Gold Rush Fever in Business Cycles

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The Klondike Gold Rush of 1896-1904
The Klondike Gold Rush of 1896-1904

First, Rushing
The Klondike Gold Rush of 1896-1904

First, Rushing

Second, Working Hard and Investing
The Klondike Gold Rush of 1896-1904

First, Rushing

Second, Working Hard and Investing

Then, Registering
Plan of the talk

1. Motivation (with Some Interesting Features of the Data)
2. An Analytical Model
3. Taking The Model to the Data
4. Conclusion
1. Motivation (with Some Interesting Features of the Data)
2. An Analytical Model
3. Taking The Model to the Data
4. Conclusion
Gold rushes: economic boom – large increases in expenditures – securing claims near new found veins of gold.

Define *Market rush*: economic boom – securing “position” (monopoly rents) on a market.

Define *gold rush*: inefficient *market rush*: Historically, gold eventually expands the stock of money.

May business cycles fluctuations resemble market rushes? Gold rushes?
Macroeconomic Facts (1)

- A well known set of facts shed some light on the existence of market rushes
- Run a VAR on consumption and output (US quarterly data 1947Q1 to 2004Q4) [in the line of Cochrane, QJE 1991]
Macroeconomic Facts (2)

• LR matrix associated with the Wold representation has 1 full zero column

⇒ puts some structure on the permanent/temporary and Choleski identifications:

Permanent shock = Consumption shock

• \( C \) is only explained by the permanent shock (at all horizons) \((\geq 96\%)\)

• The other shock matters for \( Y \) in the BC \((\sim 70\% \text{ at } 1 \text{ step})\)
Long Run Identification

Motivation
An Analytical Model
Taking the Model to the Data
Conclusion
Long Run Identification versus Choleski Identification
LR-SR Comparison

- Graph 1: Comparison of $\varepsilon^P$ vs $\varepsilon^C$
- Graph 2: Comparison of $\varepsilon^T$ vs $\varepsilon^Y$
Very Robust Feature: Specification
LR Identification

![Graphs showing consumption and output over quarters with different lines representing Benchmark, Coint. Est., 8 lags, and Levels.]
Very Robust Feature: Specification (2)

Choleski Identification

[Diagrams showing graphs of Consumption - ε^C and Output - ε^C, Consumption - ε^Y and Output - ε^Y with various markers and shades representing different estimations and series.]
Very Robust Feature: Data
LR Identification

Motivation
An Analytical Model
Taking the Model to the Data
Conclusion
Very Robust Feature: Data (2)

Choleski Identification

![Graphs showing consumption and output with different identifiers over quarters.](image-url)
Forecast Error Variance Decomposition, \((C, Y)\) Benchmark VECM.

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Output (\varepsilon_t)</th>
<th>Output (\varepsilon_Y)</th>
<th>Consumption (\varepsilon_t)</th>
<th>Consumption (\varepsilon_Y)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>62.01%</td>
<td>79.86%</td>
<td>3.90%</td>
<td>0.00%</td>
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<tr>
<td>4</td>
<td>28.10 %</td>
<td>46.05 %</td>
<td>1.16%</td>
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<td>17.20 %</td>
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<td>20</td>
<td>9.79 %</td>
<td>22.21%</td>
<td>0.42%</td>
<td>2.13%</td>
</tr>
<tr>
<td>(\infty)</td>
<td>0 %</td>
<td>3.89%</td>
<td>0%</td>
<td>3.89%</td>
</tr>
</tbody>
</table>
**Hours Worked**

- **(ML) Regression:**
  
  \[ x_t = c + \sum_{k=0}^{K} \left( \alpha_k \varepsilon_{t-k}^P + \beta_k \varepsilon_{t-k}^T + \gamma_k \varepsilon_{t-k}^H \right), \]

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Level Specification</th>
<th>Difference Specification</th>
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<tbody>
<tr>
<td></td>
<td>( \varepsilon^P )</td>
<td>( \varepsilon^T )</td>
</tr>
<tr>
<td>1</td>
<td>19 %</td>
<td>75 %</td>
</tr>
<tr>
<td>4</td>
<td>37 %</td>
<td>56 %</td>
</tr>
<tr>
<td>8</td>
<td>61 %</td>
<td>32 %</td>
</tr>
<tr>
<td>20</td>
<td>60 %</td>
<td>21 %</td>
</tr>
<tr>
<td>40</td>
<td>54 %</td>
<td>20 %</td>
</tr>
</tbody>
</table>

- \( H \): mainly explained by the transitory component (\( \sim 80\% \) at 1 step)
Nominal and Real Interest Rates

- Same regressions for the interest rate (Tbill, and Tbill-Pgdp)

<table>
<thead>
<tr>
<th>k</th>
<th>( \varepsilon^P )</th>
<th>( \varepsilon^T )</th>
<th>( \varepsilon^P )</th>
<th>( \varepsilon^T )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.1116</td>
<td>0.0970</td>
<td>0.0683</td>
<td>0.0606</td>
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<tr>
<td>4</td>
<td>0.0817</td>
<td>0.0909</td>
<td>0.0875</td>
<td>0.0831</td>
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<tr>
<td>8</td>
<td>0.0598</td>
<td>0.0826</td>
<td>0.0686</td>
<td>0.0729</td>
</tr>
</tbody>
</table>

- Interest rates do not respond negatively to the second shock
  \( \implies \) Not a monetary shock
Summary

Data suggest that

• There is a shock that acts as an investment shock,
Summary

Data suggest that

- There is a shock that acts as an investment shock,
- with no long run impact,
Summary

Data suggest that

- There is a shock that acts as an investment shock,
- with no long run impact,
- that explains a good part of the BC fluctuations in $Y$ and $H$
Data suggest that

- There is a shock that acts as an investment shock,
- with no long run impact,
- that explains a good part of the BC fluctuations in $Y$ and $H$
- and that does not look like a technology, monetary or preference shock in the short run
**Our View**

- Suggest an alternative view
- Suggest something akin to gold rushes: Market rushes
- Role of investors’ expectations in fluctuations (Pigou, Wicksell, Keynes)
  - Not a sunspot story
  - Inherent aspect of capitalist economies: Uncertainty about investment profitability + News about it.
Elements of the Model

- Expanding varieties model

Perception of an increase in the set of technologically feasible goods → Setup a prototype firm → Market Rush

WHY?

Hope of securing a monopoly position in the New Market

Shake out: 1 prototype secures the dominant position in market
Elements of the Model

- Expanding varieties model
- The growth in the potential set of varieties is technologically driven and exogenous.
Road Map

1. Motivation (with Some Interesting Features of the Data)
2. An Analytical Model
3. Taking The Model to the Data
4. Conclusion
An Analytical Model

• The objective here is to derive an analytical solution to a model that possesses “Market Rush” properties
• I will then discuss some of the implications of the model
Technologies

Final Good:

- \[ Q_t = (\Theta_t h_t)^{\alpha_h} N_t \frac{(1-\alpha_h)(1-\chi)}{\chi} \left( \int_0^{N_t} X_{j,t}^\chi d\chi \right)^{\frac{1-\alpha_h}{\chi}}, \]
- No impact of \( N_t \)

Intermediate Good:

- Each existing intermediate good is produced by a monopolist,
- Survive with probability \((1 - \mu)\),
- It takes 1 unit of the final good to produce 1 unit of \( X_{j,t} \).

Startups:

- Invest 1 in t and be a monopolist in t+1 with probability \( \rho_t \)
Households

Preferences:

\[ \max \mathbb{E} \sum_{i=0}^{\infty} [\log C_{t+i} + g(h - h_{t+i})] \]

Budget constraint:

Period t:

\[ C_t + P_t^E \varepsilon_t + S_t = w_t h_t + \varepsilon_t \pi_t + P_t^E (1 - \mu) \varepsilon_{t-1} + P_t^E \rho_{t-1} S_{t-1} \]

Period t+1:

\[ C_{t+1} + P_{t+1}^E \varepsilon_{t+1} + S_{t+1} = w_{t+1} h_{t+1} + \varepsilon_{t+1} \pi_{t+1} + P_{t+1}^E (1 - \mu) \varepsilon_t + P_{t+1}^E \rho_t S_t \]
New Markets

• Probability that a startup at time $t$ will become a functioning firm at $t + 1$:

$$
\rho_t = \min \left\{ 1, \frac{\epsilon_t N_t}{S_t} \right\}
$$
New Markets

- Probability that a startup at time \( t \) will become a functioning firm at \( t + 1 \):

\[
\rho_t = \min \left\{ 1, \frac{\epsilon_t N_t}{S_t} \right\}
\]

- Evolution of markets

\[
N_{t+1} = N_t - \mu N_t + \epsilon_t N_t
\]
New Markets

- Probability that a startup at time $t$ will become a functioning firm at $t + 1$:

$$\rho_t = \min \left\{ 1, \frac{\epsilon_t N_t}{S_t} \right\}$$

- Evolution of markets

$$N_{t+1} = N_t - \mu N_t + \epsilon_t N_t$$

- Parameters are such that it is always optimal to fill available space on the market
Value Added

- Value added is given by:

\[ Y_t = Q_t - \int_0^{N_t} P_{j,t} X_{j,t} \, dj = A\Theta_t h_t \]
Value Added

- Value added is given by:

\[ Y_t = Q_t - \int_0^{N_t} P_{j,t} X_{j,t} \, dj = A\Theta_t h_t \]

- Value-added \( Y_t \) is used for consumption \( C_t \) and startup expenditures \( S_t \) purposes

\[ Y_t = C_t + S_t \]
Equilibrium

• From the household program:

\[
\frac{1}{\rho_t C_t} = \beta \mathbb{E}_t \left[ \frac{\pi_{t+1}}{C_{t+1}} \right] + \beta \mathbb{E}_t \left[ \frac{(1 - \mu)}{\rho_{t+1} C_{t+1}} \right]
\]

\[
\iff 1 = \beta \rho_t \mathbb{E}_t \sum_{\tau=1}^{\infty} (1 - \mu)^{\tau} \beta^{\tau} \frac{C_t}{C_{t+\tau}} \pi_{t+\tau}
\]

• Startup cost = discounted sum of expected profits
• Expectation driven startup investment
Using labor decisions, equilibrium conditions collapse to

$$(h_t - \zeta_0) = \beta \delta_t \zeta_1 \mathbb{E}_t [h_{t+1}] + \beta \delta_t \mathbb{E}_t \left[ \left( \frac{1}{\delta_{t+1}} - 1 \right) (h_{t+1} - \zeta_0) \right].$$

with

- $\delta_t = \varepsilon_t / (1 - \mu + \varepsilon_t)$ is a increasing function of the fraction of newly opened markets $\varepsilon_t$,
- $\zeta_0$ and $\zeta_1$ are complicated functions of the deep parameters.
Employment is a purely forward looking, and therefore indirectly depends on all the future $\delta_t$. 

**Result**

*Equilibrium (3)*
VAR Representation

- Output and consumption are given by

\[ Y_t = k_Y \Theta_t h_t \quad \text{and} \quad C_t = k_C \Theta_t \]

s.t.

\[
\begin{align*}
\log Y_t &= k_Y + \log \Theta_t + \log h_t \\
\log C_t &= k_C + \log \Theta_t 
\end{align*}
\]

- Assume

  - \( \log \Theta_t = \log \Theta_{t-1} + \varepsilon_t^\Theta \),
  - \( \varepsilon_t \ i.i.d., \ E(\varepsilon_t) = \mu \) and \( \varepsilon_t^N = \log(\varepsilon_t) - \log(\mu) \).
Implications

- We have

\[
\begin{pmatrix}
\Delta \log(C_t) \\
\Delta \log(Y_t)
\end{pmatrix} =
\begin{pmatrix}
1 & 0 \\
1 & b(1 - L)
\end{pmatrix}
\begin{pmatrix}
\varepsilon^\Theta_t \\
\varepsilon^N_t
\end{pmatrix} =
C(L)
\begin{pmatrix}
\varepsilon^\Theta_t \\
\varepsilon^N_t
\end{pmatrix}
\]

- Shares a lot of dynamic properties with the data:
  1. Consumption is a random walk, only affected by $\varepsilon^\Theta$
Implications

- We have

\[
\begin{pmatrix}
\Delta \log(C_t) \\
\Delta \log(Y_t)
\end{pmatrix} = \begin{pmatrix}
1 & 0 \\
1 & b(1 - L)
\end{pmatrix}\begin{pmatrix}
\varepsilon_\Theta_t \\
\varepsilon_N t
\end{pmatrix} = C(L)\begin{pmatrix}
\varepsilon_\Theta_t \\
\varepsilon_N t
\end{pmatrix}
\]

- Shares a lot of dynamic properties with the data:
  1. Consumption is a random walk, only affected by $\varepsilon_\Theta$
  2. Output is also affected in the short run by $\varepsilon_N$
Implications

• We have

\[
\begin{pmatrix}
\Delta \log(C_t) \\
\Delta \log(Y_t)
\end{pmatrix}
= \begin{pmatrix} 1 & 0 \\ 1 & b(1 - L) \end{pmatrix}
\begin{pmatrix}
\epsilon^\Theta_t \\
\epsilon^N_t
\end{pmatrix}
= C(L)
\begin{pmatrix}
\epsilon^\Theta_t \\
\epsilon^N_t
\end{pmatrix}
\]

• Shares a lot of dynamic properties with the data:
  1. Consumption is a random walk, only affected by \( \epsilon^\Theta \)
  2. Output is also affected in the short run by \( \epsilon^N \)
  3. Orthogonalization would give:

\[\epsilon^P = \epsilon^C = \epsilon^\Theta \text{ and } \epsilon^T = \epsilon^Y = \epsilon^N\]
Implications

- We have

\[
\begin{pmatrix}
\Delta \log(C_t) \\
\Delta \log(Y_t)
\end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1 & b(1 - L) \end{pmatrix} \begin{pmatrix} \varepsilon_{t}^{\Theta} \\ \varepsilon_{t}^{N} \end{pmatrix} = C(L) \begin{pmatrix} \varepsilon_{t}^{\Theta} \\ \varepsilon_{t}^{N} \end{pmatrix}
\]

- Shares a lot of dynamic properties with the data:
  1. Consumption is a random walk, only affected by \(\varepsilon^{\Theta}\)
  2. Output is also affected in the short run by \(\varepsilon^{N}\)
  3. Orthogonalization would give:

\[
\varepsilon^{P} = \varepsilon^{C} = \varepsilon^{\Theta} \text{ and } \varepsilon^{T} = \varepsilon^{Y} = \varepsilon^{N}
\]

  4. Hours are only affected by \(\varepsilon^{N}\)
Implications

- We have
  \[
  \begin{pmatrix}
  \Delta \log(C_t) \\
  \Delta \log(Y_t)
  \end{pmatrix} =
  \begin{pmatrix} 1 & 0 \\ 1 & b(1 - L) \end{pmatrix}
  \begin{pmatrix} \varepsilon^\Theta_t \\ \varepsilon^N_t \end{pmatrix} =
  C(L) \begin{pmatrix} \varepsilon^\Theta_t \\ \varepsilon^N_t \end{pmatrix}
  \]

- Shares a lot of dynamic properties with the data:
  1. Consumption is a random walk, only affected by \( \varepsilon^\Theta \)
  2. Output is also affected in the short run by \( \varepsilon^N \)
  3. Orthogonalization would give:
     \[
     \varepsilon^P = \varepsilon^C = \varepsilon^\Theta \quad \text{and} \quad \varepsilon^T = \varepsilon^Y = \varepsilon^N
     \]
  4. Hours are only affected by \( \varepsilon^N \)
  5. The interest rate does not respond to \( \varepsilon^N \)
Implications (2)

- One can prove that the decentralized investment decisions are the same that previously, so that the dynamics of $h$ is the same.
- The socially optimal allocations are in this case
  \[ h_t = C^{te} \]
- All $\varepsilon^N$-driven fluctuations are suboptimal
1. Motivation (with Some Interesting Features of the Data)
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An extended Model

- Turn to the quantitative aspect of the problem
- Aim: Assess the quantitative relevance of the model
- Some extra features:
  1. Capital accumulation,
  2. Adjustment costs to investment,
  3. Habit persistence in consumption,
  4. Two types of intermediate goods.
Extra Features

- **Final Good**

\[
Q_t = K_t^{1 - \alpha_x - \alpha_z - \alpha_h} (\Theta_t h_t)^{\alpha_h} \times \ldots \\
\times N_{\xi, t} \left( \int_0^{N_{x, t}} X_t(i)^\chi \, di \right)^{\alpha_x \chi} \tilde{N}_{\xi, t} \left( \int_0^{N_{z, t}} Z_t(i)^\chi \, di \right)^{\alpha_z \chi}
\]

with $\alpha_x, \alpha_z, \alpha_h \in (0, 1)$, $\alpha_x + \alpha_z + \alpha_h < 1$ and $\chi \geq 1$. 
Extra Features

- Final Good

\[ Q_t = K_t^{1-\alpha_x-\alpha_z-\alpha_h} (\Theta_t h_t)^{\alpha_h} \times \ldots \]

\[ \times N_{\tilde{\xi},t} \left( \int_0^{N_x,t} X_t(i)^\chi \, di \right)^{\frac{\alpha_x}{\chi}} N_{\tilde{\xi},t} \left( \int_0^{N_z,t} Z_t(i)^\chi \, di \right)^{\frac{\alpha_z}{\chi}} \]

with \( \alpha_x, \alpha_z, \alpha_h \in (0, 1), \alpha_x + \alpha_z + \alpha_h < 1 \) and \( \chi \geq 1 \).

- \( \tilde{\xi} = -\alpha_x (1 - \chi)/\chi : N_{x,t} \) has no impact
Extra Features

• Final Good

\[ Q_t = K_t^{1-\alpha_x-\alpha_z-\alpha_h} (\Theta_t h_t)^{\alpha_h} \times \ldots \]
\[ \times N_{\bar{\xi},t} \left( \int_0^{N_{x,t}} X_t(i)^\chi di \right)^{\alpha_x/\chi} N_{\tilde{\xi},t} \left( \int_0^{N_{z,t}} Z_t(i)^\chi di \right)^{\alpha_z/\chi} \]

with \( \alpha_x, \alpha_z, \alpha_h \in (0, 1), \alpha_x + \alpha_z + \alpha_h < 1 \) and \( \chi \geq 1 \).

• \( \bar{\xi} = -\alpha_x (1 - \chi) / \chi : N_{x,t} \) has no impact

• \( \tilde{\xi} = (\chi (1 - \alpha_x) - \alpha_z) / \chi : Q_t \) is linear in \( N_{z,t} \)
Extra Features (2)

- Variety:

\[
N_{x,t+1} = (1 - \mu + \varepsilon_t^x)N_{x,t} \\
N_{z,t+1} = (1 - \mu + \varepsilon_t^z)N_{z,t}.
\]
Extra Features (2)

- **Variety:**

  \[
  N_{x,t+1} = (1 - \mu + \varepsilon_t^x) N_{x,t} \\
  N_{z,t+1} = (1 - \mu + \varepsilon_t^z) N_{z,t}.
  \]

- **Shocks:**

  \[
  \log(\varepsilon_t^x) = \rho_x \log(\varepsilon_{t-1}^x) + (1 - \rho_x) \log(\bar{\varepsilon}^x) + \nu_t^x \\
  \log(\varepsilon_t^z) = \rho_z \log(\varepsilon_{t-1}^z) + (1 - \rho_z) \log(\bar{\varepsilon}^z) + \nu_t^z \\
  \log \Theta_t = \log \Theta_{t-1} + \varepsilon_t^\Theta.
  \]
Estimation
Simulated Method of Moments

1. Solve Model for a given set of parameters $\theta$
2. Simulate Model $\Rightarrow C(\theta) \text{ and } Y(\theta)$
3. SVAR on Historical Data for $C$ and $Y$
4. SVAR on Simulated Data
5. IRF of $Y$ to Permanent and transitory components ($I(\text{var})$)
6. IRF of $Y$ to Permanent and transitory components ($I(\theta)$)
7. $\theta$ minimizes $\|\text{var}-I(\theta)\|$
Estimation (2)

Not all parameters are estimated

<table>
<thead>
<tr>
<th>Preferences</th>
<th></th>
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<tr>
<td>Discount factor</td>
<td>$\beta$</td>
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<table>
<thead>
<tr>
<th>Technology</th>
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<tr>
<td>Elasticity of output to intermediate goods</td>
<td>$\alpha_x$</td>
</tr>
<tr>
<td>Elasticity of output to hours worked</td>
<td>$\alpha_h$</td>
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<tr>
<td>Depreciation rate</td>
<td>$\delta$</td>
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<tr>
<td>Elasticity of substitution bw intermediates</td>
<td>$\chi$</td>
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<tr>
<td>Rate of technology growth</td>
<td>$\gamma$</td>
</tr>
<tr>
<td>Monopoly death rate</td>
<td>$\mu$</td>
</tr>
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</table>
Impulse Response Functions VAR versus Model (LR identification)
Impulse Response Functions VAR versus Model (SR identification)

- Consumption: $\epsilon^C$ vs. Horizon
- Output: $\epsilon^Y$ vs. Horizon

Data and Model Comparison

- S.D. Shock: Standard Deviation
- Horizon: Time Horizon

Graphs showing the response of consumption and output to shocks over time, comparing data and model predictions.
## Estimated Parameters

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Symbol</th>
<th>Estimate</th>
<th>Standard Error</th>
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<tbody>
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<td>Persistence of the X Variety shocks</td>
<td>$\rho_x$</td>
<td>0.9166</td>
<td>(0.0336)</td>
</tr>
<tr>
<td>Standard dev. of X Variety shocks</td>
<td>$\sigma_x$</td>
<td>0.2865</td>
<td>(0.0317)</td>
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<tr>
<td>Persistence of the Z Variety shocks</td>
<td>$\rho_z$</td>
<td>0.9164</td>
<td>(0.6459)</td>
</tr>
<tr>
<td>Standard dev. of Z Variety shocks</td>
<td>$\sigma_z$</td>
<td>0.0245</td>
<td>(0.1534)</td>
</tr>
<tr>
<td>Standard dev. of the Technology shocks</td>
<td>$\sigma_{\Theta}$</td>
<td>0.0131</td>
<td>(0.0015)</td>
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<tr>
<td>Habit Persistence parameter</td>
<td>$b$</td>
<td>0.5900</td>
<td>(0.1208)</td>
</tr>
<tr>
<td>Adjustment Costs parameter</td>
<td>$\varphi$</td>
<td>0.4376</td>
<td>(0.3267)</td>
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## Goodness of Fit

<table>
<thead>
<tr>
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<th>J–stat(Y)</th>
<th>Chi–stat(C)</th>
<th>Chi–stat(C,Y)</th>
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<tr>
<td>Test</td>
<td>17.41</td>
<td>42.51</td>
<td>92.78</td>
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<tr>
<td>P–value</td>
<td>[0.99]</td>
<td>[0.12]</td>
<td>[0.06]</td>
</tr>
</tbody>
</table>
Does the model match Hours variance decomposition?

- (ML) Regression:
  \[ h_t = c + \sum_{k=0}^{K} (\alpha_k \varepsilon_{t-k}^P + \beta_k \varepsilon_{t-k}^T + \gamma_k \varepsilon_{t-k}^H), \]

<table>
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<tr>
<th>Horizon</th>
<th>Data</th>
<th>Model</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>(\varepsilon^P)</td>
<td>(\varepsilon^T)</td>
</tr>
<tr>
<td>1</td>
<td>19 %</td>
<td>75 %</td>
</tr>
</tbody>
</table>
# Business cycle accounting

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Output</th>
<th>Consumption</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\varepsilon^\Theta$</td>
<td>$\varepsilon^x$</td>
<td>$\varepsilon^z$</td>
</tr>
<tr>
<td>1</td>
<td>64 %</td>
<td>36 %</td>
<td>0 %</td>
</tr>
<tr>
<td>4</td>
<td>86 %</td>
<td>14 %</td>
<td>0 %</td>
</tr>
<tr>
<td>8</td>
<td>92 %</td>
<td>8 %</td>
<td>0 %</td>
</tr>
<tr>
<td>20</td>
<td>96 %</td>
<td>3 %</td>
<td>1 %</td>
</tr>
<tr>
<td>$\infty$</td>
<td>96 %</td>
<td>0 %</td>
<td>4 %</td>
</tr>
</tbody>
</table>
Alternative Stories

• Common to all models
  • habit persistence,
  • adjustment costs to investment
  • permanent technology shock
  • Shut down the permanent market shock

\[ Q_t = K_t^{1-\alpha_x-\alpha_h}(\Theta_t h_t)^{\alpha_h} N_{x,t}^{\xi} \left( \int_0^{N_{x,t}} X_t(i)^\chi di \right)^{\alpha_x \chi} \]

• Compete our market shock against alternative shocks.


Alternative Stories (2)

Investment Specific Shock

\[ Y_t = C_t + S_t + e^{-\zeta_t} l_t, \]

<table>
<thead>
<tr>
<th></th>
<th>PIS–1</th>
<th>PIS–2</th>
<th>TIS–1</th>
<th>TIS–2</th>
</tr>
</thead>
<tbody>
<tr>
<td>J–stat</td>
<td>17.31</td>
<td>60.96</td>
<td>14.89</td>
<td>59.48</td>
</tr>
<tr>
<td></td>
<td>[0.99]</td>
<td>[0.86]</td>
<td>[1.00]</td>
<td>[0.87]</td>
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<tr>
<td>( D(C, Y) )</td>
<td>99.42</td>
<td>92.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.03]</td>
<td></td>
<td>[0.06]</td>
<td></td>
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</table>
Alternative Stories (3)
Investment Specific Shock: Variance decomposition

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Output</th>
<th>Consumption</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\varepsilon^\Theta$</td>
<td>$\nu^x$</td>
<td>$\zeta$</td>
</tr>
<tr>
<td>PIS–1: $\zeta=$Permanent Investment Specific Shock</td>
<td>64%</td>
<td>36%</td>
<td>0%</td>
</tr>
<tr>
<td>$\infty$</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>PIS–2: $\zeta=$Permanent Investment Specific Shock</td>
<td>55%</td>
<td>45%</td>
<td>0%</td>
</tr>
<tr>
<td>$\infty$</td>
<td>96%</td>
<td>0%</td>
<td>4%</td>
</tr>
<tr>
<td>TIS–1: $\zeta=$Temporary Investment Specific Shock</td>
<td>53%</td>
<td>42%</td>
<td>5%</td>
</tr>
<tr>
<td>$\infty$</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>TIS–2: $\zeta=$Temporary Investment Specific Shock</td>
<td>56%</td>
<td>42%</td>
<td>2%</td>
</tr>
<tr>
<td>$\infty$</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Alternative Stories (4)
Transitory technology and preference shocks

- Transitory technology shock

\[ Q_t = e^{\xi_t} K_t^{1-\alpha_x-\alpha_h} (\Theta_t h_t)^{\alpha_h} \bar{N}_{\xi,t} \left( \int_0^{\bar{N}_{\xi,t}} X_t(i) \chi \, di \right)^{\alpha_x} \]

- Preference shocks

\[ \mathbb{E}_t \sum_{\tau=0}^{\infty} \left[ \log(C_{t+\tau} - bC_{t+\tau-1}) + \psi e^{\xi_t+\tau}(\bar{h} - h_{t+\tau}) \right] \]

<table>
<thead>
<tr>
<th>T.T.</th>
<th>T.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>J–stat</td>
<td>54.65</td>
</tr>
<tr>
<td></td>
<td>[0.95]</td>
</tr>
</tbody>
</table>
## Alternative Stories (5)

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Output $\varepsilon^\Theta$, $\nu^\times$, $\zeta$</th>
<th>Consumption $\varepsilon^\Theta$, $\nu^\times$, $\zeta$</th>
<th>Hours $\varepsilon^\Theta$, $\nu^\times$, $\zeta$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T.T.: $\zeta$=Temporary Technology Shock</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>21 %</td>
<td>38 %</td>
<td>41 %</td>
</tr>
<tr>
<td>$\infty$</td>
<td>99 %</td>
<td>0 %</td>
<td>0 %</td>
</tr>
<tr>
<td><strong>T.P.: $\zeta$=Temporary Preference Shock</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>27 %</td>
<td>39 %</td>
<td>34 %</td>
</tr>
<tr>
<td>20</td>
<td>70 %</td>
<td>8 %</td>
<td>22 %</td>
</tr>
<tr>
<td>$\infty$</td>
<td>100 %</td>
<td>0 %</td>
<td>0 %</td>
</tr>
</tbody>
</table>
Road Map

1. Motivation (with Some Interesting Features of the Data)
2. An Analytical Model
3. Taking The Model to the Data
4. Conclusion
Conclusion

- We have found a new source of shocks, that looks like animal spirits, although it comes from a model with determinate equilibrium.
- A quite pessimistic view that a non trivial share of the Business Cycle is inefficient \( \leadsto \) large welfare cost of fluctuations.
- Part of a research program in which we explore the importance of the arrival of information as a source of impulse in the BC.
Investment Specific Shocks vs TFP
**Investment Specific Shocks vs TFP**

\[ \sigma(\Delta \text{TFP}): 0.7999, \sigma(\Delta \text{ISTP}): 0.5020 \]
## Alternative Stories?

### Estimation Results

<table>
<thead>
<tr>
<th></th>
<th>RBC–P</th>
<th>RBC–T</th>
<th>RBC–Q</th>
<th>CEE</th>
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</thead>
<tbody>
<tr>
<td>(b)</td>
<td>0.8813</td>
<td>0.8813</td>
<td>0.7181</td>
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<tr>
<td>(\phi)</td>
<td>0.6682</td>
<td>0.6683</td>
<td>2.0353</td>
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<tr>
<td>(\sigma_{\gamma})</td>
<td>0.0143</td>
<td>0.0143</td>
<td>0.0153</td>
<td>0.0129</td>
</tr>
<tr>
<td>(\rho_T)</td>
<td>0.5973</td>
<td>0.4974</td>
<td>0.6024</td>
<td>–</td>
</tr>
<tr>
<td>(\sigma_T)</td>
<td>0.0155</td>
<td>0.0099</td>
<td>0.0306</td>
<td>–</td>
</tr>
<tr>
<td>(J\text{-stat}(Y))</td>
<td>30.96</td>
<td>30.96</td>
<td>18.05</td>
<td>23.06</td>
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</table>

[0.66], [0.66], [0.99], [0.96]
## Alternative Stories?

<table>
<thead>
<tr>
<th></th>
<th>PIS–1</th>
<th>PIS–2</th>
<th>TIS–1</th>
<th>TIS–2</th>
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</thead>
<tbody>
<tr>
<td>$b$</td>
<td>0.6108</td>
<td>0.3125</td>
<td>0.6457</td>
<td>0.3062</td>
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<tr>
<td></td>
<td>(0.1229)</td>
<td>(0.1921)</td>
<td>(0.1180)</td>
<td>(0.2184)</td>
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<tr>
<td>$\varphi$</td>
<td>0.4195</td>
<td>0.2534</td>
<td>0.6099</td>
<td>0.2775</td>
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<tr>
<td></td>
<td>(0.3227)</td>
<td>(0.3201)</td>
<td>(0.6675)</td>
<td>(0.4235)</td>
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<tr>
<td>$\sigma_\Theta$</td>
<td>0.0131</td>
<td>0.0088</td>
<td>0.0126</td>
<td>0.0089</td>
</tr>
<tr>
<td></td>
<td>(0.0017)</td>
<td>(0.1592)</td>
<td>(0.0017)</td>
<td>(0.0016)</td>
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<tr>
<td>$\rho_x$</td>
<td>0.9117</td>
<td>0.8919</td>
<td>0.9143</td>
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<tr>
<td></td>
<td>(0.0323)</td>
<td>(0.0395)</td>
<td>(0.0374)</td>
<td>(0.0420)</td>
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<tr>
<td>$\sigma_x$</td>
<td>0.1575</td>
<td>0.1859</td>
<td>0.1594</td>
<td>0.1775</td>
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<tr>
<td></td>
<td>(0.0217)</td>
<td>(0.0349)</td>
<td>(0.0197)</td>
<td>(0.0266)</td>
</tr>
<tr>
<td>$\rho_T$</td>
<td>–</td>
<td>–</td>
<td>0.5328</td>
<td>0.8478</td>
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<tr>
<td></td>
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<td></td>
<td>(0.2742)</td>
<td>(0.4974)</td>
</tr>
<tr>
<td>$\sigma_T$</td>
<td>0.0003</td>
<td>0.0038</td>
<td>0.0118</td>
<td>0.0032</td>
</tr>
<tr>
<td></td>
<td>(0.0243)</td>
<td>(0.0082)</td>
<td>(0.0137)</td>
<td>(0.0048)</td>
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</table>
## Alternative Stories?

<table>
<thead>
<tr>
<th></th>
<th>T.T.</th>
<th>T.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b$</td>
<td>0.3420</td>
<td>0.3877</td>
</tr>
<tr>
<td></td>
<td>(0.1869)</td>
<td>(0.1472)</td>
</tr>
<tr>
<td>$\varphi$</td>
<td>0.3125</td>
<td>0.3699</td>
</tr>
<tr>
<td></td>
<td>(0.2645)</td>
<td>(0.3228)</td>
</tr>
<tr>
<td>$\sigma_\Theta$</td>
<td>0.0062</td>
<td>0.0075</td>
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<tr>
<td></td>
<td>(0.0044)</td>
<td>(0.0037)</td>
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<tr>
<td>$\rho_x$</td>
<td>0.9195</td>
<td>0.9075</td>
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<tr>
<td></td>
<td>(0.0234)</td>
<td>(0.0259)</td>
</tr>
<tr>
<td>$\sigma_x$</td>
<td>0.1768</td>
<td>0.1825</td>
</tr>
<tr>
<td></td>
<td>(0.0278)</td>
<td>(0.0297)</td>
</tr>
<tr>
<td>$\rho_T$</td>
<td>0.9143</td>
<td>0.8799</td>
</tr>
<tr>
<td></td>
<td>(0.1148)</td>
<td>(0.1959)</td>
</tr>
<tr>
<td>$\sigma_T$</td>
<td>0.0046</td>
<td>0.0068</td>
</tr>
<tr>
<td></td>
<td>(0.0021)</td>
<td>(0.0030)</td>
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</table>