International Macroeconomics

Crisis: The big picture and the classical theory of currency crises

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Roadmap

1. Financial Crises: The big picture - Reinhart and Rogoff
2. "Generations of crisis models:
   2.1 The 80s: currency crises as bad policy
   2.2 The early 1990s: Policymakers, George Soros and multiple equilibria
   2.3 The late 1990s: Pangloss investments, rotten incentives and the asian crisis
I. Financial crises: The big picture

  • Long-run (800 years) data on default, external and domestic debt, inflation, exchange rates, trade, GDP, interest rates, commodity prices.
  • 66 countries
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*The importance of sovereign default: 1800-2006*
Percent of countries in sovereign default: 1800-2006

Sovereign External Debt: 1800-2006
Percent of Countries in Default or Restructuring
Financial Crisis: The big picture

- Sovereign default comes in waves, serial default is common
- “The current lull stands out [...] against the preceding century” (p.4)
The importance of external shocks: 1800-2006
Default and Commodity Prices 1800-1940

World commodity prices, deviation from trend, 3-year average
Number of new defaults, 3-year sum
Default and Commodity Prices 1940-2006

Number of new defaults
3-year sum (left axis)

World commodity prices,
deviation from trend
3-year average
(right axis)
Banking crises and capital mobility

Capital Mobility and the Incidence of Banking Crisis: All Countries, 1800-2007

Share of Countries in Banking Crisis, 3-year Sum (right scale)

Capital Mobility (left scale)
UK+US CA and Default pre-WWII

Net Capital Flows from the Financial Center and Default
1818-1968

UK and US Current account balance,
3-year sum as a percent of GDP
(right axis)

Number of new defaults
3-year sum
Financial Crisis: The big picture

- Sovereign default comes in waves, serial default is common
- “The current lull stands out [...] against the preceding century” (p.4)
- External developments are important
  - capital flow and commodity price booms predict default episodes
  - Shocks in financial center predict default
    - Great depression 1930s
    - 1980 US disinflation
    - 1825 financial crisis in London
    - 1873 stock market crash in Germany
Domestic Debt
Domestic Debt as a share of public debt

Domestic Public Debt as a Share of Total Debt,
1900-2006

of which North America

All countries

of which Latin America
Financial Crisis: The big picture

- Sovereign default comes in waves, serial default is common
- “The current lull stands out [...] against the preceding century” (p.4)
- External developments are important
- Domestic debt does not prevent default
Default through Inflation
Median Inflation 1800-2006

Median Inflation Rate All Countries
5-Year Moving Average: 1500-2006
Financial Crisis: The big picture

• Sovereign default comes in waves, serial default is common
• “The current lull stands out [...] against the preceding century” (p.4)
• External developments are important
• Domestic debt does not prevent default
• By reducing debt-principal, (unanticipated) inflation is akin to default and common even with commodity-currencies (debasement)
Exchange rate crises
High Depreciation countries

Financial Crisis: The big picture

- Sovereign default comes in waves, serial default is common
- “The current lull stands out [...] against the preceding century” (p.4)
- External developments are important
- Domestic debt does not prevent default
- By debt-principal, inflation is akin to default and common even with commodity-currencies (debasement)
- Exchange changes go in hand with inflation, more ER volatility in 20th century
One crisis comes rarely alone

• Sovereign default (fail principal/IR payment)
• Domestic default (fail payment or freeze bank acct)
• Banking crisis (Bank run or forced merger)
• High inflation
• High ER depreciation
Average number of crises

Variety of Crises, Asia: 1800-2006
Average Number of Crises per Country, 5-year Average
Financial Crisis: The big picture

- Sovereign default comes in waves, serial default is common
- “The current lull stands out [...] against the preceding century” (p.4)
- External developments are important
- Domestic debt does not prevent default
- By debt-principal, inflation is akin to default and common even with commodity-currencies (debasement)
- Exchange changes go in hand with inflation, more ER volatility in 20th century
- Crises come together: banking crisis are often preceded by surges in capital inflows, and followed by surges in public debt
Recap Theory So Far

- Sovereign default can be caused by domestic real shocks (Arellano 2008)
- Neglects:
  - Nominal Frictions
  - External shocks
  - Government policies
  - Investor behaviour
**Step back: what are crises?**

- “Extreme events” - default, bank runs, large swings in exchange rates, risk premia, capital flows
- Difficult to get non-smooth outcomes in standard RE models with consumption smoothing
- Elements that might yield extreme outcomes
  - Occasional extreme shocks (see e.g. Barro, “Rare events and the equity premium”, NBER WP 1130 on how this might explain Equi premium).
  - Strong amplification of small shocks (non-convexities)
  - Foreseeable, optimal, non-smooth reaction to slow deterioration of fundamentals at a cutoff (1st Gen. Currency Crises)
  - Switch between multiple equilibria: Either everybody runs to the bank, or nobody. (Diamond & Dybvig, QJE 91) 2nd Generation Model of Currency Crises)
II. The 3 generations of currency crises and their models

1. 1970s/80s: Speculative attacks on currency peg as fully rational, foreseeable result of policy-inconsistency

2. ERM crisis (1992): Fundamentals only determine vulnerability, speculative attack can be self-fulling if economic fundamentals are sufficiently bad

3. Asian crisis (1997): Moral Hazard in International Lending can lead to overinvestment, contagion
Roadmap

1. Introducing money
2. 3 generations of currency crises models
3. Next Session: The current crisis
Learning Points

1. How money and nominal ER can be introduced in an adhoc way

2. Role in currency crisis of
   - Economic fundamentals (inflation, public liabilities, …)
   - Investor expectation and speculation
   - Private financial companies and their incentives
Excursion: Introducing Money and Nominal Exchange Rates

- ER: The price of 1 unit of foreign currency in unit of home currency
- Money: Generally accepted means of payment for debts / goods (if by law: ”Legal tender”)
- Commodity money: metal coins (cigarettes,...), or paper notes credibly backed by, and exchanged for, metal (cigarettes,...)
- vs. Fiat money: Paper money not backed by commodity, just by legal tender declaration or convention
- Used as means of transaction, store of value, unit of account
Why do people hold money?

- Real bonds: “1-period holding return” of $R_t$, usually $= \frac{1}{\beta} > 1$
- Money: real return of $\frac{P_t}{P_{t+1}}$, usually $< 1$
- Discounted “User cost”:
  $$\beta[R_t - \frac{P_t}{P_{t+1}}] = 1 - \frac{P_t}{p_{t+1}R_t} = 1 - \frac{1}{1+i_t} = \frac{i}{1+i_t} > 0$$
- So money is a bad store of value. Agents hold it anyway because of
  - "Lack of double coincidence of wants" (Wicksell 1934)
  - Credit frictions: Money replaces credit relations with spot trade (see last session and Kyotaki and Moore AER 2002)
  - Limited participation in markets for bonds and other assets
Modelling money?

• 3 ways
  1. Introduce frictions that give rise to money demand
  2. Postulate ad-hoc (utility, shopping time, ...) benefit of money; money demand outcome of individual maximisation
  3. Postulate ad hoc MD as function of aggregate variables ($Y, i$)
The “monetary model”: “old-style” flex price model of $M$ and $ER$

- Ad-hoc demand for “real money balances”
  
  \[ m_t - p_t = a_1 Y_t - a_2 i_t, \ a_2, a_1 > 0 \]  
  (1)

- Arbitrage between domestic and foreign nominal bonds: UIP

  \[ 1 + i_t = (1 + i^*_t) E_t \left[ \frac{S_{t+1}}{S_t} \right] \]
  \[ \Rightarrow i_t \approx i^*_t + E_t[s_{t+1}] - s_t \]  
  (2)

- PPP

  \[ P_t = SP^* \]
  \[ \Rightarrow p_t \approx p^*_t + s_t \]  
  (3)
The “monetary model”: “old-style” flex price model of $M$ and $ER$

- $p_t \approx p_t^* + s_t$
- $m_t - p_t = a_1 Y_t - a_2 i_t \Rightarrow s_t = m_t - p_t^* - a_1 Y_t + a_2 i_t$
- $i_t \approx i_t^* + E_t[s_{t+1}] - s_t \Rightarrow$
  
  $$(1 + a_2)s_t = m_t - p_t^* - a_1 Y_t + a_2[i_t^* + E_t[s_{t+1}]]$$

- $\Rightarrow s_t = \frac{1}{1+a_2} \sum_{l=t}^{\infty} \left( \frac{a_2}{1+a_2} \right)^{l-t} E_t(m_l - a_1 y_l + a_2 i_{l+1}^* - p_l^*)$
- Exchange rate is an “asset price”; PDV of future benefits
- When $M$ is $AR(1)$ with persistence $\rho$, a shock $\epsilon_M$ implies $\Delta s = \frac{1}{1-\rho} \epsilon_M$. So get high exchange rate fluctuations.
- But: no budget constraint, no maximisation, no first principals, why no bubbles?
- Later: micro-founded models of money and exchange rates
Back to crises...
Ist Generation models

- Speculative attacks on currency peg as fully rational, foreseeable result of policy-inconsistency
Ist Generation models

- Example
The Krugman (1979)-Flood and Garber (1984) model

- Objective: Explain currency collapse after exchange rate-peg
- Predecessor: Salant et al (1978, commodity price fixing)
- Key ingredients:
  - Continuous time linear model, perfect foresight, flexible prices
  - SOE: World interest rates $i^*_t$ and prices $P^*_t$ given
  - CB bal sheet $M = D + R$, exog seignorage-driven growth in domestic credit
    \[ \dot{D}_t = \mu > 0 \]  \hspace{1cm} (4)
  - Interest-rate elastic money demand
    \[ m = \frac{M_t}{P_t} = a_0 - a_1 i_t, \quad a_0, a_1 > 0 \]
  - Arbitrage/UIP links $i, i^*$ with ER change
    \[ i_t = i^*_t + \frac{\dot{S}}{S} \]
  - PPP
    \[ P_t = SP^*, \quad \dot{P}^* = 0 \]
The Krugman (1979)-Flood and Garber (1984) model

- Government defends peg until reserves run out, so initially
  \[ \dot{P}_t = \dot{S}_t = 0 \]  \hspace{1cm} (5)
  \[ i_t = i^*_t \]  \hspace{1cm} (6)
  \[ m = \frac{M_t}{P_t} = a_0 - a_1 i^*_t \]  \hspace{1cm} (7)

- So \( \dot{R}_t = \dot{D}_t \).
  
  Since \( R \) is finite, the currency peg is unsustainable.

- When and how does the currency peg collapse?
The Krugman (1979)-Flood and Garber (1984) model

\[ \dot{P}_t = \dot{S}_t = 0 \]  
\[ i_t = i^*_t \]  
\[ m = \frac{M_t}{P_t} = a_0 - a_1 i^*_t \]  
\[ \dot{R}_t = \dot{D}_t \]

- Suppose the currency peg collapses at \( t_1 \) when \( R \) runs out. Variables at \( t > t_1 \) are
  - \( \dot{M}^{post} = \dot{D} = P^{post} = \dot{S}^{post} = \mu > 0 \)
  - From UIP: \( i^{post} = i^*_t + \frac{\dot{S}^{post}}{S} > i^{pre}_t \)
  - MD implies \( m^{post} < m^{pre} \), so at \( t_1 \), given \( M(t_1) \), \( P \) and (from PPP) \( S \) have to jump.
  - Is this possible? No. Arbitrage prevents jumps in \( P, S \): could sell bonds \( t = t_1 - \epsilon \) and make profit
The Krugman (1979)-Flood and Garber (1984) model

- So when and how does peg end?
- Define shadow ER $\tilde{S}$ as the rate that would prevail with $M = D$ under a float.
- Again $\dot{M}_{\text{post}} = \dot{D} = \dot{P}^{\text{post}} = \dot{S}^{\text{post}} = \mu > 0$ and $\tilde{i} = i^{\text{post}} > i^{\text{pre}}$
- So real money demand is lower.
- To avoid a jump, the peg collapses when $\tilde{S} = \overline{S}$ at $t = t_0 < t_1$
  - Investors anticipate float, with reduced domestic money holdings
  - To avoid losses, they sell $M^{\text{pre}} - M^{\text{post}}(t_0)$ for the remaining $R(t_0)$ at $t_0$
  - The size of the attack is $M^{\text{pre}} - M^{\text{post}}(t_0) = P^{\text{pre}} a_1 [i^{\text{post}} - i^{\text{pre}}] = P^* a_1 \dot{S}^{\text{post}}$
The Krugman (1979)-Flood and Garber (1984) model -

**Discussion**

- “Speculative attack” is not speculative at all, but perfectly foreseen arbitrage by rational investors
- Results from incompatibility between domestic (Expansion of domestic credit) and external goals of MP (ER peg)
- Government policy is passive. Government wastes exchange reserves on defending a doomed peg. Why?
2nd Generation models

- Motivated by ERM crisis
ERM crisis

- European Monetary System, created in 1979: Exchange Rate mechanism plus European Currency Unit (ECU)
- ERM: Exchange rate bands (+/- 2.25 percent)
- Fr, Ger, It, Bel, Den, Irl, Lux, NL, Spain (89), UK (90), Port (92)
- Lead Currency Deutschmark
- But: Post-reunification fiscal deficit ($\leq 13 \% \text{ of GDP}$) plus conversion of Ostmark at 1.8 : 1 imply inflationary pressure
- High German interest rates increase the cost of the ERM for other countries
**ERM crisis: 1992**

- September 1992: Currency speculation on eve of French Maastricht referendum
- 16 Sep - Black Wednesday: Bank of England increases interest rates to 12, then 15 percent, spends reserves worth 27 bn GBP to defend the peg, leaves the ERM (so does IT)
- Spain devalues within the ERM, Franc is supported by Bundesbank
- Speculation continues, bands for Austrian Schilling, French and Belgian Franc are enlarged to 15 %
- Soros makes a billion US Dollar (Krugman)
ERM currencies

Source: Obstfeld 1996
2nd Generation models - motivation

- Speculators put pressure on currencies that had ex post sustainable exchange rates
2nd Generation models - key ingredients

- Defending a peg against speculation has costs and benefits
- Costs are increasing in the size of speculation, and decreasing in the fundamental health of the economy
- Government decides abandon / defend
- Investors decide attack / not attack
- Gives rise to
  1. Uncertainty about speculative attacks
  2. Multiple equilibria
  3. Strategic complementarity among investors
Key intuition

“Like a run on a bank, speculation against a currency creates objective economic conditions that make liability devaluation more likely” (Obstfeld 1996)
Strategic Complementarities

(a) High Reserve game ($R = 20$)

(b) Low Reserve game ($R = 6$)

(c) Intermediate Reserve game ($R = 10$)
**Obstfeld (1996) - a model based on unemployment**

- Government objective function
  \[
  L = (y - y^*)^2 + \beta \epsilon^2 + C(\epsilon), \ \epsilon \equiv \epsilon - \epsilon_{-1}
  \]  
  (12)

- Expectations-augmented Phillips Curve
  \[
  y = \bar{y} + \alpha(\epsilon - \epsilon^e) - u
  \]  
  (13)

- $\epsilon^e$ “expected change in ER”

- Time-inconsistency: $\bar{y} < y^*$
Obstfeld (1996) - a model based on unemployment

\[ L = (y - y^*)^2 + \beta \epsilon^2 + C(\epsilon) \] (14)

\[ y = \bar{y} + \alpha(\epsilon - \epsilon^e) - u \] (15)

- With \( C(\epsilon) = 0 \), government chooses constant rate of depreciation

\[ \epsilon = \frac{\alpha(y^* - \bar{y} + u) + \alpha^2 \epsilon^e}{\alpha^2 + \beta} \] \Rightarrow (16)

\[ L^{\text{flex}} = \frac{\beta(y^* - \bar{y} + u + \alpha \epsilon^e)^2}{\alpha^2 + \beta} \] (17)

- With \( C(\epsilon) \) high enough for \( \epsilon \neq 0 \), gov chooses \( \epsilon = 0 \)

\[ L^{\text{fix}} = (y^* - \bar{y} + u + \alpha \epsilon^e)^2 < L^{\text{flex}} \] (18)
Obstfeld (1996) - a model based on unemployment

• For given $\epsilon^e$, with $C(\epsilon)$ finite for $\epsilon \neq 0$, gov chooses $\epsilon = 0$ for small realisations of $u$, but abandons peg for large realisations of $u$

• But for given $u$, the government may deliver $\epsilon > 0$ when $\epsilon^e > 0$ and vice versa: multiple RE equilibria

• Assume $u$ is iid uniform on $-\mu, \mu$, yields cutoffs of de-/revaluation as functions of $\epsilon^e$: $\bar{u}, \underline{u}$

• Using probabilities $u < \underline{u}, u > \bar{u}$, can express $E(\epsilon)$ as function of $\epsilon^e$
Multiple equilibria

\[
\frac{dEe}{d\epsilon^e} = \begin{cases} 
\frac{\alpha^2}{\alpha^2 + \beta} & \text{(for } u > -\mu) \\
\frac{\alpha}{\alpha^2 + \beta} \left[ \frac{\alpha}{2} + \frac{\alpha}{2\mu} (y^* - \bar{y} + \alpha \epsilon^e) \right] & \text{(for } u = -\mu) \\
\frac{\alpha^2}{\alpha^2 + \beta} & \text{(for } \bar{u} = -\mu) 
\end{cases}
\]
Obstfeld (1996) - Discussion

- Government’s dislike of unemployment implies rising cost of peg when devaluation is expected: ME
- Alternative mechanisms:
  - Cost of public debt is higher when markets expect devaluation (or default!!)
  - Banks may become fragile when peg is under attack
  - Defense of speculative attacks may redistribute income / wealth in undesirable way
  - Contagion: other countries’ devaluation may harm trade
Obstfeld (1996) - Critique

- Cannot explain WHEN attack occurs
- Has difficulty in making policy prescription
- Assumes common knowledge about fundamental
Morris and Shin (1998)

- Assume
  - Investors get noisy signal about “fundamental” $u$: 
    $$\tilde{u} = u + \epsilon, \epsilon \sim U[e, \bar{e}].$$
  - Cost of defending is increasing in $u$, and in mass of speculators $\pi$, implies a cut-off $\pi^*$ above which government devalues.
  - Plus some other assumptions, see paper.
**Morris and Shin (1998)**

- **Theorem:** “There is a unique $u^*$ such that, in any equilibrium of the game with imperfect information, the government abandons the currency peg if and only if $u > u^*$.”

- **Intuition:**
  1. Investor with signal $\tilde{u}$ assesses probability that government is “vulnerable” / $u$ is high. There is a unique cutoff $\tilde{u}^*$ s.t. all investors with $\tilde{u} > \tilde{u}^*$ attack.
  2. Thus, the mass of attackers is $\pi(u) = \frac{1}{2e}(u + e - \tilde{u}^*)$.
  3. Only if sufficient speculators attack, i.e. for $u > u^* : \pi(u^*) = \pi^*$ the attack is successful.
Morris and Shin (1998) - Discussion

- “Global Game” eliminates multiple equilibria
- Further reading:
The 3rd generation of crises - Asia 1997 and beyond

1. Facts
2. Models
3. Contagion
The 3rd generation of crises - Asia 1997 and beyond

- South East Asia: success story during 1990s
- Large capital inflows to “Asian Tigers”
- Currency bands with US Dollar
- Countries suffer from stong dollar, ToT deterioration, slow-down in Japan
- 1997-98: Quick collapse in several, different countries (MIT economies vs. South Korea)

- **May 1997**: Thai spends bn of $ defending baht
- **July 2**: Thai devalues 20 % goes to IMF
- **July 11**: Phillipines devalue peso
- **Aug**: 42 Thai “fin. comp.s” closed, Ind. abandons cur band
- **Oct**: Ind. asks IMF and WB for assistance after rupiah falls 30 percent; HK raises IR to 300 percent to defend currency peg, stock market falls 10%
- **Nov**: South Korea sees currency fall strongly, goes to IMF (bailout of 57 bn $ approved in Dec)
- **Jan 1998**: SK meets international bankers, agrees rollover
- **May 21**: Suharto resigns after 32 years as president of Ind.
- **Aug 17**: Russia devalues ruble;90-d foreign debt moratorium
- **Sep 23**: US fin. inst.s give 3.5 bn bailout to hedge fund LTCM
Asian Crisis - Key elements

- No “1st generation”-style fundamental inconsistency (fiscal balance, responsible MP)
- No substantial unemployment problem
- Boom-bust in asset prices prior to crisis
- Key role of financial intermediaries
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Asian Growth “miracle”


- Economic Growth in Asian Tigers mainly due to factor increases, rather than TFP
# Introduction Nominal ER and Money

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Krugman’s Pangloss Overinvestment

Krugman, Paul: WHAT HAPPENED TO ASIA?, www

- Limited liability financial firms invest borrowed funds in land that produces $F = aL$ but fails with prob $1 - \pi$
- Foreign lenders expect government bailout in case of trouble, require return $R$
- Results in “Pangloss overinvestment”
  - Domestic lenders maximise $\pi(aL - P^L R_L) + (1 - \pi)0$
  - Leads to asset price boom $P^L_* : \frac{a}{P^L_*} = R$, so $E(\frac{F}{P^L_*}) = \pi a < R$
  - But if bailout happens only once, or only with good fiscal situation, 1 bankruptcy can cause exodus of foreign investors
Corsetti et al “Paper Tigers”


- (Implicit) promise to bailout financial firms is a contingent liability to governments
- Once realised, it requires structural reform / monetisation, and leads to currency attack
### Contagion
Contagion

- Via fundamental linkages (Trade, etc)
- Due to common fundamental shocks (US interest rates)
- True contagion: Definitions (Corsetti et al 2005)
  - Different from Interdependence
  - “Significant increase in the probability of a crisis in one country, conditional on a crisis occurring in another country”
  - “Volatility spillover from the crisis country to the financial markets of other countries”
  - “Spillovers that cannot be explained in terms of fundamentals”
Contagion - Empirics

- Boyer et al. (1999) and Forbes and Rigobon (2002)
  - Contagion as increase in asset price correlation across countries
  - For Asian Crisis usually rejected in favour of interdependence
  - Standard test biased: Suppose $r_i = \alpha + \beta r_j + \epsilon$
    Then $\text{Corr}(r_i, r_j) = \frac{\beta}{2\beta + \text{Var}(\epsilon) \text{Var}(r_j)}$ rises if $\text{Var}(r_j)$ rises
  - Factor model, test for structural breaks in loadings of $r_i$ on $r_j$
  - Find evidence for contagion
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