International Macroeconomic Comovement

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Outline

- Business Cycle Fluctuations
- Trade and Macroeconomic Comovement
- What is the Cost of Business Cycles?
- Major Recessions
Business Cycle Fluctuations
Motivation

Business Cycle: The period of expansions and contractions in the level of economic activity around its long-run growth trend.

Open Economy Macroeconomics
Development of a workhorse model that can serve as a laboratory for policy analysis.

- What are the features of the model that make it successful with the data?
- Extending predictions related to the closed economy macro models.
Measurement

Focus on high frequency movements

- Low frequency (long-run) versus high frequency (short-run)
- Construct cycle component that corresponds to high frequency movements of economic variables (GDP, consumption, investment, employment etc)
  - Linear detrending or Hodrick-Prescott (HP) filter
  - De-trended data: Actual data minus trend component
Example of Linear De-Trending
Trend of GNP with an HP filter

Fig. 1.—Example of a U.S. time series detrended with the Hodrick-Prescott filter.
Macroeconomic Comovement


- logged and HP filtered data

Main macroeconomic variables are positively correlated.

| (C) Cross country correlations and international relative price volatility |
|-----------------------------|-----------------------------|
| correlation between         | % std. dev.                 |
| Economy                     | \( y_1, y_2 \) | \( c_1, c_2 \) | \( x_1, x_2 \) | \( n_1, n_2 \) | \( p \) | \( r_x \) |
| Data                        | 0.58 | 0.36 | 0.30 | 0.42 | 2.99 | 3.73 |

- GDPs more correlated than consumption.
- Investments \((x)\); relatively low correlation.
Trade and Macroeconomic Comovement
Trade & International Business Cycles: Cross-Sectional Evidence

- Is trade the main link?... GDP correlation is linked to trade.

Figure: Kose and Yi (2006). Trade and International Business Cycles Correlation

Fig. 1. GDP correlation and trade intensity.
Relationship Between Trade and Comovement

Kose & Yi (J of International Econ, 2006, “Can the standard international business cycle model explain the relation between trade & comovement?”)

- Authors look how GDP correlation is changing with trade

\[ GDP\ Corr_{ij} = \beta_0 + \beta_1 \ln(Trade_{ij}) + \varepsilon_{ij} \]

where \( i, j \) are different trade partners (e.g., \( i = USA, j = FRA \) etc)
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- Coefficient \( \beta_1 \approx .08 \). Thus, doubling trade increases correlation of GDP by \( .08 \times \ln (2) = .055 \) higher GDP correlation among the country pair

- Relationship first uncovered by Frankel and Rose (1998, Economic Journal, “The endogeneity of the optimum currency area criteria”)

Output fluctuations: Evidence from the US-Mexico trade Agreement

US-Mexico output fluctuations seem to be more correlated after the North American Free Trade Agreement. NAFTA went into effect on Jan 1st, 1994.

Figure: De-trended (HP filtered) US GDP vs Mexico GDP (blue: USA, red: Mexico) 1970-1993. Own calculations
US-Mexico output fluctuations

US-Mexico output fluctuations seem to be more correlated after NAFTA.

Figure: De-trended (HP filtered) US GDP vs Mexico GDP (blue: USA, red: Mexico) 1994-2002. Own calculations.
Trade-Comovement and Business Cycle Theories

Standard Business Cycle Theory has a problem accounting for the increased correlation due to increased trade.

- Kose & Yi, 2006
  - Propagation of shocks through trade is very weak.
  - Is it something else? (e.g., the financial system etc)
Conclusion: Trade and Business Cycles

Trade integration implies BC-comovement of countries.

- Is this good or bad?
- It is an important question given globalization, economic integration of European Union etc.
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Positives

- Gains from increased specialization and trade.
- Economic upturn of one country propagates to others.
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Positives

- Gains from increased specialization and trade.
- Economic upturn of one country propagates to others.

Negatives

- Harder to achieve risk sharing.
- Crisis of one country propagates to others.
What is the Cost of Business Cycles?
Lucas 2003: Macroeconomic Priorities

- What is the cost of Business Cycle Fluctuations?

  - Depends on a variety of factors: intensity of fluctuations, risk aversity, other preference parameters etc.
Lucas 2003: Macroeconomic Priorities

- What is the cost of Business Cycle Fluctuations?
  - Depends on a variety of factors: intensity of fluctuations, risk aversity, other preference parameters etc.

- How do we measure this magnitude?
  - Question: What is the effect on welfare if all consumption variability could be eliminated?
    - Consumer would prefer to minimize consumption fluctuation because she is risk averse.
  - Answer: Need to find what is the percent increase in his uncertain consumption in order to be indifferent with a deterministic outcome.
Utility Function and Risk Aversion

- What is the gain from eliminating Business Cycle Fluctuations?

  - Consider a representative consumer and the welfare gain from eliminating uncertainty in \( t \) years from now. Utility function:

    \[
    U_t = \beta^t \frac{c_t^{1-\gamma}}{1-\gamma}
    \]

  \( \beta \): discount factor, \( \gamma \): coefficient of risk aversion. The higher \( \gamma \), the more averse you are to fluctuations in your consumption. If \( \gamma = 0 \), timing is not important.
Expected Utility

- What is the gain from eliminating Business Cycle Fluctuations?

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  - Example: two states of the world, $s_1$ and $s_2$, with probabilities $\pi(s_1)$ and $\pi(s_2)$ where $\pi(s_1) + \pi(s_2) = 1$. Expected utility:

  \[ EU_t = \beta^t \pi(s_1) \frac{c_t(s_1)^{1-\gamma}}{1-\gamma} + \beta^t \pi(s_2) \frac{c_t(s_2)^{1-\gamma}}{1-\gamma} \]

  where $c_t(s_1) \neq c_t(s_2)$: consumption in the two states of the world.
Risk Aversion

- We will proceed below ignoring the discount factor (does not affect results)

- The utility function we consider has constant relative risk aversion
  - To see this, notice that relative risk aversion is given by

\[
R(c) = - \frac{c \times U''(c)}{U'(c)}
\]

\[
= - \frac{c \times (-\gamma) c_t^{-\gamma - 1}}{c_t^{-\gamma}}
\]

\[
= \gamma
\]
Risk Aversion: An Example

- Individuals are risk averse as long as $\gamma > 0$. This means that they prefer the safe consumption than the risky one.

  - Formally

    \[
    EU(C) < U(EC)
    \]

    which is true as long as $U$ is concave $\implies \gamma > 0$.

  - Example: Consider two states $c(s_1) = 1$, $c(s_2) = 2$ with $\pi(s_1) = \pi(s_2) = 0.5$ and $\gamma = 0.5$. Then

    \[
    0.5 \times \frac{1^{0.5}}{0.5} + 0.5 \times \frac{2^{0.5}}{0.5} < \frac{(0.5 \times 1 + 0.5 \times 2)^{0.5}}{0.5} \implies
    \]

    \[
    0.5 \times 1 + 0.5 \times 2^{0.5} < (0.5 \times 1 + 0.5 \times 2)^{0.5}
    \]
Lucas 2003: Calculating the Gain

- What is the gain from eliminating Business Cycle Fluctuations?
  
  - Consider a representative consumer and the welfare gain from eliminating uncertainty.
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- What is the gain from eliminating Business Cycle Fluctuations?

  • Consider a representative consumer and the welfare gain from eliminating uncertainty.

  • Simple calculations under a standard model would give that the welfare gain is \( \sim \frac{1}{2} \gamma \sigma^2 \)
    
    • Consider an individual that faces income uncertainty: \( c_t = \bar{c} \varepsilon_t \), where \( \varepsilon_t \) is random
- What is the gain from eliminating Business Cycle Fluctuations?

- Consider a representative consumer and the welfare gain from eliminating uncertainty.

- Simple calculations under a standard model would give that the welfare gain is $\simeq \frac{1}{2} \gamma \sigma^2$
  - Consider an individual that faces income uncertainty: $c_t = \bar{c} \epsilon_t$, where $\epsilon_t$ is random
  - Imagine that we could provide him with certainty $\tilde{c}_t = E (\bar{c} \epsilon_t)$. What is the utility difference (say $\lambda$) that the consumer would experience?
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- What is the gain from eliminating Business Cycle Fluctuations?
  
  • Consider a representative consumer and the welfare gain from eliminating uncertainty.
  
  • Simple calculations under a standard model would give that the welfare gain is $\simeq \frac{1}{2} \gamma \sigma^2$
    
    • Consider an individual that faces income uncertainty: $c_t = \bar{c}\varepsilon_t$, where $\varepsilon_t$ is random
    
    • Imagine that we could provide him with certainty $\tilde{c}_t = E(\bar{c}\varepsilon_t)$. What is the utility difference (say $\lambda$) that the consumer would experience?
    
    • This $\lambda$ is the gain from eliminating business fluctuations.
Lucas 2003: Calculating the Gain

- What is the gain from eliminating Business Cycle Fluctuations?
Find $\lambda$ such that

$$\frac{[\bar{c}_t]^{1-\gamma}}{1-\gamma} = \frac{E\left[(1 + \lambda) c_t\right]^{1-\gamma}}{1-\gamma} \quad \implies$$

where $\bar{c}\varepsilon_t$ is consumption with $\bar{c}$ a certain component and $\varepsilon_t$ a stochastic component.
Lucas 2003: Calculating the Gain

- What is the gain from eliminating Business Cycle Fluctuations?
Find $\lambda$ such that

\[
\frac{E (\bar{c}\epsilon_t)^{1-\gamma}}{1-\gamma} = E \frac{((1 + \lambda) \bar{c}\epsilon_t)^{1-\gamma}}{1-\gamma} \implies
\]
utility under certainty

\[
\frac{\bar{c}E\epsilon_t}{1-\gamma} = (1 + \lambda)^{1-\gamma} E \frac{\bar{c}\epsilon_t}{1-\gamma} \implies
\]

\[
1 + \lambda = \frac{E\epsilon_t}{\left( (E [\epsilon_t]^{1-\gamma})^{1/(1-\gamma)} \right)^{1/(1-\gamma)}} \geq 1
\]

where the last inequality follows from concavity (related to what we argued above for the utility)
Lucas 2003: The Numbers

- What is the gain from eliminating Business Cycle Fluctuations?
  
  • Simple calculations (log normal distribution) imply $\lambda \simeq \frac{1}{2} \gamma \sigma^2$
  
  **Putting numbers:**
  
  • $\sigma$: In the US data 1947-2001 standard deviation of log consumption is 0.032.
  • $\gamma$: Macroeconomics and finance literature uses 1 to 4.
Lucas 2003: The Numbers

- What is the gain from eliminating Business Cycle Fluctuations?

  • Simple calculations (log normal distribution) imply \( \lambda \approx \frac{1}{2} \gamma \sigma^2 \)

Putting numbers:

  • \( \sigma \): In the US data 1947-2001 standard deviation of log consumption is 0.032.
  • \( \gamma \): Macroeconomics and finance literature uses 1 to 4.

• Using these numbers:

Gains from Eliminating Business Cycles

\[ \approx \frac{1}{2} \gamma \sigma^2 = \frac{1}{2} \times 4 \times (0.032)^2 = 0.205\% \text{ of consumption} \]

• Is this number too small?
Lucas 2003: The Numbers

- Gain $< \frac{1}{2} \gamma \sigma^2 = \frac{1}{2} \times 4 \times (0.032)^2 = 0.205\%$ of consumption

- Is this number too small?
  Extremely small!

  - Research has argued that gains from eliminating 10% inflation about 10 times higher
  - Gains from higher capital accumulation $\geq 2\%$.
  - Gains from Trade (Arkolakis, Costinot, Rodriguez-Clare 2012) for the US: 0.7%-1.4%.
  - Each of these calculations gives a number almost an order of magnitude larger than the gains from eliminating high frequency fluctuations.
Large Recessions
So Why do we Care about Fluctuations so Much?

Answer: mostly care about large fluctuations of output. Major recessions could reduce GDP growth & propagate major shocks across countries.

Figure: real GDP growth (source World Development Indicators)
So Why do we Care about Fluctuations so Much?

World is becoming increasingly integrated.

- Tighter trade links across countries make contagion more likely.

Figure: Post War US Trade to GDP (source: Levchenko, Lewis, Tesar ’10)
What is the Welfare Cost of a Large Recession?

Similar to what we did before, we can reformulate the question as: “What fraction of annual consumption would a worker be willing to pay to set the current probability of encountering a Depression-like event to zero?”

- Turns out that large recessions are extremely rare events for developed countries (about once or twice every century).
What is the Welfare Cost of a Large Recession?

Chatterjee & Corbae, 2007 (Journal of Monetary Economics), compute the welfare costs of the great depression.

- Depends on the ability of smoothing consumption
  - If markets are complete, welfare loss is about 1%.
  - But with incomplete markets (recall: research on International Financial Markets), welfare loss might increase to almost 7%.