Can News be a Major Source of Aggregate Fluctuations?
A Bayesian DSGE Approach

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August 4, 2009
Contributions of this paper

- Empirically examine the role of news shocks in explaining the business cycles
  - Previous analyses used bivariate VAR approach to identify the news shocks
  - We instead estimate a fully specified structural DSGE model to identify the news shocks using Bayesian methods.
  - We apply our procedure to both Japanese and US economies

- Advantages of our approach
  1. Based on standard New Keynesian or New Neoclassical Synthesis models with rich features of frictions in the economy
  2. This class of model can generate expectation-driven cycles (not all model can generate such cycles)
  3. We can rely on setting priors based on former Bayesian estimates
Related literature

- **Expectation-driven cycles:** Expectation of future rise in TFP ⇒ Pro-cyclical $l$, $i$, and $c$
  - Theoretical analysis
    - Pigou(1926), Barro-King(1984), Beaudry-Portier(2004)
  - Empirical analysis (based on bivariate VAR)
    - Beaudry-Portier(2005) for Japan
    - Beaudry-Portier(2006) for US
  - Bayesian estimation of CEE type DSGE model
    - CEE model (an empirically plausible New-Keynesian model)
      - Christiano-Eichenbaum-Evans(2005)
    - Bayesian estimation
      - Sugo-Ueda(2008) for Japan
  - No empirical work of news shock under DSGE framework!
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Expectation-driven cycles - how does it work?

- News about future rise in TFP (e.g., 8-period ahead)

- Frictionless economy (standard RBC model)
  - If income effect dominates, $c \uparrow$, $l \downarrow$, $y \downarrow$, $i = y - c \downarrow$
  - If substitution effect dominates, $i \uparrow\uparrow$, $l \uparrow\uparrow$, $y \uparrow$, $c = y - i \downarrow$
  - negative c-i correlation, negative c-l correlation
  - cannot produce expectation-driven cycles (Barro-King, 1984)

- Economy with frictions
  - introduce (1) adjustment cost to change investment, and (2) consumption habit
  - with (1) $i \uparrow\uparrow$ and $c = y - i \downarrow$ but (2) implies consumption smoothing and $c = y - i \uparrow$
  - CEE model has this feature (Christiano-Ilut-Motto-Rostagno, 2007)
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Overview of CEE type model

► Households
  ▶ consumption habit: household \( j \) maximize
  \[ U(C, L) = \ln C^* - L^* \]
  \[ C^* = \frac{1}{1-\sigma_c} (C_t(j) - \lambda C_{t-1})^{1-\sigma_c} \]
  and
  \[ L^* = \frac{1-\sigma_c}{1+\sigma_l} L_t(j)^{1+\sigma_l} \]

► Firms
  ▶ final good producers use intermediate good \( i \)
  ▶ producers of intermediate good \( i \) use capital and labor
  ▶ adjustment cost of investment: \( I_t - S(v_tI_t/I_{t-1})I_t \)
  ▶ choose utilization rate of capital
  ▶ sticky price: set prices monopolistically but cannot change with prob. \( \xi_p \) (with inflation indexation \( \iota_p \))

► Labor union
  ▶ sticky wage: set wage monopolistically but cannot change with prob. \( \xi_w \) (with inflation indexation \( \iota_w \))

► Government (monetary authority)
  ▶ controls interest rate using Taylor rule
News shocks in productivity

- Production function (in log deviations)

\[ y_t = \phi_p \left[ \alpha k_t^s + (1 - \alpha) l_t + z_t \right] \]

\( \phi_p \): one plus the share of the fixed costs in production
\( \alpha \): capital share

- Total factor productivity (TFP) follows an AR(1)

\[ z_t = \rho z_{t-1} + \varepsilon_t^z \]
\[ = \rho z_{t-1} + \nu_{0,t} + \nu_t^* \]

- Technological innovation \( \varepsilon_t^z \sim iid \ N(0, \sigma_z^2) \)
  decomposed into
  1. Unexpected component
  2. Expected component (news shocks)

\[ \nu_{0,t} \sim iid \ N(0, \sigma_{z0}^2) \]

\[ \nu_t^* = \sum_{j=1}^{n} \nu_{j,t-j} \sim iid \ N(0, \sum_{j=1}^{n} \sigma_{zj}^2) \]
When $n = 4$ (news shocks up to 4 period ahead)

$$z_t = \rho z z_{t-1} + \nu_{0,t} + \nu_{1,t-1} + \nu_{2,t-2} + \nu_{3,t-3} + \nu_{4,t-4}$$

then,

$$E_t z_{t+1} = \rho z z_{t-1} + \left( \nu_{1,t} + \nu_{2,t-1} + \nu_{3,t-2} + \nu_{4,t-3} \right)$$

$$E_t z_{t+2} = \rho^2 z z_{t-1} + \rho z \left( \nu_{1,t} + \nu_{2,t-1} + \nu_{3,t-2} + \nu_{4,t-3} \right) + \left( \nu_{2,t} + \nu_{3,t-1} + \nu_{4,t-2} \right)$$

$$E_t z_{t+3} = \rho^3 z z_{t-1} + \rho^2 z \left( \nu_{1,t} + \nu_{2,t-1} + \nu_{3,t-2} + \nu_{4,t-3} \right) + \rho z \left( \nu_{2,t} + \nu_{3,t-1} + \nu_{4,t-2} \right) + \left( \nu_{3,t} + \nu_{4,t-1} \right)$$

$$E_t z_{t+4} = \rho^4 z z_{t-1} + \rho^3 z \left( \nu_{1,t} + \nu_{2,t-1} + \nu_{3,t-2} + \nu_{4,t-3} \right) + \rho^2 z \left( \nu_{2,t} + \nu_{3,t-1} + \nu_{4,t-2} \right) + \rho z \left( \nu_{3,t} + \nu_{4,t-1} \right) + \nu_{4,t}$$
Other equations

- Remaining parts of the model is slightly simplified version of Smets and Wouters (2007)
- 13 equations (including production function)
- 13 (nonexpectation) endogenous variables
  1. $y_t$: output
  2. $c_t$: consumption
  3. $i_t$: investment
  4. $q_t$: real value of existing capital
  5. $k^s_t$: current capital services in production
  6. $k_t$: physical capital
  7. $u_t$: capacity utilization rate
  8. $r^k_t$: rental rate of capital
  9. $\mu^p_t$: price markup
  10. $\pi_t$: inflation rate
  11. $w_t$: nominal wage
  12. $l_t$: hours worked
  13. $r_t$: nominal interest rate
Other shocks

- 5 additional exogenous variables (other than technology related disturbances)
  1. $g_t$: government expenditure shock
  2. $v_t$: investment specific technology shock
  3. $m_t$: monetary policy shock
  4. $a_t$: cost push shock
  5. $b_t$: wage mark-up shock

- Each shock follows an AR(1) process

\[
\begin{align*}
g_t &= \rho_g g_{t-1} + \varepsilon_t^g, & \varepsilon_t^g &\sim \text{iid } N(0, \sigma_g^2) \\
v_t &= \rho_v v_{t-1} + \varepsilon_t^v, & \varepsilon_t^v &\sim \text{iid } N(0, \sigma_v^2) \\
m_t &= \rho_m m_{t-1} + \varepsilon_t^m, & \varepsilon_t^m &\sim \text{iid } N(0, \sigma_m^2) \\
a_t &= \rho_a a_{t-1} + \varepsilon_t^a, & \varepsilon_t^a &\sim \text{iid } N(0, \sigma_a^2) \\
b_t &= \rho_b b_{t-1} + \varepsilon_t^b, & \varepsilon_t^b &\sim \text{iid } N(0, \sigma_b^2)
\end{align*}
\]

- When $n = 4$, total number of shocks is 10
Current capital services used in production

\[ k_t^s = k_{t-1} + u_t \]

Capacity utilization rate

\[ u_t = \frac{1 - \psi}{\psi} r_t^k \]

0 < \psi < 1: function of elasticity of capacity utilization adjustment cost function.

Aggregate resource constraint

\[ y_t = c_t + i_t + r_k k_t u_t + g_t \]
Consumption Euler equation

\[ c_t = \frac{\lambda}{\gamma \left(1 + \frac{\lambda}{\gamma}\right)} c_{t-1} + \left[1 - \frac{\lambda}{\gamma \left(1 + \frac{\lambda}{\gamma}\right)}\right] E_t c_{t+1} \]

\[ + \frac{(\sigma_c - 1) (wC_l)}{\sigma_c \left(1 + \frac{\lambda}{\gamma}\right)} (l_t - E_t l_{t+1}) - \frac{1 - \frac{\lambda}{\gamma}}{\sigma_c \left(1 + \frac{\lambda}{\gamma}\right)} (r_t - E_t \pi_{t+1}) \]

\[ \lambda: \text{parameter on the external habit, } \gamma: \text{steady state growth rate, } \sigma_c: \]

\[ \text{inverse of the intertemporal elasticity of substitution} \]

Investment Euler equation

\[ i_t = \frac{1}{1 + \beta \gamma^{1-\sigma_c}} i_{t-1} + \left(1 - \frac{1}{1 + \beta \gamma^{1-\sigma_c}}\right) E_t i_{t+1} \]

\[ + \frac{1}{(1 + \beta \gamma^{1-\sigma_c}) \gamma^2 \varphi} q_t + v_t \]

\[ \beta: \text{subjective discount factor, } \varphi: \text{steady state elasticity of the investment} \]

\[ \text{adjustment cost fun.} \]
Capital Euler equations

\[
q_t = \beta \gamma^{-\sigma_c} (1 - \delta) E_t q_{t+1} + [1 - \beta \gamma^{-\sigma_c} (1 - \delta)] E_t r^k_{t+1} - (r_t - E_t \pi_{t+1}),
\]

\(\delta\): capital depreciation rate

Capital accumulation

\[
k_t = \frac{1 - \delta}{\gamma} k_{t-1} + \left(1 - \frac{1 - \delta}{\gamma}\right) i_t + \left(1 - \frac{1 - \delta}{\gamma}\right) \left(1 + \beta \gamma^{1-\sigma_c}\right) \gamma^2 \varphi_v
\]

Rental rate of capital

\[
r^k_t = -(k^s_t - l_t) + w_t
\]
New Keynesian Phillips curve

\[
\pi_t = \frac{\iota_p}{1 + \beta \gamma^{1-\sigma_c} \iota_p} \frac{\beta \gamma^{1-\sigma_c}}{1 + \beta \gamma^{1-\sigma_c} \iota_p} E_t \pi_{t+1} - \frac{(1 - \beta \gamma^{1-\sigma_c} \xi_p) (1 - \xi_p)}{(1 + \beta \gamma^{1-\sigma_c} \iota_p) \xi_p [(\phi_p - 1) \epsilon_p + 1]} \mu_t^p + a_t
\]

\(\iota_p\): degree of indexation to past inflation, \(\xi_p\): degree of price stickiness, \(\epsilon_p\): curvature of goods market aggregator

Price markup

\[
\mu_t^p = \alpha (k_s^t - l_t) + z_t - w_t
\]

Monetary policy rule

\[
r_t = \rho r_{t-1} + (1 - \rho) (r_\pi \pi_t + r_y \Delta y_t) + m_t
\]

\(\rho, r_\pi, r_y\): positive policy parameters
Wage Phillips curve

$$w_t = \frac{1}{1 + \beta \gamma^{1-\sigma_c}} w_{t-1} + \left(1 - \frac{1}{1 + \beta \gamma^{1-\sigma_c}}\right) (E_t w_{t+1} + E_t \pi_{t+1})$$

$$- \frac{1 + \beta \gamma^{1-\sigma_c} \ell_w}{1 + \beta \gamma^{1-\sigma_c}} \pi_t + \frac{\ell_w}{1 + \beta \gamma^{1-\sigma_c}} \pi_{t-1}$$

$$- \frac{(1 - \beta \gamma^{1-\sigma_c} \xi_w) (1 - \xi_w)}{(1 + \beta \gamma^{1-\sigma_c}) \xi_w} \left[(\phi_w - 1) \epsilon_w + 1\right] \mu^w_t + b_t,$$

\(\ell_w\): degree of indexation to past wage inflation, \(\xi_w\): degree of nominal wage stickiness, \(\epsilon_w\): curvature of the labor market aggregator

Wage markup

$$\mu^w_t = w_t - \left[\sigma_l l_t + \frac{1}{1 - \frac{\lambda}{\gamma}} \left(c_t - \frac{\lambda}{\gamma} c_{t-1}\right)\right]$$

\(\sigma_l\): elasticity of labor supply to the real wage
Estimation Strategy

- We estimate the model using Bayesian methods.
  - Based on the posterior distributions of the structural parameters, we compute variance decompositions and impulse responses to analyze the roles of the news shocks.

- Data: real GDP, real consumption, real investment, real wage, hours worked, CPI inflation rate (GDP deflators for US), and overnight call rate (federal funds rate for US)

- Japan
  - Data and priors: Sugo and Ueda (2008)
  - Sample period: 1981:2 to 1998:4
  - Excludes zero interest rate policy period

- US
  - Data and priors: Smets and Wouters (2007)
  - Sample period: 1983:1 to 2004:4
  - Excludes period of indeterminacy (pre-Volcker)
Finding 1: Importance of the News Shock

- News shocks play an important role in business cycles.
- News shocks with a longer forecast horizon has larger effects on nominal variables.
### Table 2A(1): Variance Decomposition - Japan

<table>
<thead>
<tr>
<th>Shock</th>
<th>Mean</th>
<th>90% Interval</th>
<th>Shock</th>
<th>Mean</th>
<th>90% Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td></td>
<td></td>
<td>Inflation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unexpected productivity</td>
<td>41.01</td>
<td>[31.61, 51.61]</td>
<td>Unexpected productivity</td>
<td>16.74</td>
<td>[9.66, 23.20]</td>
</tr>
<tr>
<td>News 1 period ahead</td>
<td>1.07</td>
<td>[0.25, 1.84]</td>
<td>News 1 period ahead</td>
<td>0.74</td>
<td>[0.16, 1.32]</td>
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<tr>
<td>News 2 periods ahead</td>
<td>0.69</td>
<td>[0.18, 1.24]</td>
<td>News 2 periods ahead</td>
<td>1.92</td>
<td>[0.42, 3.34]</td>
</tr>
<tr>
<td>News 3 periods ahead</td>
<td>1.27</td>
<td>[0.27, 2.32]</td>
<td>News 3 periods ahead</td>
<td>5.23</td>
<td>[1.18, 9.30]</td>
</tr>
<tr>
<td>News 4 periods ahead</td>
<td>1.72</td>
<td>[0.36, 3.04]</td>
<td>News 4 periods ahead</td>
<td>7.49</td>
<td>[1.74, 12.86]</td>
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<tr>
<td>Exogenous spending</td>
<td>8.75</td>
<td>[5.46, 11.68]</td>
<td>Exogenous spending</td>
<td>2.30</td>
<td>[0.92, 3.63]</td>
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<tr>
<td>Investment</td>
<td>28.05</td>
<td>[18.25, 37.21]</td>
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<td>[21.34, 45.73]</td>
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<td>Monetary policy</td>
<td>3.84</td>
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<td>Price mark-up</td>
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<tr>
<td>Wage mark-up</td>
<td>10.77</td>
<td>[5.41, 15.74]</td>
<td>Wage mark-up</td>
<td>3.55</td>
<td>[1.03, 5.94]</td>
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<td></td>
<td></td>
<td>Wage</td>
<td></td>
<td></td>
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<tr>
<td>Unexpected productivity</td>
<td>4.06</td>
<td>[1.71, 6.35]</td>
<td>Unexpected productivity</td>
<td>42.77</td>
<td>[31.94, 54.43]</td>
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<tr>
<td>News 1 period ahead</td>
<td>0.23</td>
<td>[0.04, 0.42]</td>
<td>News 1 period ahead</td>
<td>2.57</td>
<td>[0.65, 4.29]</td>
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<tr>
<td>News 2 periods ahead</td>
<td>0.18</td>
<td>[0.04, 0.35]</td>
<td>News 2 periods ahead</td>
<td>1.54</td>
<td>[0.39, 2.77]</td>
</tr>
<tr>
<td>News 3 periods ahead</td>
<td>0.31</td>
<td>[0.04, 0.58]</td>
<td>News 3 periods ahead</td>
<td>1.89</td>
<td>[0.35, 3.40]</td>
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<td>0.47</td>
<td>[0.07, 0.86]</td>
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<td>2.36</td>
<td>[0.54, 4.11]</td>
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<td>Exogenous spending</td>
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<td>[0.02, 0.35]</td>
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<tr>
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<td>[85.71, 95.93]</td>
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<td>1.46</td>
<td>[0.22, 2.81]</td>
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<tr>
<td>Monetary policy</td>
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<td>[0.01, 0.12]</td>
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<td>4.40</td>
<td>[1.68, 7.16]</td>
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<td>[0.20, 2.37]</td>
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<td>[27.85, 48.31]</td>
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<td>Wage mark-up</td>
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<td>[0.55, 3.98]</td>
<td>Wage mark-up</td>
<td>3.96</td>
<td>[1.82, 6.08]</td>
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</tbody>
</table>
### Table 2A(1): Variance Decomposition - Japan

<table>
<thead>
<tr>
<th></th>
<th>Output</th>
<th>Interest rate</th>
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<tbody>
<tr>
<td><strong>Output</strong></td>
<td></td>
<td><strong>Unexpected productivity</strong></td>
</tr>
<tr>
<td></td>
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<td>10.30 [ 5.04, 15.84]</td>
</tr>
<tr>
<td>Unexpected productivity</td>
<td>53.93 [43.38, 67.58]</td>
<td>News 1 period ahead</td>
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<tr>
<td></td>
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<td>1.81 [0.46, 3.06]</td>
</tr>
<tr>
<td>News 1 period ahead</td>
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<td></td>
<td></td>
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<td></td>
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<td>News 4 periods ahead</td>
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<tr>
<td></td>
<td></td>
<td>2.63 [0.57, 4.65]</td>
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<tr>
<td>News 4 periods ahead</td>
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<td>Exogenous spending</td>
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<td>Exogenous spending</td>
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<td>4.58 [2.40, 7.00]</td>
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<td>Exogenous spending</td>
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<tr>
<td>Investment</td>
<td>6.22 [2.98, 9.08]</td>
<td>3.93 [1.96, 6.05]</td>
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<td>5.10 [3.10, 7.30]</td>
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<td><strong>Hours</strong></td>
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<tr>
<td>Unexpected productivity</td>
<td>3.01 [0.10, 6.57]</td>
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<td>News 1 period ahead</td>
<td>0.34 [0.01, 0.69]</td>
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<tr>
<td>News 2 periods ahead</td>
<td>0.31 [0.02, 0.62]</td>
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<tr>
<td>News 3 periods ahead</td>
<td>0.51 [0.02, 1.09]</td>
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<td>0.65 [0.02, 1.41]</td>
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<td>Exogenous spending</td>
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</tr>
<tr>
<td>Monetary policy</td>
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</tr>
<tr>
<td>Price mark-up</td>
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<td></td>
</tr>
<tr>
<td>Wage mark-up</td>
<td>80.51 [64.06, 97.90]</td>
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</table>
# Table 2B(1): Variance Decomposition - US

<table>
<thead>
<tr>
<th>Shock</th>
<th>Mean</th>
<th>90% Interval</th>
<th>Shock</th>
<th>Mean</th>
<th>90% Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumption</strong></td>
<td></td>
<td></td>
<td><strong>Inflation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
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### Table 2B(2): Variance Decomposition - US

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Figure 1: Impulse Responses - Japan

1. Introduction
2. The Model
3. Estimation Strategy
4. Results
5. Conclusion
Finding 2: TFP Shocks and Hours Worked

- TFP’s effect on hours worked was a very hot economic issue.
  - Keynesian vs Neoclassical, then SVAR vs BCA
      \[ Y_t = Z_t L_t^{1-\alpha} K_t^\alpha \]
      \[ k\overline{M}_t/P_t = \overline{Y}_t = Z_t L_t^{1-\alpha} K_t^\alpha \]
      \[ \overline{C}_t + I_t = \overline{Y}_t = Z_t L_t^{1-\alpha} K_t^\alpha \]

- Our results: Overall effect of the TFP on hours worked becomes ambiguous with news shocks.
Figure 2: Impulse Responses to Overall TFP Shocks

Japan

US

Output

Hours

Productivity
Conclusion

1. We have examined the role of the news shocks using an estimated DSGE model.

2. News shocks seem to be one of the important driving forces of business cycles in Japan and the U.S.

3. News shocks with a longer forecast horizon have larger effects on nominal variables.

4. The overall effects of TFP on hours worked become ambiguous in the presence of news shocks.

► Possible extensions:
   - News component in shocks other than TFP
   - Beyond CEE model, e.g., financial accelerator model