

A THEORETICAL OVERVIEW OF THE FIRST AND SECOND GENERATION
MODELS OF CURRENCY CRISES

A Master's Thesis

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To Nefise Emel and Şükrü

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ABSTRACT

A THEORETICAL OVERVIEW OF THE FIRST AND SECOND GENERATION MODELS OF CURRENCY CRISES

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This study reckons a comprehensive and holistic overview of first and second generation models of currency crises. The main characteristics and assumptions of these models are portrayed and the motives behind these models are illustrated. By and large, the seminal papers which have been sources of inspiration for the evolution of the currency crisis theory are demonstrated in detail. Moreover, incorporations of various elements from economic theory into these models and extensions are discussed briefly. Finally, a very basic intuition about how successful these models are in giving explanations of currency crises that countries have experienced is given.

Keywords: Currency Crises, Speculative Attacks

ÖZET

BİRİNCİ VE İKİNCİ NESİL DÖVİZ KRİZİ MODELLERİNİN TEORİK AÇIDAN GENEL GÖRÜNÜMÜ

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Bu çalışma birinci ve ikinci nesil döviz krizi modellerinin kapsamlı ve bütüncül bir görünümünü sunmaktadır. Bu modellerin temel özellikleri ve varsayımları betimlenmekte ve bu modellerin arkasındaki gerekçeler açıklanmaktadır. Genel olarak, döviz krizi teorisinin evrimine ilham kaynağı olmuş önemli makaleler ayrıntılı bir şekilde gösterilmektedir. Ayrıca, bu modellerin içinde bulundurulan ekonomi teorisinden gelen farklı unsurlar ve uzantıları kısaca tartışılmaktadır. Sonuçta, bu modellerin ülkelerin yaşadığı döviz krizlerini açıklamada ne kadar başarılı olduklarına ilişkin çok temel bir sezgi verilmektedir.

Anahtar Kelimeler: Döviz Krizleri, Spekülatif Ataklar

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CHAPTER I

INTRODUCTION

*“The government is needy for even 70 cents.”
Süleyman Demirel, the Prime Minister of Turkey, 1979*

Burnside et al. (2007: 1) define the currency crisis as an episode in which the exchange rate depreciates substantially during a short period of time. As Kaminsky (2006) reported 96 currency crises in 20 countries¹ during the period from January 1970 to February 2002, it is not surprising to see such an extensive literature on this topic. The main feature of this extensive literature is that it has a model-based approach. The models in this literature are often categorized as first-, second- which Jeanne (1999) calls also as “Escape Clause”, and third-generation.

The first-generation models were mostly developed to explain the crises occurred in Latin America in the 1960s and 1970s (Kaminsky, 2006: 505). The common deduction of these models was that unsustainable fiscal policy caused the collapse of a fixed exchange rate regime. In other words, deterioration of the fundamentals resulting from inconsistent economic policies led to financial crises (Sbracia and Zaghini, 2001: 204). These models’ main focus was on the dynamics of

¹ Industrial countries: Denmark, Finland, Norway, Spain, Sweden; Developing countries: Argentina, Bolivia, Brazil, Chile, Colombia, Indonesia, Israel, Malaysia, Mexico, Peru, the Philippines, Thailand, Turkey, Uruguay, Venezuela

speculative attacks against a currency at the root of which fundamental imbalances take place (Cavallari and Corsetti, 2000: 275-276). The classic first-generation models are those of Krugman (1979) and Flood and Garber (1984a). The former one was inspired by the main upshot of Henderson and Salant (1978) that attempts to restrict the price of any exhaustible resource by means of a buffer stock will inevitably result in a speculative attack. In Krugman's (1979) setting, the exhaustible resource was the foreign currency whereas the buffer stock was the foreign exchange reserves held by the central bank in this context. In his highly simplified macroeconomic model, the key ingredients were the assumptions made concerning purchasing power parity (PPP), the government's budget constraint, the money demand function, the post-crisis monetary policy and so on. However, due to nonlinearities involved in this model, Krugman was unable to derive an explicit solution for the collapse time in a fixed exchange rate regime. Later on Flood and Garber (1984a) came up with examples of linear models in which the time of the collapse could exactly be derived using a process of backwards induction (Agenor et. al., 1992: 358).

The limitations of first generation models in explaining European Monetary System crisis of 1992-1993 and the 1994 Mexican peso crisis led researchers to reassess their thoughts on the causes of currency crises. Flood and Marion (1996) argue that many of the European countries, and later Mexico, were running disciplined macroeconomic policies when their currencies were attacked - which was contradictory to what first-generation models envisaged. So theorists proposed new models which were named "second-generation" models in order to explain the underlying causes of the crises mentioned above. The most-widely recognized works

of second-generation models of currency crises are Obstfeld (1986, 1994, 1996), Calvo (1995), Sachs, Tornell, Velasco (1996), Cole and Kehoe (1996), Bensaid and Jeanne (1997) and Drazen (1998) all of which were based on early work done by Flood and Garber (1984b). Esquivel and Larrain (1998) emphasizes that a common theme of these alternative models is their focus on the possibility of crises even in the absence of a continuous deterioration in economic fundamentals. The main assumptions of the second-generation models are that the government is an active agent that optimizes an objective function and a circular process which leads to multiple equilibria exists. Since pure expectations might bring about a switch between various equilibria, the second-generation models accept the possibility of self-fulfilling crises.

What is more, in order to understand the nature of speculative attacks, another stream of second generation models most of which drew upon game theory arose. These models –which had different set ups and departed from each other- were chiefly examining the strategic interactions between speculators. The most famous examples of these models are Banerjee (1992), Bikhchandani, Hirshleifer and Welch (1992), Morris and Shin (1995) and Calvo and Mendoza (1997).

Lastly, accompanied by the increased level of globalization, analysts began to contemplate on *contagion* effects. Various interdependences between countries were considered as one of the reasons underlying the currency crises which could not be explained by “bad” economic fundamentals. Gerlach and Smets (1995), Buiters et al. (1996), can be held as examples of this type of second generation currency crisis models.

The remainder of the paper goes as follows: Section II gives an overview of first-generation models and presents an illustration. Section III discusses about second-generation models and Obstfeld (1994)'s model is explained in detail. Finally, section IV concludes.

CHAPTER II

FIRST GENERATION MODELS

After the collapse of the Bretton Woods agreements in 1971, a number of currency crises emerged. In the end of the 1970s and during the following decade, most of these currency crises came about in Latin America. A new strand of models, which were labeled as first-generation models, was developed in order to capture the main features and spread of the above-mentioned currency crises.

Developed in 1980s, these models echoed the prevalent views about currency crises for more than a decade. In his pioneering work, Krugman (1979) argued that when a continuous deterioration in the economic fundamentals turns out to be inconsistent with the policy of fixing the exchange rate, a currency crisis occurs. The above mentioned continuous deterioration is originated from the excessive creation of domestic credit so as to finance fiscal deficits. Basically, the model assumes that the government is restrained from accessing to capital markets; thence, it has to monetize its expenditures. Burnside et al. (2007) elucidates this juncture in an intuitive way. In a fixed exchange rate regime a government must fix the money supply in conformity with the fixed exchange rate. This exigency acutely limits the government's ability to raise seigniorage revenue. Besides, the government runs an enduring primary deficit. This deficit implies that the government must either deplete

foreign exchange reserves or borrow to finance the deficit. However, since the government faces a restriction about accessing to capital markets, it has to make use of its foreign exchange reserves-which is a constraint for the government, too and of which infinite use is impossible. Therefore, in the absence of financial reforms, the government must eventually finance the above mentioned deficit by printing money to raise seigniorage revenue which is inconsistent with keeping the exchange rate fixed. Consequently, it is predicted that the regime must eventually collapse.

Speculators play a vital role in this set up. They attack against foreign exchange reserves in anticipation of capital gains, thereby predating the collapse of the fixed exchange rate regime. This attack always occurs before the central bank would have run out of reserves in the absence of speculation. By speculating against foreign currency, investors change their portfolio composition, cutting down the proportion of domestic currency and increasing the proportion of foreign currency.

Generally speaking, the standard first-generation model combines a linear behavior rule by the private agents, namely the money demand function, with linear government behavior- domestic credit growth. All of this linearity interacts with the condition that perfectly foreseen profit opportunities are absent in equilibrium to generate a unique time for a foreseen possible speculative attack (Flood and Marion, 1998: 14).

2.1 An Example of First-Generation Model

In this section, a perfect-foresight, continuous time model by Flood and Garber (1984a) is presented. They construct a linear example in order to study the collapse time of a fixed exchange-rate regime. The model preserves essential elements of Krugman's non-linear analysis. Furthermore, they invent a new concept- shadow floating exchange rate- in order to perform the analysis.

2.1.1 Assumptions

This is a small country model with purchasing power parity (PPP). It is assumed that agents have perfect foresight and that domestic residents can hold domestic money, domestic bonds, foreign money and foreign bonds as assets. The domestic government holds a stock of foreign currency in order to use in fixing the exchange rate. It is assumed that private domestic residents will hold no foreign money since it yields no monetary services. What is more, domestic and foreign bonds are perfect substitutes.

The model is built around five equations:

$$\frac{M(t)}{P(t)} = a_0 - a_1 i(t), \quad (1)$$

$$M(t) = R(t) + D(t), \quad (2)$$

$$\dot{D}(t) = \mu, \quad \mu > 0, \quad (3)$$

$$P(t) = P^*(t)S(t), \quad (4)$$

$$i(t) = i^*(t) + [\dot{S}(t)/S(t)], \quad (5)$$

where $P(t)$, $M(t)$, and $i(t)$ are the price level, domestic money stock and interest rate, respectively. $D(t)$ and $R(t)$ represent the domestic credit and domestic government book value of foreign money holdings, respectively. $S(t)$ is the spot exchange rate, i.e. the domestic money price of foreign money. An asterisk (*) attached to a variable indicates “foreign”, and a dot over a variable (·) indicates the time derivative.

Equation (1) represents the money market equilibrium condition. Equation (2) specifies that the money supply is equal to the book value of international reserves plus domestic credit. Equation (3) states that the domestic credit always grows at the positive constant rate μ . In other words, it grows monotonically over time and this growth is used to finance government expenditure. Equations (4) and (5) reflect purchasing power parity and uncovered interest parity, respectively.

2.1.2 The Sequels of the Model

In what follows, we use (4) and (5) to get:

$$M(t) = \beta S(t) - \alpha \dot{S}(t) \quad (6)$$

where $\beta \equiv a_0 P^* - a_1 P^* i^*$ and $\alpha = a_1 P^*$. Both α and β are constants since they are linear combinations of the constants P^* and i^* .

If the exchange rate is fixed at $\bar{S}$, reserves will adjust to maintain money market equilibrium. The quantity of reserves at any time t is²

$$R(t) = \beta \bar{S} - D(t), \quad (7)$$

If we take the time derivative of (7), we can compute the rate of change of reserves, i.e. the balance of payments deficit:

$$\dot{R}(t) = -\dot{D}(t) = -\mu, \quad (8)$$

Since there is a lower bound on net reserves and $\mu > 0$, the fixed exchange rate regime cannot survive evermore due to exhaustion of finite reserve stock earmarked to support the fixed exchange rate. It is assumed that the government will support the fixed rate as long as its net reserves remain positive. After the fixed-rate regime has collapsed, the exchange rate floats freely evermore.

The main problem in finding the collapse time is in connecting the fixed-exchange rate regime to the post-collapse floating regime. The floating exchange rate

² We know that $M(t) = \beta S(t) - \alpha \dot{S}(t)$. $\dot{S}(t)$ will be zero since the exchange rate is fixed. So $M(t) = \beta \bar{S} = R(t) + D(t) \rightarrow R(t) = \beta \bar{S} - D(t)$

conditional on a collapse at an arbitrary time z , referred to as “shadow floating exchange rate” has to be determined.

If the fixed exchange rate regime collapses at any time z , the government will have depleted its foreign currency reserve stock at z . That corresponds to the situation which left the Turkish Prime Minister Süleyman Demirel in despair as stated in the quotation in the very first part.

Instantaneously, the post-attack money market equilibrium requires from Equation (6):

$$M(z_+) = \beta S(z_+) - \alpha \dot{S}(z_+), \quad (9)$$

where z_+ points out the moment after attack. Beyond what has been said, $M(z_+) = D(z_+)$ since $R(z_+) = 0$, that is there are no reserves left. In addition to this, the government does not intervene in exchange markets under the new regime, thus exchange rate floats. In order to come up with floating exchange rate solution, the method of undetermined coefficients in the solution form of $S(t) = \lambda_0 + \lambda_1 M(t)$ is used. Considering that $\dot{M}(t) = \dot{D}(t) = \mu$ and substituting this trial solution into Equation (6), we find that $\lambda_0 = \alpha\mu/\beta^2$ and $\lambda_1 = 1/\beta$. Therefore,

$$S(t) = \frac{\alpha\mu}{\beta^2} + \frac{M(t)}{\beta}, \quad t \geq z. \quad (10)^3$$

Since this is perfect-foresight model, agents can foresee the collapse. Firstly, suppose that agents expect a collapse at z and anticipate $S(z_+) > \bar{S}$. The speculators attacking government reserves at time z will make an aggregate profit of an amount $[S(z_+) - \bar{S}]R(z_-)$, where z_- is the moment just before the collapse. An individual speculator, foreseeing the attack at z , has incentives to forestall the other speculators by buying all the reserves prior to z . Hence, the attack will occur at an earlier moment.

On the other hand, assume that agents expect an attack at time z and a currency appreciation, that is, $[S(z_+) < \bar{S}]$. Then the speculators will accrue negative profits since $[S(z_+) - \bar{S}]R(z_-) < 0$. Thus, agents would have no incentive to attack against the government's reserves and consequently the fixed exchange regime would survive.

Referring to the reasoning above, we can conclude that at the moment of the anticipated attack it will be the case that $S(z_+) = \bar{S}$. Using this condition, we can derive both the timing of the attack and the level of government reserve holdings at the time of the attack. If we substitute $D(t) = D(0) + \mu * t$ for $M(t)$ in Equation (10),

³ From eq. (6) it follows that $\beta\dot{S}(t) = \dot{M}(t) + \alpha\dot{S}(t)$. If you take the time derivative of this expression you obtain: $\beta\dot{S}(t) = \dot{M}(t) = \mu$. Since $\dot{S}(t) = \mu/\beta \rightarrow S(t) = \left[\frac{\alpha\mu}{\beta^2}\right] + \frac{M(t)}{\beta}$

we obtain the shadow floating exchange rate, which would materialize at the collapse time of the fixed exchange rate. After a little algebra we get:

$$z = \frac{\bar{S}\beta - D(0)}{\mu} - \frac{\alpha}{\beta} = \frac{R(0)}{\mu} - \frac{\alpha}{\beta}. \quad (11)^4$$

Equation (11) justifies the intuitions as either a higher value of $R(0)$, namely an increase in initial reserves, or a lower value of μ , which corresponds to a lower rate of domestic growth, delays the collapse. In the limiting case, as $\mu \rightarrow 0$ the collapse is hindered indefinitely. However, either a lower $R(0)$ or a higher μ expedites the collapse.

In order to couple the domestic credit growth rate with the level of reserves prior to the collapse, we will refer to Equation (7):

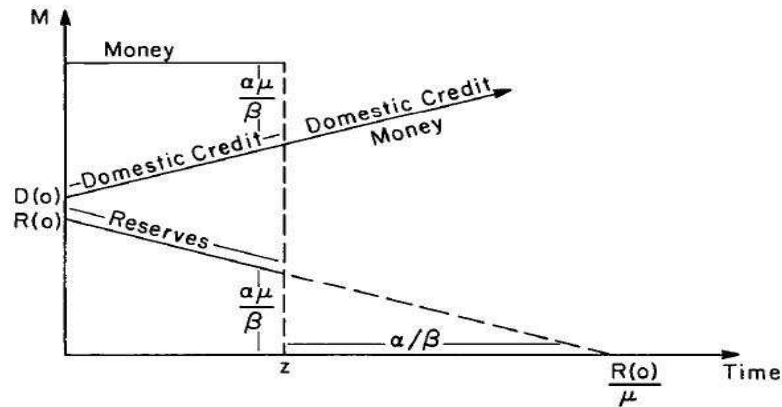
$$R(z_-) + D(z_-) = \beta\bar{S} \Rightarrow \bar{S} = \frac{R(z_-) + D(z_-)}{\beta}. \quad (12)$$

Given equations (11), (12) and the expression $D(z_-) = D(0) + \mu z$, we determine that

$$R(z_-) = \frac{\alpha\mu}{\beta}. \quad (13)$$

⁴ $S(t) = \frac{\alpha\mu}{\beta^2} + \frac{D(0) + \mu t}{\beta}$ so $\alpha\mu + \beta D(0) + \beta\mu z = \bar{S}\beta^2$. If we divide both sides by β we get $\frac{\alpha\mu}{\beta} + D(0) + \mu z = \bar{S}\beta$. We can obtain z from this expression.

Figure 1: The Time Paths of Reserves, Domestic Credit, and the Money Supply during the Period Surrounding the Collapse



Source: Flood and Garber (1984a)

In Figure 1, the time paths of reserves, domestic credit and the money supply during the period around the collapse are depicted. Money supply is constant prior to the collapse at z ; however, its constituents alter. The domestic credit grows and the foreign exchange reserves fall at the rate μ . At time z , both money and reserves decrease by $\alpha\mu/\beta$. Since there is no exchange reserve left, money equals domestic credit after z . Besides, $R(0)/\mu$ on the horizontal axis indicates the time when reserves would be depleted in the absence of a speculative attack.

2.2 General Discussion on First-Generation Models

In most first-generation models, the speculative attack is triggered by a monetary or fiscal policy which is inconsistent with the maintenance of the fixed currency peg. Thus, it is not difficult to diagnose the bad fundamental which is

simply a monetary or fiscal policy. Jeanne (1999) argues that one of the main contributions of the first-generation models was to show that the currency crises associated with the failure of stabilization plans of Latin American countries in the 1970s and 1980s were the natural consequence of the monetary and fiscal policies implemented in these countries.

Yet, these models suffered from some weaknesses. Eijffinger and Goderis (2007a) argue that the weaknesses of first-generation models became apparent after the crisis in the European Monetary System (EMS) in 1992-93, which was not characterized by structural government deficits or a gradual exhaustion of foreign reserves. Instead, governments had widened their exchange rate bands due to sudden speculative attacks on their currencies. Burnside et al. (2007) claims that a shortcoming of that type of first-generation model discussed above is the deterministic nature of the timing of the speculative attack. Obstfeld (1994) criticizes these models on that they ignored the policy options authorities can use. He concludes that since the actions of rational speculators must be stipulated on the endogenous reply of the authorities, these models give relatively little help when explaining the factors causing crises. Among the endogenous policy changes made by the government, for example, monetary policies such as interest rate decisions loom large. Eijffinger and Goderis (2007b) states that the conventional argument is that higher interest rates uphold exchange rates by discouraging capital outflows and increasing the costs of speculating against the currency of the crisis country.

What is more, Agenor et al. (1992) argues that this early literature on balance of payments crises put too much emphasis on financial aspects thereby ignoring the

real events. However, the empirical evidence reveals that balance of payments crises are often associated with huge trade balance and current account movements around the crisis period.

The lack of perfect access to international capital markets is another weakness of these types of models. In the presence of perfect access to international capital markets, the central bank can create foreign reserves by borrowing without violating the government's intertemporal budget constraint. Thus, a regime collapse could be prevented indefinitely, at least in principle, thanks to such access to unlimited borrowing.

CHAPTER III

SECOND GENERATION MODELS

The limitations of the first-generation models concerning the underlying causes of currency crises became much more apparent after the European Monetary System crises of 1992-93. The crises of EMS in 1992 and 1993 cannot be related to expansionary monetary policies since most of the European countries implemented strict and converging policies in accordance with Bundesbank in order to promote the single European currency.

Jeanne (1999) claims that while countries such as Spain and Italy were running excessively expansionist monetary and fiscal policies, the others, like France and Great Britain, were clearly not. Accordingly, a number of authors have come up with alternative explanations of currency crises- called second-generation models. A common theme of these models is their focus on the possibility of crises even in the absence of a continuous deterioration in economic fundamentals (Ezquível and Larrain, 1998: 3).

In second-generation models, the government optimizes an explicit objective function. This optimization problem is regarding when policies run by the government respond to changes in private behavior or when the government faces a trade-off between fixing the exchange rate and other alternative policies. The above mentioned optimization problem yields nonlinear behaviors by government which bring about multiple equilibria. Since pure expectations cause a switch between these equilibria, many of second-generation models accept the possibility of self-fulfilling crises. A typical example can be in the following form: when the swerve pessimism of a large group of investors stimulates a capital outflow, it leads to the collapse of the exchange rate system, thus validating the negative expectations. Ezquível and Larrain (1998) suggest that these models underline the role of expectations by taking into account the strategic complementarities of the actions of economic agents in determining the ultimate effect.

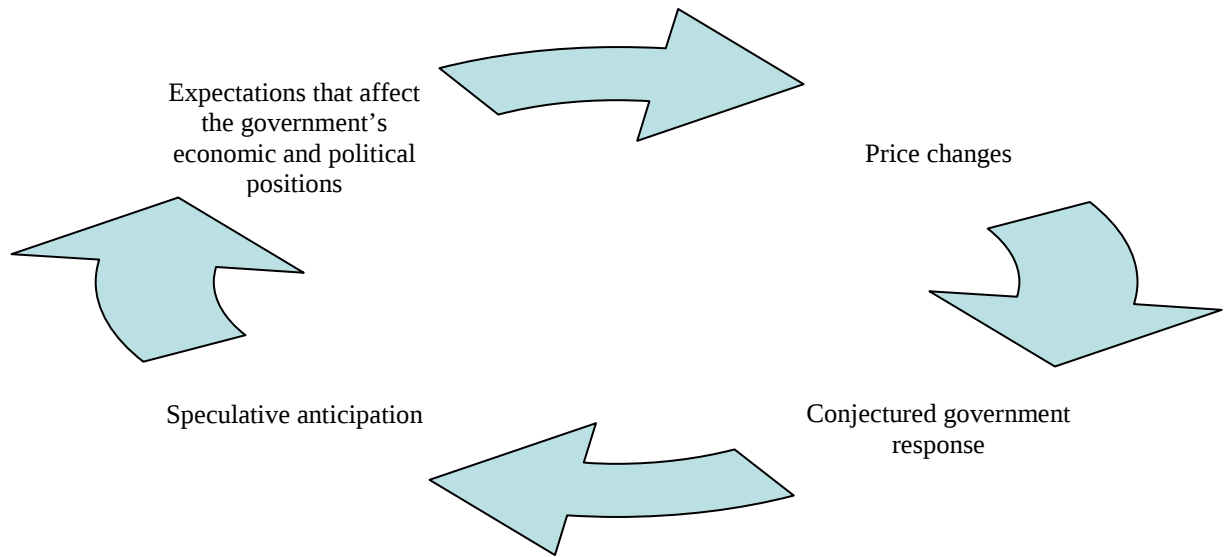
Among extensions of second-generation models, game-theoretic approach such as herd behavior looms large so as to unfold expectations and speculative attacks. Besides, in order to unveil the currency crises triggered by interdependencies between countries, the models including *contagion* effects were proposed.

3.1 An Example of Second-Generation Model

In his expository work, Obstfeld (1994) states that speculative anticipations hinge on conjectured government responses, which depend, in turn, on how price changes that are themselves kindled by expectations that affect the government's

economic and political positions. He concludes that this circular dynamic implies a potential for crises that need not have occurred, but that do occur since market participants anticipate them to. Below, his model about the role of nominal interest rates is presented in detail.

Figure 2: The Circular Dynamic Potential for Currency Crises



3.1.1 Assumptions

In this set up, the world lasts for two periods, denoted 1 and 2. We will consider the position of a government that issues a domestic currency unit (lira in this set up) but also involves in foreign currency (the mark) market. The government enters period 1 with obligations to pay claimants the nonnegative amounts ${}_0D_1$ lira in period 1 and ${}_0D_2$ lira in period 2. Likewise, in period 1 the government receives payments of ${}_0f_1$ marks in period 1 and ${}_0f_2$ marks in period 2. The real government

consumption in the two periods, g_1 and g_2 , are given exogenously. Lastly, the government can levy taxes on output at rate τ to balance its budget, but only in period 2.

The assumptions of purchasing power parity and $E = P$ are employed. In period 1, the lira/mark exchange rate is fixed at E_1 , however, in period 2 the rate may be changed to E_2 . The letter i denotes the nominal interest rate on loans made in period 1 and repaid in period 2. The new lira obligations due in period 2 incurred by the government in period 1 are denoted by ${}_1D_2$. Then the period 1 constraint is:

$${}_1D_2 = (1+i) \left[{}_0D_1 + E_1g_1 - E_1({}_0f_1) + \frac{E_1({}_1f_2)}{1+i^*} \right], \quad (14)^5$$

In period 2, the government must meet all obligations and additionally it should spend E_2g_2 lira. The revenue to finance these obligations is generated from mark assets, taxes on domestic output y , and any increase in the amount of (high-powered) money residents wish to hold in period 2, M_2 , over the amount held in period 1, M_1 . Thus, the implied period 2 constraint is:

$${}_1D_2 + {}_0D_2 - E_2[{}_1f_2 + {}_0f_2] + E_2g_2 = E_2\tau y + M_2 - M_1, \quad (15)$$

⁵ New lira obligations due in period 2 = (1+interest rate)*(lira debt service + government consumption expenditure + acquisition of new mark assets – mark receipts that accrue in period 1)

Under the capital mobility and uncovered interest-rate parity assumptions, perfect-foresight equilibrium requires the ex-post equality of lira and mark asset returns, measured in lira,

$$1+i = \frac{E_2}{E_1}(1+i^*). \quad (16)$$

Equations (14), (15) and (16) can be combined to yield the government's intertemporal budget constraint which is expressed in lira:

$$E_1({}_0f_1) - {}_0D_1 + \frac{E_2({}_0f_2) - {}_0D_2}{1+i} = E_1g_1 + \frac{E_2g_2 - \tau y - (M_2 - M_1)}{1+i}. \quad (17)$$

On the other hand, private money demand obeys the very basic quantity equation:

$$M_t = kE_t y \quad [t=1,2], \quad (18)$$

where real output is assumed to be constant.

Subsequently, the government is concerned about the distorting effects of (ex-post) inflation and the tax rate. Due to the fact that these variables are zero in period 1 by assumption, the quadratic loss function the government minimizes can be written as:

$$L = \frac{1}{2}\tau^2 + \frac{\theta}{2}\varepsilon^2, \quad (19)$$

where ε is the depreciation rate of lira against the mark (the inflation rate of lira prices) between periods 1 and 2:

$$\varepsilon = \frac{E_2 - E_1}{E_2} \quad (20)$$

We can combine Equations (14) and (15) in order to clarify the fiscal role of the depreciation rate ε . This yields:

$$\varepsilon({}_1d_2 + {}_0d_2 + ky) + \tau y = {}_1d_2 + {}_0d_2 + g_2 - {}_1f_2 - {}_0f_2, \quad (21)$$

where ${}_1d_2 = (1+i)\left({}_0d_1 + g_1 - {}_0f_1 + \frac{{}_1f_2}{1+i^*}\right)$ and the symbol ${}_td_s$ denote the real value at the period 1 price level of the lira government debt payment promised on date t for date $s > t$.

Equation (21) states that in the second period, the revenues of the inflation levy plus conventional taxes must be sufficient to repay the government's net debt and pay for current spending.

3.1.2 The Sequels of the Model

In period 2, the government chooses ε and τ to minimize its quadratic loss function subject to Equation (21). Momentously, all variables in (21) are predetermined except ε and τ . On the other side, the private sector has rational expectations regarding the objectives of the government. Besides, the forecast of lira depreciation incorporated in the nominal interest rate i is based on the assumption that the government will act in this way.

$$\text{Min}_{\varepsilon, \tau} L = \frac{1}{2}\tau^2 + \frac{\theta}{2}\varepsilon^2 \text{ subject to } \varepsilon({}_1d_2 + {}_0d_2 + ky) + \tau y = {}_1d_2 + {}_0d_2 + g_2 - {}_1f_2 - {}_0f_2.$$

If we write the Lagrangian and find the first order conditions:

$$L = \frac{1}{2}\tau^2 + \frac{\theta}{2}\varepsilon^2 - \lambda[\varepsilon_1d_2 + \varepsilon_0d_2 + \varepsilon ky + \tau y - {}_1d_2 - {}_0d_2 - g_2 + {}_1f_2 + {}_0f_2],$$

$$\frac{\partial L}{\partial \tau} = \tau - \lambda y = 0 \rightarrow \tau = \lambda y \rightarrow \lambda = \frac{\tau}{y},$$

$$\frac{\partial L}{\partial \varepsilon} = \theta\varepsilon - \lambda_1d_2 - \lambda_0d_2 - \lambda ky = 0 \rightarrow \theta\varepsilon = \lambda[{}_1d_2 + {}_0d_2 + ky],$$

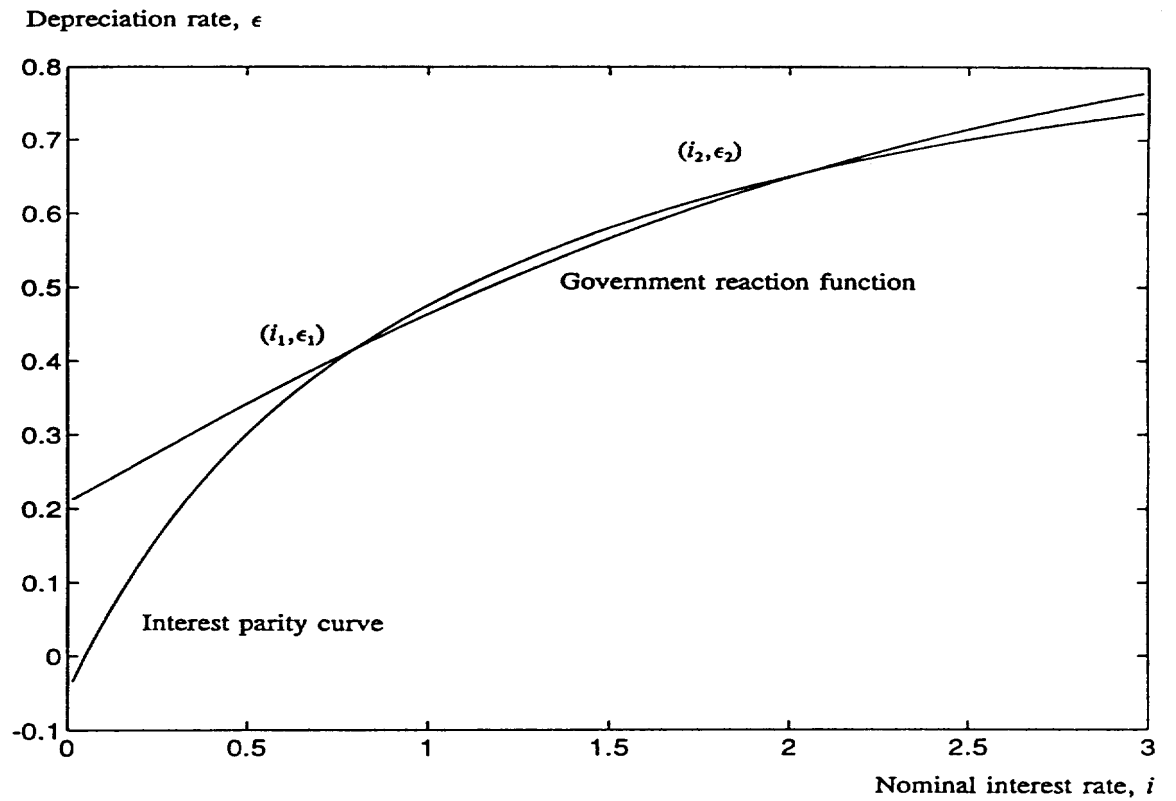
$$\frac{\theta\varepsilon}{{}_1d_2 + {}_0d_2 + ky} = \frac{\tau}{y}. \quad (22)$$

Using (22) to eliminate τ from (21) gives ε as:

$$\varepsilon = \frac{({}_1d_2 + {}_0d_2 + ky)({}_1d_2 + {}_0d_2 + g_2 - {}_1f_2 - {}_0f_2)}{({}_1d_2 + {}_0d_2 + ky)^2 + \theta y^2}. \quad (23)$$

Remembering ${}_1d_2 = (1+i)\left({}_0d_1 + g_1 - {}_0f_1 + \frac{{}_1f_2}{1+i^*}\right)$ and substituting it in the equation above shows how the government's preferred depreciation rate is influenced by the market interest rate effective in period 1 and by the currency composition government chooses for its debt.

Figure 3: The Set of Equilibrium in Period 1



Source: Obstfeld (1994)

On the vertical axis of Figure 3, we have the depreciation reaction function of the government showing the depreciation rate ε it adopts in period 2 when faced with a lira interest rate of i . It is assumed that the reaction function is positively sloped, which reflects, intuitively, that the possibility that a higher nominal 1 interest rate makes greater currency depreciation optimal by raising the inflation tax base in period 2. At the same time, we have another upward-sloping curve, the interest parity curve, demonstrating the expected rate of depreciation consistent with the lira interest rate prevailing in period 1. The derivation of the interest parity curve goes as follows: if we combine Equations (16) and (20) it follows that $\varepsilon = \frac{i - i^*}{1 + i}$ which can be seen as the reaction function of the lira bond market, namely, the interest rate it sets based on its expectations of ε .

In a perfect-foresight equilibrium, given market expectations, the depreciation rate which government finds optimal should be equal to the depreciation rate the market expects. Hence, intersection of the interest parity curve and the government reaction function determines the possible equilibria of currency depreciation and nominal interest rates. In Figure 2, there are two equilibria⁶. Clearly, the government's loss is lower in the low-depreciation equilibrium (i_1, ε_1) , but it is not guaranteed that the bond market coordinates on low lira interest rate. Here the government confronts with a dynamic inconsistency problem: it cannot make credible promises regarding not validating the expectations if the bond market agrees on the high-inflation equilibrium's interest rate.

⁶ It is obtained by setting $y = 1$, ${}_0d_1 = 1.0$, ${}_0d_2 = 0.2$, ${}_0f_1 = 0$, ${}_0f_2 = 0$, ${}_1f_2 = 0$, $g_1 = g_2 = 0.35$ and $i^* = 0.05$

Now let us consider the implications of the analysis above for a fixed exchange rate regime. A government always can relinquish a currency peg if economic conditions allow a realignment. Assume, nevertheless, that the government faces a cost c ⁷ of realigning. In this case the loss function is:

$$L = \frac{1}{2}\tau^2 + \frac{\theta}{2}\varepsilon^2 + cZ \quad \{Z = 1 \leftrightarrow \varepsilon \neq 0, Z = 0 \leftrightarrow \varepsilon = 0\}. \quad (23)$$

If the superfluous loss of a fixed exchange rate regime is greater than c , the government will find it optimal to devalue.

Suppose the market expects the currency to be devalued at the rate ε_2 and sets the nominal interest rate at the corresponding level i_2 as shown in Figure 3. Then the government will be induced to exercise the anticipated devaluation regardless of the realignment cost c . This is an example of a self-fulfilling speculative attack: there exists an equilibrium in which the exchange parity can survive, however, the government is led to change the parity since private expectations make it too costly not to.

Obstfeld (1994) asserts that this model captures aspects of the Italian crisis in September 1992, when the government was forced to hinge heavily on Bank of Italy in order to finance its high cash-flow requirements. Besides, the model applies to other situations such as Britain's in the 1950s and 1960s, when the authorities strived to prevent the collapse of the value of the pound against a large and increasing public debt.

⁷ This may be a cost that could reflect political embarrassment and credibility loss.

3.2 The Second-Generation Models Examining the Interactions Among Speculators

It is not surprising to see the elements of game theory in explaining the interactions among speculators since this analysis focuses mainly on human behavior. In this context, an explanation for the onset of a currency attack is information cascades. The cascades story hinges on actual observations of others' actions. In this sense, Banerjee (1992) develops a model in which paying attention to what everyone else is doing is rational because their decisions may reflect information that they have and the others do not. It then comes out that a possible outcome of people trying to use this information is what we call herd behavior—everyone doing what everyone else is doing, even in the existence of private information which requires doing something different.

Flood and Marion (1998) comes up with a concrete example: Suppose each speculator has some information about the state of the economy and decides sequentially and publicly whether to hold the currency or sell it. If the first n investors receive bad signals regarding the state of the economy and sell the currency, then the $(n+1)^{\text{th}}$ investor may choose to ignore his own information even if it suggests that the fixed exchange rate can survive. Accordingly, he sells based on the revealed information of those who came before him. This sequential decision rule eventuates in herd behavior. In conclusion, if some traders begin selling the currency,

others will partake in the herd, moving the economy from the no-attack to the attack equilibrium.

However, a pure cascades story may not capture the driving forces of currency attacks. Firstly, as Lee (1993) has discussed, the cascade argument hinges on a discrete action space so that individuals totally ignore their own information. Nonetheless, it can be the case, as in Morris and Shin (1995)'s model, that traders can vary their strategies continuously and so can adjust their strategies to new information. What is more, if the potential gains resulting from the action of one agent do not depend on the actions chosen by others, then it may be unsatisfactory to rely on cascades argument.

3.3 Contagion Effects

Calvo and Mendoza (2000) defines the contagion as a situation in which utility-maximizing investors choose not to pay for information that would be relevant for their portfolio decision or in which investors optimally choose to mimic arbitrary "market" portfolios. Their view reflects rather the herding behavior argument. Their earlier work on a global scale provides a contagion example which is based on herding behavior. Calvo and Mendoza (1997) deviate from the sequential decision-making framework and think of a global market where many identical investors formulate their decisions simultaneously. They show that under informational frictions, herding behavior may become more predominant as the world capital market grows. Because globalization lessens the motives to collect country-specific

information and raises the probability that fund managers who are concerned about their performances will select the very same investment portfolio. Accordingly, small hearsays may result in herding behavior and move the economy from the no-attack to the attack equilibrium.

A similar analysis based on informational issues can be found also in Caplin and Leahy (1994). In their model, financial market participants anticipate a crisis but they hold different beliefs regarding its timing. It is costly for investors to take position prior to crisis. Each investor is uncertain whether other investors share his or her belief on the occurrence of crisis. They exchange “cheap talk” amongst themselves but make inferences only by observing the market. The outcome is normal market conditions with no clues of crisis until it abruptly breaks out. Once it happens, nevertheless, market actors claim that they knew that the crisis was about to occur and they were readying themselves for the consequences (wisdom after the fact). Eichengreen et al. (1996) argues that an illustrative application of this model would be to the ERM crises of 1992-93. The story goes as follows: There was a popular belief that ERM could not continue to operate indefinitely without a realignment. However, its extraordinary stability since January 1987 led investors to accept the view that the system could now work without further realignments. Other circumstances such as the political difficulties of ratifying the Maastricht Treaty then initiated a crisis (which resulted in the devaluation of the Italian lira) which abated this belief. It came out to all investors that what they privately thought was correct—that the realignments were still necessary.

On the other hand, Fratzscher (2002) looks from a different perspective and suggests another definition. According to him, contagion is the transmission of a crisis to a particular country due to its real and financial interdependence with countries that are already experiencing a crisis.

The examples of crisis transmission via real interdependence can be found in Eichengreen et al. (1996). They reveal that the attack on the U.K. in September 1992 and the sterling's subsequent depreciation are reported to have damaged the international competitiveness of the Republic of Ireland, for which the U.K. is the most important export market and to have triggered the attack on the punt at the beginning of 1993. Finland's devaluation in August 1992 was widely considered as having had negative implications for Sweden, not because of direct trade linkages between the two countries but because of their exporters' competition in the same third markets. Attacks on Spain in 1992-1993 and the depreciation of the peseta are said to have detrimental effects on the international competitiveness of Portugal, which relies heavily on the Spanish export market and to have stimulated an attack on the escudo in spite of the absence of imbalances in domestic fundamentals.

The first scientific theoretical explanations for the real interdependence argument can be found in Gerlach and Smets (1995). They consider two countries linked by trade in manufactures and financial assets. In their model, a successful attack on one exchange rate leads to its real depreciation, which improves the competitiveness of the country's merchandise exports. This generates a trade deficit in the second country, thereby a gradual decrease in its central bank's international reserves. Finally, it causes an attack on its currency.

On the other hand, financial interdependence can be a channel for transmitting the crisis into another economy, too. Buiter et al. (1996) develops a model in order to analyze the spread of currency crises in a system of $N+1$ countries, N of which (periphery) peg their currencies to the remaining country's (center). The center is assumed to be more risk averse than the others and is therefore reluctant to follow a cooperative monetary policy formulated to stabilize exchange rates. If a negative shock to the center causing interest rates to go up occurs, then the members of the periphery will find it optimal to leave the system⁸ as long as they cooperate. However, if some subset of peripheral countries with the least tolerance for high interest rates finds it optimal to leave the system, then contagion will be limited to this subset.

3.4 General Discussion on Second-Generation Models

Jeanne (1999) claims that the first contribution of the second-generation models is that it led researchers to rethink about the notion of fundamentals. He asserts that the notion of fundamental is much broader in scope than in first generation models. Besides, he makes a categorization among fundamentals: “hard” observable fundamentals such as unemployment or the trade balance and “soft” fundamentals such as the beliefs of the foreign exchange market players. Moreover, he suggests that the second contribution of the second generation models is that it provides a new theory of self-fulfilling speculation and multiple equilibria.

⁸ This is the extreme case of contagion.

In this context, we can say that the second-generation models show that the self-fulfilling and “fundamentalist” views are not mutually exclusive. For a currency to be exposed to an attack, the fundamentals must first signal a state of weakness. However, in second-generation models the occurrence and exact timing of a crisis may be inestimable merely based on fundamentals.

Beyond what has been said, Flood and Marion (1998) compares the first-and second- generation models of currency crises. They suggest that most of the differences between these two models can be traced to one crucial assumption: first-generation models assume the commitment to a fixed exchange rate is state invariant while second-generation models allow it to be state dependent. They argue that the government’s commitment to the fixed exchange rate is often constrained by factors such as unemployment, the size of the public debt or upcoming elections. Taking into account that these factors influence the government’s commitment to the fixed exchange rate is a major contribution of the second-generation models.

In order to overcome the shortfalls of the first- and second-generation models, Kaminsky (2006)’s work provide us important starting points. She examines currency crises experienced in a variety of countries during the period from January 1970 to February 2002. Her results are summarized in Table 1:

Table 1: The Breakdown of Currency Crises According to Their Causes and Country Origins between January 1970 and February 2002

Crises in emerging and mature markets						
Countries	Number of crises (in percent)					
	Current Account	Financial Excesses	Fiscal Deficits	Sovereign Debt	Sudden Stops	Self-fulfilling
Emerging	13	35	6	45	2	0
Mature	17	13	4	33	17	17

Source: Kaminsky (2006)

According to the results, the causes of the crises differ across emerging and mature economies. Current account and competitiveness problems are more associated with mature markets (17% of the crises) than that of emerging economies (13% of the crises). These problems indicate the failure of first generation models. We can explain these kinds of currency crises using second-generation currency crises models focusing on real-interdependence between countries.

Moreover, 86% of the crises in emerging economies are crises with multiple domestic vulnerabilities such as financial excesses, fiscal deficits and sovereign debt problems while economic fragility only characterizes 50% of the crises in mature markets. This simply implies that first-generation models are somewhat successful in explaining crises in emerging economies with a large number of vulnerabilities.

Sudden-stop problems which are characterized by adverse shocks to international capital markets and cannot be foreseen by first-generation models are also more common in mature markets (17% of all crises) than in emerging markets (2% of all crises). In this context, second-generation models are more successful.

Finally, while most of the crises are related to real, financial, or external vulnerabilities, a small number of crises are unrelated to deteriorating fundamentals, namely self-fulfilling crises, which is the main point of the second-generation models. These crises are not a feature of emerging markets but tend to occur in mature markets.

We can simply suggest that second-generation models bring more sound explanations in order to analyze crises in mature economies.

CHAPTER IV

CONCLUSION

Referring to the quotation in the very first part, it can be suggested that the currency crises will be on researchers' agenda for a long time due to its drastic implications for governments and economies. As economies evolve and transform themselves, new streams of currency crises models will emerge.

This paper has focused on the first- and second-generation models of currency crises. Moreover, two examples from each stream of models have been demonstrated in detail. The first-generation models deduce that unsustainable fiscal policy causes the collapse of a fixed exchange rate regime. In other words, deterioration of the fundamentals resulting from inconsistent economic policies leads to financial crises.

Moreover, after EMS crisis in 1992-93 second-generation models the assumptions of which were that the government is an active agent that optimizes an objective function and a circular process which leads to multiple equilibria exists were developed. Since pure expectations might bring about a switch between various

equilibria, the second-generation models accepted the possibility of self-fulfilling crises.

However, Eijffinger and Goderis (2007a) suggest that although first- and second-generation models have done reasonably well in explaining many past crises, they do not bring sound explanations on order to understand the crisis in East Asia 1997–98. They argue that these countries did not go through any first-generation-like fiscal problems and nor did they counter the policy trade-off, as some EMS crisis countries did during 1992-93 period. Therefore, new models were needed and the first attempts to develop such models focused on problems in the banking sector which later emerged as a new strand of literature. This literature, sometimes referred to as ‘third-generation literature’, emphasized the importance of balance sheet vulnerabilities and international capital flows.

As a concluding word, it can be proposed that these two models capture different aspects of currency crises and they provide systematic theoretical treatment of currency crises even though they have a number of shortcomings.

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