Lecture 4

Extensions to the Open Economy

and

Emerging Market Crises

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Objectives

- Develop micro-founded open-economy quantitative macro model with real/financial interactions
- Application to modeling emerging market crises
- Implications for fixed versus flexible exchanges.
- Illustrate the general relevance of monetary policy for financial propagation mechanisms.
Approach (Based on Gertler, Gilchrist Natalucci, 2007)

- Develop small open economy variant of the financial accelerator model of Bernanke, Gertler and Gilchrist (1999).

- Use the framework to model the 1997-98 Korean crisis

- Study the performance of alternative monetary policy regimes
Background Motivation

"Each of the major international capital market-related crises since 1994 - Mexico, in 1994, Thailand, Indonesia and Korea in 1997, Russia and Brazil in 1998, and Argentina and Turkey in 2000 - has in some way involved a fixed or pegged exchange rate regime."

“Exchange Rate Regimes: Is the Bipolar View Correct?”

Background Motivation

• Recent crises (Kaminsky and Reinhart (1999))
  – Link between financial crises and currency crises:
  – Fixed exchange rate regime (often) forces interest rates to adjust in a manner that amplifies the crisis.

• Features of historical crises (Eichengreen (1992)):
  During the Great Depression, countries that did not abandon the gold standard early suffered:
  – More severe economic downturns.
  – More severe financial crises.
1997-1998 Korean crisis: Summary

Onset:

- Fixed exchange rate regime prior to crisis
- 5% rise in country risk premium.
- Monetary policy initially defended fixed rate, producing a sharp rise in the call money rate
1997-1998 Korean crisis (con’t)

Effect on real side of the economy:

• Sharp drop in real GDP (-14%).

• Collapse in investment spending (-45%).

• Fall in labor productivity (-5%).
1997-1998 Korean crisis (con’t)

Effect on financial markets:

- Collapse in stock market (-50%).
- Sharp rise in corporate bond spreads (9%).
- Currency depreciation (-70%).
* Series are shown on a log scale and are detrended.
Figure 1B
Korean Data

EMBI Global Korea

Corporate Credit Spread*

Overnight Call Rate

CPI Inflation**

Korean Won to US Dollar

Stock Prices (KOSPI)

* The line depicts the difference in yields between a 3-year corporate bond and the Treasury security of corresponding maturity.

** CPI inflation is year-over-year growth.
* Series are shown on a log scale and are detrended.
Model Description:

- DSGE small open economy framework.
- A variant of Gali/Monacelli with
  - Capital;
  - Financial accelerator à la BGG (1999);
  - Variable capital utilization to capture TFP movements.
Sectors within the home country:

- Households

- Business sector:
  - Entrepreneurs (wholesale goods)
  - Capital producers
  - Retailers (final goods)

- Foreign sector

- Central bank
Domestic and foreign goods:

Consumption is composite of domestic and foreign tradables:

\[
C_t = \left[ \left( \gamma \right)^{\frac{1}{\rho}} \left( C_{H,t} \right)^{\frac{\rho-1}{\rho}} + \left( 1 - \gamma \right)^{\frac{1}{\rho}} \left( C_{F,t} \right)^{\frac{\rho-1}{\rho}} \right]^{\frac{1}{\rho-1}}
\]

Price indexes

\[
P_t = \left[ \left( \gamma \right) \left( P_{H,t} \right)^{1-\rho} + \left( 1 - \gamma \right) \left( P_{F,t} \right)^{1-\rho} \right]^{\frac{1}{1-\rho}}
\]
Household’s preferences:

\[ E_0 \sum_{t=0}^{\infty} \beta^t U\left( \frac{(C_t)^{1-\phi} (1 - L_t)^{\phi}}{1 - \sigma} \right)^{1-\sigma} \]
Household’s budget constraint

\[ P_tC_t + S_tB^*_{t+1} + B_{t+1} = \]

\[ W_tL_t + S_t\Psi_{t-1}(1 + i^*_{t-1})B^*_t + (1 + i_{t-1})B_t + \Pi_t - T_t \]

with

\[ \Psi_t > 1 \text{ if } B^*_t < 0 \]

\[ = 1 \text{ if } B^*_t \geq 0 \]
Household optimality conditions

Consumption/saving:

\[ \lambda_t = \beta E_t \left\{ \lambda_{t+1}(1 + i_t) \frac{P_t}{P_{t+1}} \right\} \]

\[ \lambda_t = (1 - \phi) (C_t)^{(\sigma-1)(\phi-1)-1} (1 - L_t)^{\phi(1-\sigma)} \]

Uncovered interest parity condition:

\[ E_t \left\{ \lambda_{t+1} \frac{P_t}{P_{t+1}} \left[ (1 + i_t) - \Psi_t (1 + i^*_t) \frac{S_{t+1}}{S_t} \right] \right\} = 0 \]
Household optimality conditions (con’t)

Intra-temporal consumption allocation:

\[
\frac{C_{H,t}}{C_{F,t}} = \frac{\gamma}{1 - \gamma} \left( \frac{P_{F,t}}{P_{H,t}} \right)^{\rho_h}
\]

Labor supply:

\[
(1 - \phi) \frac{1}{C_t} \frac{W_t}{P_t u} = \phi \frac{1}{1 - L_t}
\]
Foreign sector

• Baseline
  – For $J = H, F$: Law of one price:
    \[ P_{J,t} = S_t P_{J,t}^* \]
  – Foreign demand for domestic tradables:
    \[ C_{H,t}^* = \left( \frac{P_{H,t}^*}{P_t^*} \right)^{-\xi} C_t^* \]
  – $(1 + i_t^*)$, $P_{F,t}^*$, $P_t^*$, $C_t^*$ are exogenous.

• We also consider local currency pricing with imperfect pass through and slow adjustment in foreign demand
Entrepreneurs

- Produce wholesale goods using labor and capital services

\[ Y_t = \zeta_t A_t (u_t K_t)^\alpha (L_t)^{1-\alpha} \]

- Borrow to obtain capital: Face credit market frictions

- Risk neutral agents with finite expected horizon face
  - \( \gamma \) survival probability \( \rightarrow \frac{1}{1-\gamma} \) expected life time.
Variable Input Demands

Labor demand:

\[
\frac{P_{W,t}}{P_{H,t}} (1 - \alpha) \frac{Y_t}{L_t} = \frac{W_t}{P_{H,t}}
\]

Optimal capital utilization:

\[
\frac{P_{W,t}}{P_{H,t}} \alpha \frac{Y_t}{u_t} = \delta (u_t)' K_t \frac{P_t}{P_{H,t}}
\]
Expected Return to Capital

\[ E_t \{ R_{kt+1} \} = \]

\[ E_t \left\{ \frac{P_{Wt+1}}{P_{t+1}} \alpha \frac{Y_{t+1}}{K_{t+1}} + \left[ \frac{Q_{t+1}}{P_{t+1}} - \delta (u_{t+1}) \right] \right\} \frac{Q_t}{P_t} \]
Capital Demand

If debt is in units of domestic currency.

\[ E_t \{ R_{kt+1} \} = (1 + \chi_t(\cdot)) E_t \left\{ (1 + i_t) \frac{P_t}{P_{t+1}} \right\} \]

with

\[ \chi_t(\cdot) = \chi \left( \frac{Q_t K_{t+1}}{N_t} \right) \]

\[ \chi'(\cdot) > 0, \quad \chi(0) = 0, \quad \chi(\infty) = \infty \]
Capital Demand (con’t)

If debt is in units of foreign currency

\[ E_t \{ R_{kt+1} \} = (1 + \chi_t(\cdot)) E_t \left\{ \psi_t (1 + i^*_t) \frac{S_{t+1}}{S_t} \frac{P_t}{P_{t+1}} \right\} \]
Evolution of net worth (with debt in local currency)

\[ N_{t+1} = \gamma V_t + (1 - \gamma) D \]

\[ V_t = (1 - m_t) R_{kt} \frac{Q_{t-1}}{P_{t-1}} K_t - \left[ (1 + i_{t-1}) \frac{P_{t-1}}{P_t} \right] \frac{B_t}{P_{t-1}} \]

with

\[ R_{kt} = \left( \frac{P^W_t}{P_t} \alpha \frac{Y_t}{K_t} + \left[ \frac{Q_t}{P_t} (1 - \delta (u_t)) \right] / Q_{t-1} \right) \]
Evolution of net worth (with foreign denominated debt)

Entrepreneurial net worth

\[ V_t = R_{kt} \frac{Q_{t-1}}{P_{t-1}} K_t - \]
\[ \left[ (1 + \chi(\cdot)) \Psi_{t-1} (1 + \dot{i}_{t-1}^*) \frac{S_t}{S_{t-1}} \frac{P_{t-1}}{P_t} \right] \frac{S_{t-1} B_{t-1}^*}{P_{t-1}} \]

An unanticipated depreciation (increase in \( S_t \)) reduces net worth,
Capital producers (competitors)

- New capital:

\[ \Phi \left( \frac{I_t}{K_t} \right) K_t \]

with \( \Phi' > 0, \Phi'' < 0 \).

- Capital Accumulation

\[ K_t = \Phi \left( \frac{I_t}{K_t} \right) K_t + (1 - \delta(u_t))K_t \]

Tobin’s Q

\[
\frac{Q_t}{P_{t+1}^H} - \left[ \Phi' \frac{I}{K} \left( \frac{I_t}{K_t} \right)^{-1} \right] = 0
\]
Retailers (monopolistic competitors)

- Buy wholesale output and sell as differentiated final product.
- Set prices on a staggered basis (a la Calvo (1983)).
- Domestic inflation:
  \[
  \frac{P_t^H}{P_{t-1}^H} = \left( \mu \frac{P_t^W}{P_t^H} \right) ^{\lambda} E_t \left\{ \frac{P_{t+1}^H}{P_t^H} \right\}
  \]
- CPI inflation:
  \[
  \frac{P_t}{P_{t-1}} = \left( \frac{P_t^H}{P_{t-1}^H} \right)^{\gamma} \left( \frac{S_t}{S_{t-1}} \right)^{1-\gamma}
  \]
Monetary policy

- Fixed exchange rate regime:

\[ S_t = S_{t-1}, \forall t \]
\[ \implies i_t = \Psi_t i_t^* \]

- Flexible exchange rate regime: Open economy version of the Taylor rule.

\[
(1 + i_t) = \left[ (1 + r^{ss}) \left( \frac{P_c^t}{P_{c,t-1}} \right)^{\gamma_{\pi^c}} \right]^{1-\tau} (1 + i_{t-1})^\tau
\]

with \( \gamma_{\pi^c} > 1 \) and \( 0 \leq \tau < 1 \).

- Switching regime. Begin in fixed, abandon with fixed probability \( \Pi \).
Parametrization

• Quantitative analysis meant to be suggestive – Korean data when possible.

• Capital markets less developed relative to U.S.:
  – SS external finance premium roughly 150 basis points higher than U.S. data
  – Debt-equity ratio is 50% higher than historical U.S. data

• Exports share of domestic output set at 40%

• Capital share is 50 percent
The Korean experiment

- 5% shock to country-risk premium. $\rho = 0.95$.

- Alternative monetary policies to consider:
  - Fixed exchange rates.
  - Initially fixed exchange rates, but abandoned probabilistically.
    * Low abandonment probability $\Pi = 0.1$. See Krueger et al. (2001).

- Switching exchange rate regime:
  - abandon earlier than expected (one quarter)
  - economy experiences ”good news” and asset prices rise.
Figure 2A
Korean Crisis Experiment

Output

Investment

Flexible Exchange Rate
Regime Switch
Fixed Exchange Rate

Capital Utilization Rate

Labor Productivity

Household Consumption

Net Exports

Figure 2B

Korean Crisis Experiment

- Nominal Interest Rate
- Real Interest Rate
- CPI Inflation
- External Finance Premium
- Nominal Exchange Rate
- Real Exchange Rate

Figure 3
The Amplification Effect of the Financial Accelerator
Regime Switch Experiment

Note. Model’s response to a Country Risk Premium Shock. The case without the financial accelerator mechanism corresponds to $\chi_t = 0$ for all $t.$
Figure 4

The Role of Utilization Margins
Regime Switch Experiment

Output

Labor Productivity

Note. Model's response to a Country Risk Premium Shock. In the case without variable capacity utilization, $\mu_1 = 1$ for all $t$ and $k$ is equal to zero.
Figure 5

The Role of Frictions in the International Sector
Regime Switch Experiment

Real Exchange Rate

Net Exports

Note. Model’s response to a Country Risk Premium Shock. In the case without frictions, we eliminated trading frictions owing to inertia in foreign demand (i.e., $\nu = 1$) and nominal rigidities for foreign goods at the retail level.
Figure 6

Foreign Denominated Debt

Output

Investment

Conclusions

- Exercise does well at matching key features of Korean crisis.
  - Matches real side reductions in spending and rise in external finance premia.
  - Endogenous financial collapse through financial accelerator accounts for over 50% of output movement.
  - Model implies endogenous fall in labor productivity – warning against arguing that productivity is driving force in crisis.
• Policy implications:

  – Ex post abandonment nearly as bad as remaining on fixed exchange rate following crisis – not a good substitute for ex ante flexible rates.

  – Flexible rates desirable even with dollar denominated debt owing to debt overhang and need to finance existing capital stock.

• Main Caveat

  We ignore possible credibility value of fixed exchange rates.