Currency crises

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[International Macroeconomics]

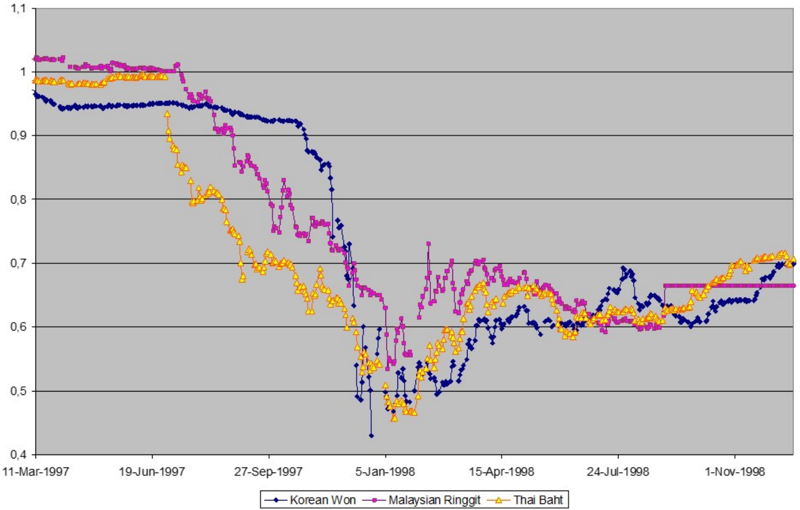
Outline

Definition and questions

What is a currency crisis? $15 - 25$ per cent depreciation / devaluation within a year.

General problem: why is there a “sudden”, dramatic change in the currency exchange rate?

Three currencies in the East Asian crisis.



Typology

- Early views: arbitrary large shifts in expectations or disturbances (Kindleberger, 1978)
- First-generation models: Reconciling RE models with currency crises (Krugman, 1979).
- Second-generation models: multiple equilibria (Obstfeld, 1996).
- Third-generation models: balance sheet effects - the importance of external liabilities (Chang and Velasco, 2001). Fire sales, safe assets etc. (see Simsek 2017).
- Sudden stops in capital flows: lead to a sudden reversal of the current account (Calvo 1998).

Remarks

- First- and Second generation models: associated with attacks on *fixed* exchange rate regimes. In general: a tension between free capital flows, fixed exchange rate regimes and monetary policy (Mundell's triangle).
- Third-generation models and "sudden stops" allow to analyze also floating regimes.
- Since Obstfeld (1996) the literature is parallel to that of self-fulfilling equilibria, information aggregation, herding etc.
  - Morris and Shin (1998), Angeletos et al. (2006), Angeletos and Werning (2006), Hellwig et al. (2006) etc.

First-generation models

A "classic" model of balance of payments crises (KFG)

Adapted from Krugman (1978) and Gerber and Flood (1984).

Assumptions:

- Inititally a fixed exchange rate regime $\bar{s}$
- Flexible prices
- UIRP holds
- No uncertainty
- Rational expectations (perfect foresight)

The shadow exchange rate

- The monetary model describes the shadow exchange rate $\widehat{s}$
- Denote $k_t = -m_t^{\star} - c(y_t - y_t^{\star})$ being the fundamental and rewrite the monetary model as

$$\widehat{s}_t = m_t + k_t + b(E_t(s_{t+1}) - s_t) \tag{1}$$

- We will set $k_t = k$ for simplicity.

A credible fixed exchange rate regime

With a fixed exchange rate

$$M_t = R_t + C_t \tag{2}$$

and in a credible regime $b(E_t(s_{t+1}) - s_t) = 0$ so

$$\bar{s}_t = m_t + k \tag{3}$$

Hence $m_t = m$ if $\bar{s}$ is expected to be constant. This implies

$$\dot{M}_t = \dot{R}_t + \dot{C}_t = 0 \tag{4}$$

A government policy

- The government follows a constant money growth rate $\frac{\dot{C}_t}{C_t} = \mu$ so
$$\dot{R}_t = -C_t\mu \tag{5}$$
- and does not change this policy no matter what.
- Interpretation:
  - financing a constant deficit in the current account or
  - the government runs a fiscal deficit financed by printing money or
  - a "runaway" monetary policy

Post-collapse exchange rate

- The currency is floated (post-collapse) at time T.
- The money stock still grows at the rate μ.
- The money stock contains now only domestic credit.

$$M_t = C_t \tag{6}$$

- The exchange rate follows

$$s_{T^+} = m_{T^+} + k + b(E_T(s_{T^+}) - s_T) \tag{7}$$

- Since after the collapse $\dot{s} = \dot{m} = \mu$

$$s_{T^+} = m_{T^+} + k + b\mu \tag{8}$$

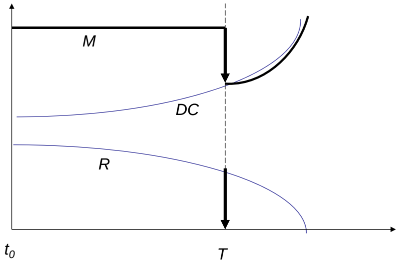
Time of the collapse (I)

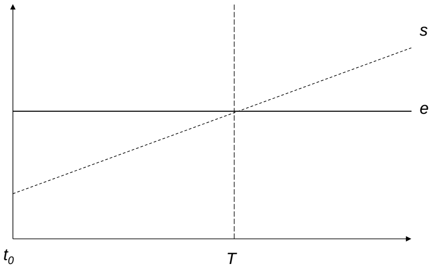
- Agents are rational, forward-looking and there is no uncertainty. The currency cannot jump: unlimited profits o/w.
- The reserves cannot run out forcing a discrete jump in the exchange rate.
- The only time T that is feasible when $\widehat{s}_T = \bar{s}_T$
- This means that:

$$s_{T^+ \to T} = m_{T^+} + k + b\mu = m_T + k = \bar{s}_T \tag{9}$$

- As $\mu > 0$ this means there needs to be a discontinuity at T in the money supply.
- At time T the agents exchange domestic currency wiping all reserves as the currency is floated.

Events around the collapse





Time of the collapse (II)

What is the collapse time T?

- From $\widehat{s_T} = C_0 + T\mu + k + b\mu = \bar{s}$ solve for T
- $T = \frac{\bar{s} - C_0 - k - b\mu}{\mu} = \frac{R_0 - b\mu}{\mu}$

Some questions:

- Is the currency overvalued at time $t = 0$?
- What happens in the model if $\dot{k}_t > 0$?

Problems with this first-generation model

"Facts"

- The model is internally consistent when it comes to the interest rate parity. But in reality: peso problems.
- The exchange rate is not overvalued. The attack occurs exactly where the shadow exchange rate matches the fixed rate.
- There is no "jump" of the exchange rate.
- No possibility of an interest-rate defense: UIRP holds at all times.

"Assumptions"

- Everybody is rational but the government itself. In fact, the attack is perfectly avoidable if the government changes policy.
- Why do we have the system in the first place?
- With uncertainty: a distribution of probabilities of an attack.

Some fixed in Broner (1999), Lahiri and Vegh (2003), Rebelo and Vegh (2008).

What do we learn from this?

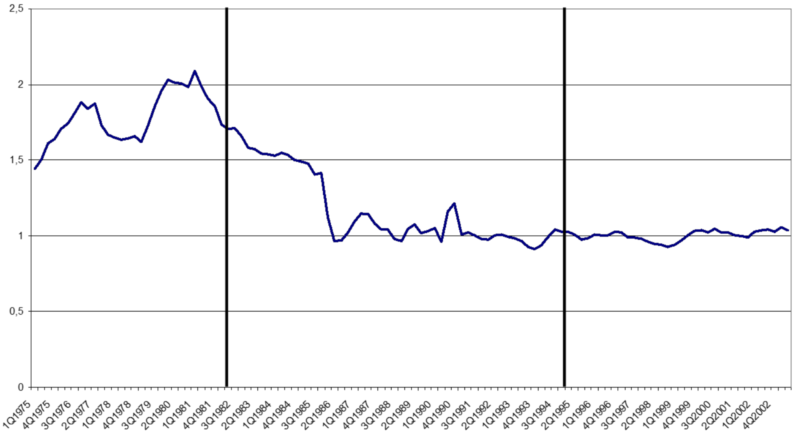
- A model with discontinous changes in reserves and an attack on the currency in the presence of
  - no uncertainty
    and rational, forward-looking agents.
  - Forward-looking behavior may be a source of huge moves today!
- To have a credible fixed-exchange rate regime: the monetary policy should be dissociated with fiscal policy. So: an independent central bank?

Literature

- Broner, F., 2008. Discrete devaluations and multiple equilibria in a first generation model of currency crises. Journal of Monetary Economics 55: 592–605.
- Flood, R.P., Garber, P.M., 1984. Collapsing exchange-rate regimes: some linear examples. Journal of International Economics 17: 1–13.
- Krugman, P., 1979. A model of balance-of-payments crises. Journal of Money, Credit and Banking 11:311–325.
- Lahiri A., Vegh C., 2003. Delaying the inevitable: Interest rate defense and BOP crises. Journal of Political Economy 111: 404–424.
- Rebelo, S.,Vegh, C., 2008. When is it optimal to abandon a fixed exchange rate? 1. Review of Economic Studies 75: 929–955.

Second-generation models

Case of Mexico 1994: terms of trade (export/import prices) vs. the exchange rate



Second-generation models

- It's difficult to explain the ERM crisis of 1992 or the Mexican crisis of 1994 as a result of some runaway government policy as in the KFG model.
- Why would any government run out of reserves? (as long as it is solvent?)
- That having said, the government may have different objectives than the fixed exchange rate (output, employment).
- In the period of mass capital flows, central banks and investors may react to each other's actions and play games.
- Perhaps there can be currency crises with self-fulfilling features.

Obstfeld (1996) model with self-fulfilling equilibria

Assumptions

- The PPP holds: $s_t = p_t - p_t^\star$. Assume that $p_t^\star = p^\star$.
- The government minimizes a loss function

$$\Lambda_t = (y_t - \widetilde{y}_t)^2 + \chi\pi_t^2 + C(\pi_t) \tag{10}$$

- Here:
  - y is the output while $\widetilde{y}$ it the targeted output
  - π is the inflation rate and, under the assumed PPP also the realized rate of currency depreciation.
  - $C(\pi_t)$ is some additional inflation cost term. $C(0) = 0$ but $C(\pi) = \overline{c}$ if $\pi > 0$ and $C(\pi) = \underline{c}$ if $\pi < 0$. (a fixed cost of changing the peg).

Output in the model

Private agents commit to nominal contracts one period before they bind. They care about the real wage and form expectations of inflation π^e.

If inflation is higher than expected, then firms employ more workers and output rises.

Output is then given by an expectations-augmented Phillips curve

$$y = \overline{y} + (\pi - \pi^e) - z \tag{11}$$

where

- $\overline{y}$ is the natural or flexible-price equilibrium output
- π^e is the expected inflation rate
- z is an i.i.d. mean-zero shock.

Also, $\widetilde{y} - \overline{y} = k > 0$ or the targeted level of output is higher than the natural output.

The game between investors and the government

- The private sector chooses depreciation (inflation) expectations π^e before observing z and π.
- The government observes z and π^e and sets π.
- A one shot game.

The outcomes in the model [I]

- With no cost $C(\pi)$ of changing the exchange rate, the solution is

$$\pi = \frac{k + \pi^e + z}{1 + \chi} \tag{12}$$

- while the Loss function is going to be

$$\Lambda^{FLEX} = \frac{\chi}{1 + \chi}(k + \pi^e + z)^2 \tag{13}$$

- With no option of changing the exchange rate, the loss is

$$\Lambda^{FIX} = (k + \pi^e + z)^2 \tag{14}$$

- Then $\Lambda^{FIX} > \Lambda^{FLEX}$: so the government wants to devalue the exchange rate (increase inflation) no matter what.

Government choice

With a cost $C(\pi)$ of changing the exchange rate, given the π^e the government will choose to

- devalue if $z > \bar{z}$ is high enough

$$\Lambda^{FIX} - \Lambda^{FLEX} > \bar{c} \tag{15}$$

  so when $\bar{z} = \sqrt{\bar{c}(1+\chi)} - k - \pi^e$

- revalue if $z < \underline{z}$ is low enough

$$\Lambda^{FIX} - \Lambda^{FLEX} > \underline{c} \tag{16}$$

  so when $\underline{z} = \sqrt{\underline{c}(1+\chi)} - k - \pi^e$.

Private agents' expectations

What is the rational expectation of inflation (depreciation) π?

$$E\pi = E[\pi|z < \underline{z}]Prob(z < \underline{z}) + E[\pi|z > \overline{z}]Prob(z > \overline{z}) \qquad (17)$$

Expected inflation impacts both the inflation rate chosen by the government conditional on choosing to realign and the probability of a realignment.

It is possible that there are multiple rational expectations equilibria.

A parametric example

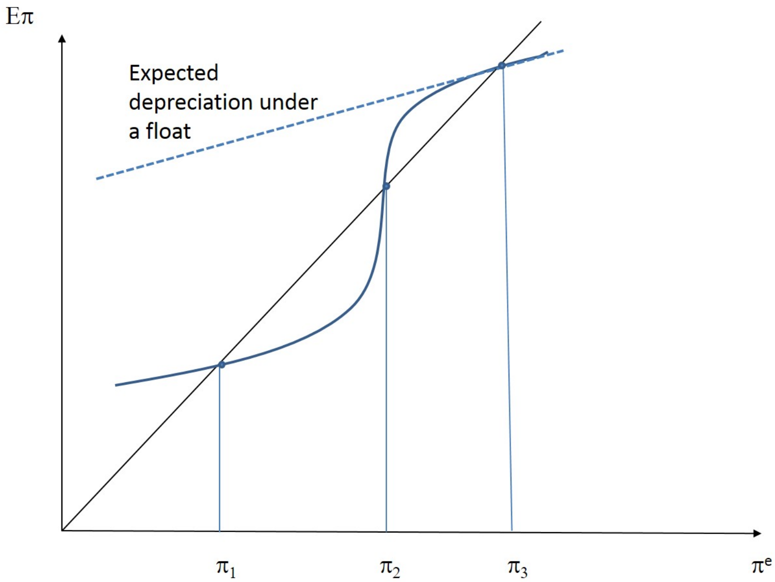
Suppose $z \in [-Z, Z]$ and is uniformly distributed. Then

$$E\pi = \frac{1}{1+\chi}[(1 - \frac{\overline{z} - \underline{z}}{2Z})(k + \pi^e) - \frac{\overline{z}^2 - \underline{z}^2}{4Z}] \qquad (18)$$

In equilibrium $\pi^e = E\pi$ and there are multiple solutions given $\underline{z}$ and $\overline{z}$ found previously.

It is possible that there are multiple rational expectations equilibria.

Three possible equilibria



Interpretation and remarks

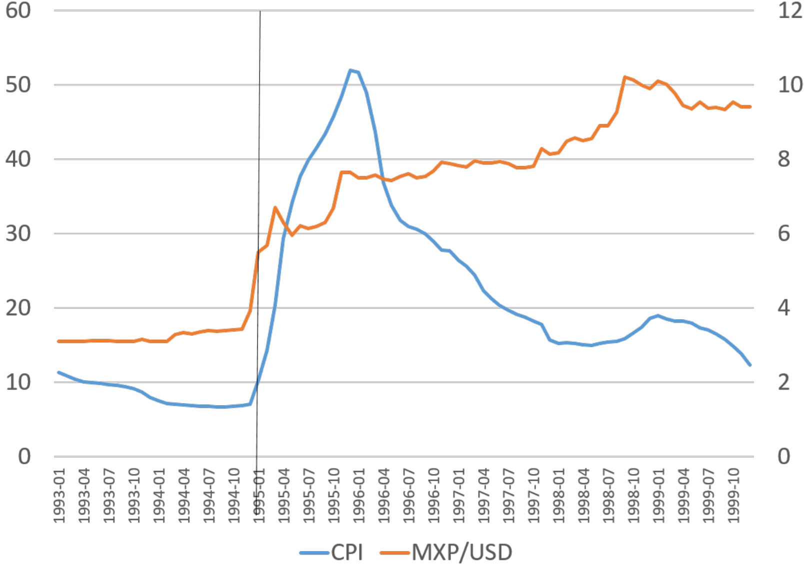
Interpretation

- High expected inflation (depreciation) would rise unemployment if not matched by actual inflation.
- So the government then has a natural incentive to devalue (create inflation).

Remarks

- A change in expectations can cause the government to react differently to the same shock z.
- But, a government with stronger fundamentals $(\bar{c}, \chi)$ large or k low is less vulnerable to shifts of equilibria.
- So, on average, "weaker" countries will fall prey to attacks.

Case of Mexico 1994: inflation and exchange rates?



Problems with second-generation models

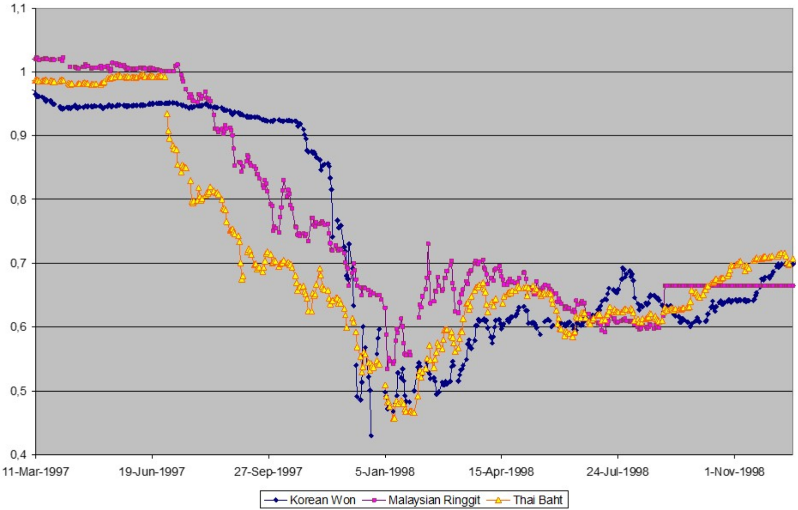
- Stylized? But: can be embedded in a small open economy model a la Gali and Monacelli (2005).
- The government again has a problem: it is stuck with some undesired exchange rate arrangement.
- The cost of changing the peg: not related to inflation.
- A one shot game? Reputation has a role in coordinating on the right equilibrium.
- Multiplicity of equilibria: so no predictive power? But: the global games literature. Introducing some imperfect information to obtain sharper and unique predictions (Morris and Shin, 1998).
- Coordinating on the "right" equilibrium by managing information: A big literature on the social value of information.

Literature

- Gali, J., Monacelli, T., 2005. Monetary policy and exchange rate volatility in a small open economy. Review of Economic Studies 72:707–734.
- Morris, S., Shin, H., 1998. Unique equilibrium in a model of self-fulfilling currency attacks. American Economic Review 88: 587–597.
- Obstfeld M., 1996. Models of currency crises with self-fulfilling features. European Economic Review 40: 1037–1048.

Third-generation models

Three currencies in the East Asian crisis: revisited



Balance sheet effects

- Many currency crises coincide with the crises in the banking sector.
- What is the role of banks in causing and propagating currency crises?
- There may be balance sheet effects.
    - Observation: revenues are denominated often in local currencies (claims on the nontradable sector) but liabilities are often denominated in foreign currency terms (in tradeable goods). There may be currency mismatches. Velasco (1987): an upgraded KFG model.
    - Banks and firms may face liquidity shocks when financing long-term projects with short-term borrowing. Chang and Velasco (2001): An open economy version of the Diamond-Dybvig (1983) model.

Chang and Velasco (2001) Assumptions [I]

- Small open economy
- Three periods $t = 0, 1, 2$.
- One tradeable good with a fixed price in the international currency.
- Domestic agents have an endowment $e > 0$ and have a technology that yields $r < 1$ in period 1 per unit invested and $R > 1$ in period 2. (illiquidity)
- A world capital market with a bond return of 1 in each period.
- A credit constraint of $f > 0$ for domestic agents.

Chang and Velasco (2001) Assumptions [II]

- At $t = 1$ the agents discover their "type" that is drawn in an i.i.d. fashion (no aggregate uncertainty).
- With a probability λ they are "impatient" and want to consume early in period 1.
- O/w they are "patient" and consume at time $t = 2$.
- The type is privately known to the agent.
- Let the expected utility of a representative agent at time 0 be

$$\lambda u(c_1) + (1 - \lambda)u(c_2) \tag{19}$$

  with $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$ (allows closed-form solutions).
- If agents knew they are "impatient" they would prefer to invest abroad than at home.

Chang and Velasco (2001) Assumptions [III]

- Domestic agents form a "bank" (coalition). The bank maximizes the welfare of depositors given by (19).
- By the Revelation Principle, one needs to consider only feasible contingent allocations that give no agent an incentive to misrepresent their type.
- The constraints are:

$$k \leq d + e \tag{20}$$

$$\lambda c_1 \leq b + rl \tag{21}$$

$$(1 - \lambda)c_2 + d + b \leq R(k - l) \tag{22}$$

$$d \leq f \tag{23}$$

$$d + b \leq f \tag{24}$$

$$c_2 > c_1 \tag{25}$$

where d and b is net foreign borrowing in periods 0 and 1, k is the amount invested in the long-term asset, and l is the liquidation value of the long-term asset in period 1.

The social optimum

- $\widetilde{l} = 0$ (no early liquidation).
- The latter implies $\lambda \widetilde{c}_1 = \widetilde{b}$
- The debt ceiling binds: $\widetilde{d} + \widetilde{b} = \widetilde{f}$.
- One can collapse all constraints into one

$$R\lambda\widetilde{c}_1 + (1-\lambda)\widetilde{c}_2 = eR + (R-1)f \equiv Rw \qquad (26)$$

- and one can solve $\lambda\widetilde{c}_1 = \theta w$ and $(1-\lambda)\widetilde{c}_2 = (1-\theta)Rw$ where $\theta \in [0,1]$ and $\theta = \frac{1}{1+\frac{(1-\lambda)}{\lambda}R^{(\sigma-1)/\sigma}}$
- This social optimum is better than autarky: the bank can pool the risks (exactly a fraction λ is "impatient": no aggregate uncertainty) whereas in a decentralized equilibrium an "impatient" individual may liquidate their investments prematurely which is inefficient.

How to implement the social optimum?

- A mechanism of “demand deposits”
- Each agent pays the endowment e into the bank and the funds borrowed abroad.
- The bank will invest $\widetilde{k}$ in the long-term technology, borrow $\widetilde{d}$ in period 0 and $\widetilde{b}$ in period 1.
- The agent then can withdraw either $\widetilde{c}_1$ in period 1 or $\widetilde{c}_2$ in period 2.

Additional assumptions on the bank

- A sequential service constraint: first-come first-serve basis.
- The bank commits to repay (foreign) debt at all circumstances.
- Then, there is a limit on period 1 liquidation $l^+ = \frac{(R\widetilde{k}-f)}{R}$.
- The model becomes of course more interesting if foreign debt is not guaranteed: foreign creditor refusals to lend add to the problem.

Timing of withdrawals in period 1

- A depositor arrives and may withdraw $\widetilde{c}_1$ if the bank is still open.
- The bank first tries to borrow up to $\widetilde{b}$ on the foreign markets to meet liquidity demands
- and then starts liquidating the long-term asset up to the maximum l^+
- If the demands exceed that, the bank closes down and disappears.

Equilibria

An “honest” equilibrium

- Each depositor withdraws according to her true type: “impatient” withdraw $\widetilde{c}_1$ in period 1 and the “patient” obtain $\widetilde{c}_2$ in period 2.

A bank run equilibrium:

- All depositors try to withdraw deposits in period 1: a coordination failure.
- The bank fails if $\widetilde{c}_1 > \widetilde{b} + rl^+$ (if it is illiquid).

Extensions

- A role for the exchange rate.
- The role of foreign creditors: a run may be possible if and only if they refuse to lend in period 1.
- Borrowing in period 0 the full limit: does not solve the problem with positive bank run probability (Chang and Velasco 2000).
- The maturity of external debt...

More recent models

Channels of strategic complementarities?

- Self-fulfilling crises: sovereign defaults, bond prices and lending (Lorenzoni and Werning, 2013)
- Fire sales of assets (Caballero and Simsek, 2016, 2017)
- Externalities of firm borrowing decisions upon others (Korinek 2017)
- Modeling more carefully capital flow transmission and the banking sector (Coimbra and Rey, 2017)

Literature

- Chang R., Velasco A., 2001. A model of financial crises in emerging markets. Quarterly Journal of Economics 116: 489–517.
- Diamond, D., Dybvig, P., 1983. Bank runs, deposit insurance, and liquidity. Journal of Political Economy 91: 401–419.
- Velasco A., 1987. Financial crises and balance of payments crises: A simple model of the southern cone experience. Journal of Development Economics 27: 263–83.

A good introduction to international financial crises:

Lorenzoni G., 2014. International financial crises. Handbook of International Economics, Vol. 4. Elsevier.

This is the end: thank you!

Assignment due: end of March 2018, by mail.

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