Models of Currency Crisis

Why do fixed exchange rate regimes collapse?
First generation models

- They identify in government budget deficits the main source of currency crisis
- Government deficits make the commitment to maintain fixed exchange rate not credible
  1. Fiscal deficit is financed issuing money
  2. Inflation arises
  3. Real exchange rate appreciates
  4. A current account deficit appears
  5. Foreign exchange reserves decrease
  6. The fixed exchange rate cannot be maintained
First generation models

- A formal model with perfect forecast (Krugman)

\[ m_t - p_t = \hat{y} - ki_t \]

Domestic money supply is a weighted average of domestic credit \( b \) and foreign exchange reserves \( ru \)

\[ m_t = \gamma b^d_t + (1 - \gamma)ru_t \quad 0 < \gamma < 1 \]

Setting \( P^* = 1 \) PPP equation in logarithmic form becomes \( p_t = s_t \)

\[ i_t = i_t^* + \dot{s} \quad \text{(UIP condition)} \]

\[ \dot{b}^d = \mu \quad \text{(Rate of growth of domestic credit)} \]
Central Bank finances government debt purchasing treasury bonds

If we define $\delta = \hat{y} - k\hat{i}^*$ from UIP $i_t = i_t^* + \hat{s}$

$$\delta = \hat{y} - k(i - \hat{s})$$

$$\delta = \hat{y} - ki + k\hat{s}$$

$$m_t - s_t = \delta - k\hat{s} \quad [p = s]$$
First generation models

- Central Bank has a commitment to defend a fixed exchange rate that conflicts with the need to finance government deficit

- In a fixed exchange rate regime \( s_t = \bar{s} \) \( \dot{s} = 0 \)

Equation \( m_t - s_t = \delta - k\dot{s} \) \( [p = s] \) Becomes \( m_t - \bar{s}_t = \delta \)

Using \( m_t = \gamma b_t^d + (1 - \gamma)ru_t \) \( m_t - \bar{s}_t = \delta \) becomes

\[
\gamma b_t^d + (1 - \gamma)ru_t = \bar{s} + \delta
\]

\[
(1 - \gamma)ru_t = \bar{s} + \delta - \gamma b_t^d
\]

therefore \( ru_t = \frac{\bar{s} + \delta - \gamma b_t^d}{(1 - \gamma)} \)
First generation models

According to  

\[ ru_t = \frac{s + \delta - \gamma b_t^d}{(1 - \gamma)} \]

Foreign exchange reserves depends on official exchange rate and domestic credit

Defining  \( \Theta = \frac{1 - \gamma}{\gamma} \)  

the change of official reserves is

\[ \frac{dru_t}{dt} = -\frac{\gamma}{1 - \gamma} db_t^d \]

\[ r\dot{u} = \frac{dru}{dt} = -\Theta \frac{db^d}{dt} = -\Theta \mu \]

Foreign exchange reserves decrease at a rate that depends on the monetary financing of government deficit
First generation models

- The timing of currency crisis
  - If government deficit is continuous, foreign exchange reserve stock eventually fully depletes
  - Fixed exchange rate cannot be maintained once reserves vanish \((ru = 0)\)
  - When \(ru = 0\) Central Bank announces that the fixed exchange rate will be abandoned
  - Rational agents anticipate that event and a speculative attack arises \(before ru = 0\) is reached
  - As a consequence, exchange rate is allowed to freely float before Central Bank announces it
First generation models

- The timing of currency crisis
  - Speculators compare the fixed exchange rate with the exchange rate that would prevail if the exchange rate were free to float (*shadow exchange rate*)

  If \( \tilde{s} < s \)
  
  No speculation against domestic currency arises since the shadow exchange rate is *lower* than official parity (expected *appreciation*)

  if \( \tilde{s} > s \)
  
  Agents speculate against domestic currency

  Speculative attack arises when \( \tilde{s} = s \)

  The higher is the official reserve stock and the lower is domestic credit growth, the longer is the period of time before a currency crisis occurs.
Second generation models

- In first generation models, Government and Central Bank behaviour is not fully rational.

- In the 1990s currency crisis occurred even in the presence of good “economic fundamentals”.

- As a consequence new currency crisis model were developed.

- In 2° generation models the exit from a fixed exchange rate regime is the result of a strategic game between government and private agents.
Second generation models

- Government minimizes a loss function that incorporates agents expectations

\[ L = \left\{ \alpha (\hat{s} - s) + \beta (s^e - s) \right\}^2 + C(\Delta s) \]

\( C(\Delta s) \)  Is the loss of credibility from exiting the fixed exchange regime

\( (\hat{s} - s) \)  Is the cost of currency deviation from PPP long run equilibrium level

\( (s^e - s) \)  Is the cost of maintaining a fixed exchange rate when agents expect a depreciation

If exchange rate remains fixed, then \( C(\Delta s) = 0 \)
Second generation models

- Case 1: agents expect the fixed exchange rate regime to continue $s^e = \bar{s}$

  If government keep the exchange rate fixed, then $s = \bar{s} \rightarrow \Delta s = 0 \rightarrow C = 0$

  The cost of that policy is $L = \alpha (\hat{s} - \bar{s})^2$

  If domestic currency devaluates, government loss is

  $$L = \beta (\bar{s} - \hat{s})^2 + C(\Delta s)$$

  Government keeps the fixed exchange rate if

  $$\alpha (\hat{s} - \bar{s})^2 < \beta (\bar{s} - \hat{s})^2 + C(\Delta s) \text{ or } (\alpha^2 - \beta^2)(\hat{s} - \bar{s})^2 < C(\Delta s)$$
Second generation models

• Case 2: agents expect the fixed exchange rate regime to collapse: \( s^e = \hat{s} \)

If government keep the exchange rate fixed, then \( s = \bar{s} \rightarrow \Delta s = 0 \rightarrow C = 0 \)

\[
L = \left\{ \alpha(\hat{s} - \bar{s}) + \beta(\hat{s} - \bar{s}) \right\}^2
\]

The cost of that policy is

\[
L = \left\{ (\alpha + \beta)(\hat{s} - \bar{s}) \right\}^2
\]

Note that now the defence of exchange rate is more expensive since

\[
\left\{ \alpha(\hat{s} - \bar{s}) \right\}^2 < \left\{ \alpha(\hat{s} - \bar{s}) + \beta(\hat{s} - \bar{s}) \right\}^2
\]

If domestic currency devalues, government loss is \( L = C(\Delta s) \) since \( s = \hat{s} \)

Devaluation is convenient when \( \left\{ (\alpha + \beta)(\hat{s} - \bar{s}) \right\}^2 > C \)
Second generation models

- To devaluate or not?

- Define $F_1 = (\alpha^2 - \beta^2)(\hat{s} - \bar{s})^2$, $F_2 = [(\alpha + \beta)(\hat{s} - \bar{s})]^2$

Government compare the cost of credibility loss with the costs of maintaining the fixed exchange rate

Case 1: it is always convenient to devaluate if $C < F_1 < F_2$

Case 2: it is always convenient to keep the fixed exchange rate if $F_1 < F_2 < C$

Case 3: multiple equilibria are possible when $F_1 < C < F_2$

In case 3, the final outcome depends on self-fulfilling expectations:
- if agents expect devaluation, then it occurs
- if agents expect stability of exchange rate, then it occurs
Third Generation Models

- They were developed after the Asian crisis of 1997
- First and second generation models were not able to predict it
- Economic fundamental were sound
- Moral hazard was a major problem
- Asian countries received huge flow of foreign investment
- Foreign investors were “protected” by governments against default risks
- Asian commercial banks obtained large dollar loans
- Asian countries exchange rates were pegged to the dollar
Third Generation Models

- Three majors disequilibria arose:
  - An excess of risky investments because of moral hazard (government bail-out of foreign debt)
  - Mismatch between short term debt an long term investments (housing bubble)
  - Mismatch between dollar foreign debt and domestic money investments
- The crisis started in Thailand because of the default of one of the most important bank
- Contagion problem: the crisis very soon spread all over the region hitting Korea, Malesia, Indonesia...
Third Generation Models

- A formal model

\[ \frac{M_t^S}{P_t} = L(Y_t, i_t) \quad \text{(LM)} \]

\[ 1 + i_t = \left(1 + i^* \right) \frac{S_{t+1}}{S_t} \quad \text{(UIP)} \]

There are two periods: \( t = 1, 2 \). In period 2 PPP holds, \( i = i^* \), \( P^* = 1 \). Therefore

\[ S_2 = P_2 \]

\[ 1 + i_1 = \left(1 + i^* \right) \frac{S_2}{S_1} = \left(1 + i^* \right) \frac{P_2}{S_1} \rightarrow S_1 = \frac{1 + i^*}{1 + i_1} P_2 \]

And, using LM

\[ P_2 = \frac{M_2^S}{L(Y_2, i^*)} \rightarrow S_1 = \frac{1 + i^*}{1 + i_1} \frac{M_2^S}{L(Y_2, i^*)} \]
Third Generation Models

- Agents have a wealth $W$ and can borrow only a fraction of their wealth. They can also borrow from abroad.

- The maximum amount of investment is

$$\left(1 + \beta\right)W = \left(1 - \mu\right)\beta W + \mu S \beta W$$

$\beta$ is the fraction of wealth, $\mu$ is the share of foreign debt.

$$Y = \gamma \left(1 + \beta\right)W$$

Is the production function.
Third Generation Models

- Profits in period 1 are

\[ \Pi_1 = P_1 Y_1 - (1 + i_1)(1 - \mu)\beta W_1 - (1 + i^*)S_1 \mu \beta W_1 \]

Agents consume a share of their profits \( \alpha \)

Wealth in period 2 is

\[ W_2 = (1 - \alpha) \frac{\Pi_1}{P_1} \]

Output in period 2 is

\[ Y_2 = \gamma (1 + \beta) W_2 \]

\[ Y_2 = \gamma (1 + \beta)(1 - \alpha) \frac{\Pi_1}{P_1} \]

\[ Y_2 = \gamma (1 + \beta)(1 - \alpha) \left[ Y_1 - (1 + i_1)(1 - \mu)\beta \frac{W_1}{P_1} - (1 + i^*)S_1 \mu \beta \frac{W_1}{P_1} \right] \]
Third Generation Models

\[ Y_2 = \gamma (1 + \beta) (1 - \alpha) \left[ Y_1 - (1 + i_1) (1 - \mu) \beta \frac{W}{P_1} - (1 + i^*) S_1 \mu \beta \frac{W}{P_1} \right] \]

Output in period 2 is a decreasing function of period 1 exchange rate.

We may find equilibria drawing the above function together with

\[ S_1 = \frac{1 + i^*}{1 - i_1} \frac{M^S_2}{L(Y_2, i^*)} \]
Third Generation Models

\[ Y_2 = \gamma(1+\beta)(1-\alpha) \left[ Y_1 - (1+i_1)(1-\mu)\frac{W_1}{P_1} - (1+i^*) \right] \]

\[ S_1 = \frac{1+i^*}{1-i_1} \frac{M_2^S}{L(Y_2,i^*)} \]

A is a “bad” equilibrium
B is a “good” equilibrium