International Macroeconomics

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

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Stockholm Doctoral Program in Economics

Roadmap

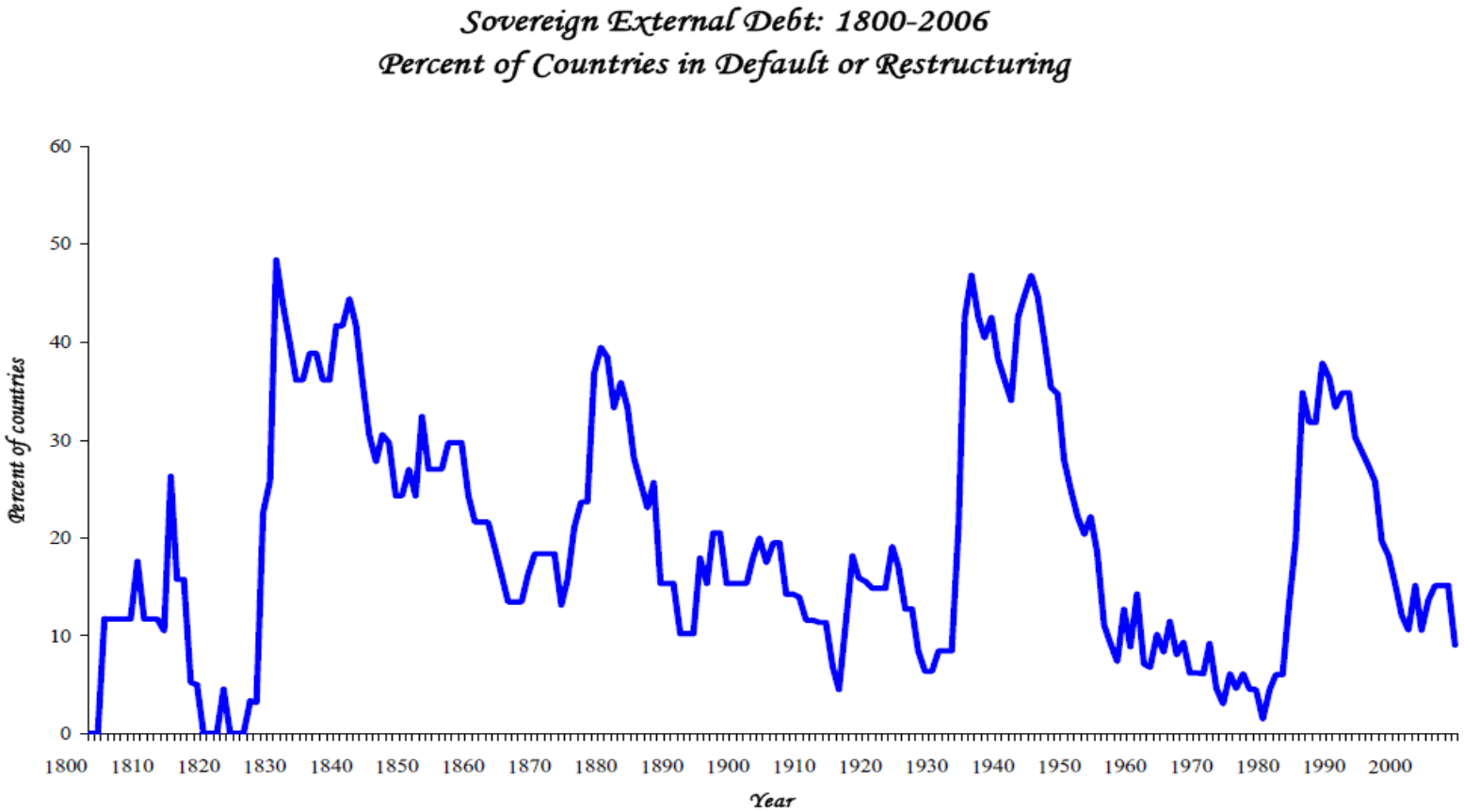
1. Financial Crises: The big picture - Reinhart and Rogoff
2. "Generations of crisis models:
   - 2.1 The 80s: currency crises as bad policy
   - 2.2 The early 1990s: Policymakers, George Soros and multiple equilibria
   - 2.3 The late 1990s: Pangloss investments, rotten incentives and the asian crisis

I. Financial crises: The big picture

- Reinhard and Rogoff, "This time it's different: A panoramic view of Eight Centuries of Financial Crises", NBER Working Paper 13882, March 2008.
  - Long-run (800 years) data on default, external and domestic debt, inflation, exchange rates, trade, GDP, interest rates, commodity prices.
  - 66 countries

The importance of sovereign default: 1800-2006

Percent of countries in sovereign default: 1800-2006

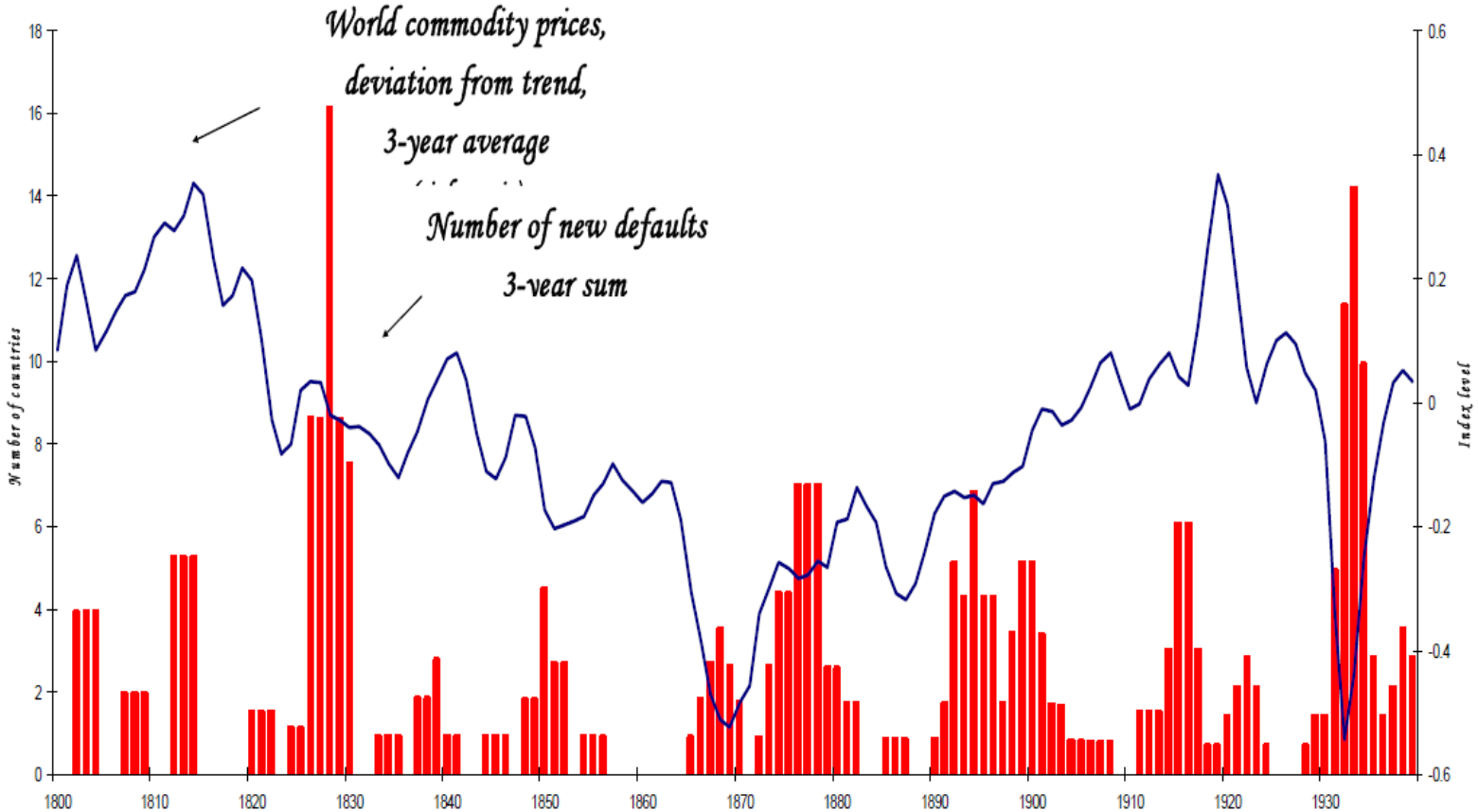


Financial Crisis: The big picture

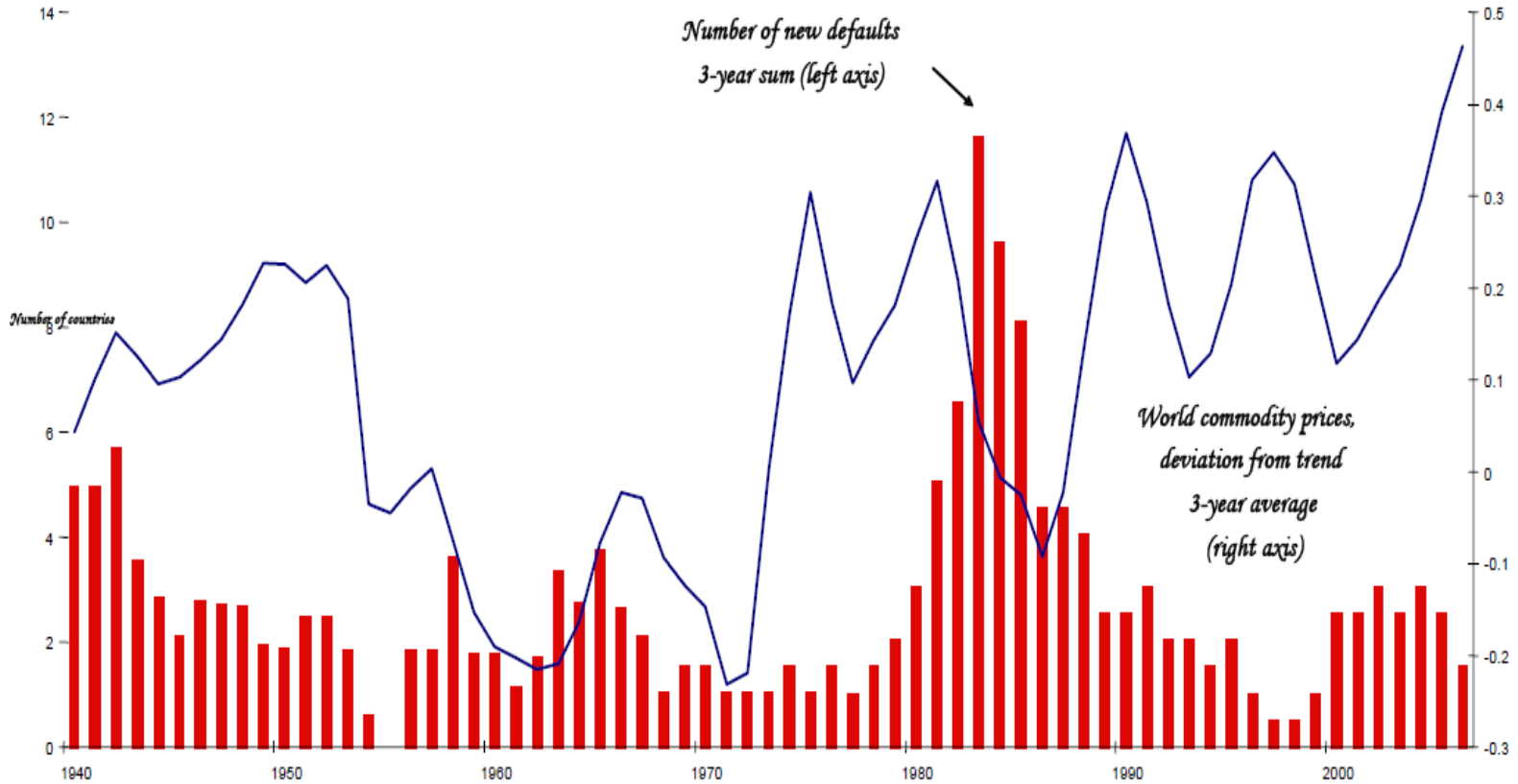
- Sovereign default comes in waves, serial default is common
- "The current lull stands out [...] against the preceding century" (p.4)

The importance of external shocks: 1800-2006

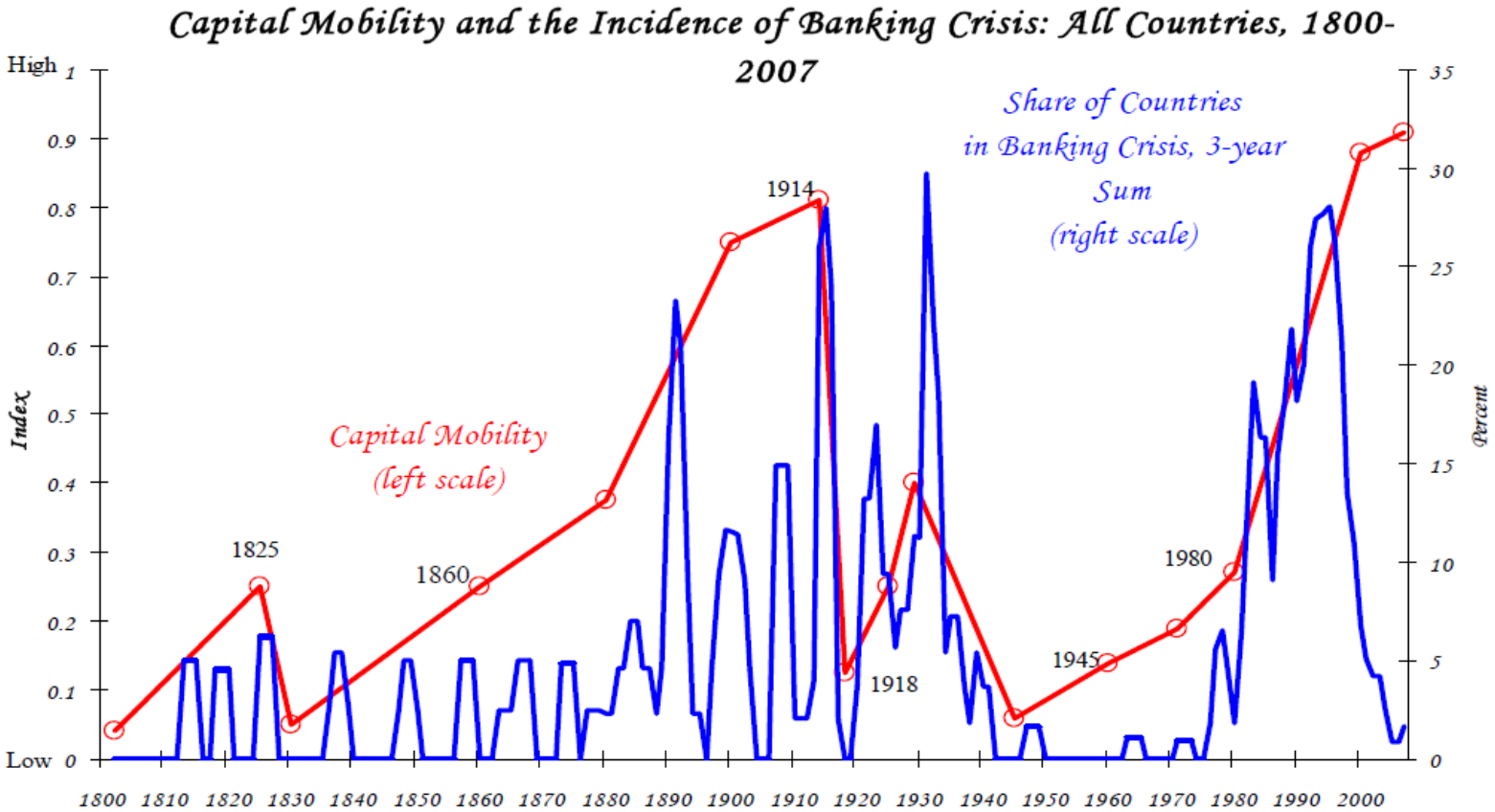
Default and Commodity Prices 1800-1940



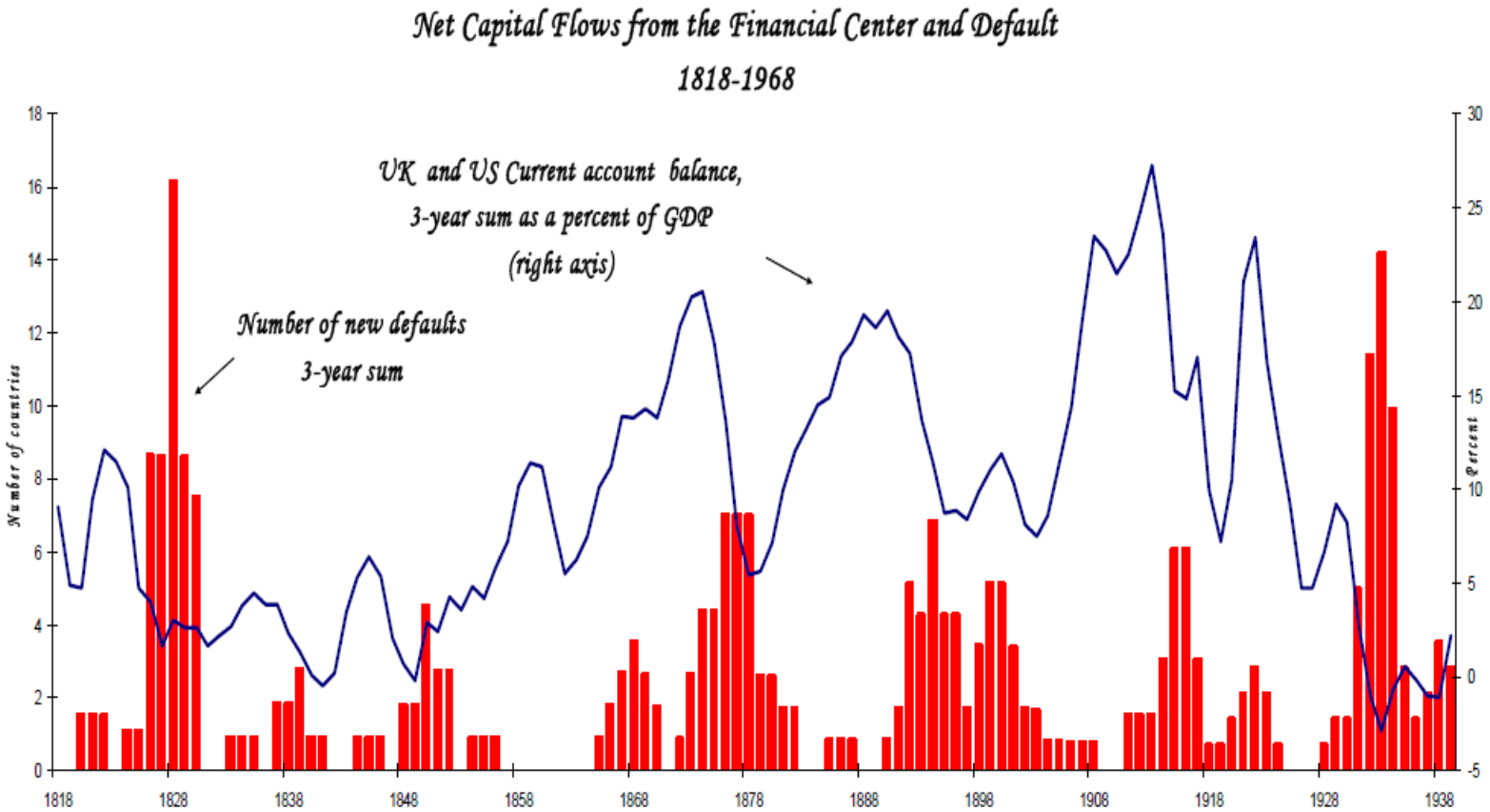
Default and Commodity Prices 1940-2006



Banking crises and capital mobility



UK+US CA and Default pre-WWII

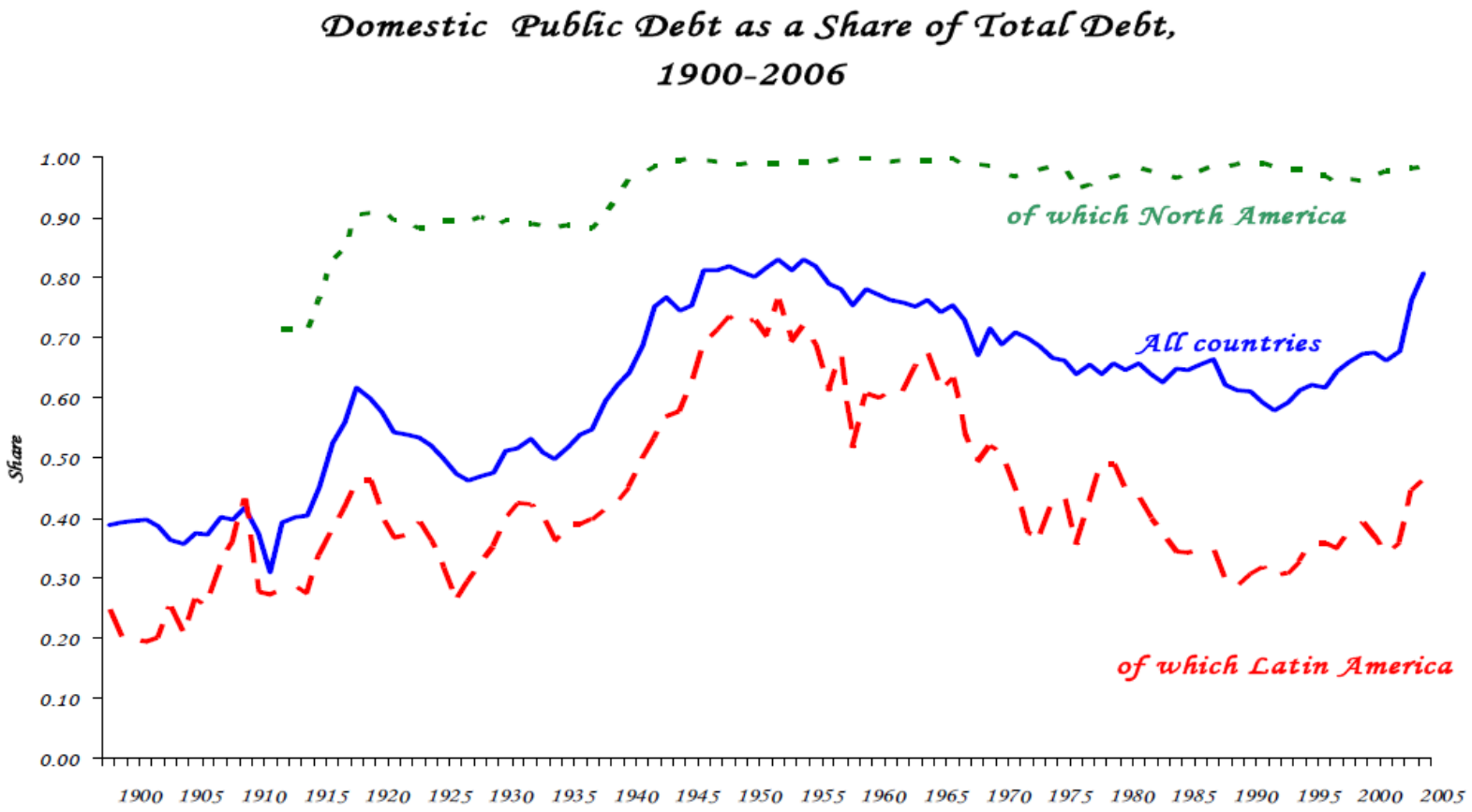


Financial Crisis: The big picture

- 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 commidity 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



Financial Crisis: The big picture

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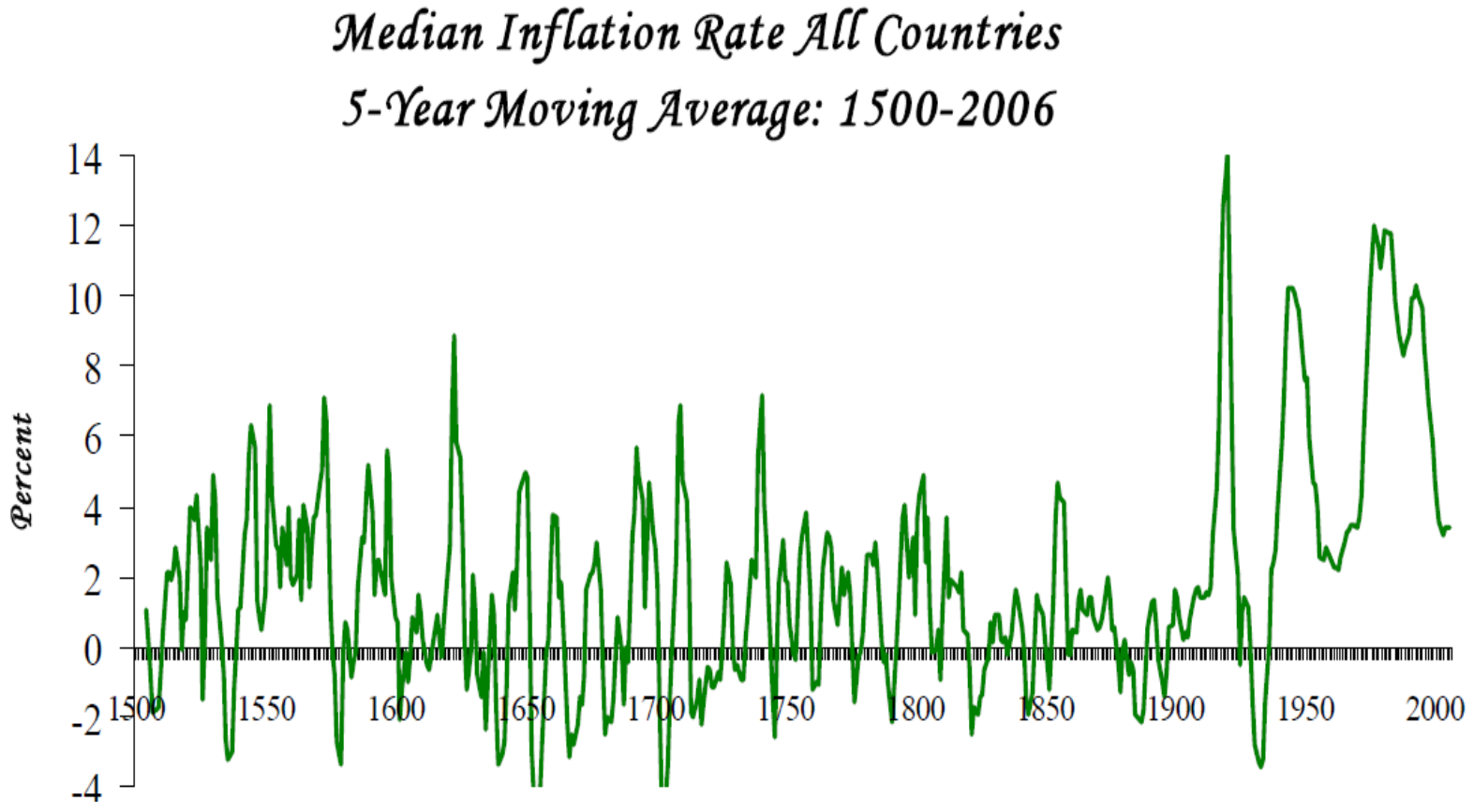
- Domestic debt does not prevent default

Default through Inflation

Median Inflation 1800-2006



Financial Crisis: The big picture

- Sovereign default comes in waves, serial default is common
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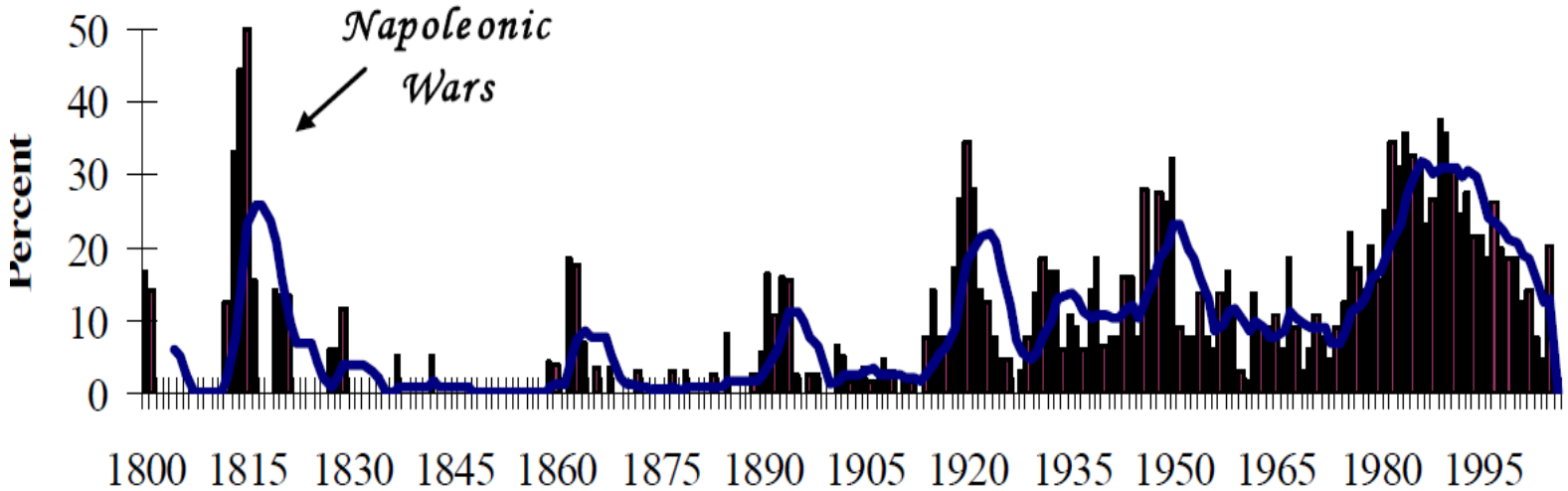
- By reducing debt-principal, (unanticipated) inflation is akin to default and common even with commodity-currencies (debasement)

Exchange rate crises

High Depreciation countries

Currency Crashes: Share of Countries with an Annual Depreciation Greater than 15 Percent: 1800-2006



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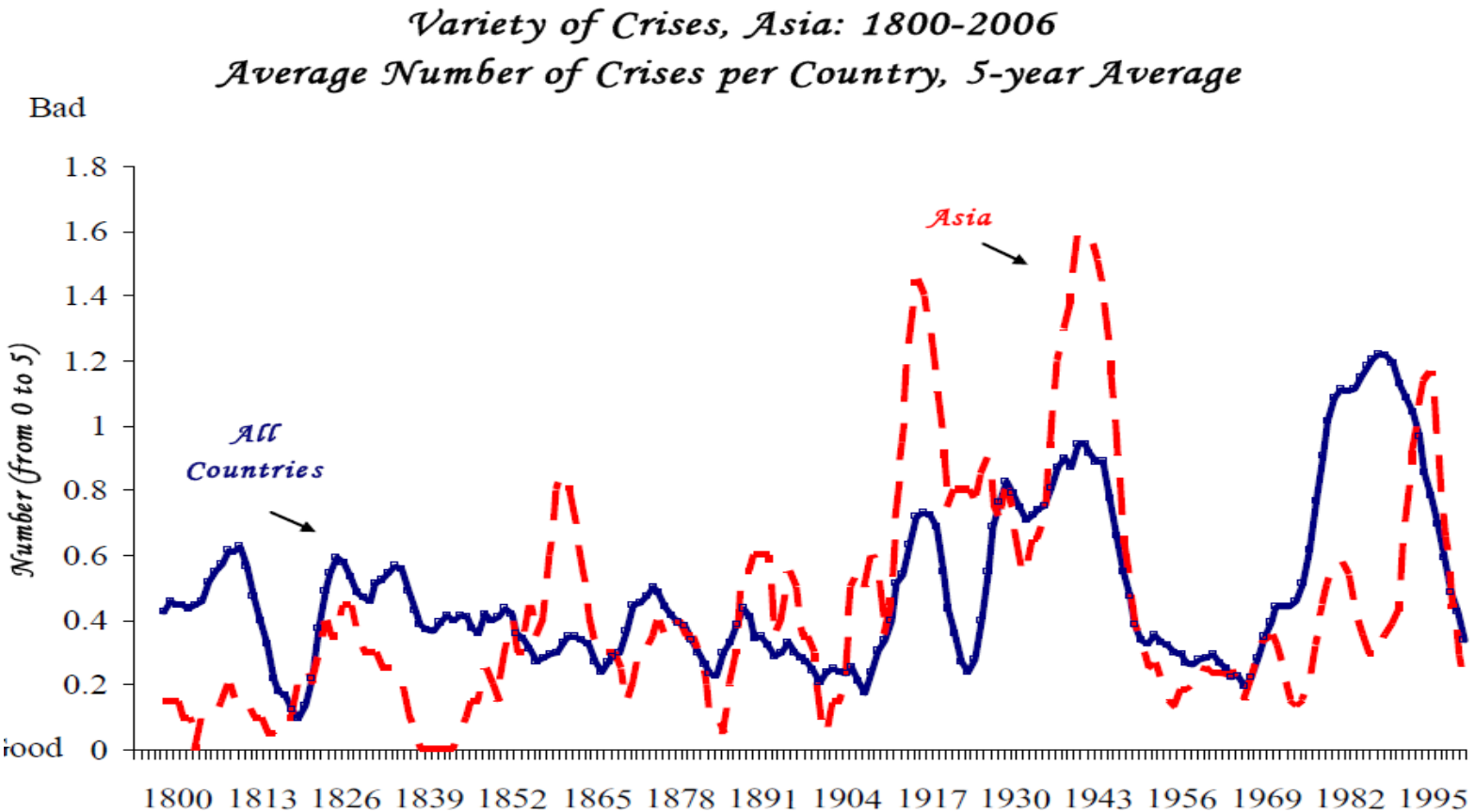
- Exchange changes go in hand with inflation, more ER volatility in 20th century

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



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- 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 Equ 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 equilibriua: 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"

$$m_t - p_t = a_1 Y_t - a_2 i_t, \;\; a_2, a_1 > 0 \tag{1}$$

- Arbitrage between domestic and foreign nominal bonds: UIP

$$\begin{aligned} 1 + i_t &= (1 + i_t^\star) E_t[\frac{S_{t+1}}{S_t}] \\ \Rightarrow i_t &\approx i_t^\star + E_t[s_{t+1}] - s_t \end{aligned} \tag{2}$$

- PPP

$$\begin{aligned} P_t &= SP^\star \\ \Rightarrow p_t &\approx p_t^\star + s_t \end{aligned} \tag{3}$$

The "monetary model": "old-style" flex price model of M and ER

- $p_t \approx p_t^\star + s_t$
- $m_t - p_t = a_1 Y_t - a_2 i_t \Rightarrow s_t = m_t - p_t^\star - a_1 Y_t + a_2 i_t$
- $i_t \approx i_t^\star + E_t[s_{t+1}] - s_t \Rightarrow$
  $(1 + a_2)s_t = m_t - p_t^\star - a_1 Y_t + a_2[i_t^\star + E_t[s_{t+1}]]$
- $\Rightarrow s_t = \frac{1}{1+a_2} \sum_{l=t}^{\infty} (\frac{a_2}{1+a_2})^{l-t} E_t(m_l - a_1 y_l + a_2 i_{l+1}^\star - p_l^\star)$
- Exchange rate is an "asset price"; PDV of future benefits
- When M is $AR(1)$ with persistence ρ, a shock ϵ_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 $i_t^\star$ and prices $P_t^\star$ given
  - CB bal sheet $M = D + R$, exog seignorage-driven growth in domestic credit

$$\dot{D}_t = \mu > 0 \tag{4}$$

  - Interest-rate elastic money demand
    $m = \frac{M_t}{P_t} = a_0 - a_1 i_t, \;\; a_0, a_1 > 0$
  - Arbitrage/UIP links $i, i^\star$ with ER change
    $i_t = i_t^\star + \frac{\dot{S}}{S}$
  - PPP
    $P_t = SP^\star, \;\; \dot{P}^\star = 0$

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

- Government defends peg until reserves run out, so initially

$$\dot{P}_t = \dot{S}_t = 0 \tag{5}$$

$$i_t = i_t^\star \tag{6}$$

$$m = \frac{M_t}{P_t} = a_0 - a_1 i_t^\star \tag{7}$$

- 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

$$\dot{P}_t = \dot{S}_t = 0 \tag{8}$$

$$i_t = i_t^\star \tag{9}$$

$$m = \frac{M_t}{P_t} = a_0 - a_1 i_t^\star \tag{10}$$

$$\dot{R}_t = \dot{D}_t \tag{11}$$

- Suppose the currency peg collapses at t_1 when R runs out. Variables at $t > t_1$ are
  - $\dot{M}^{post} = \dot{D} = \dot{P}^{post} = \dot{S}^{post} = \mu > 0$
  - From UIP: $i^{post} = i_t^\star + \frac{\dot{S}^{post}}{S}^{post} > i_t^{pre}$
  - 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 $\widetilde{S}$ as the rate that would prevail with $M = D$ under a float.
- Again $\dot{M}^{post} = \dot{D} = \dot{P}^{post} = \dot{S}^{post} = \mu > 0$ and $\widetilde{i} = i^{post} > i^{pre}$
- So real money demand is lower.
- To avoid a jump, the peg collapses when $\widetilde{S} = \overline{S}$ at $t = t_0 < t_1$

  - Investors anticipate float, with reduced domestic money holdings
  - To avoid losses, they sell $M^{pre} - M^{post}(t_0)$ for the remaining $R(t_0)$ at t_0
  - The size of the attack is $M^{pre} - M^{post}(t_0) = P^{pre} a_1 [i^{post} - i^{pre}] = P^{\star} a_1 \dot{S}^{post}$

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
- Obstfeld "Currency crises with self-fulfilling features", EER 40.

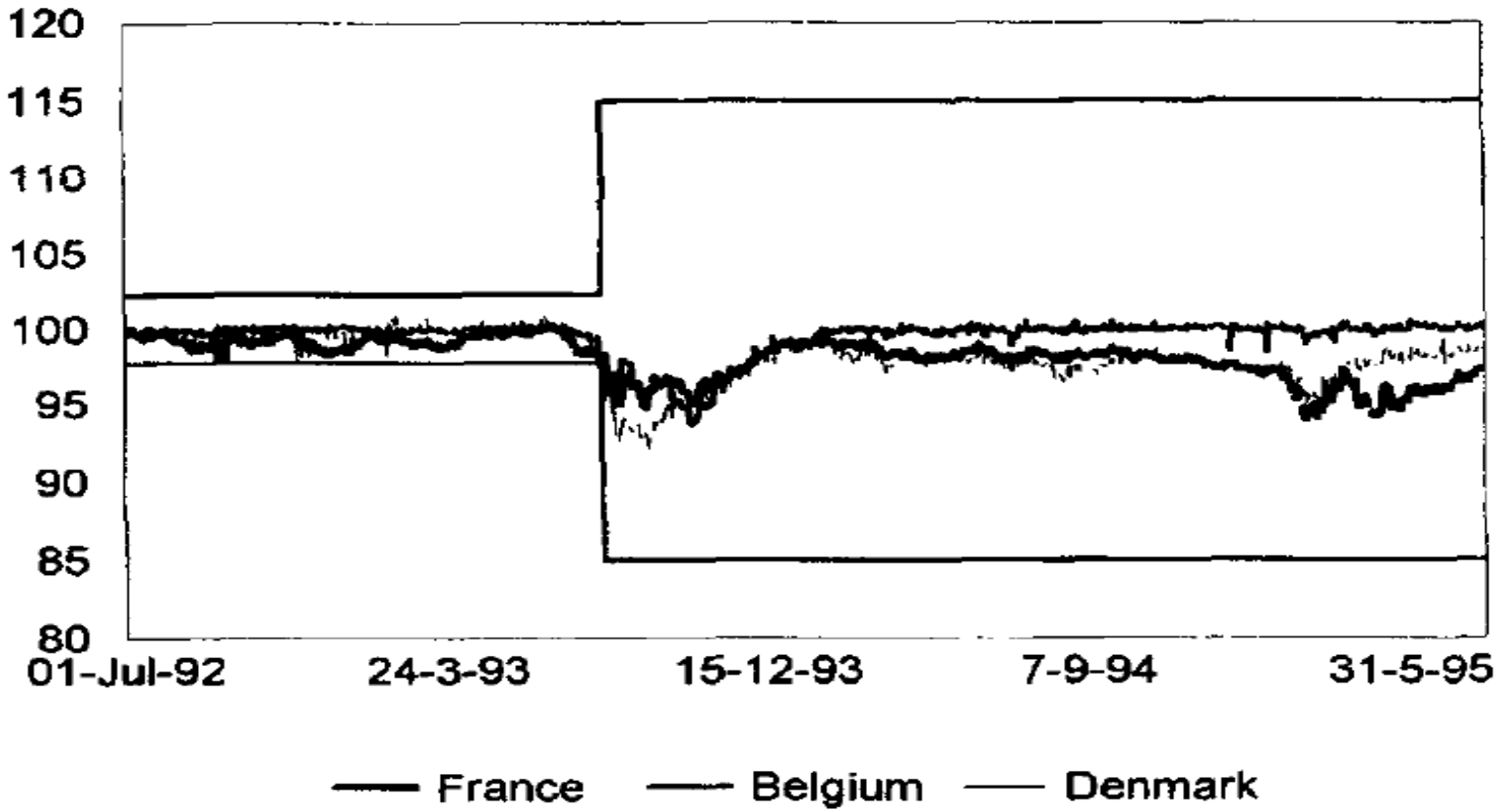
ERM crisis

- 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 % of GDP) plus conversion of Ostmark at 1.8 : 1 imply inflationary pressure
- High German interet 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

Trader 1 \ Trader 2	*Hold*	*Sell*
Hold	0, 0	0, -1
Sell	-1, 0	-1, -1

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

Trader 1 \ Trader 2	*Hold*	*Sell*
Hold	0, 0	0, 2
Sell	2, 0	1/2, 1/2

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

Trader 1 \ Trader 2	*Hold*	*Sell*
Hold	0, 0	0, -1
Sell	-1, 0	3/2, 3/2

(c) Intermediate Reserve game ($R = 10$)

Obstfeld (1996) - a model based on unemployment

- Government objective function

$$L = (y - y^\star)^2 + \beta\epsilon^2 + C(\epsilon),\ \epsilon \equiv \varepsilon - \varepsilon_{-1} \tag{12}$$

- Expectations-augmented Phillips Curve

$$y = \overline{y} + \alpha(\epsilon - \epsilon^e) - u \tag{13}$$

- ϵ^e "expected change in ER"
- Time-inconsistency: $\overline{y} < y^\star$

Obstfeld (1996) - a model based on unemployment

$$L = (y - y^\star)^2 + \beta\epsilon^2 + C(\epsilon) \tag{14}$$

$$y = \overline{y} + \alpha(\epsilon - \epsilon^e) - u \tag{15}$$

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

$$\epsilon = \frac{\alpha(y^\star - \overline{y} + u) + \alpha^2\epsilon^e}{\alpha^2 + \beta} \Rightarrow \tag{16}$$

$$L^{flex} = \frac{\beta(y^\star - \overline{y} + u + \alpha\epsilon^e)^2}{\alpha^2 + \beta} \tag{17}$$

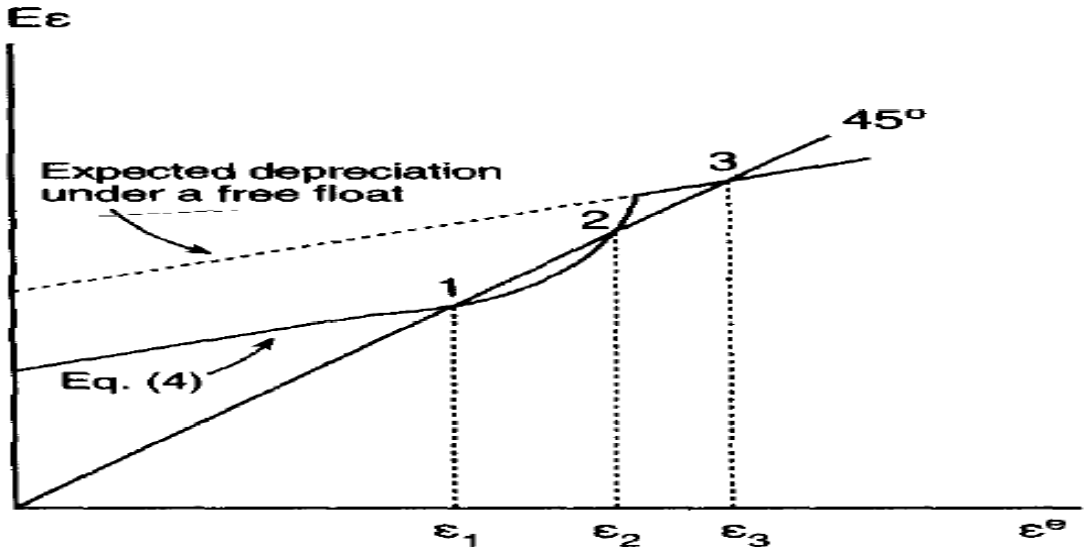
- With $C(\epsilon)$ high enough for $\epsilon \neq 0$, gov chooses $\epsilon = 0$

$$L^{fix} = (y^\star - \overline{y} + u + \alpha\epsilon^e)^2 < L^{flex} \tag{18}$$

Obstfeld (1996) - a model based on unemployment

- For given ϵ^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 ϵ^e: $\overline{u}, \underline{u}$
- Using probabilities $u < \underline{u}$,$u > \overline{u}$, can express $E(\epsilon)$ as function of ϵ^e

Multiple equilibria



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

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
- $\Rightarrow$ Morris and Shin (1998), "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks", AER.

Morris and Shin (1998)

- Assume
  - Investors get noisy signal about "fundamental" u: $\widetilde{u} = u + \epsilon$, $\epsilon \sim U[\underline{e}, \overline{e}]$.
  - Cost of defending is increasing in u, and in mass of speculators π, implies a cut-off $\pi^\star$ above which government devalues.
  - Plus some other assumptions, see paper.

Morris and Shin (1998)

- Theorem: "There is a unique $u^\star$ such that, in any equilibrium of the game with imperfect information, the government abandons the currency peg if and only if $u > u^\star$."
- Intuition:
  1. Investor with signal $\widetilde{u}$ assesses probability that government is "vulnerable" / u is high. There is a unique cutoff $\widetilde{u}^\star$ s.t. all investors with $\widetilde{u} > \widetilde{u}^\star$ attack.
  2. Thus, the mass of attackers is $\pi(u) = \frac{1}{2e}(u + e - \widetilde{u}^\star)$.
  3. Only if sufficient speculators attack, i.e. for $u > u^\star : \pi(u^\star) = \pi^\star$ the attack is successful.

Morris and Shin (1998) - Discussion

- "Global Game" eliminates multiple equilibria
- Further reading:
  - Corsetti et al (2004). "Does One Soros Make a Difference? A Theory of Currency Crises with Large and Small Traders," ReStud

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)

Asian Crisis - Timeline 1997/1998

- *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

Asian Growth "miracle"

Asian Growth "miracle"

Young, Alwyn, "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience," QJE 1995.

- Economic Growth in Asian Tigers mainly due to factor increases, rather than TFP

Krugman's Pangloss Overinvestment

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 $\pi(aL - P^L RL) + (1 - \pi)0$
  - Leads to asset price boom
    $P^{L\star} : \frac{a}{P^{L}{}_{\star}} = R$, so $E(\frac{F}{P^{L}{}_{\star}}) = \pi a < R$
  - 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"

Corsetti et al "Paper tigers?: A model of the Asian crisis", EER 1999.

- (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
- Corsetti et al "Some contagion, some interdependence: More pitfalls in tests of financial contagion", JIMF 2005.
  - Standard test biased: Suppose $r_i = \alpha + \beta r_j + \epsilon$
    Then $Corr(r_i, r_j) = \frac{\beta}{\sqrt[2]{\beta + Var(\epsilon) Var(r_j)}}$ rises if $Var(r_j)$ rises
  - Factor model, test for structural breaks in loadings of r_i on r_j
  - Find evidence for contagion

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