China’s Long-term Real Business Cycles and the 1978 Reform: Productivity and Fiscal Policy Changes

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Motivation

- Few studies on China’s business cycles.
  - its growth attracts more attention;
  - data availability and quality. Business cycle features are not well understood.
- Market-oriented reforms started in 1978: a structural change
  - from a planning economy to a market-oriented economy;
  - how does the development of markets affect its economic fluctuations?
Questions of Interest

- What are the features of China’s long-term business cycles after WWII?
- Any pattern change after the 1978 reform?
- What factors can explain the long-term business cycle features and the pattern change after 1978?
  - Do the standard RBC models work here?
Contribution

- Overcome some data problems, improve the measurement of China’s business cycles and discover its long-term features.
- Examine the effects of the market-oriented reform on economic fluctuations.
- Study the factors that can explain the features of China’s business cycles and the pattern change after the 1978 reform.
- Examine the effects of the Chinese government’s fiscal policies on economic fluctuations.
Main Findings I

Stylized Facts:

- Economic fluctuations were largely moderated in the post-1978 period (78-06).
- Relative volatility diverges: household consumption relative to output became more volatile in the post-1978 period, while private investment relative to output became less volatile.
Main Findings II

Analysis Findings:

- A standard RBC model with technology (TFP) shocks can explain the moderation in volatility, but not the relative volatility changes.
- Government expenditure process changed from pro-cyclical to counter-cyclical after 1978.
- Addition of government expenditure and investment processes helps the model to explain the relative volatility changes.
Outline

- Data & Stylized Facts of China’s business cycles
- Baseline model
  Standard neoclassical growth model with TFP shocks
  What it can do & can not do?
- Extension – government expenditure
- The mechanism: effects of government expenditure
- Concluding remarks
Data

- All public data:
  - China Statistics Yearbook / National Bureau of Statistics of China
  - Finance Yearbook of China / Ministry of Finance

- Data problems
  - Availability, quality and consistency,…
  - Lots of cross-verifications, estimations and adjustments needed.
Data problem

An example: a jump of employment in 1990.

Figure: Employment
Data problem

- Employment is not time consistent.
  - In 1990 SSB changed the methodology of data collection – from firm survey to household survey.

- Hidden unemployment
  - A large number of laid-offs and early retirements from SOEs started in 1993.
  - They were counted in employment until 2007.
Data problem

Adjustment:

- Assume there is constant gap between firm survey to household survey.
  - Firms tend to underreport their employee number.
  - Fill the gap to prevent an unreasonable jump of employment in 1990.
- Deduct the SOE laid-offs and early retirements from the employment.
Data – employment adjustment

Figure: Employment – official and adjusted
Stylized Facts I

Great moderation on economic fluctuations after 1978

Table: Standard deviation from the trend (%)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-1978</th>
<th>Post-1978</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output ($Y$)</td>
<td>7.5</td>
<td>1.7</td>
<td>-78</td>
</tr>
<tr>
<td>Consumption ($C_h + G'$)</td>
<td>4.2</td>
<td>1.7</td>
<td>-60</td>
</tr>
<tr>
<td>Household ($C_h$)</td>
<td>4.0</td>
<td>1.7</td>
<td>-57</td>
</tr>
<tr>
<td>Government ($G'$)</td>
<td>9.1</td>
<td>3.0</td>
<td>-67</td>
</tr>
<tr>
<td>Investment ($I_p + I_g$)</td>
<td>20.7</td>
<td>3.6</td>
<td>-83</td>
</tr>
<tr>
<td>Private Invt ($I_p$)</td>
<td>28.5</td>
<td>4.4</td>
<td>-85</td>
</tr>
<tr>
<td>Government Invt ($I_g$)</td>
<td>20.9</td>
<td>6.5</td>
<td>-69</td>
</tr>
<tr>
<td>Labor* ($L$)</td>
<td>1.7</td>
<td>0.3</td>
<td>-80 (-8)</td>
</tr>
</tbody>
</table>

Notes: * Labor is employment only. We estimate the labor hours for the post-1978 period. The volatility of the estimated labor hours, 1.5%, is shown in the parenthesis.
Output fluctuations

Figure: Output fluctuations
Stylized Facts II

Diversity in Relative volatility (volatility of $x$ / output volatility)

Table: Standard deviation relative to output (%)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-1978</th>
<th>Post-1978</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output ($Y$)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Consumption ($C_h + G$)</td>
<td>55</td>
<td>102</td>
</tr>
<tr>
<td>Household ($C_h$)</td>
<td>53</td>
<td>103</td>
</tr>
<tr>
<td>Government ($G$)</td>
<td>121</td>
<td>182</td>
</tr>
<tr>
<td>Investment ($I_p + I_g$)</td>
<td>276</td>
<td>217</td>
</tr>
<tr>
<td>Private Invt ($I_p$)</td>
<td>379</td>
<td>267</td>
</tr>
<tr>
<td>Government Invt ($I_g$)</td>
<td>278</td>
<td>395</td>
</tr>
<tr>
<td>Labor* ($L$)</td>
<td>22</td>
<td>17 (93)</td>
</tr>
</tbody>
</table>

Notes: * Labor is employment only. We estimate the labor hours for the post-1978 period. The volatility of the estimated labor hours is shown in the parenthesis.
## Stylized Facts III

### Table: World Comparison (%)

<table>
<thead>
<tr>
<th>Country</th>
<th>$Y$</th>
<th>$C_h$</th>
<th>$G$</th>
<th>$I$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asian countries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>1.12</td>
<td>0.91</td>
<td>1.08</td>
<td>3.34</td>
</tr>
<tr>
<td>Korea</td>
<td>1.50</td>
<td>1.42</td>
<td>1.30</td>
<td>5.56</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.88</td>
<td>1.27</td>
<td>1.50</td>
<td>3.28</td>
</tr>
<tr>
<td><strong>Developed countries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>1.56</td>
<td>1.22</td>
<td>0.88</td>
<td>6.40</td>
</tr>
<tr>
<td>France</td>
<td>0.96</td>
<td>0.82</td>
<td>0.75</td>
<td>5.21</td>
</tr>
<tr>
<td>Japan</td>
<td>1.39</td>
<td>1.26</td>
<td>1.23</td>
<td>4.29</td>
</tr>
<tr>
<td>UK</td>
<td>1.72</td>
<td>1.88</td>
<td>0.91</td>
<td>7.41</td>
</tr>
<tr>
<td>USA</td>
<td>1.73</td>
<td>1.41</td>
<td>0.66</td>
<td>6.68</td>
</tr>
<tr>
<td>China (1954-1977)</td>
<td>7.58</td>
<td>3.23</td>
<td>9.10</td>
<td>20.80</td>
</tr>
<tr>
<td>China (1978-2006)</td>
<td>1.73</td>
<td>1.93</td>
<td>3.00</td>
<td>3.70</td>
</tr>
</tbody>
</table>

Notes: Numbers for countries other than China are from Rand and Tarp (2002) and calculated from data for the period 1970-97.
What can account for the business cycle features?

Baseline model: standard neo-classical growth model with population growth, productivity growth and TFP shocks

\[
\max \left\{ c_t, k_{t+1}, h_t \right\}_{t=0}^{\infty} \quad E_0 \left[ \sum_{t=0}^{\infty} \beta^t N_t \ln(c_t) + \alpha \ln(h_t) \right]
\]

subject to

\[
N_t y_t = e^{z_t} (N_t k_t)^{\theta} (g_t N_t h_t)^{1-\theta}
\]

\[
N_t c_t + N_{t+1} k_{t+1} = N_t y_t + (1 - \delta) N_t k_t
\]

\[
N_{t+1} = \eta N_t
\]

\[
z_t = \rho_z z_{t-1} + \epsilon_t
\]
## Calibration – parameters

### Table: Model Parameters

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preference</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.955</td>
<td>0.955</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>1.443</td>
<td>1.443</td>
</tr>
<tr>
<td><strong>Production</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.0545</td>
<td>0.0545</td>
</tr>
<tr>
<td>$\theta$</td>
<td>0.456</td>
<td>0.456</td>
</tr>
<tr>
<td><strong>Growth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\eta$</td>
<td>1.0194</td>
<td>1.0152</td>
</tr>
<tr>
<td>$g$</td>
<td>1.0322</td>
<td>1.0607</td>
</tr>
<tr>
<td><strong>Shock process</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho_z$</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>$\sigma_z$</td>
<td>0.105</td>
<td>0.025</td>
</tr>
</tbody>
</table>
### Simulation results - baseline model I

**Table**: Simulation results – Standard deviation from trend (%)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data</th>
<th></th>
<th>Model</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-78</td>
<td>Post-78</td>
<td>change</td>
<td>Pre-78</td>
</tr>
<tr>
<td>Output</td>
<td>7.6</td>
<td>1.7</td>
<td>-78</td>
<td>7.7</td>
</tr>
<tr>
<td>Consumption (Household C)</td>
<td>4.1</td>
<td>1.7</td>
<td>-60</td>
<td>3.4</td>
</tr>
<tr>
<td>Investment (Private I)</td>
<td>20.7</td>
<td>3.6</td>
<td>-83</td>
<td>16.0</td>
</tr>
<tr>
<td>Labor*</td>
<td>1.7</td>
<td>0.3</td>
<td>(1.5)</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Notes: Labor is employment, and in parenthesis are values for the estimated labor hour volatility.
## Simulation results - baseline model II

**Table:** Simulation results – Relative volatility to output (%)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data Pre-78</th>
<th>Data Post-78</th>
<th>Model Pre-78</th>
<th>Model Post-78</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Consumption</td>
<td>55</td>
<td>102</td>
<td>43</td>
<td>46</td>
</tr>
<tr>
<td>(Household C)</td>
<td>(53)</td>
<td>(103)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment</td>
<td>276</td>
<td>217</td>
<td>208</td>
<td>197</td>
</tr>
<tr>
<td>(Private I)</td>
<td>(379)</td>
<td>(267)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor*</td>
<td>22</td>
<td>17(93)</td>
<td>37</td>
<td>35</td>
</tr>
</tbody>
</table>

Notes: Labor is employment. In parenthesis are values for the estimated labor hour volatility.
Findings form the baseline model

It Can:

- generate the big moderation after the 1978 reform.
  - TFP process catches the inefficiency in the economy prior to the reform
    1) no formal markets to guide economic activities;
    2) planner made mistakes.
  - Development of markets improves economic efficiency and leads to a smoother TFP process.
- the smoother TFP process might also reflect the decline in agriculture share
- the ways the model economy and the real economy response to TFP shocks are similar, even in the pre-78 period.
Findings form the baseline model

It does not do well on:

- Volatility of $C$
  - Volatility of $C$ lower than data.
  - Relative Volatility of $C$ in post-1978 much lower than data.
- Volatility of $I$
  - Volatility of $I$ in pre-1978 lower than data.
  - Relative Volatility of $I$ decreased more after 1978 in data.
- Diverse relative volatility: $C$ becomes higher ($53 \rightarrow 103$) and $I$ becomes lower ($379 \rightarrow 267$).
What can account for those features not well explained?

- Our suggestion: government fiscal policies
  - Government highly involved in economic activities.
  - Chinese government expenditure \((G + I_g)\) is about 20% of GDP.
- Characterize government expenditure \((G, I_g)\) into the model
  - Shocks to households.
  - Growth component: growing with the economy, \(\eta g\).
  - Disturbance component: \(z_g, zI_g\).
**Model: government expenditure**

Consider government consumption and investment as additional shocks.

$$\max_{\{c_t, k_{t+1}, h_t\}} \sum_{t=0}^{\infty} \beta^t N_t \ln(c_t) + \alpha \ln(h_t)$$

(2a)

subject to

$$N_t c_t + N_t i_t + Ig_t + G_t = N_t y_t; \quad (2c)$$

$$N_{t+1} k_{t+1} = (1 - \delta) N_t k_t + N_t i_t + Ig_t; \quad (2d)$$

$$N_{t+1} = \eta N_t; \quad z_t = \rho z_{t-1} + \epsilon_t; \quad (2e)$$

$$G_t = G_0 (\eta g)^t e^{z_{gt}}; \quad Ig_t = Ig_0 (\eta g)^t e^{z_{Igt}}; \quad (2g)$$

$$z_{gt} = \rho g z_{gt-1} + \rho g z z_{t-1} + \epsilon_{gt}; \quad (2i)$$

$$z_{Igt} = \rho Ig z_{Igt-1} + \rho Ig z z_{t-1} + \epsilon_{Igt}; \quad (2j)$$
Estimation of government expenditure processes

\[ z_{gt} = \rho_g z_{Gt-1} + \rho_{gz} z_{t-1} + \epsilon_{gt} \]  
\[ z_{Ig_t} = \rho_{Ig} z_{Ig_{t-1}} + \rho_{Igz} z_{t-1} + \epsilon_{Ig_t} \]  

Table: Estimation results

<table>
<thead>
<tr>
<th>Period</th>
<th>Govt consumption</th>
<th></th>
<th></th>
<th>Govt investment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\rho_g$</td>
<td>$\rho_{gz}$</td>
<td></td>
<td>$\rho_{Ig}$</td>
<td>$\rho_{Igz}$</td>
</tr>
<tr>
<td>pre-1978</td>
<td>-0.12</td>
<td>0.74***</td>
<td>-0.26</td>
<td>2.04***</td>
<td></td>
</tr>
<tr>
<td>post-1978</td>
<td>0.39**</td>
<td>-0.58*</td>
<td>0.17</td>
<td>-0.61</td>
<td></td>
</tr>
</tbody>
</table>

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.
Changes in government expenditure processes

From pro-cyclical (pre-1978) to counter-cyclical (post-1978):

- Government consumption process:
  \[ \rho_{gz} = 0.74 \Rightarrow \rho_{gz} = -0.58 \]

- Government investment process:
  \[ \rho_{I_g z} = 2.04 \Rightarrow \rho_{I_g z} = -0.61 \]
## Simulation results I - model with government

**Table:** Simulation results – Standard deviation from trend (%)

<table>
<thead>
<tr>
<th>Var</th>
<th>Data</th>
<th>Baseline Model</th>
<th>Model ((G, I_g))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pre-78</td>
<td>post-78</td>
<td>change</td>
</tr>
<tr>
<td>(Y)</td>
<td>7.6</td>
<td>1.7</td>
<td>-78</td>
</tr>
<tr>
<td>(C_h)</td>
<td>4.0</td>
<td>1.7</td>
<td>-57</td>
</tr>
<tr>
<td>(I_p)</td>
<td>28.5</td>
<td>4.4</td>
<td>-85</td>
</tr>
<tr>
<td>(L^*)</td>
<td>1.7</td>
<td>0.3</td>
<td>-80</td>
</tr>
<tr>
<td>(h)</td>
<td>(1.5)</td>
<td>(-8)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Labor is employment. In parenthesis are values for the estimated labor hour volatility.
**Simulation results II - model with government**

**Table:** Simulation results – Relative volatility (%)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-78</th>
<th>Post-78</th>
<th>Pre-78</th>
<th>Post-78</th>
<th>Pre-78</th>
<th>Post-78</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cons' (C_h)</td>
<td>53</td>
<td>103</td>
<td>43</td>
<td>46</td>
<td>48</td>
<td>72</td>
</tr>
<tr>
<td>Inv't (I_p)</td>
<td>379</td>
<td>267</td>
<td>204</td>
<td>196</td>
<td>327</td>
<td>242</td>
</tr>
<tr>
<td>Labor*</td>
<td>22</td>
<td>17(93)</td>
<td>37</td>
<td>35</td>
<td>30</td>
<td>16</td>
</tr>
</tbody>
</table>

Notes: Labor is employment. In parenthesis are values for the estimated labor hour volatility.
Data and Simulation - Consumption

Household Consumption: fluctuations from the trend

Min Zhao\textsuperscript{a,b} Minchung Hsu\textsuperscript{a} \textsuperscript{a} National Graduate Institute for Policy Studies (GRIPS), Tokyo \textsuperscript{b} World Bank, Beijing Office

China’s Long-term Real Business Cycles and the 1978 Reform: Productivity and Fiscal Policy Changes
Data and Simulation - Investment

Private Investment: fluctuations from the trend

-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8

Private Investment: fluctuations from the trend
predicted
data

Figure:

Min Zhao$^a,b$ Minchung Hsu$^a$ National Graduate Institute for Policy China’s Long-term Real Business Cycles and the 1978 Reform: Productivity
Data and Simulation - Labor (employment)

Labor (Employment): fluctuations from the trend

Figure: Private Investment

Min Zhao\textsuperscript{a, b} Minchung Hsu\textsuperscript{a} National Graduate Institute for Policy Studies (GRIPS), Tokyo

\textsuperscript{b} World Bank, Beijing Office

China’s Long-term Real Business Cycles and the 1978 Reform: Productivity
The effects of government expenditure shocks

- Effects of counter-cyclical $G$ (wealth effect):
  - suppose a bad productivity shock happens $z \downarrow$ (a recession), subsequently $Y, C, I, L \downarrow$.
  - $G$ will increase – a bad wealth shock to HHs.
  - HHs then will consume even less ($C \downarrow$), save more ($I \uparrow$) and work more ($L \uparrow$) in response to $G$ increase.
  - that increases $C$ volatility but reduces volatility $I$ and $L$ in the post-78.
  - this helps to explain the relative volatility diverse on $C$ and $I$.

- Government investment $I_g$ only has a crowding-out effect on private Investment.
  - that makes private investment more volatile (both periods).
  - this helps to explain the high investment volatility in data.
### Table: Comparison of models: Deviation from the trend (%)

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>adding $G$</th>
<th>adding $I_g$</th>
<th>adding $G &amp; I_g$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>(2)/(1)</td>
<td>(3)/(1)</td>
<td>(4)/(1)</td>
<td></td>
</tr>
<tr>
<td>Pre-78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_h$</td>
<td>3.4</td>
<td>3.6</td>
<td>3.4</td>
<td>3.6</td>
</tr>
<tr>
<td>$I_p$</td>
<td>16.0</td>
<td>15.5</td>
<td>25.2</td>
<td>24.8</td>
</tr>
<tr>
<td>$L$</td>
<td>2.9</td>
<td>2.3</td>
<td>2.9</td>
<td>2.3</td>
</tr>
<tr>
<td>$Y$</td>
<td>7.9</td>
<td>7.6</td>
<td>7.9</td>
<td>7.6</td>
</tr>
<tr>
<td>Post-78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_h$</td>
<td>0.9</td>
<td>1.2</td>
<td>0.9</td>
<td>1.2</td>
</tr>
<tr>
<td>$I_p$</td>
<td>3.6</td>
<td>3.0</td>
<td>4.7</td>
<td>4.0</td>
</tr>
<tr>
<td>$L$</td>
<td>0.7</td>
<td>0.3</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>$Y$</td>
<td>1.9</td>
<td>1.6</td>
<td>1.9</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Notes:

Min Zhao$^{a,b}$, Minchung Hsu$^a$ National Graduate Institute for Policy China’s Long-term Real Business Cycles and the 1978 Reform: Productivity
Concluding remarks

- Great moderation in economic fluctuations after the 1978 reform.
  - Economic volatility is much higher than other countries during the planning economy period.
  - Economic volatility is comparable to other countries after the market-oriented reform.
- Diversity of relative volatility changes
  - Relative to $Y$, volatility of $C$ becomes more volatile.
  - Relative to $Y$, volatility of $I$ becomes less volatile.
- The standard RBC model with TFP shocks generates the great moderation, but fails to explain the relative volatility changes.
- Change of government expenditure process from pro-cyclical to counter-cyclical can account for the relative volatility changes.
- Addition of government expenditure shocks improves model performance.
Concluding remarks

- unsolved questions: fluctuations of employment and labor hours
  - data of work hours are only available for the years 1991–98 and 2001–06.
  - Estimated labor hours are more volitive than employment (78–06), and cannot be explained by this model.
  - The model even cannot predict the fluctuations of employment well.
- difficulties:
  1. a large number of informal workers
  2. SOE reform and labor market structural changes
- further studies on labor market needed
Data and Simulation - Labor (hours, post-78)

Labor: fluctuations from the trend, 78–06

Figure:

Private Investment

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