KEYNESIAN DSGE MODELS

CHRISTIANO, EICHENBAUM & EVANS, "NOMINAL RIGIDITIES"

(1) Look at time-series US data. See how a "monetary shock" (as distinct from "real" shock, like productivity) affects variables.

(2) Create a sticky-price model that reproduces these patterns.

Simple NK IS/LM (like King's) won't do it:
need to make more complicated assumptions that

- allow for investment
- create real rigidity
- slow down reaction of endogenous variables to shocks, make variables more <u>persistent</u>.

(1) Identify effects of monetary policy shock

Assume "monetary policy" means changing interest rate.
Problem: most changes in i are policymakers' <u>reactions</u> to changes in state of the economy as they attempt to stabilize π, y.

CEE want to identify <u>exogenous</u> shocks to i & see their effects on π, y, etc.

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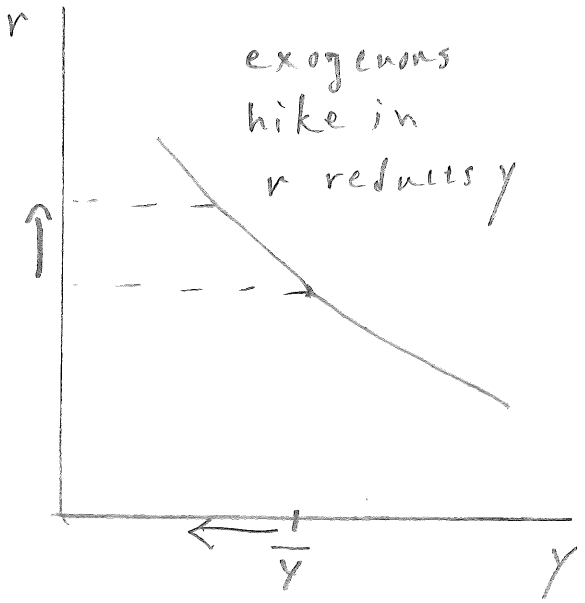
① Identify effects

Simple example

What we want to observe:

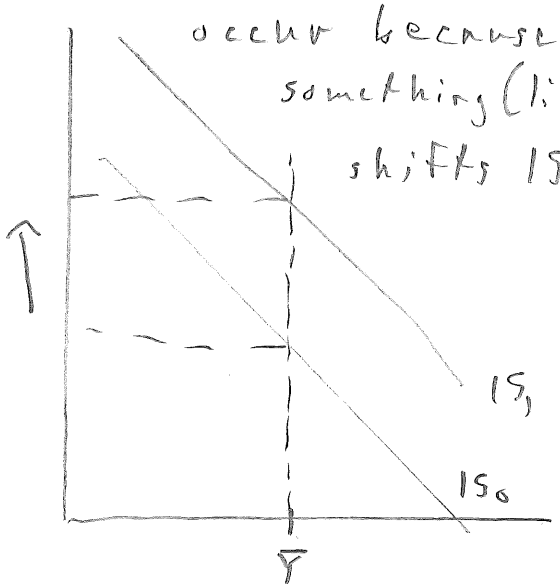


$$\uparrow \pi = \pi^e + \beta (y - \bar{y}) + \varepsilon$$

which causes y to Fall

What happens most of the time:

Fed hikes r to prevent increase in y that would otherwise occur because something (like G↑) shifts IS out



or

Fed hikes r to reduce y to prevent hike in π that would otherwise occur because of "supply shock"

$$\pi = \pi^e + \beta (y - \bar{y}) + \varepsilon\uparrow$$

no change in π

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(1) Identify effects (cont.)

What CEE do:

1) Assume systematic, react-to-data part of monetary policy can be described by

$$R_t = f(\Omega_t) + \varepsilon_t$$

- R_t: Fed Funds rate
- Ω_t: vector of variables dated t or earlier
  - Y_t and lags
  - C_t "
  - I_t "
  - P_t "
  - $\frac{W}{P}_t$ "
  - $\frac{Y}{L}_t$ "
  - $\left(\frac{\text{Corporate Profits}}{P}\right)_{t-1}$ "
  - ΔM_{t-1} "

} note these two variables are lagged "to maintain consistency with the model" (see next page)

ε_t is exogenous shock

(note $\varepsilon_t \downarrow$ is monetary loosening)

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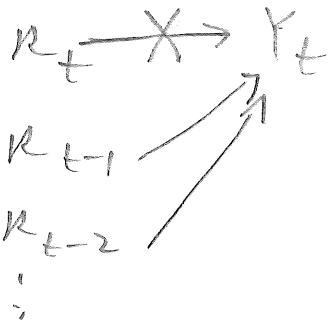
① Identify effects

What CEE do (cont.)

2) Assume Y_t ---- $\frac{Y}{L_t}$ are affected by R but only with a one-period lag



Under these assumptions, you can observe effects of monetary shocks as follows:

① Regress R_t on Ω_t ⟵ (recall this includes Y_t, ---- $\frac{Y}{L_t}$ but not $\left(\frac{Prof}{P}\right)_t$, ΔM_t

Residual is ε_t.

② Regress Y_t etc. on ε_{t-1}

Note lag structure is key:

$Y_t \rightarrow R_t \rightarrow Y_{t+1}$ < OK

$Y_t \rightarrow R_t$ < can't untangle cause & effect

$R_t \rightarrow \frac{Profits}{P} \rightarrow R_{t+1}$ < OK

$R_t \rightarrow \frac{Profits}{P}$ < Not OK

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① Identify effects

How CEE do it

Recursive VAR.

$$Y_t = A_1 Y_{t-1} + \dots A_4 Y_{t-4} + C\eta_t$$

(assumed structure imposed on residuals)

"lower triangular matrix" times vector of i.i.d. ε's

RHS Variables

Dependent Variable	4 lags of everything	Residuals
Y_t	$Y_{t-1}, C_{t-1}, I_{t-1} \dots R_{t-1} \dots$ etc.	$+\varepsilon_Y$
C_t		$+\beta_{CY}\varepsilon_Y + \varepsilon_C$
I_t		$+\beta_{IY}\varepsilon_Y + \beta_{IC}\varepsilon_C + \varepsilon_I$
P_t		
$\left(\frac{w}{P}\right)_t$		
$\left(\frac{Y}{L}\right)_t$		
R_t		$+\beta_{RY}\varepsilon_Y + \dots \beta_{R(Y/L)}\varepsilon_{Y/L} + \varepsilon_R$
$Prof_t$		$+\beta_{Prof Y}\varepsilon_Y + \dots \beta_{Prof R}\varepsilon_R + \varepsilon_{Prof}$
$\%\Delta M2_t$		

Monetary policy shock

Note: variables placed before R_t are those which affect R_t without a lag, are affected by R_t with a lag

" " after R_t are those which are affected by R_t without a lag, affect R_t with a lag

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① Identify effects

How CEE do it (cont.)

How does this recursive VAR do the trick?

— It is equivalent to regressing a variable on current and lagged values of all previously-ordered variables, so ε_R in VAR is ε_R in $R_t = f(\Omega_t) + \varepsilon_t$

Simple example: 3 variables Y C R one lag

Underlying equations:

$$Y_t = a Y_{t-1} + b C_{t-1} + c R_{t-1} + \varepsilon_Y$$

$$C_t = d Y_t + e Y_{t-1} + f C_{t-1} + g R_{t-1} + \varepsilon_C$$

$$R_t = h Y_t + i C_t + j Y_{t-1} + k C_{t-1} + \ell R_{t-1} + \varepsilon_R$$

Substituting 1st equation into 2nd,

$$C_t = d(a Y_{t-1} + \dots \varepsilon_Y) + e Y_{t-1} + \dots \varepsilon_C$$

$$\Rightarrow C_t = (da+e) Y_{t-1} + (db+f) C_{t-1} + (dc+g) R_{t-1} + d\varepsilon_Y + \varepsilon_C$$

— Apply estimated coefficients to a hypothetical realization of ε_R (assuming $\varepsilon_R = 0$ before), magnitude one S.D. get "impulse response functions" for all variables.

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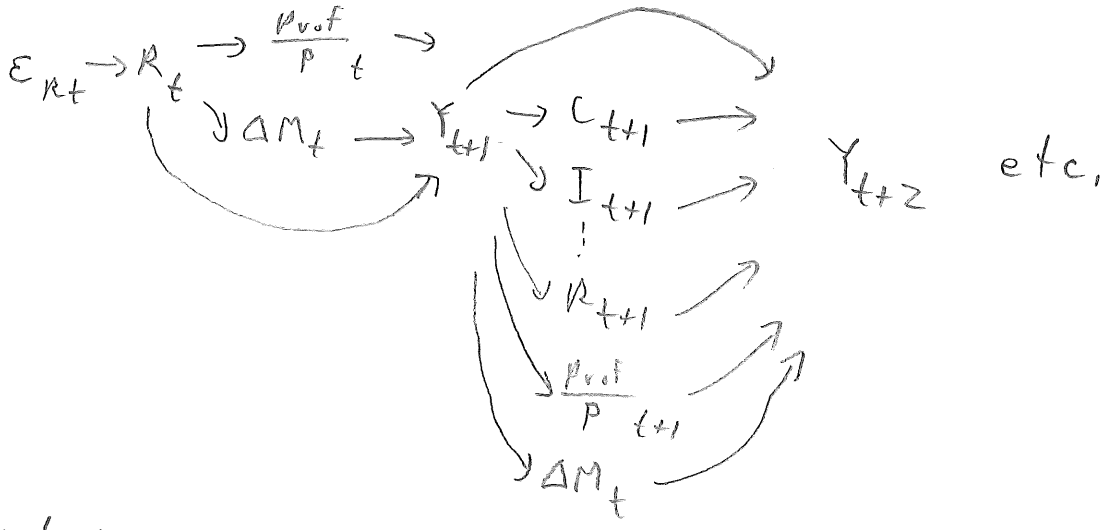
① Identify effects

How CEE do it (cont.)

Impulse response function

Example: effect on ε_{Rt} on $Y_t, Y_{t+1}, Y_{t+2}, \cdots$



Note:

- Changing the order of variables preceding R_t (like putting C first, Y second) doesn't affect impulse-resp. of those variables to ε_R.

- Moving a variable from a position preceding R_t (which means $X_t \to R_t \not\to X_t$) to after R_t ('means $R_t \to X_t \not\to R_t$) } or vice-versa

does affect everything

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① Identify effects

Potential problem with any VAR-type exercise to identify effects of monetary policy

What if policymakers observe & systematically react to some variable econometrician didn't include in Ω, & policymakers use that variable because it indicates shifts in IS variable and/or supply shocks (why else would policymakers use it)?

Those reactions will appear as ε_R's but won't be followed by effects of a true monetary-policy shock.

(We'll mistake some reactions to IS shifts or supply shocks for exogenous variations in R)

⇒ we'll underestimate true effects of exogenous monetary shocks.

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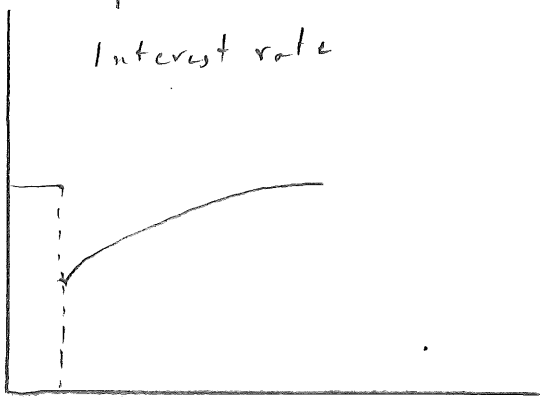
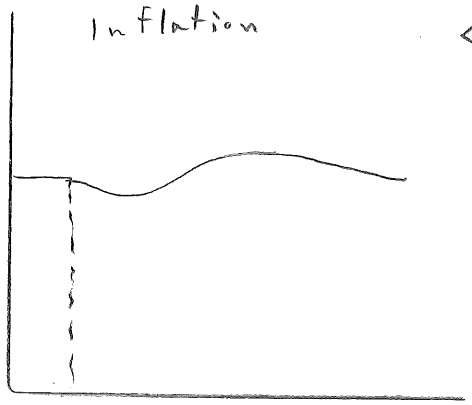
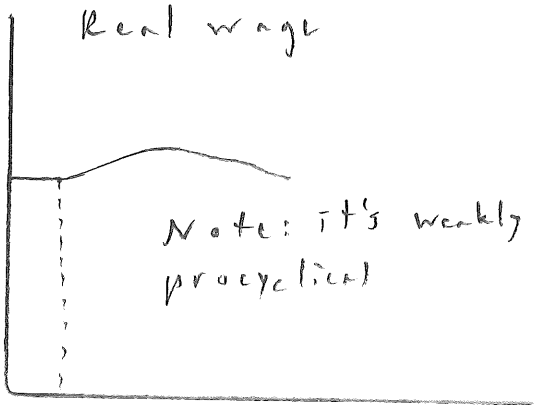
① Effects (cont.)

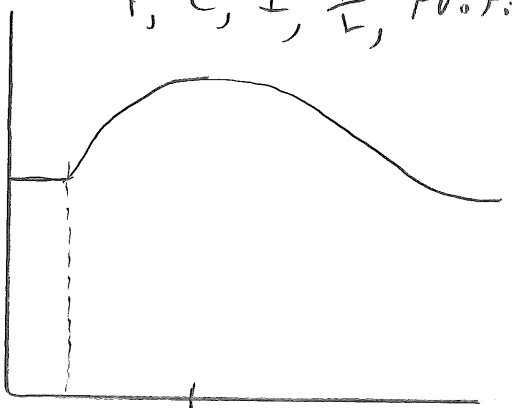
Impulse responses to ε_R (interest-rate cut)





← Note: they believe inflation doesn't rise much at all in response to i cut





← Note: "hump-shaped" response, peaks 1-2 years after shock

Problem: these responses aren't consistent with simple DSGE assumptions (like baseline RBC model) or original Calvo New-Keynesian Phillips curve.

So CEE must modify assumptions.