports ratios of the Root Mean Squared Forecast Errors (RMSFE) from a
bivariate VAR to the RMSFE for an AR process. The VAR includes the two variables in each
panel. 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.

Out-of-sample Predictability: NFCI-Leverage

Table: Comparisons of Bivariate to Univariate Pseudo-Out-of-Sample Forecasts for the NFCI-Leverage: **RMSFE Ratio VAR/AR**

Horizon	NFCI-Lev. & Output Gap		NFCI-Lev. & UNR Gap	
	VAR(1)	VAR(4)	VAR(1)	VAR(4)
1	1.11	0.98	1.12	1.02
2	1.16	1.05	1.18	1.04
4	0.93	0.89	0.98	1.03
8	0.89	0.98	0.91	1.05

Notes: The table reports ratios of the Root Mean Squared Forecast Errors (RMSFE) from a bivariate VAR to the RMSFE for an AR process. The VAR includes the two variables in each panel. 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.

Out-of-sample Predictability: NFCI-Nonfin.Leverage

Table: Comparisons of Bivariate to Univariate Pseudo-Out-of-Sample Forecasts for the NFCI-Nonfin. Leverage: **RMSFE Ratio VAR/AR**

Horizon	NFCI-NF Lev. & Output Gap		NFCI-NF Lev. & UNR Gap	
	VAR(1)	VAR(4)	VAR(1)	VAR(4)
1	**0.64**	**0.55**	0.77	**0.68**
2	0.72	**0.62**	0.83	**0.69**
4	0.81	**0.50**	0.88	**0.70**
8	0.93	**0.80**	0.96	0.89

Notes: The table reports ratios of the Root Mean Squared Forecast Errors (RMSFE) from a bivariate VAR to the RMSFE for an AR process. The VAR includes the two variables in each panel. 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.

# Econometric Analysis: Out-of-sample Predictability II

What do conditional forecasts say for recent overheating periods?

- Produce conditional forecast of NFCI assuming we know the evolution of the output gap into the expansion periods up to one-year ahead; this means that all shocks to output are realized!

- We look at three periods
  - 2000:Q2
  - 2005:Q1
  - 2018:Q1 (here, we use CBO projections up to 2019:Q1)

- Tighter link between the NFCI index and output gap most recently may be due to smaller estimation uncertainty (more data) and the inclusion of the GFC (when NFCI and output gap co-moved a lot)

Conditional Forecast of NFCI
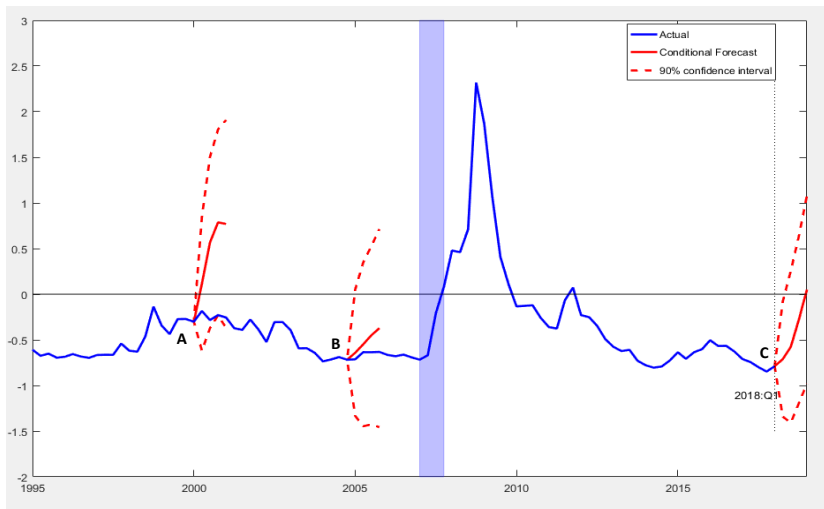
# Conditional Forecast of NFCI-Nonfin. Leverage
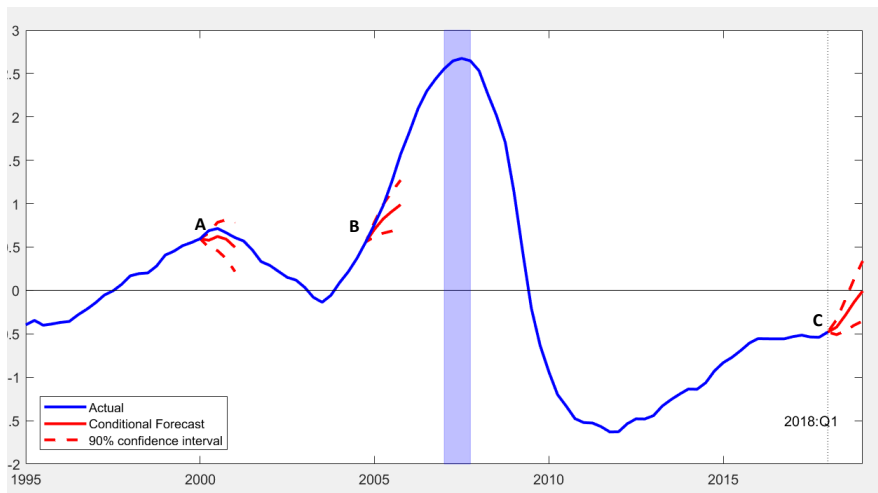
What about quantile regressions?

- We reverse Adrian et al. (2017) and ask whether conditional distributions of financial conditions are a function of the output gap (or unemployment gap)

- Results show that there is not that much evidence for this

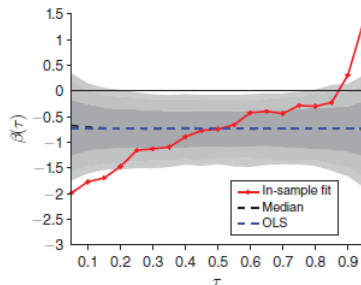- Output gaps are relatively uninformative in predicting a tail event in financial conditions
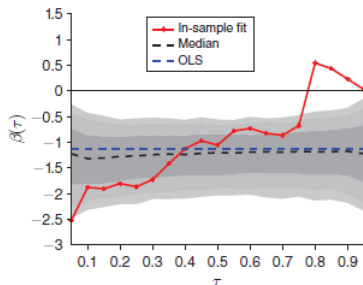
FIGURE 4. ESTIMATED QUANTILE REGRESSION COEFFICIENTS

Notes: The figure shows the estimated coefficients in quantile regressions of one-quarter-ahead (left column) and one-year-ahead (right column) real GDP growth on current real GDP growth and NFCI. We report confidence bounds for the null hypothesis that the true data-generating process is a general, flexible linear model for growth and financial conditions (VAR with four lags); bounds are computed using 1,000 bootstrapped samples.
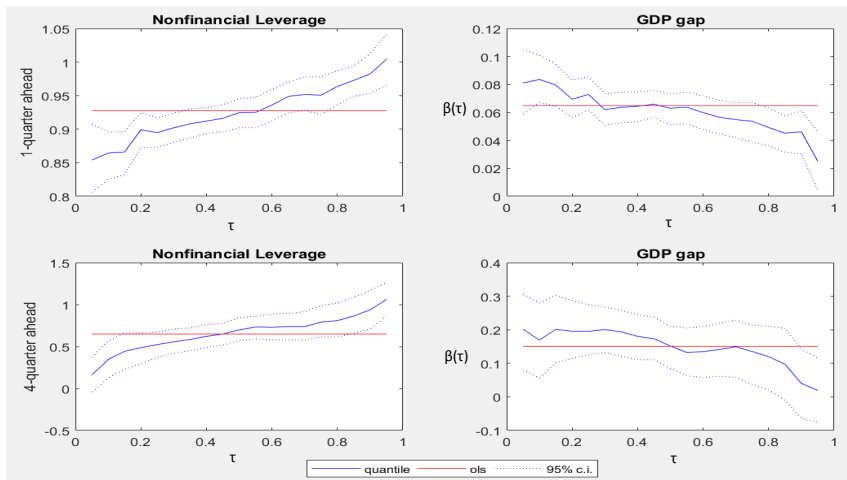
Conclusion

- Financial disturbances tend to occur after macro overheating
- Narrative historical accounts show that this relationship may not be causal, perhaps with the exception of developments leading up to the Dot-com crash and the GFC
- Usually many reasons for financial disturbances or crises, especially the GFC; and many of the reasons are related to financial innovation, rapid market development, and regulation/supervision (and not necessarily to macro overheating)
- Statistically, current positive output gaps are associated with greater vulnerability or tighter financial conditions in the future
- However, out-of-sample forecasting exercise shows a weak relationship, perhaps with the exception of nonfinancial leverage
- Results are similar when we look at credit-to-GDP gap, AKLPW, and LPS

Caveats and Next Steps

- There may have been a structural change in the relationship between overheating and financial vulnerability more recently
- Monetary policy may have played different roles in different episodes of overheating
- Macroprudential policy may play a role in the future relationship between overheating and financial vulnerability
- Would want to investigate this relationship more deeply with a panel of countries

International Cross-correlograms with Credit-to-GDP Gap