# Financial Vulnerabilities, Macroeconomic Dynamics, and Monetary Policy

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# Disclaimer

*The opinions in this paper are those of the authors and do not necessarily reflect the views of Bank of England and the Board of Governors of the Federal Reserve System.*

# In this paper

We evaluate if financial vulnerabilities, in the United States, can be captured by two sets of measures of financial imbalances:[1]

1. Private-sector debt measures;
2. Risk appetite and asset valuations measures.

We find that **shocks to the first set of measures may lead to economic contractions**, suggesting that they are useful measures of financial vulnerabilities.

Shocks to risk appetite and asset valuations measures **may not lead to contractions**, but they **may stimulate credit expansions**, which can in turn lead to contractions.

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[1]In the paper we also evaluate measures of financial leverage and of "runnable" liabilities

# In this paper

We find that **the effect of shocks** to vulnerabilities **is nonlinear**: shocks lead to contractions when private credit measures are high, but not when they are low.

We also find that, in periods of **high vulnerability**, **monetary policy** shocks are **ineffective**, suggesting a role for macroprudential policies as vulnerabilities escalate.

When we decompose credit, we find that **shocks to business, nonproperty and nonbank credit lead to economic contraction**, suggesting that policymakers may wish to also pay particular attention to these forms of credit

# Outline

## Motivation

The recent global **financial crisis** highlighted in dramatic fashion the **damage** to economic performance **from falling asset prices** amid **high levels of credit** and fragile financial institutions.

**Policymakers** have since been encouraged to **monitor** the buildup of so-called **macrofinancial "imbalances"** -see Adrian et al. (2013)- in order to inform policy decision about:

- How bad is the current level of vulnerability in terms of expected economic impact?
- How much longer can it grow without causing unacceptable deterioration in the expected outlook?
- What would be the effect of a shift in monetary policy? Can it be used to stop growing vulnerabilities?

## Motivation

Cross-sectional studies of advanced economies have found that **private nonfinancial sector debt** and **asset valuations** are **early warning indicators** of **economic recessions** and financial crises and that high credit growth and asset bubbles combined lead to significantly weaker economic recoveries.

Moreover, **periods of high vulnerability** are thought to be qualitatively **different** because they are susceptible to self-fulfilling negative dynamics.

# Motivation

Cross-sectional studies of advanced economies have found that **private nonfinancial sector debt** and **asset valuations** are **early warning indicators** of **economic recessions** and financial crises and that high credit growth and asset bubbles combined lead to significantly weaker economic recoveries.

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***Are there non-linearities?***

# Motivation

**We define measures of financial imbalances as vulnerabilities if a shock to them presage an economic contraction.**

Our goal is to find which macrofinancial aggregate can identify financial vulnerabilities.

We evaluate two sets of measures suggested by theory and historical experience:[2]

1. Private-sector debt measures;
2. Risk appetite and asset valuations measures.

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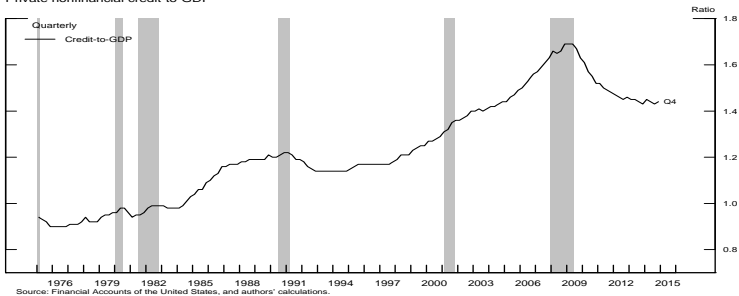[2]In the paper we also evaluate measures of financial leverage and of "runnable" liabilities

# Data

We measure private nonfinancial debt with **nonfinancial credit-to-GDP gap** that has been shown in cross-sectional country analyses to be a good predictor of future credit busts. (Borio and Lowe, 2002 and 2004; Borio and Drehmann, 2009; and Drehmann and Juselius, 2013).
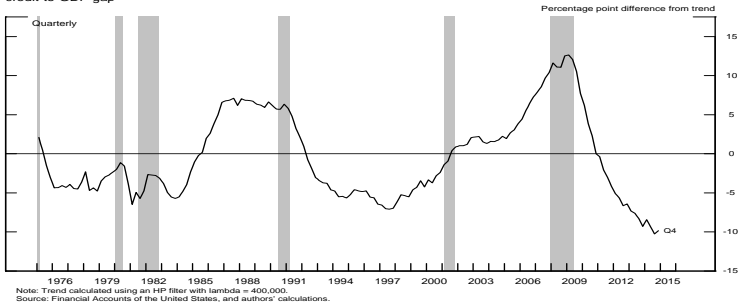
Since 1975 it shows two build-ups:

1. starts in the early 1980s and ends in the recession of 1990-91
2. starts in the late 1990s and accelerates for a sustained period until the Great Recession

**Private nonfinancial credit-to-GDP**

Ratio

Quarterly
— Credit-to-GDP

1.8
1.6
1.4
1.2
1.0
0.8

Q4

1976  1979  1982  1985  1988  1991  1994  1997  2000  2003  2006  2009  2012  2015

Source: Financial Accounts of the United States, and authors' calculations.

**Private nonfinancial
credit-to-GDP gap**

Percentage point difference from trend

Quarterly

15
10
5
0
-5
-10
-15

Q4

1976  1979  1982  1985  1988  1991  1994  1997  2000  2003  2006  2009  2012  2015

Note: Trend calculated using an HP filter with lambda = 400,000.
Source: Financial Accounts of the United States, and authors' calculations.

# Data

We also **decompose** the **credit-to-GDP gap** in three ways:

1. a sectoral decomposition of credit provided to households and businesses;
2. a bank vs nonbank decomposition, based on where the credit exposures are being held
3. a decomposition into debt secured by commercial or residential real estate ("property" debt) vs debt not secured by real estate ("nonproperty" debt)

# Data

However, private nonfinancial debt signals elevated vulnerabilities for a significant period after the financial cycle turns.

This may reflect borrowers drawing upon pre-committed lines of credit they have with banks in such situations, which delays the recognition of tight financing conditions in credit measures.

It may also reflect GDP falling more quickly than credit in the early stages of a downturn because of long-lived debt contracts, such as mortgages.

Therefore, our second set of candidate measures are related to investors' **willingness to accept risk** that may provide an **earlier indication** of agents willingness **to borrow than credit** or funding measures because asset prices are forward-looking (see Stein, 2013).

Risk appetite reflects financial variables that could foster a buildup of vulnerabilities at banks and credit markets, and at borrowers, including household (consumer and mortgage) credit, business unsecured debt, commercial real estate, and the equity market.

# Data

We consider two measures of risk appetite:

- ALLM measure of risk appetite;

  A measure that captures asset valuations and lending standards in business credit markets, commercial

  real estate, household credit (including consumer credit and residential mortgages), and equity markets.

- excess bond premium (EBP) measure of Gilchrist and Zakrajsek (2012);

  Stein (2013) emphasized the information in **bond risk premiums**: when they are unusually low there is a

  greater probability of an upward spike, which may be associated with significant adverse economic effects.

Our measure of risk appetite leads the credit-to-GDP gap (max correlation at 8 quarters), suggesting that **strong risk appetite tends to create the conditions for a period of high aggregate credit-to-GDP gap**, and it rises ahead the four recessions:
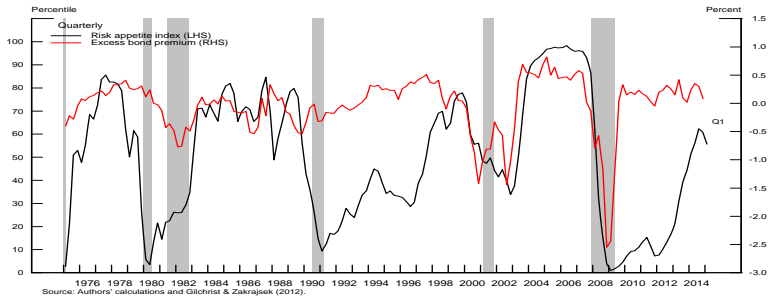
In the 1970s because of business credit and equities;

in the 1980s becasue of household credit and commercial real estate, before expanding to business credit, culminating in the LBO bust;
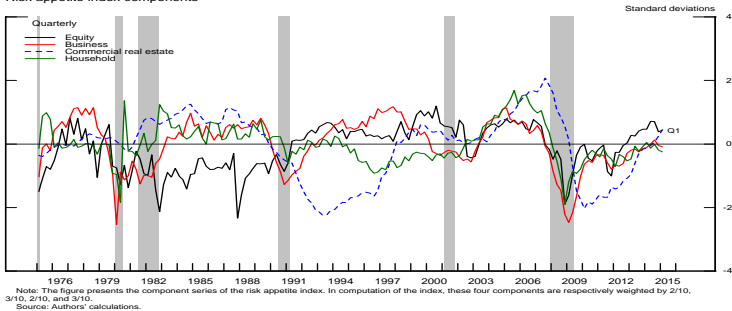
in the 1990s because of business credit, for the tech and telecom sectors;

All four components were high by the late 2000s, and all fell simultaneously in the Great Recession.

**Risk appetite index and -1*excess bond premium**

Percentile

Quarterly
- Risk appetite index (LHS)
- Excess bond premium (RHS)

Percent

Q1

1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014

Source: Authors' calculations and Gilchrist & Zakrajsek (2012).

**Risk appetite index components**

Standard deviations

Quarterly
- Equity
- Business
- Commercial real estate
- Household

Q1

1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015

Note: The figure presents the component series of the risk appetite index. In computation of the index, these four components are respectively weighted by 2/10, 3/10, 2/10, and 3/10.

Source: Authors' calculations.

# Interaction with monetary policy

When the economy is expanding, highly **accommodative monetary policy** can lead to a **build-up of financial vulnerabilities** and an increase in the probability of a severe recession or financial crisis in the future (see Adrian and Liang, 2014, for a review).

Low interest rates encourage banks to take on more risk. On the asset side, banks reach for yield (Rajan, 2005) by increasing their investments in risky assets. On the funding side, loose monetary policy incentivizes banks to use more short-term funding.

However, **monetary policy could work to reduce vulnerabilities**.

Ajello et al. (2015) find that optimal interest rate policy should respond to crisis risk, but only by a very small amount.

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***We investigate, in our framework, this interaction!***

# Econometric Framework

We evaluate potential measures of financial vulnerability using quarterly U.S. data from 1975:Q1 to 2014:Q4. Our baseline specifications contain:

- $100 \times$ logarithm of real Gross Domestic Product.
- $100 \times$ logarithm of the Gross Domestic Product deflator.
- Unemployment rate.
- Candidate vulnerability measure defined so that higher values indicate increased vulnerability
- Federal funds rate (effective), per annum.

# Econometric Framework

In order to exploit the possible non-linearities we estimate **threshold vector autoregressions** (TVARs). In practice, the VARs are estimated over disjoint subsamples, i.e. when the vulnerability measure ($X_t$) is high (above its mean, $\mu_X$) and when the vulnerability measure is low (below $\mu_X$).

$$y_t = c^{(j)} + A(L)^{(j)} y_{t-1} + \varepsilon_t^{(j)} \quad \begin{cases} j = \textit{high}, & \text{if } X_t > \mu_X \\ j = \textit{low}, & \text{if } X_t \leq \mu_X \end{cases} \quad (1)$$

Here $y_t$ is the vector of endogenous variables.

# Econometric Framework

We estimate the TVARs using Bayesian techniques, following the estimation strategy proposed by Giannone et al. (2015) that is based on the so-called Minnesota prior, first introduced in Litterman (1979; 1980).

This prior is centered on the assumption that each variable follows a random walk, possibly with a drift; this reduces estimation uncertainty and leads to more stable inference.

In computing impulse response functions, we identify shocks using a Cholesky decomposition:

- the federal funds rate last so that reacts to all shocks contemporaneously as in Christiano et al. (1996);

- the vulnerability measure reacts to all shocks within a quarter save monetary policy;

- unemployment rate, the GDP deflator, and real GDP react to shocks to the vulnerability measure and monetary policy with a one-quarter lag.

# Credit-to-GDP as Vulnerability

We begin by evaluating the gap between the credit-to-GDP ratio and its trend, estimated using a Hodrick-Prescott filter (with $\lambda = 400,000$).
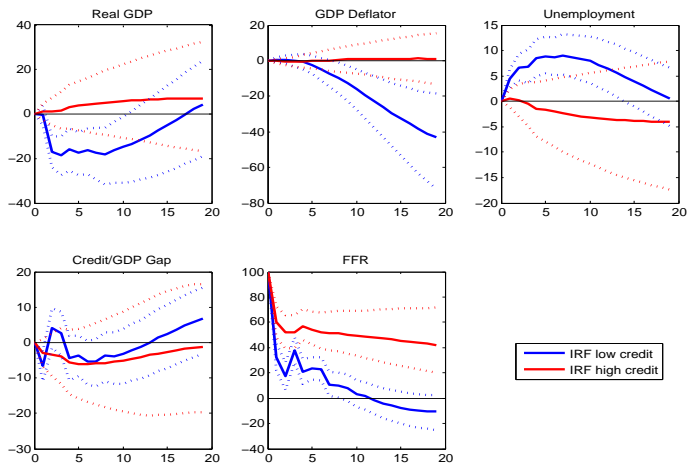
Real GDP appears in our baseline specification both directly and as a component of the credit-to-GDP gap.

When we compute the impulse responses to shocks to the credit-to-GDP gap we do not mechanically adjust real GDP or the gap to reflect this accounting relationship. Thus, shocks to the gap can be interpreted as shocks to credit.

# Credit Shock
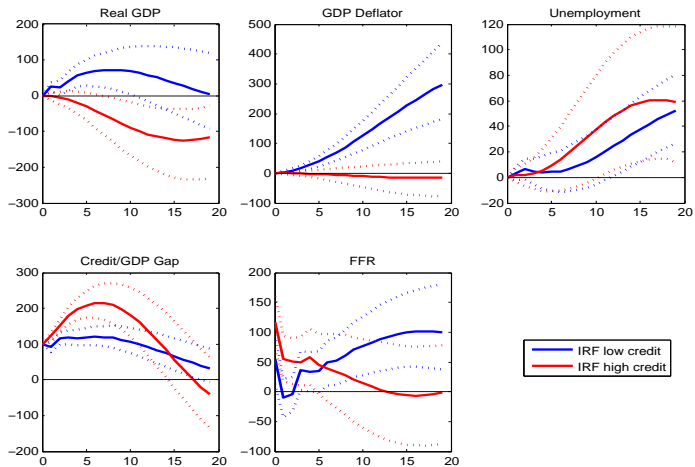
# Monetary Policy Shock

# Additional work on Monetary Policy Shocks

Are monetary policy shocks less effective in high credit-to-GDP gap periods because they can't stop an ongoing boom or because they can't stimulate an economy after a credit boom?

- Our measure is high before and after a credit-to-GDP peak.

- We tested an alternative measure that is high when credit-to-GDP gap is rising and low when it is falling.

- Monetary policy shocks are less effective in the rising than the falling periods, suggesting that it's harder to stop a boom.

- More work needed on this question.

# Additional work on Monetary Policy Shocks

Results when we use high-frequency measures a la Hanson-Stein (2015) to identify monetary policy shocks rather than Cholesky decomposition:

- Permit analysis of the effect of shocks on forward Treasury rates.

- Results are broadly similar: when the credit-to-GDP gap is above zero, the reaction of rates along the yield curve is smaller.

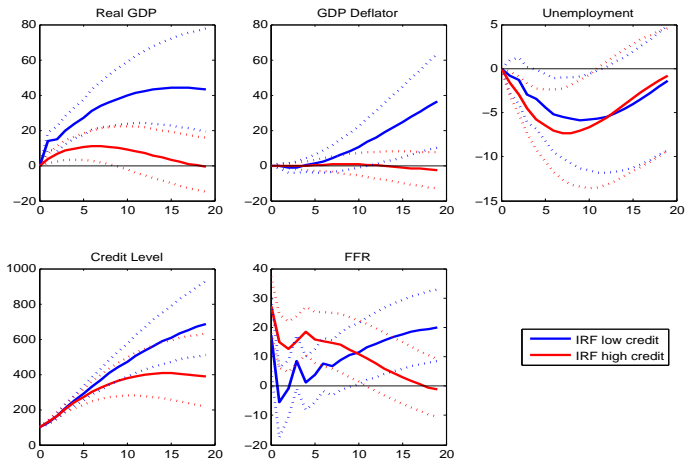- The attenuation is particularly pronounced at medium and longer maturities.

# Robustness Tests on Credit-to-GDP

The use of the credit-to-GDP gap as a candidate indicator of vulnerability raises certain obvious questions:
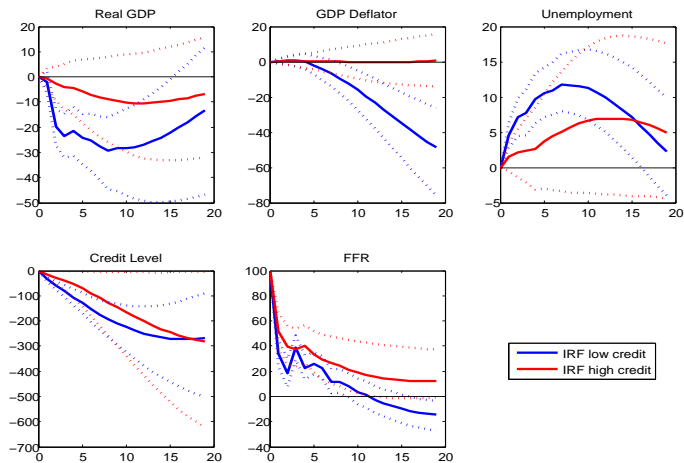
1. although we argue that shocks to this measure can be interpreted as credit shocks, it is instructive to test whether the level of credit (rather than a ratio to GDP) also results in the same general findings;

2. because actual GDP falls in bad times, one might be concerned that the causation runs from recessions to higher credit-to-GDP ratios;

3. if monetary policy is reacting to the credit-to-GDP gap, this may be the channel by which shocks to the gap translate to economic contractions.

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⇒ *we substitute credit-to-GDP with the level of credit*

# Credit shock with the level of credit



Real GDP | GDP Deflator | Unemployment

Credit Level | FFR

IRF low credit
IRF high credit
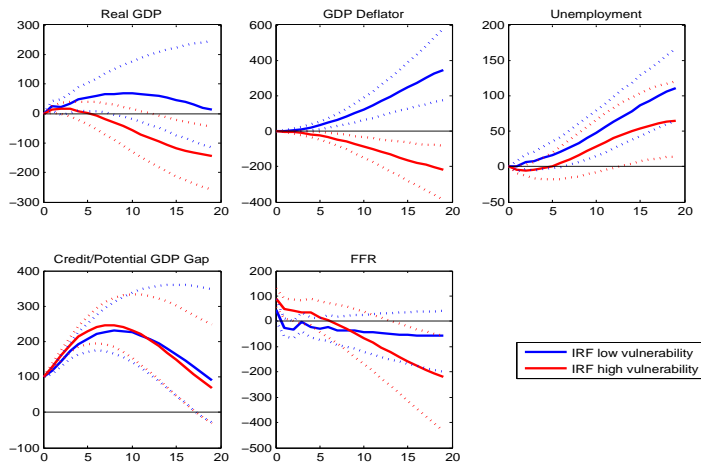
# Monetary policy shock with the level of credit

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⇒ *we substitute credit-to-GDP with credit-to-potential GDP*

# Credit shock with credit-to-potential GDP

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⇒ *we shut down the federal funds rate channel*

# Credit shock shutting down the FFR channel
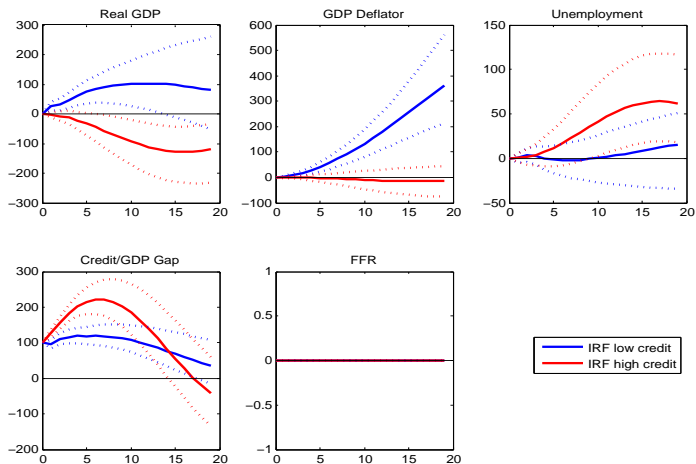
# Credit-to-GDP components as Vulnerabilities

Our credit-to-GDP gap vulnerability measure is based on total nonfinancial debt. However, one might suspect that different forms of debt may pose more or less danger to the financial system.

We consider three different disaggregation of total credit:

1. into debt owed by households vs. debt owed by (nonfinancial) businesses;
2. into debt secured by property (i.e. residential and commercial mortgages) vs. other forms of debt (e.g. credit cards, bonds, etc.);
3. into credit provided by banks vs. nonbanks.

# Credit-to-GDP components as Vulnerabilities

Table: Real GDP response

| Shock to | when vulnerability is: Low | High |
|---|---|---|
| Household debt | Expansion | Expansion |
| Business debt | Expansion[a] | Contraction |
| | | |
| Property debt | Expansion | Expansion |
| Nonproperty debt | Contraction | Contraction |
| | | |
| Bank credit | Expansion | Contraction[a] |
| Nonbank credit | Expansion | Contraction[a] |

*a* Indicates response is not statistically different from zero.
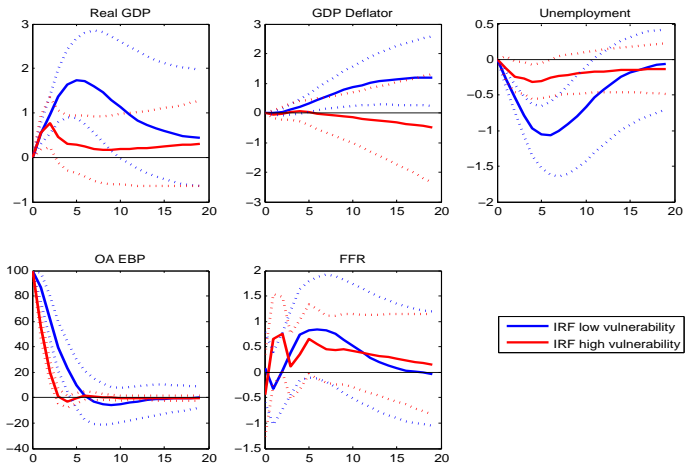
# Risk appetite as Vulnerability

We use two different measures of risk appetite:

1. ALLM risk appetite: it captures asset valuations and lending standards in business credit markets, commercial real estate, household credit (including consumer credit and residential mortgages), and equity markets

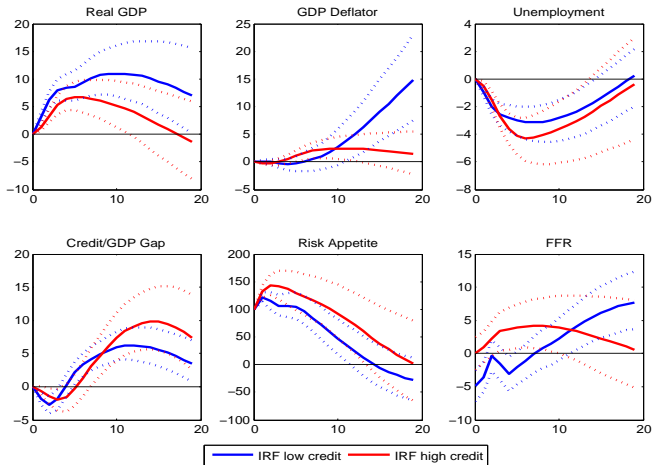2. the (negative) excess bond premium (EBP) measure of Gilchrist and Zakrajsek (2012)

# ALLM risk appetite shock
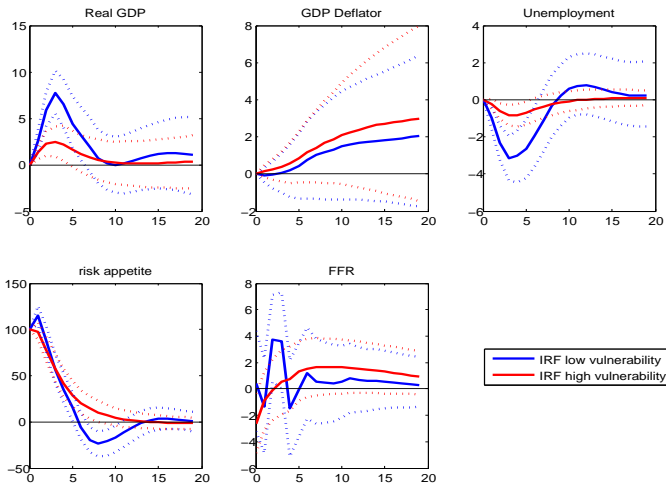
# Excess bond premium shock

# ALLM risk appetite shock



| IRF low credit | IRF high credit |

## Conclusions

We evaluated a range of vulnerability measures including the credit-to-GDP gap, and measures of risk appetite.

We find **credit-to-GDP gap is a vulnerability**, with impulses to the gap leading to a decline in real GDP and a rise in unemployment **when it is high**.

**Monetary policy** is generally **ineffective** at restraining the economy once the **credit-to-GDP gap is high**, suggesting the credit gap may affect monetary policy transmission channels. Because a high credit gap precedes contractions, **policies to limit excessive credit growth** could be **beneficial** for the economy.

Although shocks to our **risk appetite** measures are not followed by these kinds of economic contractions, risk aversion appears to **presage** future **credit growth**.