ECON 815

Technology vs. Demand Shocks

Winter 2014

What does really drive BCs?

Some correlations for Canada (1/1981-3/2013):

- corr(GDP, Hours) = 0.696
- corr(GDP, Prod) = 0.491
- corr(Prod, Hours) = -0.285

So hours move countercyclical relative to prod. shocks.

In the RBC model, we need very high intertemporal elasticity of substitution (η or σ), so that the income effect dominates the substitution effect.

1) What shocks are then responsible for cycles?

2) How can we identify these from the data?

VAR Analysis

Consider the following model specification:

$$\mathbf{y}_t = \mu + \mathbf{\Gamma}_1 \mathbf{y}_{t-1} + \cdots + \mathbf{\Gamma}_p \mathbf{y}_{t-p} + \epsilon_t$$

For theoretical exposition, we can always stack vectors of longer lags to only consider a first-order VAR

$$\mathbf{y}_t = \mu + \mathbf{\Gamma} \mathbf{y}_{t-1} + \epsilon_t$$

We are interested again either in the IRFs or in estimating (long-run) correlations between variables.

For that purpose, we can transform the VAR into its MA representation (presuming that $\mathbf{\Gamma}$ is stable).

Then, by repeated substitution we can rewrite the VAR as

$$\begin{aligned} \mathbf{y}_t &= \mu + \mathbf{\Gamma}\mathbf{y}_{t-1} + \epsilon_t \\ &= \mu + \mathbf{\Gamma}\mu + \mathbf{\Gamma}^2\mathbf{y}_{t-2} + \epsilon_t + \mathbf{\Gamma}\epsilon_{t-1} \\ &= [\mathbf{I} - \mathbf{\Gamma}(\mathbf{L})]^{-1}(\mu + \epsilon_t) \\ &= \bar{\mathbf{y}} + \sum_{t=0}^{\infty} \mathbf{\Gamma}^i \epsilon_{t-i} \end{aligned}$$

Interpretation:

- we can use the $\mathbf{\Gamma}^i$ matrices to figure out IRFs
- element is given by $\gamma_{ml}(i)$
- deviation of $y_{m,t+i}$ from its mean to a one-time shock in $\epsilon_{l,t}$

One can use OLS to (point) estimate $\Gamma(L)$. Standard errors are not straightforward to obtain.

Gali, AER (1999)

Model – VAR in hours n_t and (labour) productivity z_t

We (log) first-difference productivity and hours

- $\Delta z_t = \log z_t - \log z_{t-1}$
- $\Delta n_t = \log n_t - \log n_{t-1}$

Specification:

$$\begin{pmatrix} \Delta z_t \\ \Delta n_t \end{pmatrix} = \begin{bmatrix} \gamma_{11}^{(t-1)} & \gamma_{12}^{(t-1)} \\ \gamma_{21}^{(t-1)} & \gamma_{22}^{(t-1)} \end{bmatrix} \begin{pmatrix} \Delta z_{t-1} \\ \Delta n_{t-1} \end{pmatrix} + \cdots + \begin{pmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{pmatrix}$$

We could estimate IRFs and correlations from this model, but it would not be useful for answering our question.

Why? We can neither interpret coefficients (γ's) nor shocks (ϵ's).

Problem: Identification

We would like to obtain a 1-1 mapping between the estimated coefficients and shocks to a theoretical model that allows for an interpretation of these objects.

We would like to call some shocks *supply or technology* shocks and others *demand* shocks and obtain correlations *conditional* on these shocks.

Assumptions:

1) Shocks are orthogonal, or $E\epsilon_{\mathbf{t}}\epsilon_{\mathbf{t}}' = \Sigma = I$.

2) Productivity is influenced in the long-run only by technology shocks, or $\gamma_{12} = 0$.

Structural VAR

For simplicity, we assume now a lag of one period only. We have then the following recursive structure:

$$\begin{aligned}\Delta z_t &= \gamma_{11}\Delta z_{t-1} + \epsilon_{1t} \\ \Delta n_t &= \gamma_{12}\Delta z_{t-1} + \gamma_{22}\Delta n_{t-1} + \epsilon_{2t}\end{aligned}$$

Since the shocks are orthogonal to each other, the system is a fully recursive and we can estimate the VAR now equation by equation.

Under these restrictions, the parameters of a theoretical model of the form

$$\Theta \mathbf{y_t} = \Psi \mathbf{y_{t-1}} + \eta_t$$

where $E[\eta_t \eta_t'] = \mathbf{\Omega}$ would be identified.

Interpretation of the SVAR

Shocks

- technology

$$\log z_t = \log z_{t-1} + \eta_t$$

- demand or policy shock

$$\log M_t^s = \log M_{t-1}^s + \chi_t$$

Firms are monopolistic price-setters, but need to wait one period to change prices.

With technology shock, firms will not adjust output since real balances do not change and, thus, demand is constant.

$\Longrightarrow$ *negative* correlation between hours and productivity.

With demand shock, real balances rise for one period (prices are fixed) and, thus output increases.

$\Longrightarrow$ *positive* correlation between hours and (measured) productivity possible (e.g. short-run increasing returns to scale).

Evidence from Canadian Data

Step 1 – Reduced from VAR:

- lag of 1
- coefficient matrix

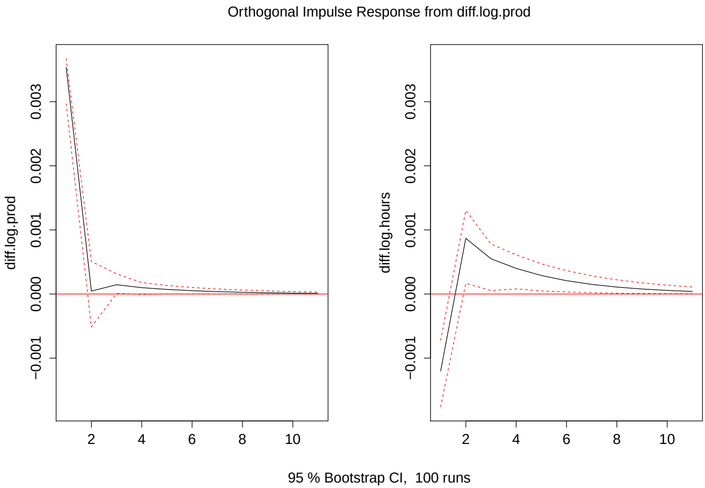
$$\mathbf{\Gamma} = \begin{bmatrix} 0.0686 & 0.16273 \\ 0.4527 & 0.6087 \end{bmatrix}$$

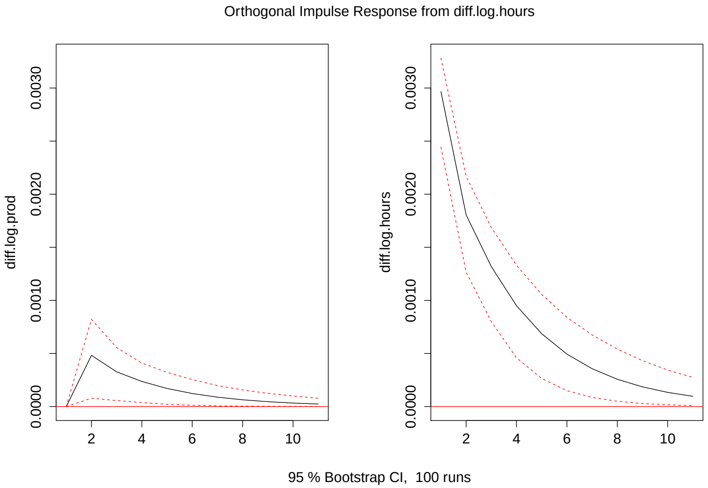
- used bootstrapping for constructing confidence intervals

Step 2 – Structural VAR as in Gali (1999):

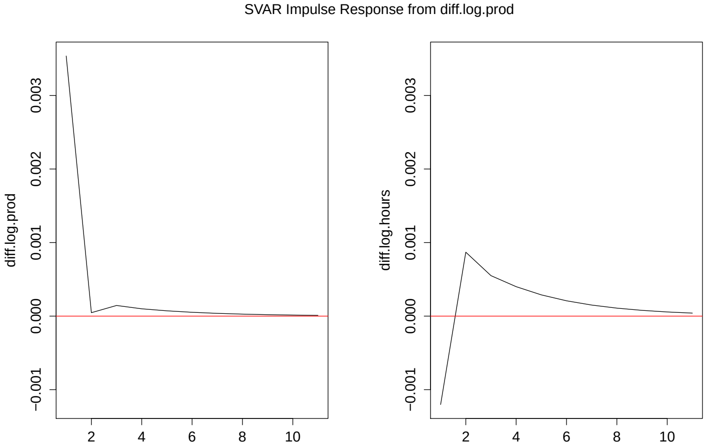
- restrictions as above
- calculated conditional correlations from MA representation
  - $corr(\Delta z_t, \Delta n_t|1) = -0.6784$
  - $corr(\Delta z_t, \Delta n_t|2) = 0.6620$

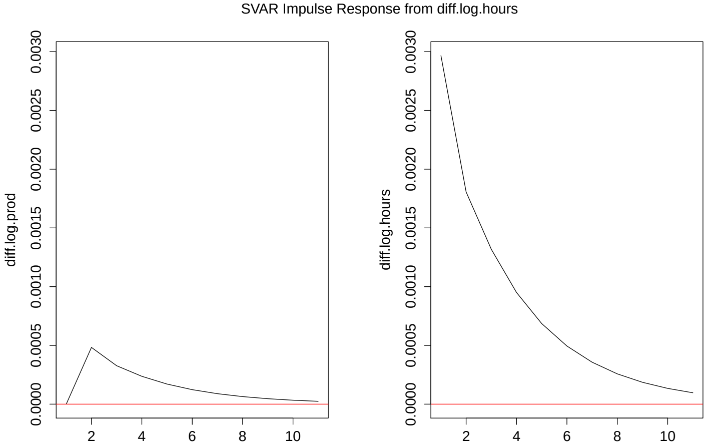
IRFs – Reduced Form VAR




Orthogonal Impulse Response from diff.log.hours
diff.log.prod
diff.log.hours
0.0000
0.0010
0.0020
0.0030
2
4
6
8
10
95 % Bootstrap CI, 100 runs

IRFs – SVAR acc. to Gali, AER (1999)




SVAR Impulse Response from diff.log.hours
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