Naughton Chapter 18: Macroeconomic trends and cycles

• Growth has primarily been an investment led story. Trade is secondary.
  – Was true under central planning, True today
  – Need savings to fund investment.
    * Under central planning, SOEs did almost all the saving.
    * Under Central planning, tax system and financial system were non issues.
  – Since the 1978 reforms, household saving has been exceptionally high.

• Fiscal policy
  – Transitional loss of revenues.
  – 1994 tax reform is important for the transition process.
  – Local Government Finance
    * Shortcomings in local rural finances is still a challenge.

• Monetary Policy:
  – Monetary policy driven by controlling monetary aggregates, monitoring the velocity of money.
Risk-Sharing, Complete Markets and Pareto Optimality

Overview

- Concept of perfect risk sharing in environment of complete markets attains the social optimum in the sense of Pareto.

- Give an intro to the concept, which forms the basis of all of modern finance theory.

- Purpose
  - To compare risk-sharing under central planning and post reform economies of China.
    Again, the communist mantra: From each according to one’s ability, to each according to one’s needs.
  - Ask if China’s post-reform macro economy is significantly different from other major countries. i.e., can the same economic tools (business cycle models) used to study the US be used for China?

- Question: What is the role of financial markets?
  Fama’s answer: To allow people to trade risk in exchange for return. People bearing risk can offload it for a price (of insurance)
  Workers can partially insure against job loss by buying shares of their firm (Uber drivers should buy shares in Uber when it goes public).

The Social Optimum

- An endowment economy. Good is nonstorable.

- Let there be two states of nature, \( \{1, 2\} \) each occurring with equal probability \( p(1) = p(2) = 1/2 \).

<table>
<thead>
<tr>
<th>state</th>
<th>probability</th>
<th>Ron</th>
<th>Jon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.5</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>0.5</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>
• Ron and Jon have log utility. Planner weights them equally
  – They are risk averse.

\[
\begin{align*}
\text{Bear the risk} & \quad \frac{1}{2} \ln(2) + \frac{1}{2} \ln(4) < \frac{1}{2} \ln(3) + \frac{1}{2} \ln(3) \\
& \quad 2.08 < 2.19
\end{align*}
\]

• Social Planner’s problem

\[
\text{max } \ln(c_1) + \ln(c_2)
\]

subject to

\[
y = c_1 + c_2
\]

– Set up Lagrangian,

\[
L = \ln(c_1) + \ln(c_2) + \lambda (y - c_1 - c_2)
\]

– First-order conditions

\[
c_1 : \frac{1}{c_1} - \lambda = 0
\]

\[
c_2 : \frac{1}{c_2} - \lambda = 0
\]

\[
\lambda : y - c_1 - c_2 = 0
\]

– Hence, efficient or optimal risk-sharing says,

\[
c_1 = c_2
\]

Easy. This is what Mao should have done. Maybe he did.

Decentralized and Complete Markets

• If there is a demand (for a product, commodity, security), a market will emerge to provide it.

• Intertemporal setting. Securities trading occurs before state of nature is revealed.
• Assets are **state-contingent** securities (bonds) that pay one unit of the consumption good if that state of nature occurs, and expires worthless if that state does not occur.

  – Think of insurance contract. Purchase security with premium, and payoffs if state occurs (accident) or not.

• We will use prime notation to denote next period.

• $s = 1, 2$ denotes state of nature. Ron and Jon’s endowments $y_1(s), y_2(s)$

<table>
<thead>
<tr>
<th>State 1</th>
<th>State 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ron</td>
<td>$y_1(1) = 2$</td>
</tr>
<tr>
<td>Jon</td>
<td>$y_2(1) = 4$</td>
</tr>
</tbody>
</table>

• State-contingent securities. For $s = \{1, 2\}$, $b_1(s)$: Number of state-$s$ securities bought (+) or sold (-) by Ron. $b_2(s)$: Number of state-$s$ securities bought (+) or sold(-) by Jon.

Each security pays one unit of consumption good if the state occurs.

• $q(s)$ is the price of the state-securities. $q(1)$ for the $s = 1$ security. $q(2)$ for the $s = 2$ security.

• Ron’s budget constraints

Today: Assume that $s = 2$ today

$$y_1(2) + b_1(2) = c_1(2) + \underbrace{(q(1) b_1'(1) + q(2) b_1'(2))}_{\text{Investment Portfolio}}$$ (9)

Tomorrow

$$y'_1(s) + b'_1(s) = c'_1(s) + (q'(1) b'_1'(1) + q'(2) b'_1'(2))$$ (10)

• Jon’s budget constraints: replace 1 subscript with 2.

$$y_2(2) + b_2(2) = c_2(2) + \underbrace{(q(1) b_2'(1) + q(2) b_2'(2))}_{\text{Investment Portfolio}}$$ (11)

$$y'_2(s) + b'_2(s) = c'_2(s) + (q'(1) b'_2'(1) + q'(2) b'_2'(2))$$ (12)
• Jon’s problem. Maximize expected utility subject to his budget constraints.

  - Let’s assume today was state \( s = 2 \). Form the Lagrangian,

\[
L = \ln (c_1 (2)) + \left[ \frac{1}{2} \ln (c_1' (1)) + \frac{1}{2} \ln (c_1' (2)) \right] \\
+ \lambda_1 (y_1 (2) + b_1 (2) - c_1 (2) - [q (1) b_1' (1) + q (2) b_2' (2)]) \\
+ \frac{1}{2} \lambda_1' (y_1' (1) + b_1' (1) - c_1' (1) - [q' (1) b_1'' (1) + q_2' (2) b_2'' (2)]) \\
+ \frac{1}{2} \lambda_1' (y_1' (2) + b_1' (2) - c_1' (2) - [q' (1) b_1'' (1) + q_2' (2) b_2'' (2)])
\]

  - Choices to make today: \( c_1 (2), b_1' (1), b_1' (2) \).

  - First-order conditions

\[
c_1 (2) : \quad \frac{1}{c_1 (2)} - \lambda_1 = 0 \\
b_1 (1) : \quad q (1) \lambda_1 - \frac{1}{2} \lambda_1' (1) = 0 \\
b_1 (2) : \quad q (2) \lambda_1 - \frac{1}{2} \lambda_1' (2) = 0
\]

  - Eliminate the multipliers

\[
q (1) = \frac{1}{2} \frac{c_1 (2)}{c_1' (1)} \quad (13) \\
q (2) = \frac{1}{2} \frac{c_1 (2)}{c_1' (2)} \quad (14)
\]

  - Now do the same for Jon. From Jon’s problem, we get

\[
q (1) = \frac{1}{2} \frac{c_2 (2)}{c_2' (1)} \quad (15) \\
q (2) = \frac{1}{2} \frac{c_2 (2)}{c_2' (2)} \quad (16)
\]

  - The law-of-one price gives

\[
\frac{c_1 (2)}{c_1' (s)} = \frac{c_2 (2)}{c_2' (s)} \quad (17)
\]

5
for any state \( s = 1, 2 \) in the future. If today was state 1, replace the 2 with a 1 in (17). So regardless of what state of nature we are in today, the growth rate in consumption will be equalized. A solution to (17) is to set consumption equal across individuals in every state of nature,

\[
c_1(s) = c_2(s)
\]

- The complete markets equilibrium replicates the planner’s solution

**Paper by Curtis and Mark**

- **Question**: How did characteristics of the economy change between pre- and post-reform periods? (special attention paid to risk-sharing).

- **Data**: provincial-level, and on per capita terms

- **Quality**: Do we trust these data? Probably poor quality, but what can you do? This is what we have.

1. **Question**: How does per capita consumption growth rate vary across subperiods.
   (a) Plotted in Figure 1
      i. Growth is much higher in post-reform period
      ii. Implies that saving is higher in post-reform period. Why?

2. How has volatility of consumption growth changed? (Think of as informal measure of riskiness of economic life).
   (a) See figure 2
      i. General reduction in consumption volatility.
      ii. Not sure how it would look if Great Famine were eliminated from computations.

3. How has GDP growth changed?
   (a) Plotted in Figure 3
      i. GDP growth clearly much higher in post reform period.
4. What about GDP volatility?
   (a) Plotted in Figure 4.
      i. Volatility of GDP growth has declined.
      ii. In post-reform period, is about the same volatility as in the U.S. before the Great Moderation.
   (b) Correlation between provincial and aggregate GDP growth. Single macro factor would cause correlation to be high. Preponderance of idiosyncratic factors would cause correlation to be low.
   (c) See Figure 5: Correlation is higher in pre-reform period. (explanation?)
   (d) Skip figure 6 which is for the U.S.

5. Figure 7: Correlation between provincial and aggregate consumption growth. Good, extensive risk sharing would imply high correlations.
   (a) Correlations are generally pretty low in the first place.
   (b) Correlations decline in 15 of 24 provinces.


- Correlations computed above are statistics, which are subject to sampling error. Even though correlation between province consumption growth and aggregate consumption growth is less than 1, we don’t know if it is significantly less than 1.
- Let’s be scientific about this. Devise and implement a test of perfect risk-sharing.
- **Strategy**: Formulate a null hypothesis (perfect risk sharing). Test the hypothesis.
  - **Null** hypothesis: Provincial level and aggregate level consumption growth are perfectly correlated.
  - **Alternative** hypothesis: There is no risk sharing, and each province is a permanent income consumer.
• Let $\Delta c_{j,t}$ consumption growth in province $j$. (The change in log per capita consumption). $\Delta C_t$ is aggregate consumption growth. $y^p_{j,t}$ is a measure of permanent income. (Skipping the details of construction). Nest the two hypotheses in a regression.

$$\Delta c_{j,t} = \alpha_j + \lambda_j \Delta C_t + (1 - \lambda_j) \Delta y^p_{j,t} + \epsilon_{j,t}$$

- Null hypothesis: $\lambda_j = 1$ (perfect risk sharing)
- Alternative hypothesis $0 \leq \lambda_j \leq 1$ (imperfect risk sharing).
- Alternative hypothesis: $0 = \lambda_j$ (no risk sharing).

• Compute 95 percent confidence interval for $\lambda_j$. Ask if it includes 1 or 0.

• Results in Table 6. I,II, and III refer to different ways of measuring permanent income. Let’s just look at I:

• Cannot reject perfect risk sharing for more provinces in post reform period than pre-reform period.

• Cannot reject no risk sharing for more provinces in pre-reform period than in post-reform period.

• Conclude that risk-sharing (while far from perfect) improved in the post-Mao period.
The Real Business Cycle Model

- The basis for all modern macroeconomic research
- Based on the social planner’s problem. Exploit the equivalence between the competitive equilibrium and the social optimum. Solutions are easier to obtain
- Curtis and Mark evaluate performance of the basic RBC model for China and compare it to Canada
- A stripped down, two-period version of the model.
  - There’s no government sector.
  - Representative consumer
- Utility
  \[ u(c, h) = \ln(c) - \frac{h^{1+\chi}}{1 + \chi} \]
  $1/\chi$ is the elasticity of labor supply.

Technology, capital dynamics, and budget constraint

\[ y = a k^\alpha h^{1-\alpha} \quad (19) \]
\[ k' = (1 - \delta) k + i \quad (20) \]
\[ c + i = y \quad (21) \]

Problem
\[ \max u(c, h) + \beta E(u(c', h')) \]
subject to \((19)-(21)\), with $k$ and $a$ given.

Lagrangian,
\[
\ln(c) - \frac{h^{1+\chi}}{1 + \chi} + \lambda \left( a k^\alpha h^{1-\alpha} - c - k' + (1 - \delta) k \right) + \beta E \left\{ \ln(c') - \frac{h'^{1+\chi}}{1 + \chi} + \lambda' \left( a' k'^\alpha h'^{1-\alpha} - c' - k'' + (1 - \delta) k' \right) \right\}
\]
• First-order conditions

\[ c : \frac{1}{c} - \lambda = 0 \]
\[ h : h^\chi - \lambda (1 - \alpha) \frac{y}{h} = 0 \]
\[ k' : \lambda - \alpha E \left( \frac{y}{k} \right) = 0 \]

• Eliminate the multipliers

\[ h^\chi = \frac{1}{c} (1 - \alpha) \frac{y}{h} \]
\[ 1 = \beta \alpha E \left( \frac{c}{c'} \right) \frac{y'}{k'} \]

marginal benefit

• Solutions:
  – Given \( k, a \), choose \( h \to y \). Choose \( k' \to i, c \).
  – Next period, observe \( k', a' \to repeat \).

• In Curtis and Mark, they add
  – Adjustment costs of investment
  – A wasteful government sector

• Calibration: Setting parameters, informed by other studies that match various features of the data. Parameters such as \( \beta, \chi, \alpha, \delta \).

• Simulation: Simulate the model, obtain computer generated observations. Ask how similar they are to the actual economy.

• They did not report, but found to be useful, that \( \frac{i}{y}, \frac{s}{y} \) in the model are too low. The model has trouble explaining consumption, saving, and investment.