Optimism Shock

on the Australian Business Cycle

Adam Wang

University of Melbourne

Introduction

In this research project, I...

- R package **bsvarSIGNs**
  - hopefully on CRAN next semester!
- Implements **Arias, Rubio-Ramírez, and Waggoner (2018)**
- Replicates US data
- Extends to Australian data and more

bsvarSIGNs

- Bayesian structural vector autoregression (bsvar)
- Simultaneous equations + autoregression
- Identified with many restrictions
  - zero restrictions
  - sign restrictions
  - narrative restrictions

Question

Does optimism shock drive business cycles?

- Theory suggests **yes** (Angeletos, Collard, and Dellas 2018)
- Optimistic → spend more and work harder → economic boom!
- What does the data say?

Optimism shock

- **Positively** affects stock prices
- **Zero** impact on productivity

$$\begin{bmatrix} u_t^{\text{productivity}} \\ u_t^{\text{stock prices}} \\ u_t^{\text{consumption}} \\ u_t^{\text{real interest rate}} \\ u_t^{\text{hours worked}} \end{bmatrix} = \begin{bmatrix} 0 & * & * & * & * \\ + & * & * & * & * \\ * & * & * & * & * \\ * & * & * & * & * \\ * & * & * & * & * \end{bmatrix} \begin{bmatrix} \varepsilon_t^{\text{optimism}} \\ \varepsilon_t^2 \\ \varepsilon_t^3 \\ \varepsilon_t^4 \\ \varepsilon_t^5 \end{bmatrix}$$

u_t reduced-form errors, ε_t structural shocks, $* =$ no restrictions

Penalty function approach

Beaudry, Nam, and Wang (2011)

- Studies optimism shock with penalty function approach (PFA).
- Concludes optimism shock **drives** business cycle
- Since significant boom in **consumption and hours worked**.

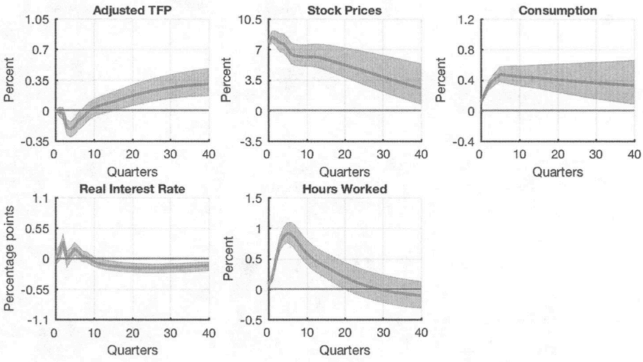

Figure 1: US optimism shock impulse responses with PFA

Original paper

Arias, Rubio-Ramírez, and Waggoner (2018)

- Proves PFA imposes **additional** restrictions
- Proposed an importance sampler that gives **true** solutions
- Concludes optimism shock does **not** drive business cycle

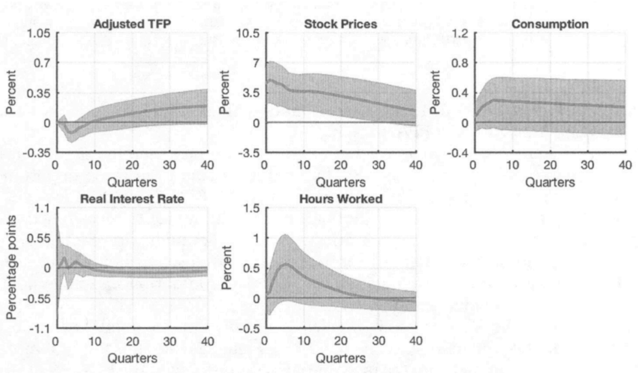

Figure 2: US optimism shock impulse responses with importance sampler

Importance sampler algorithm

Orthogonal reduced-form parameterization:

$$y_t' = x_t' B + e_t' Q' \operatorname{chol}(\Sigma, \text{upper})$$

1. Sample (B, Σ, Q) conditional on the zero restrictions.
2. If the sign restrictions are satisfied, keep the draw and compute an importance weight, otherwise discard.
3. Repeat steps 1-2 until the desired number of samples is obtained.
4. Resample with replacement using the importance weights.

Replication

Same US data, different code

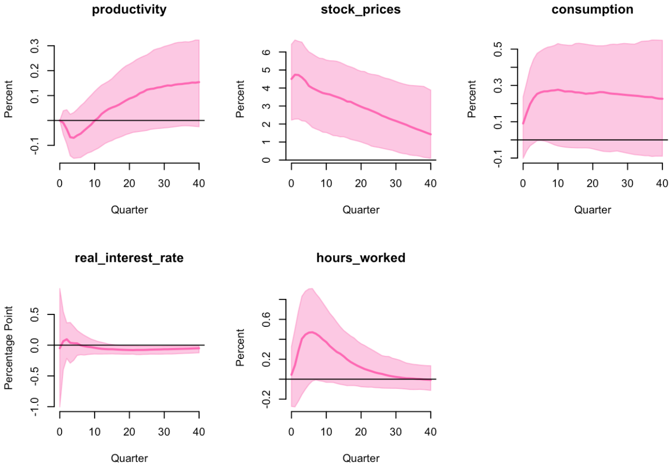

Figure 3: US optimism shock impulse responses using bsvarSIGNs

Extension 1: Australian data

No significant impact

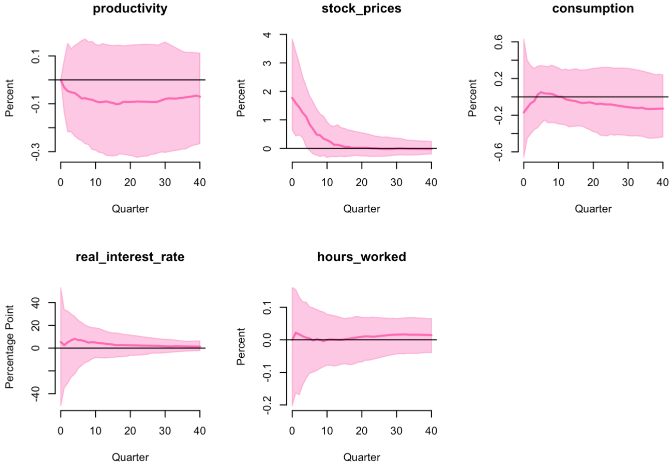

Figure 4: Australian optimism shock impulse responses using bsvarSIGNs

Extension 2: narrative restriction

Antolín-Díaz and Rubio-Ramírez (2018)

- Algorithm to impose narrative restrictions
- **Sign** of structural shocks
- ...

Assume additionally that the optimism shock

- is **negative** when Covid-19 hits Australia in 2020 Q1

$$\varepsilon_{2020Q1}^{\text{optimism}} < 0$$

Extension 2: Covid-19

A pessimism shock

Figure 5: ASX 200 index

Extension 2: pseudo proof

(To my knowledge) no paper has combined the two algorithms[1]

Both papers use importance sampler

- Suppose the importance weights are w_1 and w_2
- To **combine** the two algorithms, resample with weights w
- Where $w = w_1 \times w_2$

A more rigorous proof (with no guarantee of correctness) is available *here*

[1] Arias, Rubio-Ramírez, and Waggoner (2018) and Antolín-Díaz and Rubio-Ramírez (2018)

Extension 2: result

No significant impact (but Australians work less!)

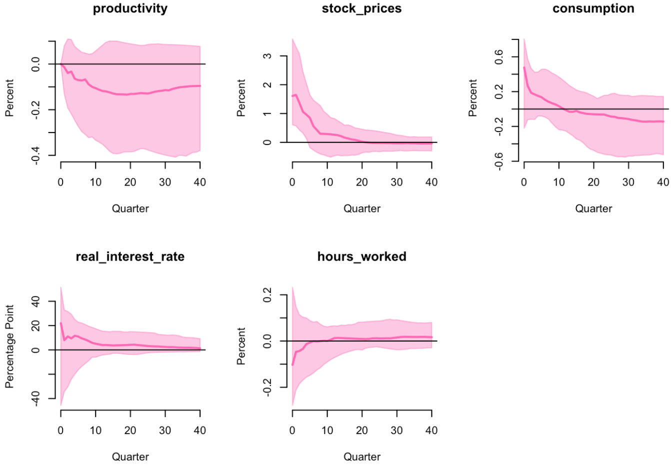

Figure 6: Australian optimism shock impulse responses with narrative restriction

Summary

- Optimism shock does **not** drive business cycle
- Result holds for both US and Australia
- Result is robust to restriction on Covid-19

Appendix: simulation study

Suppose the true structural model is

$$\begin{bmatrix}-1 & 1\\ 1 & 0\end{bmatrix}\begin{bmatrix}y_{1,t}\\ y_{2,t}\end{bmatrix} = \begin{bmatrix}-1 & 1\\ 1 & 0\end{bmatrix}\begin{bmatrix}y_{1,t-1}\\ y_{2,t-1}\end{bmatrix} + \begin{bmatrix}\varepsilon_{1,t}\\ \varepsilon_{2,t}\end{bmatrix}, \begin{bmatrix}\varepsilon_{1,t}\\ \varepsilon_{2,t}\end{bmatrix} \sim \mathcal{N}(\begin{bmatrix}0\\ 0\end{bmatrix}, \begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix})$$

equivalently, we can simulate 1,000 observations from the reduced-form

$$\begin{bmatrix}y_{1,t}\\ y_{2,t}\end{bmatrix} = \begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}\begin{bmatrix}y_{1,t-1}\\ y_{2,t-1}\end{bmatrix} + \begin{bmatrix}u_{1,t}\\ u_{2,t}\end{bmatrix}, \begin{bmatrix}u_{1,t}\\ u_{2,t}\end{bmatrix} \sim \mathcal{N}(\begin{bmatrix}0\\ 0\end{bmatrix}, \begin{bmatrix}1 & 1\\ 1 & 2\end{bmatrix})$$

Putting zero and sign restrictions on the inverse of the structural matrix

$$\begin{bmatrix}-1 & 1\\ 1 & 0\end{bmatrix}^{-1} = \begin{bmatrix}0 & 1\\ 1 & 1\end{bmatrix} \Rightarrow \begin{bmatrix}0 & +\\ + & +\end{bmatrix}$$

Posterior mean of 1,000 draws of the structural matrix is

```
         [,1]    [,2]
[1,] -0.9636 1.0463
[2,]  0.9630 0.0000
```

References

Angeletos, George-Marios, Fabrice Collard, and Harris Dellas. 2018. “Quantifying Confidence.” *Econometrica* 86 (5): 1689–1726.

Antolín-Díaz, Juan, and Juan F Rubio-Ramírez. 2018. “Narrative Sign Restrictions for SVARs.” *American Economic Review* 108 (10): 2802–29.

Arias, Jonas E, Juan F Rubio-Ramírez, and Daniel F Waggoner. 2018. “Inference Based on Structural Vector Autoregressions Identified with Sign and Zero Restrictions: Theory and Applications.” *Econometrica* 86 (2): 685–720.

Beaudry, Paul, Deokwoo Nam, and Jian Wang. 2011. “Do Mood Swings Drive Business Cycles and Is It Rational?” National Bureau of Economic Research.