Feedbacks: Financial Markets and Economic Activity

September 10, 2017

Aims of the research

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Methods

- multiple-equation,
- Bayesian,
- and weakly structural.

Why multiple equation?: Isolating monetary policy effects

We know monetary policy has effects on output and prices, and it may work in part through placing stress on the financial system. If we are reliably to locate independently arising financial stress, we need at least two shocks and equations.

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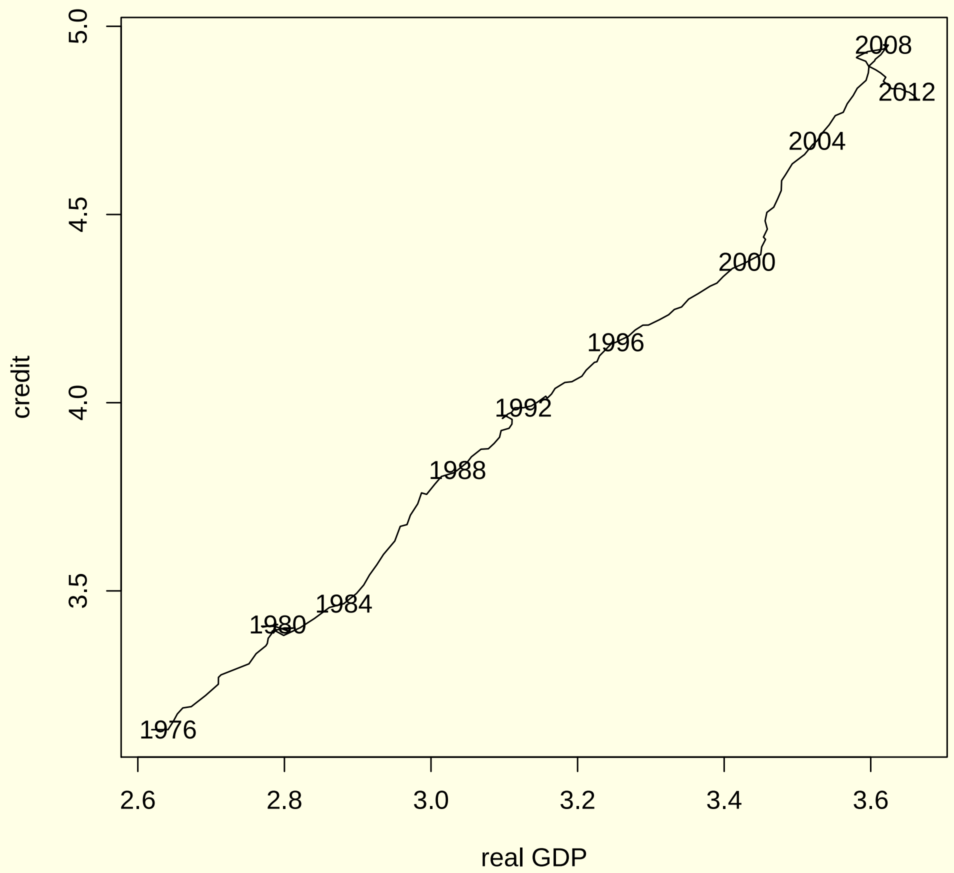
- Over long spans of time, credit grows relative to gdp as gdp increases.
- Countries with high gdp per capita tend to have high credit/gdp.

US real GDP and household credit (BIS quarterly `aha`)



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- Credit expansion might be associated with increased gross exposures, so that the risk of chains of loan contracts defaulting at once is increased.

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Empirical negative links between credit and growth

1. Schularick and Taylor AER

2. Jorda-Schularick-Taylor

3. Mian-Sufi-Verner

4. BIS work on this, much if it by Claudio Borio

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- Except for Mian-Sufi-Verner, this work filters outcomes via a "crisis" classification scheme.
- They rely mainly on single-equation methods, mostly with a single "forecast horizon".
- MSV also use a panel VAR, but only with 3 variables — two credit quantity variables and gdp growth, no interest rates.

Credit and output: The need for a multiple equation approach

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- We got this correctly sorted out only by recognizing the endogeneity of M and the need to separate policy-generated changes in r from other sources of variation in r.

Why "semi-structural"

- DSGE's are story-telling devices; we know less restrictive models fit better.
- They're better than RBC or old Keynesian models, because they are formulated as explicit multivariate time series models that can be compared in fit to structural VAR's.
- SVAR's came first: DSGE's were built to match SVAR results.

DSGE limitations

- But they don't fit as well as SVAR's.
- We don't really believe the stories they tell. (e.g., K, I, C, L, W and P are fictions)
- They are awkward tools when, as now, we are uncertain as to whether and how we should be expanding the list of variables that enter our macro models.

Structural VAR's

Structural VAR's break up the variation in an n-dimensional vector time series $\{y_t\}$ into mutually independent, serially uncorrelated components that are meant to represent distinct, interpretable sources of variation. These are called structural shocks.

A fitted SVAR model is usually discussed and interpreted via its impulse responses — the predicted reaction over time of each component of y to a one-time disturbance in each of the model's structural shocks.

Equations

The standard form of an SVAR is

$$A(L)y(t) = c + \varepsilon(t)$$

and its impulse responses are the elements of the $A^{-1}(L)$ matrix polynomial's coefficient matrices in

$$y(t) = A^{-1}(L)(c + \varepsilon_t)$$

with $A_0\varepsilon_t$ the innovation, or one-step-ahead prediction error, in y_t.

Identifying restrictions

If y is stationary, we can estimate $\Sigma = \mathrm{Var}(A_0^{-1}\varepsilon_t)$ consistently, but Σ has fewer free parameters than does A_0. Most of the literature has therefore imposed restrictions on the model to allow the data to determine $A(L)$ uniquely.

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- My 2006 AER paper with Tao Zha showed that likelihood favors time varying residual variances in macro data much more strongly than time varying coefficients in the model's linear structure.
- So in this project from an early stage we allowed for time varying variances.

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- Initially, with a priori restrictions on A_0 like those in existing literature.
- But then we tried relying entirely on identification through heteroskedasticity, with no other restrictions, and it worked.

Identification through heteroskedasticity

$$A(L)y_i(t) = c + \Lambda_i^{-1}\varepsilon_i(t)$$

$y_i(t)$ $n \times 1$; $\varepsilon_i(t) \sim N(0, I)$, i.i.d.; Λ_i diagonal; sum of diagonal elements of Λ over i is a vector of n's.

$A^{-1}(L)\Lambda_i$ represents impulse responses for time period i, while $A^{-1}(L)$ by itself is a kind of harmonic average impulse response.

Identification through heteroskedasticity

- Under the (strong) assumption that all differences across periods are captured in the Λ_i parameters, so long as there are even as many as two periods across which the ratios of the diagonals of Λ_i are all different, the system — and hence the responses to the structural shocks $\varepsilon_i(t)$, are identified.

- We have to supply the names of the responses ourselves, but the quantitative decomposition of disturbances into independent sources of variation is unique.

- We are relying on the idea that different time periods have different relative sizes of disturbances to monetary policy, financial stability, productivity, fiscal disturbances, etc.

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- However "identification by sign restrictions". does not produce exact identification, even in large samples, whereas identification through heteroskedasticity does produce exact identification.

- Of course this may be too good to be true. It remains to be seen how well it works in practice.

Identification proof

$$\Sigma_1 = A^{-1}\Lambda_1(A')^{-1}\,, \qquad \Sigma_2 = A^{-1}\Lambda_2(A')^{-1}$$
$$\therefore \Sigma_1^{-1}\Sigma_2 = A'\Lambda_1^{-1}\Lambda_2(A')^{-1}$$

This last matrix has the columns of A' as eigenvectors and the diagonal of $\Lambda_1^{-1}\Lambda_2$ as eigenvalues. As long as the diagonal elements of $\Lambda_1^{-1}\Lambda_2$ are all distinct, the columns of A' (rows of A) are uniquely determined up to their ordering.

The data

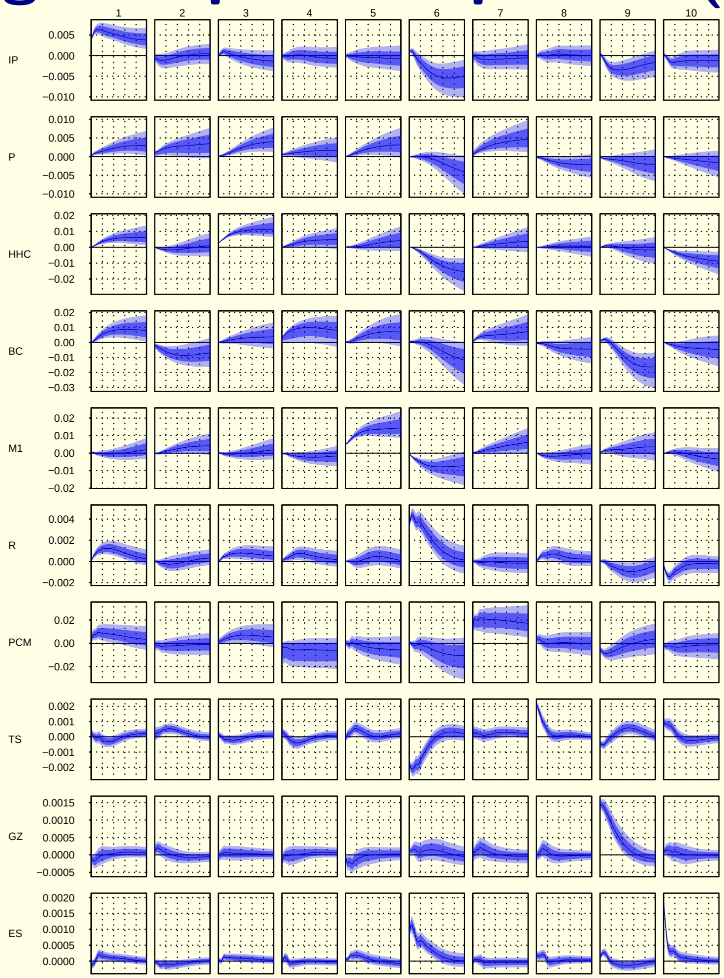
Abbv.	Description
IP	Industrial production
P	Personal consumption expenditures price index
HHC	Sum of commercial bank real estate and consumer loans
BC	Commercial bank commercial & industrial loans
M1	M1 money supply
R	Federal funds rate
PCM	CRB/BLS spot (commodity) price index
TS	Term spread of 10 year over 3 month Treasuries
GZ	Gilchrist/Zakrajšek bond spread
ES	"TED spread" of 3-month Eurodollars over 3 month Treasuries

Monthly, January 1973 to June 2015

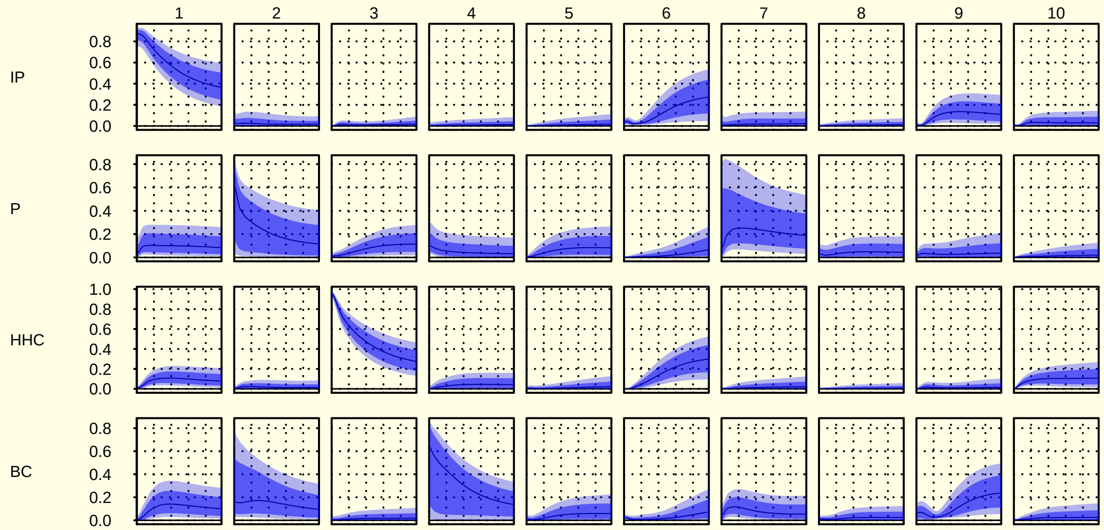
Prespecified break dates

	Start	End	Description
1	Jan 1973	Sep 1979	Oil crisis, stagflation, and Burns Fed
2	Oct 1979	Dec 1982	Volcker disinflation
3	Jan 1983	Dec 1989	Recovery from Reagan recession
4	Jan 1990	Dec 2007	Great Moderation, Greenspan Fed
5	Jan 2008	Dec 2010	Great Recession
6	Jan 2011	Jun 2015	Zero Lower Bound, Recovery from Great Recession

“Average” impulse responses (t errors)



Forecast variance decompositions



Comments on the responses

- There's a clear monetary policy shock (column 6)
- There are two "financial stress" shocks, with different impacts (9-10)
- There is one "household credit" shock (3) that raises household credit and is associated with a modest, statistically significant, later decline in output.
- Shock 3 is a relatively small contributor to GDP variance, and even to household credit variance. All other shocks that move household credit much move output in the same direction.

Credit and monetary policy: Leaning against the wind

- Shock 3 does predict a future IP decline. Would it be a good idea to suppress this type of credit expansion by changing interest rates, via monetary policy, to suppress the credit expansion?

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- Clearly not. It would only make the IP decline bigger and more long-lasting.

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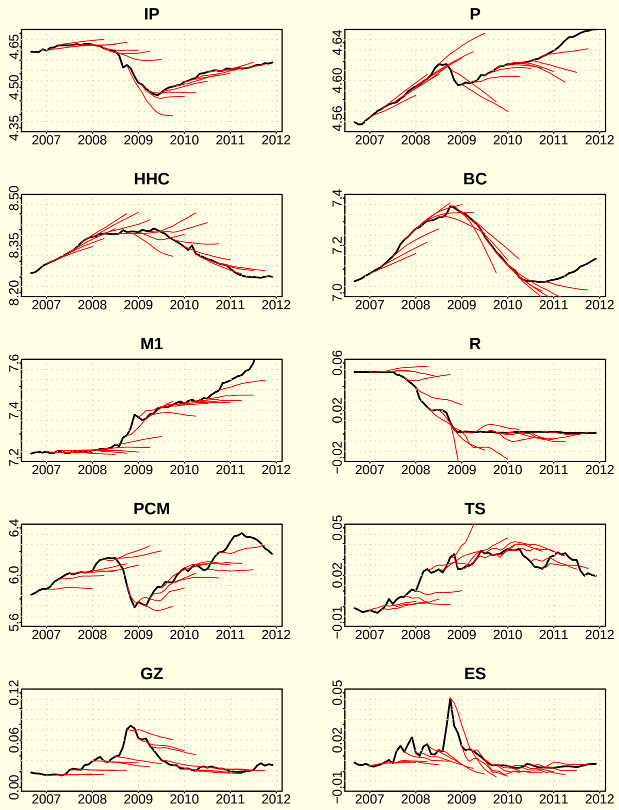
- Shock 3 predicts a rise in interest rates — quite plausibly a monetary policy response, since IP initially rises and the price level rises persistently.
- What if monetary policy did not react — i.e. we suppress the interest rate rise via a sequence of monetary policy shocks accompanying shock 3?
- In that case, there would be no IP decline — the IP decline following the credit expansion is entirely attributable to the monetary contraction it induces.

Fitting only through 2007?

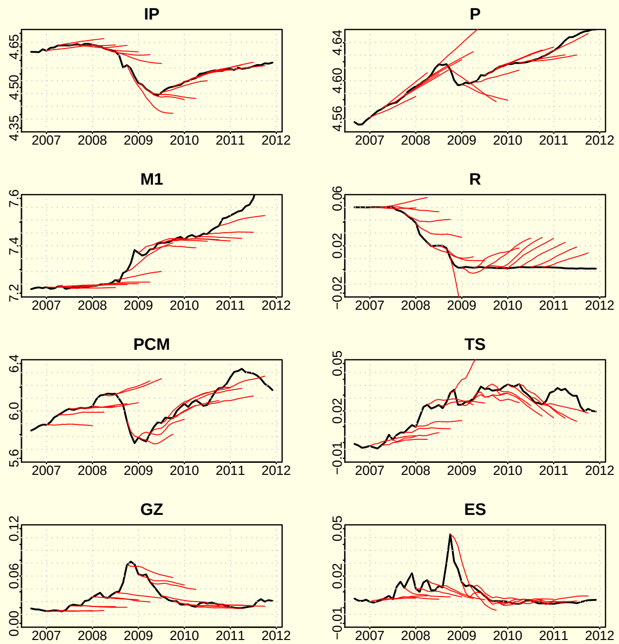
Leaves impulse responses very similar, particular the aspects singled out for discussion in the last slide.

It does shift the responses of PCM (commodity prices) to the monetary policy and GZ spread shocks, perhaps because the identification of monetary policy shocks is distorted by the ZLB period.

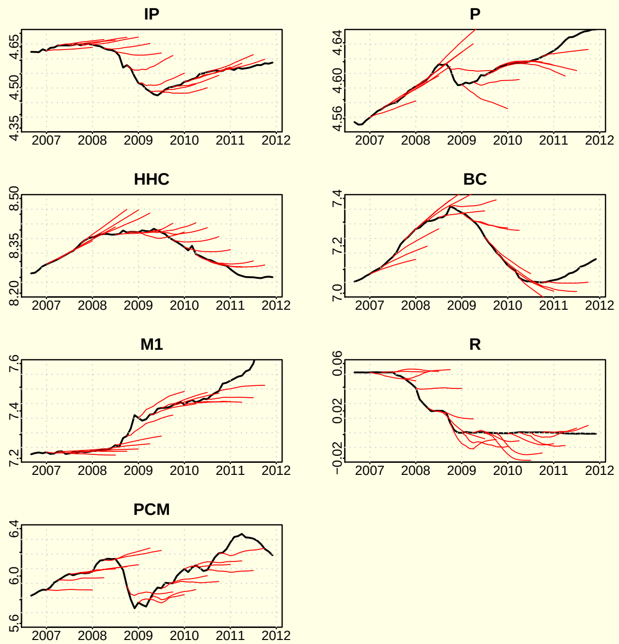
Full model forecasts



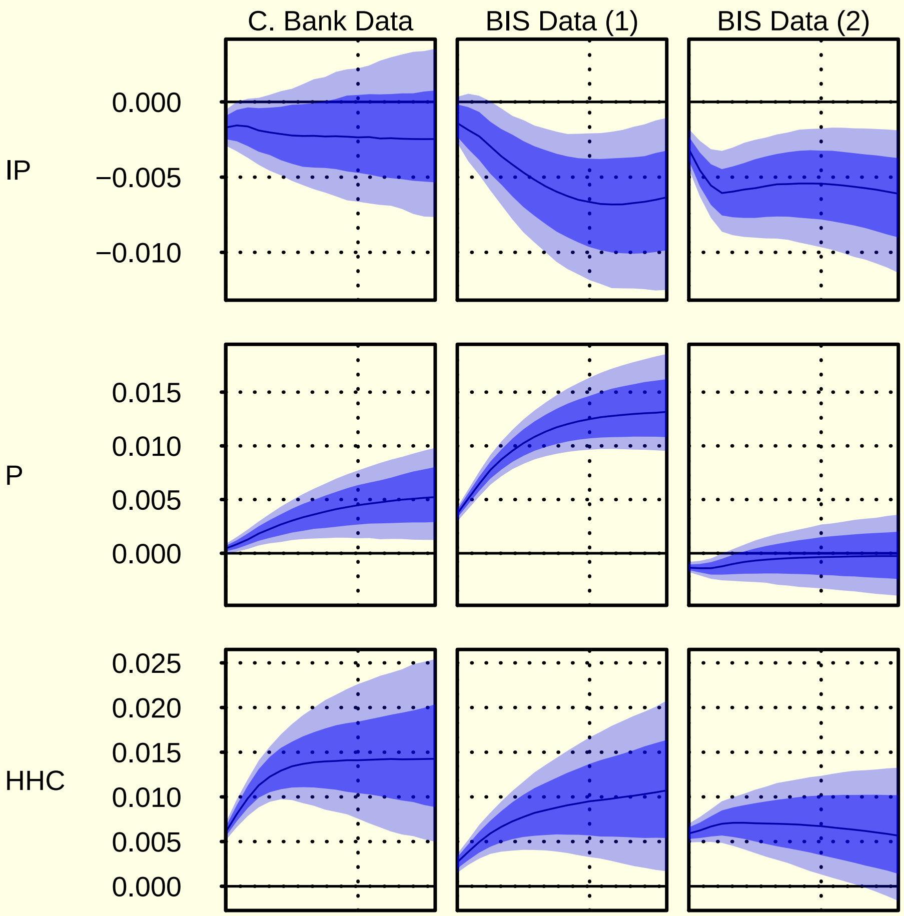
Without credit aggregates



Without spreads



A puzzle: Mian-Sufi-Verner results. BIS vs. Fed credit?



Other reasons for finding small negative impacts of credit growth

- Long term growth rates
- Nonlinearity
- Misspecification in the large model

Large model misspecification? Small VAR

Proportion $\hat{\beta} < 0$

	Household Credit	Business Credit
monthly	0.21	0.75
quarterly	0.29	0.75
annual	0.50	0.75

Proportion $\hat{\beta} < -.005$

	Household Credit	Business credit
monthly	0.00	0.11
quarterly	0.02	0.30
annual	0.16	0.45

Probability, in simulated draws from the posterior distribution of the data, of a negative or "economically significant" (more than 0.5% negative) 3-year response of IP to a positive credit shock in a 4-variable VAR.

Single-equation 3-yr forecasts

	Proportion $\hat{\beta} < 0$	
	Household Credit	Business Credit
without lagged IP	0.45	0.47
with lagged IP	0.48	0.49

	Proportion $\hat{\beta} < -.002$	
	Household Credit	Business Credit
without lagged IP	0.34	0.38
with lagged IP	0.37	0.42

Probability, in simulated draws from the posterior distribution of the data, of a negative or "economically significant" (more than 0.2%, per percentage point of credit to IP, negative) coefficient for lagged 3-year credit growth in predicting 3-year output growth.

Conclusion

- Financial stress does have an impact on inflation and growth.
- Financial stress is not one-dimensional.
- Surprise credit expansion ahead of output growth does predict later contraction, but this effect is modest and arises through induced monetary contraction.
- Identification through heteroskedasticity works surprisingly well.