DISCUSSION OF

Mind the gap! Stylized dynamic facts and structural models

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- Understand the dynamic transmission of structural shocks using 'small' empirical models (SVARs)

- Use the insights to guide the construction of 'large' structural models (DGSEs)

KEY TASK OF A MACROECONOMIST → DIFFICULT!

- This paper: when an empirical model includes fewer variables than shocks present in the DGP, two issues arise

  1. Identified shocks are combinations of different types of true structural shocks (sectoral aggregation)

  2. Identified shocks are linear combinations of past and present true structural shocks (time aggregation)

     ⇒ "Identified shocks are mongrels"

- Importantly, these issues are distinct from non-invertibility

UNDERSTANDING AGGREGATION ISSUES

Consider RBC model with TFP shocks (Z_t) and IST shocks (V_t)

$$\max \ \mathbb{E}_0 \ \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\sigma}}{1-\sigma}$$

subject to

$$
\begin{aligned}
K_{t+1} &= (1-\delta)K_t + V_t I_t \\
Y_t &= C_t + I_t \\
Y_t &= Z_t K_t^{\alpha}
\end{aligned}
$$

with $0 < \alpha < 1$, $0 < \beta \leq 1$, $0 < \delta \leq 1$, $\sigma \geq 0$

A SIMPLE CASE

For $\sigma = 1$ and $\delta = 1$, can derive policy rules analytically, from guessing and verifying $C_t = (1-s)Y_t$, $\frac{K_{t+1}}{V_t} = sY_t$

$$
\begin{aligned}
K_{t+1} &= \alpha\beta Z_t V_t K_t^{\alpha} \\
C_t &= (1 - \alpha\beta)Z_t K_t^{\alpha} \\
Y_t &= Z_t K_t^{\alpha}
\end{aligned}
$$

This is the Brock and Mirman (1972) model, but I have augmented it with IST shocks

EMPIRICAL MODEL 1

- ▶ Suppose the structural shocks are iid

- ▶ As the first empirical model, let us consider a univariate AR model in log capital

- ▶ The DGP features $q = 2$ structural shocks

$$k_{t+1} = log(\alpha\beta) + \alpha k_t + z_t + v_t$$
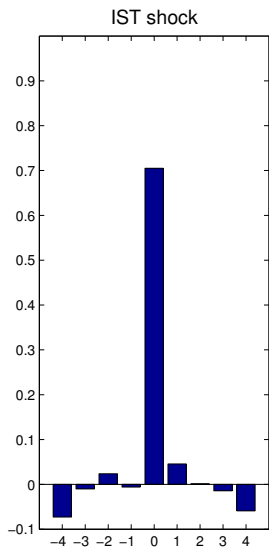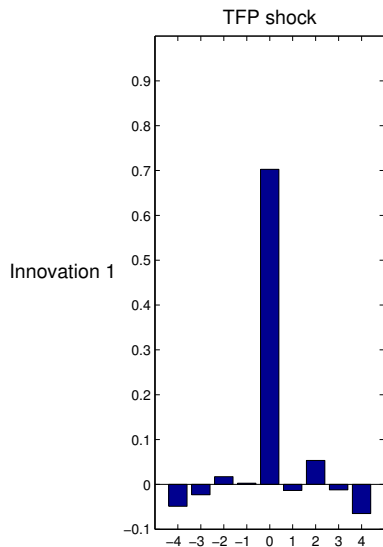
- ▶ The empirical model includes $\bar{q} = 1$ observable

$$k_{t+1} = a_0 + a_1 k_t + \xi_{kt}$$

CROSS-SECTIONAL AGGREGATION

- Easy to see that ξ_{kt} is a mongrel

- It combines z_t and v_t, so is subject to cross-sectional aggregation

- In richer model, z_t and v_t could be very different types of shocks (e.g. technology vs. preferences)

- Not an invertibility problem: $0 < \alpha < 1$

- Consider univariate version of Leeper, Walker and Young (2013) for comparison

$$k_{t+1} = \alpha k_t + \kappa(\varepsilon_{\tau,t-1} + \theta \varepsilon_{\tau,t})$$

EMPIRICAL MODEL 2: REPACKAGED STATE VARIABLE

▶ Rearrange policy rules for c_t and k_{t+1} to

$$
\begin{aligned}
c_t - \alpha c_{t-1} &= z_t + \alpha k_t - \alpha(z_{t-1} + \alpha k_{t-1}) + (1-\alpha)log(1-\alpha\beta) \\
k_t - \alpha k_{t-1} &= log(\alpha\beta) + v_{t-1} + z_{t-1}
\end{aligned}
$$

▶ Combine into a DGP for log consumption ($q = 2$):

$$c_t = c(\alpha, \beta) + \alpha c_{t-1} + z_t + \alpha v_{t-1}$$

▶ Consumption is now a state and depends on past IST shock

▶ Again, specify empirical model with $\bar{q} = 1$ observable

$$c_t = b_0 + b_1 c_{t-1} + \xi_{ct}$$

TIME AGGREGATION

- ξ_{ct} is also mongrel

- This empirical model suffers from (a form of) time aggregation: a lag of v_t is picked up by the reduced form error

- Note: I have not omitted a state but only substituted it with another one

- Again, this is not an invertibility problem

REDUCED FORM ERROR VS. STRUCTURAL SHOCKS
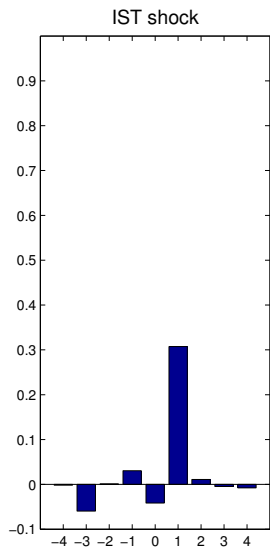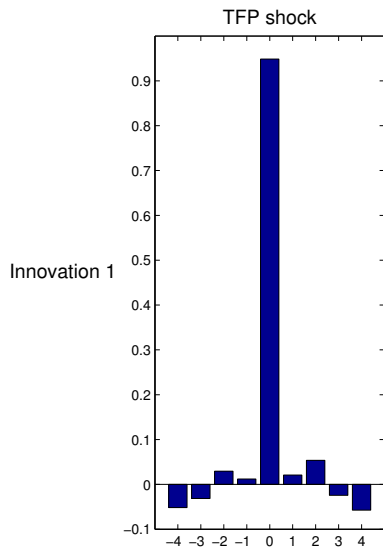
TAKING STOCK

- Aggregation can arise in *very* simple setting

- Likely to be much worse in practice
  - Cross-sectional aggregation of very different types of shocks
  - Time deformation across wider horizons

- Paper contains in-depth formal treatment of these issues, uses richer examples, even extends to higher order systems

- ► Recommendation of the authors:
    - ► Explicitly formalize structural model prior to specifying the empirical model
    - ► Guided by theory, carefully study dimensionality concerns
    - ► Example: theory tells us that 3-dimensional system can identify a monetary shock, cost push shock requires ≥ 5 observables

- ► Essentially, one should only interpret results of SVAR with an explicit structural model in mind

COMMENT 1
WHAT TO DO IN PRACTICE?

- Does it mean it is impossible to use SVARs to *select between broad classes of models*?

- Examples:
  - How do hours respond to a technology shock?
  - Does fiscal policy crowd out consumption?

- Relying on explicit structure is problematic when guiding us in deciding about broad alternative theories, about basic ingredients to a theory

COMMENT 1
WHAT TO DO IN PRACTICE?

▶ I would be very curious about the authors' view on this issue
(in the paper and in general)

▶ What about using:
  ▶ Factor-augmentation (FAVARs)
  ▶ Large Bayesian VARs

▶ Is there any hope?

- In my view, "aggregation" is not a great label
  - Sounds very unspecific
  - Perhaps sounds too neutral

- What about something like "convolution"?

- It remained unclear to me how the paper relates to Forni, Gambetti and Sala (2019 JAE)

- From their introduction: "Informational deficiency is endemic in two relevant situations. First, when the number of shocks in the theoretical model is larger than the number of variables included in the VAR. [...] Second, when the DSGE features so-called anticipated shocks."

- They propose an "informational sufficiency" test

- How is this related/different/less general?

MY OVERALL TAKE-AWAY

- ▶ Very important contribution on a discomforting issue

- ▶ Paper provides the general technical heavy lifting, the issue is easy to understand at its core

- ▶ Researchers should be very careful about interpreting SVARs, (very explicit) theory is needed

- ▶ Worthwhile continue thinking deeply about what we can and cannot learn about macroeconomic dynamics from data