# Credit and Crises

June 20, 2016

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Arguing for careful econometrics in studying the relation between financial variables and the macroeconomy, taking an approach that is

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

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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.

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- When the borrower can't repay, they throw ownership of assets into an uncertain state, to be resolved by an expensive and slow process, which hurts economic efficiency.
- 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-Werner
4. BIS work on this

## Some reasons I'm not fully convinced

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

## 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 $r$.

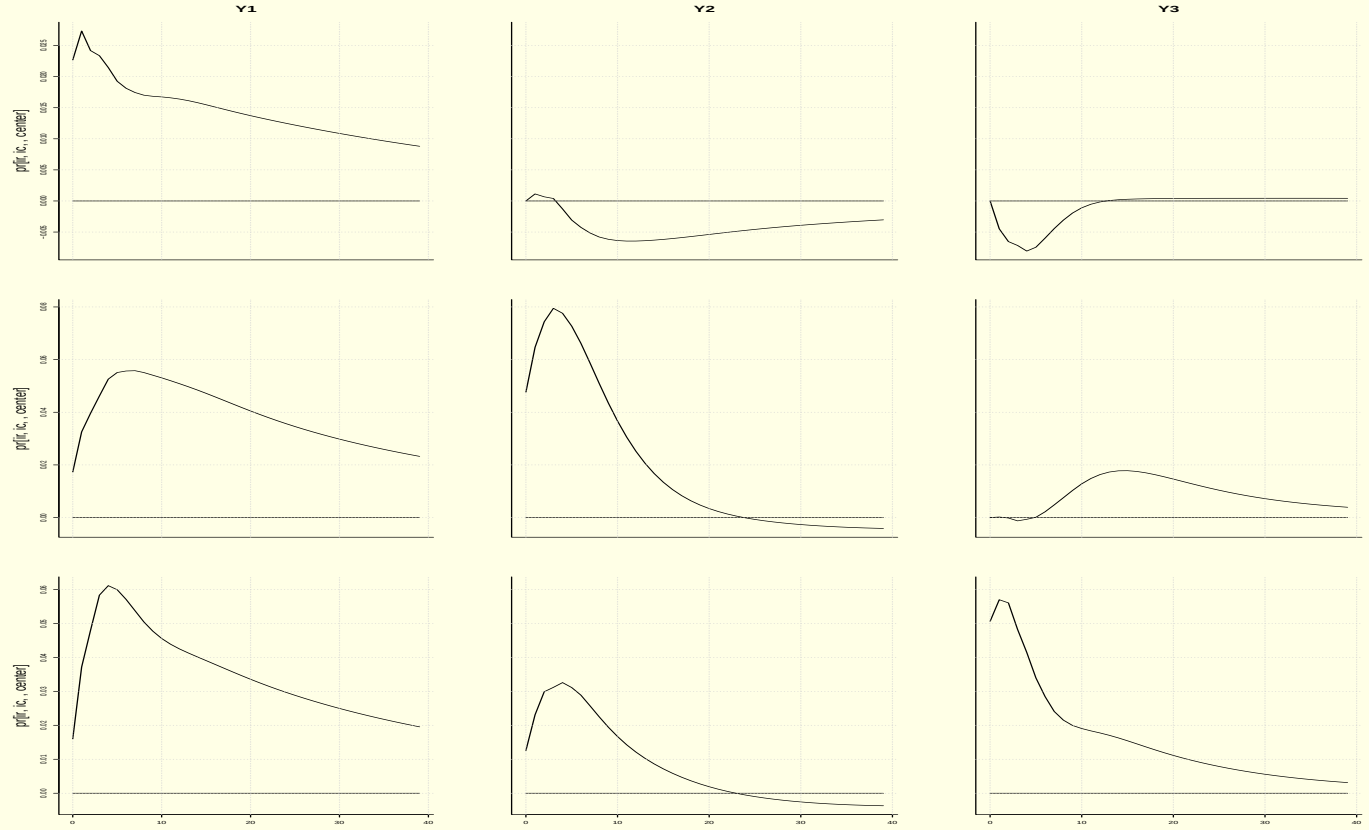
# Why "semi-structural"

- DSGE's are story-telling devices, not science.
- 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.

# A puzzle: Mian-Sufi-Verner results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# Equations

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

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

$A^{-1}(L)\Lambda_i$ represents impulse responses for country $i$, 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 countries are captured in the $c_i$ and $\Lambda_i$ parameters, so long as there are even as many as two countries across which the ratios of the diagonals of $\Lambda_i$ 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 countries have different relative sizes of disturbances to monetary policy, financial stability, productivity, fiscal disturbances, etc.

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

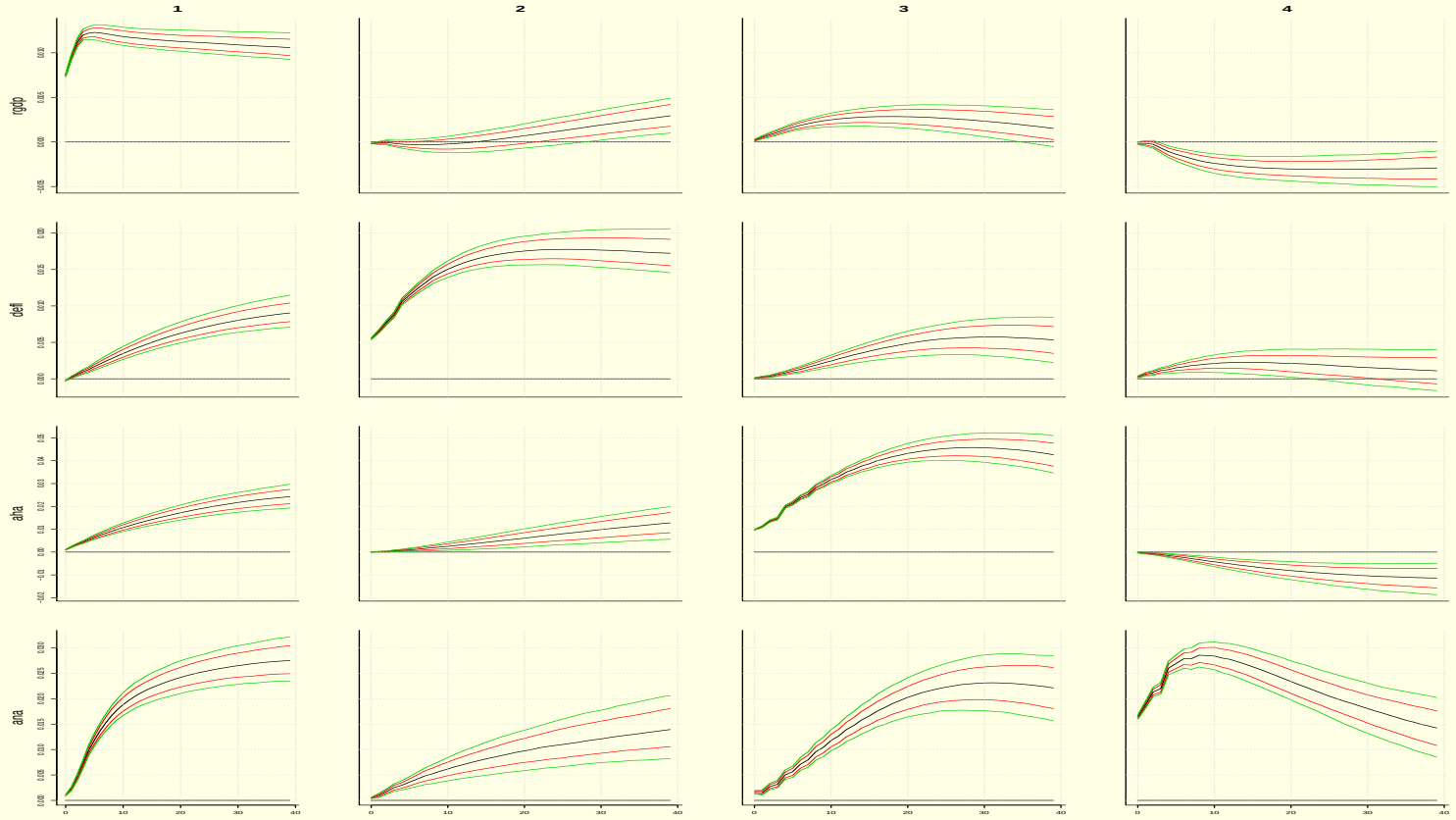
# Identification proof

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

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.

# CAS semi-replication with prior, quarterly data, ID through heteroskedasticity

## Modal responses to shocks, 30 countries



# Remarks on the replication

- The variables are real gdp and nominal credit to households and to firms, all logged.
- A positive and persistent shock to prices would increase the nominal credit variables, generate a restrictive monetary policy response, and thereby dampen GDP growth.
- In MSV's original VAR, ratios of the credit variables to nominal GDP are used, which are not directly affected by inflation.
- But as we'll see, credit-to-gdp ratios do rise with a shock that generates inflation and subsequent monetary contraction.

# A bigger model

- A panel data structural VAR for 13 countries.
- Country-specific constant terms, but the rest of the VAR constant across countries.
- Identification through heteroskedasticity, with the variances of structural shocks allowed to vary across countries.
- Probably most important: An interest rate in the data set.

# Data

13 countries: Austria, Belgium, Canada, Denmark, France, Italy, Japan, Netherlands, Norway, Sweden, United Kingdom, US, and Switzerland.

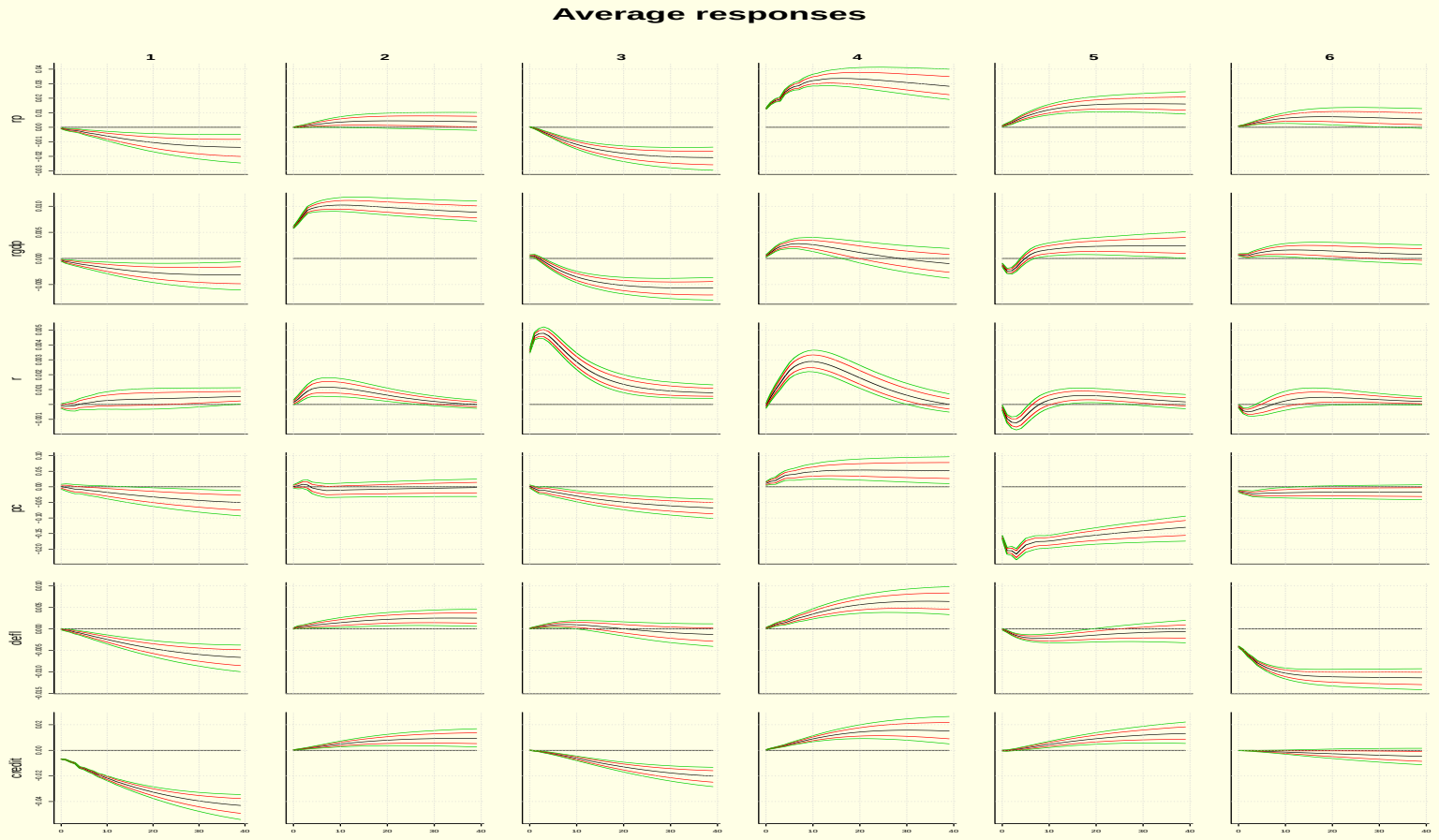
Sample periods differ across countries, based on data availability.

6 variables: real property prices (rp), real gdp (rgdp), short interest rate (usually 1-month t-bill or something similar), commodity prices (pc), gdp deflator (defl), and BIS "aha" credit (credit).

# Estimation methods

- 108 free parameters in $A_0, \Lambda$, 180 more in $A^+(L)$.
- A Bayesian approach is essential. A pure dummy-observation Minnesota prior (including pulling toward unit roots and toward cointegration) was used conditional on $A_0, \Lambda$.
- $A_0$ elements had mean 100 on the diagonal, 0 off diagonal, standard error 200. Rows of $\Lambda$ independent Dirichlet, multiplied by number of countries (so average is about 1).
- The marginal distribution of $A^+ \mid A_0, \Lambda$ is available analytically, so the model is estimated via maximization, then MCMC posterior sampling, over the distribution of $A_0, \Lambda$. This is quite fast on a laptop.

# Results



# Worth noting

- The identification approach seems to have thrown up one shock that behaves like a usual SVAR monetary policy shock (number 3)
- There is no shock that produces an increase in credit followed by below-trend gdp.
- There is one shock (number 4) that produces steady exapansion of credit, followed by expansion of real gdp for about three years, then a decline back to, or slightly below, steady state. (The 10-year response is negative, but 0 is within the 68% error band.)
- This shock is also associated with a substantial increase in inflation,

which is followed by an interest rate rise. Is it the credit expansion or the source of the inflation that dampens output growth?

# Why so different?

- Including interest rates and monetary policy reactions is important. Possibly the timing studies are just picking up the effects of monetary policy reacting to inflation and credit growth.

- No accounting for cross-country shock correlations in the same year, and these are high.

- 2008-9 is an outlier in nearly every country: mean shock is -9 standard deviations.

- MSV cluster by year, use no prior. Clustering on a highly unbalanced panel with 30 clusters is quite unreliable, tends to estimate too-small standard errors.

- Unit roots / initial conditions. The strongest priors toward unit roots were on the biggest model, and this should thus have the least problem of this sort. But requires further exploration.

# Why so different?

- Country lists and data spans don't match.
- Symmetric models don't make sense: US r should probably enter everywhere else. This might mitigate cross-country correlation of shocks, which is hard to interpret in an SVAR.
- The 6-variable model shown here includes only the household credit variable, while the 4-variable model found the negative response of rgdp only to the firm credit variable.
- Surely there is big time-varying heterosckasticity, and we've allowed only across countries.

# Conclusion

- We should not be treating the notion that rapid credit expansion implies future growth slowdowns as an established stylized fact.

- Using weakly identified models (mainly SVAR's) that allow testing of assertions about which credit indicators are statistically reliable is important.

- Introducing one or two plausible "financial" variables into a story-telling DSGE, with no test of their explanatory power, may leave the field to policy-maker "judgment", which may be strongly influenced by single-equation studies and simple correlations.