CURRENCY CRISES
FIRST- AND SECOND-GENERATION MODELS

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Economists have developed two theoretical approaches to understanding currency crises. The first, referred to as the “first-generation model” or the “canonical model”, demonstrates how a mismatch between domestic policies (typically a fiscal deficit) and an attempt to maintain a fixed exchange rate can lead to a speculative attack on a country’s currency. The second type of models look self-fulfilling speculative attack, developed to account for the interaction between policymakers’ actions and those of speculators given the existence of multiple equilibria.

I. The First-Generation Model

1. Model Specifications

The first-generation model was developed by Paul Krugman (1979) and Flood & Garber (1984) based on a standard macroeconomic monetary model for a small and open economy with flexible prices and at full-employment. There are two types of assets, namely, domestic currency and foreign currency. Perfect foresight is also assumed.

Demand for real money is given by,

$$\frac{M_t}{P_t} = k\bar{Y} - \gamma r_t \qquad (1)$$

where M_t is the money demand in nominal term; P_t is the price level; $\bar{Y}$ is the full-employment income level; r_t is the nominal domestic interest rate; k and γ are positive constant parameters; and subcript t denotes time.

The purchasing power parity holds which implies that,

$$P_t = E_t P^* \qquad (2)$$

where P^* is the foreign price level, which is assumed to be constant; and E_t is the exchange rate, which is defined as domestic currency price of foreign currency.

The covered interest parity holds in each period.

$$\frac{1+r_t}{1+r^*} = \frac{E^e_{t+1}}{E_t}$$

where r^* is the nominal foreign interest rate, which is fixed by assumption; and E^e_{t+1} is the one-year expected exchange rate.

The interest rate equation can be rewritten by approximation as,

$$r_t - r^* = \frac{\Delta E_t^e}{E_t} \quad (3)$$

where ΔE_t^e is the expected change in the exchange rate after one year. Thus, $\Delta E_t^e/E_t$ is the expected rate of depreciation of the domestic currency vis-à-vis the foreign currency.[1]

The money supply is equal to the sum of the central bank's foreign exchange reserves and the domestic credit.

$$M_t = R_t + D_t \quad (4)$$

where R_t is the foreign exchange reserve; and D_t is the domestic credit.[2]

The financing of chronic fiscal deficits by money printing implies that the domestic credit increases continually at an average rate of μ per period.

$$D_t = D_0(1 + \mu.)^t \quad (5)$$

where D_0 is the level of the domestic credit at $t = 0$.

Substituting equation (2) and (3) into equation (1), we obtain:

$$\frac{M_t}{P^* E_t} = k\overline{Y} - \gamma\left(r^* + \frac{\Delta E_t^e}{E_t}\right) \quad (6)$$

2. The Fixed Exchange Rate Regime

From period $t = 0$ onwards, a policy of fixed exchange rate is pursued the government. This implies that the expected rate of depreciation of the domestic currency is equal to zero ($\Delta E^e/E = 0$).

Equation (6) becomes:

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[1] The original expression can be written as $\frac{1+r_t}{1+r^*} = 1 + \frac{E^e_{t+1} - E_t}{E_t}$, or $\frac{1+r_t}{1+r^*} = 1 + \frac{\Delta E_t^e}{E_t}$. Taking logarithm of both sides of the equation, we obtain: $\ln(1+r) - \ln(1+r^*) = \ln\left(1 + \frac{\Delta E_t^e}{E_t}\right)$, or : $r_t - r^* = \frac{\Delta E_t^e}{E_t}$. (Note that with a small value of x, $\ln(1 + x) \approx x$).

[2] This equation can be easily derived from the consolidated balance sheet of the banking system (i.e. the central bank plus deposit-taking institutions). In this balance sheet, the sum of the foreign exchange reserves and the domestic credit on the assets side is equal to the sum of the domestic currency in circulation and the amount of bank deposits on the liabilities side, and is equal to the money supply.

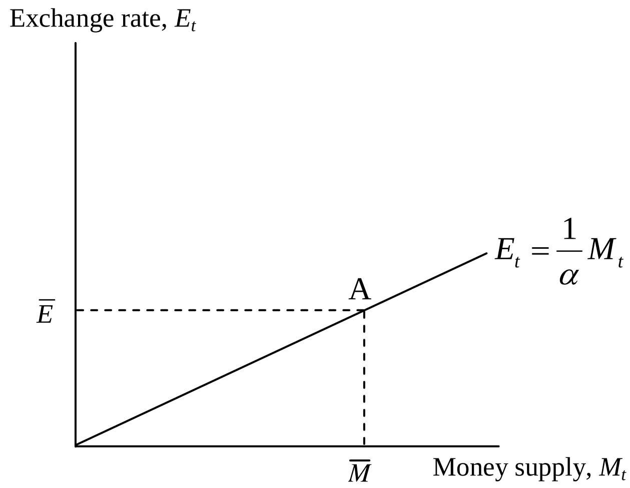
$$\frac{M_t}{P^* E_t} = k\bar{Y} - \gamma r^*$$

Solving for E_t, we obtain:

$$E_t = \frac{M_t}{P^*(k\bar{Y} - \gamma r^*)}.$$

Let $\alpha = P^*(k\bar{Y} - \gamma r^*)$, we have:

$$E_t = \frac{1}{\alpha} M_t \quad (7)$$



Under the fixed exchange rate, $E_t = \bar{E}$.
Equation (7) becomes:

$$\bar{E} = \frac{1}{\alpha}\bar{M}$$

Under the fixed exchange rate regime, the economy is at point A in the diagram. To achieve this policy target, the central bank has to fixed the money supply at $\bar{M}$.

Given the increasing amount of the domestic credit, the central bank has to reduce (sell) its foreign exchange reserves to ensure that the money supply remains unchanged. Equation (4) shows that any increase in the domestic credit has to be offset by an equal amount of the foreign exchange reserves.

3. The Floating Exchange Rate Regime

Eventually, the foreign exchange reserves will be depleted if there is no inflow. The government has no option but to abandon the fixed exchange rate.[3] If the fiscal deficit still exists and the foreign exchange reserves is already zero, then the rate of increase of the domestic credit is equal to the growth rate of the money supply, which in turn is equal to the rate of depreciation of the domestic currency.

$$\mu = \frac{\Delta D_t}{D_t} = \frac{\Delta M_t}{M_t} = \frac{\Delta E_t^e}{E_t} \quad (8)$$

Substituting equation (8) into equation (6), we obtain:

$$\frac{M_t}{P^* E_t} = k\bar{Y} - \gamma(r^* + \mu) \text{ or } E_t = \frac{M_t}{P^*[k\bar{Y} - \gamma(r^* + \mu)]} = \frac{M_t}{P^*(k\bar{Y} - \gamma r^*) - P^*\gamma\mu}$$

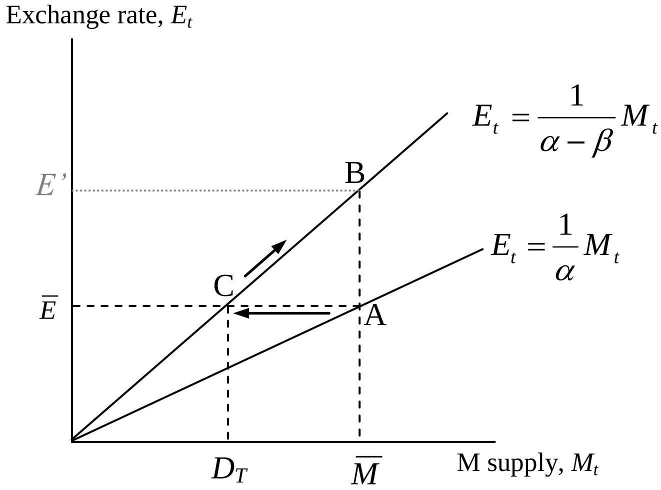
Let $\beta = P^*\gamma\mu$ and recall that $\alpha = P^*(k\bar{Y} - \gamma r^*)$, we have:

[3] In reality, the central bank is forced to abandon the fixed exchange rate when the foreign exchange reserves are below a low albeit positive level. For simplicity, we assume that that level is zero.

$$E_t = \frac{1}{\alpha - \beta} M_t \qquad (9)$$

Thus, after floatation, the exchange rate is determined by equation (9). $R = 0$ and $M_t = D_t$.

4. *Speculative Attack and the Collapse of the Exchange Rate*



The diagram on the right depicts the exchange rate equations (7) and (9).

When the exchange rate is fixed, the economy is at point A on the line $E_t = \frac{1}{\alpha} M_t$. Under the floating rate, the economy is on the line $E_t = \frac{1}{\alpha - \beta} M_t$. But exactly at which point on the line $E_t = \frac{1}{\alpha - \beta} M_t$ that the economy will move to when the floating rate policy is announced?

If the foreign exchange reserves were allowed to decline continually to zero, at which time the central bank will float the rate and the money supply will comprise entirely of the domestic credit, the shift would from A to B. The exchange rate would 'jump' immediately from $\bar{E}$ to *E'*. Anybody holding a positive amount of the currency at that point in time would suffer losses due to this sudden decline in the value of the domestic currency.

If the central bank makes public the true level of its foreign exchange reserves from time to time, investors with perfect foresight will know for certain the time at which the foreign exchange reserves is depleted. They will try to exchange any of their domestic currency for the foreign currency before the exchange rate is floated in order to avoid losses. As long as the prospect of a sudden decline in the value of the domestic currency remains, investors will try to get out of their domestic currency earlier and earlier before that time of the flotation.

As a result, at the time of the fixed exchange rate collapse and the start of the floating rate policy, the shift as depicted in the diagram above cannot be from A to B. Rather, it is from A to C so that there is no change in the exchange rate at the time of the shift. Why? When the reserves fall to a critical level, investors will become aware of the eventual collapse of the fixed exchange rate and will, therefore, sell the domestic currency for the foreign one. This is culminated in a speculative attack after which the remaining foreign exchange reserves fall *instantly* to zero. The money supply falls *instantly* by an amount equal the loss of the remaining reserves, which is represented by the distance between A and C in the diagram. As the shift in the exchange rate policy is fully anticipated, nobody suffer a loss and realize a gain since the movement is from A to C and there is no instant jump in the exchange rate. After the shift, the money supply begins to rise, causing the exchange rate to be continually depreciated along the line $E_t = \frac{1}{\alpha - \beta} M_t$.

We can determine the exact time *T*, at which the speculative attack occurs and the foreign exchange reserves fall instantly to zero.

Recall that at the particular moment *T*, the exchange rate does not change.

$$\overline{E} = E_T = \frac{1}{\alpha - \beta} M_T .$$

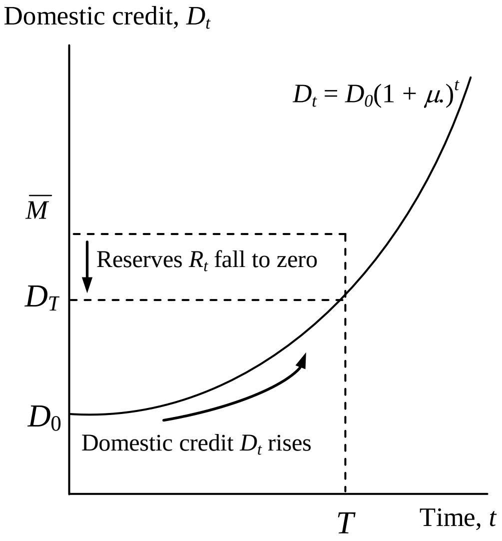
As $\overline{E} = \frac{1}{\alpha}\overline{M}$, we have: $\frac{1}{\alpha}\overline{M} = \frac{1}{\alpha - \beta} M_T$

Also at *T*, $R_T = 0$ and $M_T = D_T$. From equation (5), we have: $D_T = D_0(1 + \mu)^T$. Thus,

$$\frac{1}{\alpha}\overline{M} = \frac{1}{\alpha - \beta} D_0 (1 + \mu)^T$$

$$\Leftrightarrow \quad (1+\mu)^T = \frac{\alpha - \beta}{\alpha}\frac{\overline{M}}{D_0}$$

$$\Leftrightarrow \quad T = \log_{1+\mu}\left(\frac{\alpha - \beta}{\alpha}\frac{\overline{M}}{D_0}\right)$$



From the above diagram, the domestic credit D_t rises continually at the rate of μ. The foreign exchange reserves fall accordingly to maintain the constant supply of money. At time *T*, the reserves fall to a critical level, hastening a speculative attack. The reserves are depleted instantly causing the money supply to shrink at that moment from $\overline{M}$ to M_T (=D_T). The central bank is forced to float the exchange rate.

Concept Check Question: What would happen if the central bank chose to withhold the foreign exchange reserves data from the public?

II. The Second-Generation Model

Obstfeld (1994) developed the so-called second-generation model to explain the collapse of the European Exchange Rate Mechanism (ERM) in 1992, which cannot be explained by the first-generation model given the existence of healthy foreign exchange reserves positions and the absence of chronic budgetary deficits on the part of the ERM member countries.

As applied to the ERM crisis, the government was faced with the choice between sticking to an exchange rate peg (with no output stabilization) and a surprise devaluation which would create extra jobs: in conditions of high unemployment, it would not take much to lead people to expect the latter and it would be optimal for the government to behave accordingly, i.e., self-fulfilling. As Obstfeld and Rogoff (1997, p.652) point out "With multiple equilibria some seemingly unimportant event could trigger an abrupt change in expectations, shifting the equilibrium... Such an event would look much like [a] sudden speculative attack on [the] exchange rate".

Thus, the possibility of a speculative attack depends on the government's level of commitment in protecting the fixed exchange rate. More specifically, the government has two options: (i) maintaining the fixed exchange rate even in the face of an attack so that its policy credibility is preserved; or (ii) abandon the fixed rate to pursue expansionary monetary policy in a hope to stimulate the economy and create jobs. Speculators, at the same time, have two options: (i) attacking the domestic currency; or (ii) not attacking the domestic currency.

This interaction between the speculators' decision and the government's policy actions can be depicted by a game theory's payoff matrix as follows.

		Government	
		Abandon fixed ER	Defend fixed ER
Speculators	Attack	2; –1	–2; –4
	Don't attack	0; 1	0; 2

As shown by the matrix, multiple equilibria exist: (i) the speculators attack and the government abandon its fixed exchange rate; or (ii) the speculators do not attack and the government maintain its fixed exchange rate.

The implication of the model is that a currency crisis may occur, not because of weak economic fundamentals, but because of market expectation or self-fulfilling prophecy.