

1. MODELS OF FINANCIAL CRISES AND CLASSIFICATION OF THE BULGARIAN CRISIS

The literature on financial crises is extremely vast.² By “financial crises,” we mean any (severe) disruption in the production of financial services. This definition includes both balance-of-payments crises (currency crises), and banking crises. We are therefore adopting Mishkin (1996)’s definition: “*Financial crises involve either sharp declines in asset prices, failures of large financial and non-financial firms, deflations or des-inflations, disruptions in foreign exchange markets or some combination of all of these.*”

In a sense, banking crises (panics) and balance-of-payments crises are similar events. While the former implies a flight from bank deposits to (domestic) currency, the later involves a flight from domestic currency to foreign currency. If depositors lose confidence in domestic banks and their national currency at the same time, they can even flee directly from bank deposits to foreign cash. Not surprisingly, models of banking crises and models of balance-of-payments crises are based on similar behavioral assumptions. In particular, as in a bank run, the position in the

² The purpose of this chapter is *not* to provide a comprehensive survey of the literature, but rather, to present an overview of existing model types, with a view to characterize and classify the Bulgarian crisis. Some of the models presented in the chapter (in particular those associated with the third generation) were selected for illustrative purposes only.

queue at the central bank during a speculative attack (leading to a currency crash) matters, because currency depreciation produces a loss only to those at the end of the line.³

This chapter also highlights a fundamental distinction found in the literature between those who believe that financial systems are inherently unstable, i.e. vulnerable to random shocks (e.g., the “self-fulfillers”), and those who view crises (and runs in particular) as a result of bad policy (the “fundamentalists”).

1.1 Models of Balance-of-Payments Crises

Models of balance-of-payments crises can be grouped within three broad categories, corresponding to three “generations” of models: the “canonical” model, multiple equilibria models, and so-called “third-generation” models.

Canonical models are fundamentals-based models, where crises result from a profound inconsistency between domestic policies. In canonical models, countries achieve a currency crisis because they earn it.⁴ Models of self-fulfilling crises, on the other hand, demonstrate that even sustainable fixed exchange rate regimes (or pegs) may be attacked and broken. Self-fulfilling crises have been described as “unnecessary,” in the sense that the exchange rate would have otherwise been viable. Finally, third-generation models, born in the aftermath of the Asian crisis, while relying on self-fulfilling features, stress the relationships between balance-of-payments crises and domestic financial problems (such as banking sector weaknesses, and/or non-financial firms balance sheets deficiencies).

³ See Goldfajn and Valdés (1997), in particular

⁴ Krugman (1996)

1.1.1 First Generation Models

First generation models were pioneered by Krugman (1979) and his application of Salant and Henderson's 1978 model of speculative attacks in exhaustible resource markets, to the foreign exchange market.

Krugman (1979) demonstrates that under a fixed exchange rate regime, money financing of the budget deficit *always* ends in a speculative attack on the government's foreign exchange reserves and the abandonment of the peg. In Krugman's model only two assets are available: domestic money and foreign money. The government finances its deficit by printing money or by running down its foreign exchange reserves; the extent to which reserves are used depending on the private sector's willingness to acquire additional domestic money. In particular, if the creation of domestic credit exceeds the increase in money demand, foreign exchange reserves *will* fall.⁵ Since the demand for money is inversely related to the expected rate of inflation (perfect foresight is assumed) and since the price level varies proportionally with the supply of money, the author shows that the exchange rate regime will eventually collapse no matter how large the initial reserves. The crisis occurs as speculators, anticipating the abandonment of the fixed exchange rate, try to seize the government's remaining reserves. Interestingly enough, Krugman shows that this speculative attack always happens *before* the government would have run out of reserves in the absence of speculation. Since the exhaustion of reserves produces a jump in the price level and a loss to holders of domestic money, speculators will sell domestic money before the exhaustion of reserves. But in so doing, they will in fact advance the date of that exhaustion. Speculators will take this into account and sell

⁵ This is the standard conclusion of the monetary approach to the balance-of-payments.

even earlier, and so on. Krugman demonstrates that this speculative behavior implies the existence of a critical level of reserves (a threshold), below which the speculative attack occurs. If investors are aware of how much of its reserves the government is willing to use to defend the peg (which implies a fixed and common threshold), the economy should go through the following sequence of events: i) gradually declining reserves, ii) a sudden speculative attack, and iii) the gradual depreciation of the currency. However, Krugman shows that uncertainty about the government's foreign exchange policy introduces the possibility of a series of crises: a "*sequence of temporary speculative attacks and recoveries of confidence, before attempt to stabilize the exchange rate is finally abandoned*" (page 323). Krugman's work has inspired an enormous amount of research.

Flood and Garber (1984) provide a pair of linear examples to study the collapse of fixed exchange rate regimes. The first example, a continuous-time model with perfect foresight, is a simplified version of Krugman (1979), in which the time of the attack can be derived analytically. The analytical solution reveals that the collapse time depends both on market fundamentals (including the initial level of foreign exchange reserves and the rate of growth of domestic credit), and on an arbitrary constant capturing the speculative behavior of economic agents. Interestingly, the authors demonstrate that even with *zero* domestic credit growth, arbitrary speculative behavior can cause the collapse of a fixed exchange rate regime. The second example, a discrete-time model in which money demand is subject to stochastic disturbances, illustrates the so-called "Peso Problem:" domestic credit expansion creates a forward discount, raising the domestic interest rate and lowering both domestic money demand and the central bank foreign exchange reserves, prior to the attack. In other words, if a

speculative attack is expected, the interest rate differential between domestic-currency-denominated assets and foreign-currency-denominated assets should increase over time, as the likelihood of depreciation increases.

In Krugman (1979) and Flood and Garber (1984), and in a number of other publications, domestic credit expansion is exogenous. **Buiter (1987)** “*goes behind domestic credit expansion*” (page 222) and considers, separately, the primary government deficit, the interest cost of servicing the public debt, and the net issues of interest-bearing government debt. The paper evaluates the consequences of government borrowing to increase international reserves (through an open-market sale of interest-bearing bonds) on the timing and magnitude of speculative attacks. Without a fundamental fiscal correction (i.e., a reduction in the primary deficit), the speculative attack is brought *forward* if the borrowing takes place sufficiently long before the date at which the attack would have occurred without borrowing. It is delayed if the borrowing takes place sufficiently close to the collapse date without borrowing. The magnitude of the attack is always increased as a result of the borrowing. These findings reflect the fact that government borrowing, while reducing the stock of domestic credit, increases the rate of domestic credit expansion (as a result of the interest costs associated with the newly incurred debt). In other words, government borrowing can initially increase the stock of foreign exchange reserves but, *ceteris paribus*, also increases the rate at which foreign exchange reserves decline.⁶

⁶ It has been further shown that, short of violating the inter-temporal budget constraint of the government, an over- expansionary credit policy always leads to the collapse of the exchange rate regime even with access to *unlimited* borrowing (Agénor, Bhandari and Flood, 1992, page 374).

Agénor, Bhandari and Flood (1992) summarize various extensions brought to Krugman's 1979 framework, through a vast review of the literature. Existing extensions include: i) alternative post-collapse regimes (allowing for a temporary period of floating, followed by a new peg); ii) uncertainty in the timing of the collapse (allowing for uncertainty in the amount of international reserves that the central bank is willing to use to defend the exchange rate, and in the rate of growth of domestic credit); iii) the impact of imperfect asset substitutability and sticky prices; iv) the real effects of exchange rate collapses (in relation to output and the current account, in particular); v) measures aimed at postponing the collapse, such as external borrowing or capital controls (similar to Buiters (1987)); and vi) attempts by the government to prevent a crisis through changes in its fiscal and credit policies.⁷

Dooley's 1997 model can be viewed as a first generation model of currency crisis, based on a new set of fundamentals, where the crisis is caused by a new policy conflict (page 3), i.e., different from those postulated in Krugman (1979). In the model, the run on insured domestic liabilities (e.g., residents' deposits with commercial banks) occurs as soon as investors believe that they may suffer a loss if others decide to liquidate their investment and cash in the insurance option. In other words, as in standard models of currency crises, the "*attack... is generated by competition to avoid losses*" (page 17). The "*insurance crisis*," however does not necessarily result in a currency crisis. It may, under fixed exchange rate, if the government is expected to use its foreign exchange reserves (among other forms of official assets) to cover insurance commitments. After the attack, as international

⁷ As explained in Section 1.1.2, these endogenous macroeconomic policy responses make self-fulfilling crises possible, a key characteristic of second-generation models.

reserves have been depleted, any (negative) shock may force the government to devalue (page 19).

The canonical, fundamentals-driven, model⁸ has provided the theoretical underpinning for predicting the likelihood of balance-of-payments crises, through the monitoring of so-called “leading indicators.” An overview of the *enormous* literature on the issue is provided below.

Frankel and Rose (1996) use panel data (105 countries observed between 1971 and 1992) to identify the determinants of foreign exchange crises. They define a currency crash as “*a nominal depreciation of the currency of at least 25 percent, that is also at least a 10 percent increase in the rate of depreciation*” (page 3). The authors use four sets of variables to predict currency crises: i) domestic macroeconomic variables (growth rate of domestic credit, budget deficit as a percentage of GDP, growth rate of real output per capita); ii) variables related to the composition of the debt (Foreign Direct Investment as a fraction of total debt, maturity structure of the portfolio capital); iii) external variables (ratio of debt to GNP, ratio of foreign exchange reserves to imports, ratio of current account to GDP, real exchange rate and degree of overvaluation - defined as the deviation from purchasing power parity); and iv) foreign variables (short-term foreign interest rates and real OECD

⁸ **Dornbusch (1996)** provides an alternative “fundamentalists” view of currency crises based on real exchange rate movements. In his view, there are only two ways exchange rate crises can come about: either from an overvalued currency or from excessive indebtedness. Financial considerations (such as a fragile banking system, a liquid debt structure, or a bout of easy money) are important, but “*should not be misread as the primary source of the collapse*” (page 1). In 1996 Bulgaria, the role of real exchange rate movements was probably limited, as the current account showed a *surplus* throughout the year. In addition, as stressed by Miller (1997), there might have been a significant real appreciation of the Lev on the basis of the consumer price index, but *not* on the basis of the producer price index.

output growth). Probit estimates reveal that the likelihood of a currency crash is increased by the following factors: higher debt, lower reserves, over-valuation of the real exchange rate, sustained growth of domestic credit, sharp recession, and drying up of foreign direct investment (FDI) flows. On the other hand, neither the current account, nor the budget deficit, appears to play a significant role in the occurrence of currency crises, *when other indicators are held constant*.

Kaminsky, Lizondo and Reinhart (1997) review 25 empirical studies, identifying a total of 103 leading indicators, grouped within 10 categories. The best (most reliable) indicators include foreign exchange reserves, real exchange rate, domestic credit, credit to the public sector, and domestic inflation. Other successful variables include the trade balance, export performance, money growth, the ratio of broad money (M2) over foreign exchange reserves, real GDP growth, and fiscal deficit. The paper also provides results from a so-called “signals approach,” where an indicator emits a “signal” whenever it departs significantly from its mean (all indicators are calculated monthly, as a 12-month percentage change). The variable is then assessed in terms of the probability of a crisis conditional on a signal from that variable, the average number of months between the crisis and the “first” signal, and the persistence of signals before the crisis (measured by the average number of signals during a 24-month pre-crisis window, relative to tranquil times). Indicators with the longest lead-time include the real exchange rate, real interest rates, the M2 multiplier, and bank deposits. The most “persistent” indicators include the real exchange rate, exports and the ratio of M2 to international reserves.

1.1.2 Second Generation Models

Second-generation models were born in the aftermath of the European Monetary System (EMS) crisis of August 1993. To most economists of that time, Krugman's seminal contribution could not explain the European experience.

Obstfeld (1994) first, proposed an alternative to the canonical model. After a brief review of Krugman's 1979 paper and its limitations with respect to explaining the EMS crisis (in particular because the countries affected by the crisis had access to world capital markets and could borrow foreign exchange reserves); Obstfeld introduces two models where currency crises are driven by self-fulfilling forces. In both models, the crisis occurs through a "circular dynamic" between market expectations and government's response to these expectations: "*speculative anticipations depend on conjectured government response, which depend, in turn, on how price changes that are themselves fueled by expectations affect the government's economic and political positions*" (page 190). In the first model, devaluation expectations increase nominal interest rates, increasing the costs of servicing the public debt. Because of these expectations, the government may choose to devalue, to reduce the real costs of servicing the debt, justifying the initial expectations. In the second model, the government may choose to let the parity go in order to offset negative output shocks and limit unemployment. Market participants (workers and firms) anticipate this reaction, and set wages accordingly. With increasing labor costs and the associated loss of competitiveness, the government would have to devalue, validating the initial expectations. Note that in both models, the crisis can be avoided if the government *credibly* commits to the fixed exchange rate. **Obstfeld (1996)** stresses that the existence of self-fulfilling crises does not imply poor rationality.

“Self-fulfilling crises reflect not irrational private behavior but an indeterminacy of equilibrium that may arise when agents expect a speculative attack to cause a sharp change in government macroeconomic policy” (page 72). In other words, self-fulfilling crises are possible because of crisis-induced policy changes. Investors expect a switch to inflationary policy if a currency crisis occurs. This belief makes it unprofitable for any speculator to hold domestic currency in case of a run, leading to the possibility of multiple equilibria.

Jeanne (1995) shows how fundamentals and self-fulfilling expectations (the “animal spirits,” a sunspot variable such as the action of a major market participant, or the arrival of bad news) can complement each other in the outset of speculative attacks. In Jeanne’s model, the deterioration of fundamentals *“prepares the ground for speculation”* (page 265) but the occurrence and the precise timing of the attack is determined by self-fulfilling beliefs. Mathematically, the economy, at some point, *bifurcates* into a zone where multiple equilibria become possible. The core of the paper consists of deriving the conditions ensuring the possibility of this bifurcation. In the model, a policymaker minimizes a loss function $L_t = u_t^2 + \delta_t C_t$ where u_t , the unemployment rate, is determined by an expectations-augmented Philips curve and C_t is the cost of “opting out.” The author derives the benefits of maintaining the peg and the devaluation probabilities from the loss function. He identifies three scenarios: i) the fundamentals are good, the devaluation probability is uniquely defined and close to zero; ii) the fundamentals are bad, the devaluation probability is close to 1; and iii) the fundamentals are neither good nor bad, where self-fulfilling speculation is possible. Jeanne explains, à la Obstfeld, that: *“the devaluation expectations tend to be self-fulfilling because they make it more costly for the*

policymaker to maintain the fixed peg” (page 272). As an illustration, the model is estimated using data on the 1991-1993 French Franc crisis. The estimation results show that the French economy did enter a “crisis zone” (a zone where multiple equilibria are possible) in August 1992.

Sachs, Tornell and Velasco (1996b) explore the financial events *following* the devaluation of the Mexican Peso in December 1994. According to the authors, Mexico was subject to a self-fulfilling speculative attack: the currency crisis went far beyond what was “inevitable” based on Mexico’s fundamentals, and was largely unexpected. It also made international investors extremely nervous (pessimistic) about the conditions of other emerging markets: *“investors expected that their fellow investors would withdraw their funds whenever the fundamentals suggested the possibility of a self-fulfilling panic,”* (page 149). In other words, contagion (and the so-called “Tequila Effect”) was not random: it only reached countries with weak fundamentals (including Argentina, Brazil, and the Philippines). With a simple theoretical model of exchange rate determination (where capital outflows depend on expected depreciation and vice-versa), Sachs et al. suggest that countries that are most vulnerable to financial panics are those with a weak banking system or an overvalued real exchange rate (or both), *and* low foreign exchange reserves relative to their liquid liabilities.⁹ In this framework, again, self-fulfilling crises are possible only within a crisis zone characterized by unhealthy fundamentals.

⁹ For the authors, international reserves should be compared with a broad measure of liquid monetary assets (e.g., currency plus demand and savings deposits) to determine a country’s vulnerability to panics. In the paper, and contrary to standard models of balance-of-payments crisis, a currency can be subject to an attack even when domestic credit is *tight*, if the stock of M2 greatly exceeds the stock of reserves (Sachs, Tornell and Velasco, 1996b, page 150).

The model is validated empirically, by regressing an index of currency crisis on a set of economic fundamentals. Estimation results indicate (and confirm) that real exchange rate appreciation, a weak banking system (bank weakness is measured by the magnitude of the lending boom between 1990 and 1994!) and a high ratio of M2 to international reserves increase the likelihood of financial crises. They also show that real exchange rate appreciation and lending booms have “*powerful effects*” but only when international reserves are low, (page 170).

Krugman (1996) tries to identify what differentiates the “new” currency-crisis literature from the classical literature. The author starts with the presentation of a simplified version of the canonical model.¹⁰ He then argues that in the classical model, as in the new literature, a crisis zone (a range of reserve levels within which speculative attacks *can* occur) can be defined, but multiple equilibria are ruled out because the collapse would occur *as soon as* the economy enters that zone. In other words, “*the standard analysis predicts that a currency crisis will occur as soon as a speculative attack can succeed*” (page 349). With deteriorating fundamentals (persistent inflation, escalating debt, “*moribund*” government, etc.) that will

¹⁰ In this version, the demand for domestic money is expressed as $M = E.L(\varepsilon)$, where E is the exchange rate and ε , the expected rate of depreciation. The money supply is defined as $M = D + R$, where D stands for domestic credit, and R for the central bank’s foreign exchange reserves. The government runs a deficit financed by money creation. The central bank pegs the exchange rate through non-sterilized interventions in the foreign exchange market and is steadily losing reserves. When reserves are exhausted, the demand for money drops as the expected rate of depreciation rises (from 0 to π). Since the money supply cannot fall (with $R = 0$), the national currency *must* depreciate. Foresighted investors anticipate this event and run out of the currency before it happens. Using backward induction, Krugman shows that the speculative attack occurs as soon as reserves reach a level R^* , given by $R^* = E.L(0) - E.L(\pi) = M - E.L(\pi)$.

eventually make the peg unsustainable, the logic of currency crises becomes a simple matter of timing, and “*multiple equilibria disappear as an issue*” (page 354). If market participants know that the regime will eventually collapse, they will attack the currency as soon as this attack can succeed, not earlier. What if investors do not have the necessary information? Krugman shows that uncertainty about the government’s loss function might create a series of “*probing attacks,*” during which investors evaluate the government’s willingness to defend the peg. Even though they may not succeed, these attacks are *rational* given the information available to investors. Therefore, the mere observation of failed attacks does not provide evidence in favor of the irrational, or herding, behavior hypothesis (page 358). When the future evolution of fundamentals is unknown, however, self-fulfilling attacks become possible. In particular, if investors believe that the fixed exchange rate is not sustainable forever although it is, an *unnecessary* crisis may occur. According to Krugman, these self-fulfilling crises are rare events, as secular deteriorations in fundamentals are generally predictable.¹¹

The debate between “fundamentalists” and “self-fulfillers” came to an end in the late nineties. In the light of the Asian crises, **Krugman (1999)** recognized the existence of spontaneous self-fulfilling crises: “*I hereby capitulate. I cannot see any way to make sense of the contagion of 1997-98 without supposing the existence of multiple equilibria, with countries vulnerable to self-validating collapses in*

¹¹ In a similar spirit, Dornbusch (1996) argues that explanations in terms of multiple equilibria are not as convincing as traditional explanations, because they are contradicted by the facts: “*countries with large real appreciations suffer collapses, others do not*” (page 1).

confidence, collapses that could be set off by events in faraway economies that somehow served as a trigger for self-fulfilling pessimism” (page 463).

To conclude, the existence of self-fulfilling crises has two major implications. First, models of self-fulfilling crises suggest that predicting currency crises with standard leading indicators (or signals) might be difficult. Second, the models can be used as a basis for advocating capital controls and other forms of financial regulation, as financial systems are presented as being fundamentally unstable.

1.1.3 Third Generation Models

Developments in the aftermath of the Asian crises of 1996-98 led to two broad categories of approach: a moral-hazard approach emphasizing the effects of information asymmetries in financial markets (e.g., McKinnon and Pill, 1996), and a financial fragility approach emphasizing the potentially destabilizing effects of intermediation (e.g., Goldfajn and Valdés (1996), or Chang and Velasco, 1998a). Both approaches provide a more integrated view of financial crises and stress, in particular, the links between banking difficulties and currency crises. They are presented in Section 1.3 (“The Twin Crises: Models and Empirical Evidence”), after an overview of the literature on banking crises.

Krugman (1999), however, suggests that neither the moral hazard approach, nor the financial fragility approach, provide a good account of the Asian crises. In his attempt to explain the crises, Krugman emphasizes the role of (non-financial) companies’ balance sheets and capital flows. The paper recognizes, and addresses, three stylized facts: i) contagion, and the possibility of self-fulfilling crises; ii) the transfer problem (i.e., the need to achieve the current account counterpart of a

reversal of capital flows, either through real depreciation or a recession-induced compression of imports); and iii) balance sheet problems (the impact of currency depreciation on the domestic value of foreign debt in companies' balance sheets, and the effects of deficient balance sheets on the economy).¹² In the model, a “*spontaneous*” loss of confidence leads to a massive capital outflow, and to a transfer problem: in order to achieve the required reversal of its current account, the country *must* experience a large real depreciation. This depreciation worsens the balance sheets of domestic firms, validating the initial loss of confidence (page 464). Once it occurs, the crisis can have a sustained impact on the economy through its effect on companies' balance sheets, and their ability to borrow and invest. In this framework, factors that make a financial collapse possible include: high leverage, low marginal propensity to import, and large foreign-currency debt relative to exports (page 468). Krugman further demonstrates that the “*IMF strategy*” of defending the exchange rate with high interest rates (as opposed to letting the exchange rate go), while limiting the immediate effects of depreciation on firms' balance sheets, will reduce investment and entrepreneurs' wealth, and thereby, if leverage is high, precipitate a self-reinforcing decline in investment and output (page 469).¹³

1.2 Models of Banking Crises

Models of banking crises recognize two types of risks: i) the investment or default risk (the recipients of bank loans may not be able or willing to meet their

¹² Krugman stresses that while these balance sheets problems led to banking difficulties, they were not a banking problem per se (page 464)

¹³ In Krugman's view, there are only two ways to deal with such crises: providing emergency lines of credit, and/or imposing emergency capital controls to limit capital flight.

obligations), and ii) the withdrawal, or liquidity, risk (depositors or financial institutions may not be willing to extend or renew their credit to the bank). The realization of any of these two risks may lead to a “banking crisis.” Banking crises, in turn, may occur as panics or bank runs (realization of the withdrawal risk), or as non-panic episodes, through banking license removals, bankruptcy proceedings, and the likes.¹⁴ Models presented in this section focus on bank runs and the liquidity risk.

Models of banking panics can be grouped within two broad theories: the “random withdrawal theory,” pioneered by Diamond and Dybvig in 1983, and the “asymmetric information theory,” put forward by Mishkin (1991).¹⁵

Diamond and Dybvig (1983) introduce the random withdrawal theory, which is essentially an extension of the literature on speculative attacks to the banking sector, where economic agents run on commercial bank reserves, in lieu of central bank reserves. In the model, panics occur because withdrawals are made on a first-come-first-served basis. Under this rationing rule, bank runs may result from self-fulfilling prophecies: *“if agents think that other agents think there will be many withdrawals, then agents at the end of the sequential service line will suffer losses. Thus all agents (...) may suddenly redeem their claims, causing the very event they imagined,”* (page 121). An implication of this model is that panics could be avoided if banks’ resources were allocated on a pro-rata, rather than a first-come-first-served basis. Diamond and Dybvig also show that the knowledge that the central bank stands

¹⁴ Caprio and Klingebiel (1996) define panics as the denouement of a tragedy *“as when a terminally ill patient checks into a hospital before dying,”* and stress that banking crises should be defined as the disease itself, *“unsafe and unsound banking”* (page 11).

¹⁵ On the basis of Stiglitz and Weiss (1981)

ready to act as a lender-of-last-resort (i.e., support distressed banks) may remove the incentive for depositors to run.

Alternatively, bank runs have been presented as resulting from “*rational shifts in expectations,*” i.e., sudden revisions in the perceived risk of banks (based, for example, on the release of information on banks’ portfolio).¹⁶ In this approach, bank runs are motivated by solvency concerns towards a bank, or group of banks, and by the inability of depositors to differentiate trouble banks from sound ones. Such screening problems are at the core of the asymmetric information approach to banking crises.

The theories of banking crises based on asymmetric information, concentrate on information problems in the credit market. **Mishkin (1991)**, for example, defines a financial (banking) crisis as “*a nonlinear disruption to financial markets in which adverse selection and moral hazard problems become much worse so that financial markets are unable to efficiently channel funds to those who have the most productive investment opportunities*” (page 75). The asymmetric information view is based on the assumption that borrowers have an information advantage over lenders, i.e., that they know more about the investment project they want to undertake than lenders do. This information asymmetry results in adverse selection and moral hazard.

Briefly, *adverse selection* occurs because lenders are unable to discriminate between good borrowers (borrowers with low-risk projects) and bad borrowers (borrowers with high-risk projects) and charge an interest rate that reflects the average quality of the two. Since only those with high-risk projects are willing to

¹⁶ See Caprio and Klingebiel (1996)

pay high interest rates, good borrowers are “rationed-out” of the market, leading to a further increase in interest rates. Since higher interest rates lead to higher adverse selection, lenders faced with excess demand may reduce the number of loans they offer instead of raising the interest rate (**Stiglitz and Weiss, 1981**). They may choose quantity (credit) rationing over price rationing. As a result, some profitable investment projects may not be undertaken.

Finally, since lenders cannot easily monitor the quality of the investment projects they finance, borrowers will be tempted to engage in *moral hazard*, in activities that may be personally beneficial but that increase the probability of default (the agency problem). An illustration of moral hazard is the “*gambling-for-redemption behavior*,” in which borrowers who see their financial condition worsening engage in even riskier behavior, “*in a desperate attempt to generate cash*” (Eichengreen and Rose, 1998, page 9).

The concepts of adverse selection and moral hazard have been used extensively in the analysis of banking crisis. **Mishkin (1991)**, for example, argues that adverse selection magnifies bank’s vulnerability to external shocks¹⁷ as more loans are made to bad borrowers, whose *own* solvency is vulnerable to changes in economic conditions. In addition, the opaque nature of banks’ loan portfolio makes it difficult for depositors to distinguish between solvent and insolvent banks: a shock to a single bank (e.g., a bad news about the bank’s portfolio) can precipitate a run on the whole banking system. Finally, the concept of moral hazard has been used to discuss the impact of deposit insurance and other forms of government guarantees (direct and indirect) on the behavior of depository institutions and their customers. The existence

¹⁷ Shocks external to the banking system

of a central bank acting as lender-of-last-resort may increase bankers' willingness to take risks. Similarly, deposit insurance schemes may turn depositors away from supervising the behavior of commercial banks.

Recent models and analyses of banking crises borrow from the basic principles established by both the random withdrawal theory and the asymmetric information theory.

Caprio and Klingebiel (1996) recognize two important characteristics of banks: information imperfections and inter-temporal contracting. Contrary to non-financial firms, *“bank products or services include a promise to pay in the future, meaning that it can take time before it is evident that a bank cannot fulfill its contracts. Banks can conceal problems by rolling over bad loans or by raising more deposits and increasing the size of their balance sheet,”* (page 4). Because banks in trouble may incur *“fire sale”* losses when trying to sell their assets, they have the *incentive* to delay loss recognition, leading to Ponzi games and pyramid schemes.¹⁸ Three types of bank insolvency are identified in the paper: i) those limited to a single bank or a small number of banks; ii) overt banking system runs; and iii) so-called financial distress, when a significant fraction of the banking system is insolvent, but remains open. Interestingly, the authors explain that financial distress of the banking system is relatively common in transition economies, *“where implicit deposit insurance and/or state ownership of a large segment of the banking system leads depositors not to engage in a run. It can last for years, and is generally terminated when the public begins to doubt the validity of the government guarantee, or when the*

¹⁸ Evidence for such behavior was reported in Bulgaria; see Dobrinsky (1997), Koford and Tschoegl (1997), and Section 3.2.1 of this paper.

authorities intervene to restructure or resolve trouble banks” (page 8). In the second part of the paper, the authors analyze eighty episodes of bank insolvency, from 1975 to 1992, in sixty-nine developing countries. Insolvency episodes are identified on the basis of both official published data, and the opinion of country experts. The analysis stresses the role of microeconomic (incentive) factors; macroeconomic disturbances (volatility in output, inflation and terms-of-trade) may be the main *precipitating* factors, but they are not necessarily the most important ones.¹⁹ In conclusion, most insolvency episodes seem to originate from “*a mixture of bad luck, bad policies, and bad banking*” (page 1).

Eichengreen and Rose (1998) examine banking crises using a panel of macroeconomic and financial data, for a large sample of developing countries.²⁰ They focus on three groups of variables: i) international (foreign currency reserves as a percentage of monthly imports, degree of exchange rate overvaluation, external debt, and current account deficit – both as percentage of GDP); ii) domestic (government budget deficit as percentage of GDP, domestic credit growth, and growth rate of GDP per capita); and iii) external (real GDP growth rate in OECD countries, and Northern interest rates). Probit estimates indicate that the occurrence of banking crises is highly correlated with foreign interest rates (positively), and OECD growth (negatively). Slowing domestic growth, real overvaluation, and larger budget *surpluses* are also associated with banking crises. None of the other variables have a significant impact

¹⁹ Macroeconomic factors include general uncertainty, speculative bubbles led by excessive credit growth, and financial liberalization. Microeconomic factors include regulatory and bank management factors such as poor supervision and regulation, deficient management, asset-liability mismatch, insufficient diversification, connected or politically motivated lending, and fraud.

²⁰ Eichengreen and Rose use the list of insolvency episodes developed by Caprio and Klingebiel.

on the probability of a crisis. The authors also found a very weak correlation between the incidence of banking crises and the exchange rate regime (fixed vs. floating); their results, however, indicate that countries whose currencies are relatively stable are less prone to banking crises (after controlling for domestic credit growth and budget deficits). Finally, none of the “accessible” measures of domestic financial fragility (ratio of M2 to reserves, bank reserves as a share of bank assets, and proportion of bank lending to the public sector – as a proxy for connected lending) are found useful for predicting banking crises.

1.3 The “Twin Crises:” Empirical Evidence and Models

The joint occurrence of banking problems and currency crises in a number of countries has led to a vast body of research on the possible links between the two crises. Key empirical findings and theoretical developments are summarized in this section.

Kaminsky and Reinhart (1996) explain that the literature offers competing views about the potential connections between banking and balance-of-payments crises. The relationship can run from balance-of-payments to banking crises: the loss of foreign exchange reserves, if not sterilized, can lead to a contraction of the money supply (a credit crunch). Speculative attacks on the domestic currency can induce the monetary authority to raise interest rates, thereby hurting the banking system. These attacks can also trigger bank runs if depositors try to exchange the funds they hold in banks for foreign money. Alternatively, the relationship can run from banking to balance-of-payments crises. In particular, if the central bank finances the bailout of troubled institutions, its ability to defend the exchange rate might be compromised. If the rehabilitation program involves printing money, excess money

creation can lead to inflationary pressures. These pressures, together with expectations that the domestic currency may depreciate, can push residents to trade domestic money for hard currency, and precipitate the collapse of the exchange rate regime.²¹ Finally, the crises can be caused by a common set of factors or events. The authors mention the potentially destabilizing effects of financial liberalization and lending booms, of swings in foreign interest rates, and of exchange-rate-based inflation stabilization plans and their “perverse dynamics.”²²

Kaminsky and Reinhart’s empirical study is based on a sample of 20 industrial and developing countries, observed between 1970 and 1995. The authors mark the beginning of a banking crisis by an event: “*a bank run, the closure, merging, taking over or government assistance of several financial institutions*” (page 5). They identify balance-of-payments crises with an index of foreign currency market turbulence: a weighted average of changes in the exchange rate and changes in foreign exchange reserves.²³ They find no apparent link between banking and balance-of-payments crises during the seventies, when financial markets were highly regulated. However, in the eighties and nineties, balance-of-payments crises tend to *be preceded by* banking problems. Finally, the anatomy of the crises indicates that they tend to have common macroeconomic causes: “*the overwhelming majority of crises, external or domestic, have a multitude of weak economic fundamentals at their core and as their source*” (page 27).²⁴

²¹ As explained below, the Bulgarian crisis unfolded roughly along those lines.

²² The real exchange rate appreciation associated with the plan widens the current account deficit. The deficit eventually triggers a speculative attack on the currency.

²³ This index has been estimated for Bulgaria and is presented in Figure A-9 in the Appendices.

²⁴ Incidentally, the paper found little evidence of self-fulfilling crises.

A number of papers have attempted to provide a theoretical foundation to the “Twin Crises.” We explore a few of them below, chosen as illustrations.

Velasco (1987) introduces a simple theoretical framework, where a banking crisis provokes a balance-of-payments crisis through the government’s commitment to guarantee the liabilities of the banking sector.²⁵ In the model, only two assets are (initially) available: domestic money and foreign bonds. Money demand is proportional to real wealth, with a factor of proportionality depending on the yield on foreign bonds. Consumption is a function of real wealth. Wealth accumulation by the private sector is the excess of total income (output *plus* interest from foreign bond holdings) over consumption. Assuming no domestic credit, the equilibrium level of real wealth and real balances is a function of only three exogenous variables: r^* , the yield on foreign bonds, y , output and E , the nominal exchange rate (and price level). In this simple framework, a fall in output brings real wealth below steady state equilibrium. Given the assumed consumption function, national income exceeds consumption. Through a sustained current account surplus, foreign assets are accumulated, raising real wealth and bringing the economy back to steady state. Banks are introduced as “*domestic entities acquiring from households the claim to all domestic output forever*” (page 269). In exchange for these claims, the banks issue a stock of bonds, paying a flow of y units of output per unit of time. In this framework, a permanent fall in output pushes domestic banks to borrow abroad, so that they can keep paying interest on “deposits.” The non-bank public, unaware of the shock, continues consuming at the pre-shock level, even though income for the economy as a

²⁵ The model was designed to capture some of the stylized facts of the Southern Cone experience, in the early eighties.

whole has fallen (page 272). The bank borrowing just offsets the ensuing current account deficit with a matching capital inflow, leaving the Central Bank's foreign exchange reserves unaffected. When the economy reaches the point at which no further borrowing is possible,²⁶ the banking system runs out of resources and collapses, leaving the government with the responsibility to service the liabilities incurred. In Velasco's analysis, the government decides to redeem all domestic deposits (out of its international reserves), while continuing to hold on to the foreign loans (page 274). Interest payments on these loans create a budget deficit, and eventually lead to a Krugman-type balance-of-payments crisis.

Miller (1996) introduces a "*double-drain*" model, where a balance-of-payments crisis may precipitate a banking crisis if speculators use deposit money (the "*internal drain*") to run on the currency (the "*external drain*"). Furthermore, the banking crisis, by limiting the amount of deposit money available for speculating on the currency, may "*frustrate*" the external drain and postpone the collapse of the exchange rate regime (page 384). In the model, when the speculative attack begins, investors' desired currency-deposit ratio increases, as domestic currency is needed to purchase foreign deposits.²⁷ Commercial banks meet this increase in withdrawals by running down their reserves. If the reserve-deposit ratio falls to its minimum tolerable level *before* the actual currency-deposit ratio reaches its new desired level, banks will restrict cash payments. As cash payments are restricted, a "*currency premium*" is paid *de facto* on domestic deposits (through the interest rate parity condition). This currency premium halts the speculation on the currency. During the restriction, banks

²⁶ A ceiling on the amount the economy can borrow is imposed exogenously.

²⁷ The model is developed to address the 1893 double-drain crisis in the U.S.

accumulate the reserves that will be necessary to finance the internal drain. When banks have accumulated enough reserves, the restrictions are lifted, the currency premium disappears, and the external drain resumes. The external drain is preceded by an internal drain, which reduces the reserve-deposit ratio to its minimum level. Miller demonstrates that the *total* time involved for a successful speculative attack is longer when cash payments are restricted than when they are not (page 394). In addition to postponing the collapse, the cash payments restriction reduces the size of the devaluation: the *higher* reserve-deposit ratio (higher than what it would be without restriction) at the time of the collapse implies a *smaller* excess supply of money and, therefore, a *smaller* devaluation.

Sachs (1998) focuses on financial crises in *emerging* markets. In his view, financial crises typically evolve in three steps: i) the exchange rate becomes overvalued after a macroeconomic shock; ii) the central bank runs down its foreign exchange reserves to defend the exchange rate; iii) the exhaustion of reserves, together with the devaluation of the national currency, trigger a panicked capital outflow, leading to an economic collapse. Interestingly, in Sachs' framework, it is *not* the devaluation itself but the depletion of reserves that leads to the panic: the devaluation can trigger the panic only to the extent that it *signals* the exhaustion of reserves. Why are foreign exchange reserves so important in emerging markets? Because most of these economies are heavily in-debt to foreign lenders, and because the central bank is "*widely and rightly*" (page 4) viewed as the lender-of-last-resort to domestic debtors.²⁸ The author suggests that once the reserves are depleted, the economy

²⁸ This story has been applied to Bulgaria, although unconvincingly, in a working paper by Berlemann, Hristov and Nenovsky; see Section 1.4

becomes vulnerable to self-fulfilling runs, precisely because the central bank can no longer assume these lender-of-last-resort functions. Sachs stresses that the panic, the sudden capital outflow, can have devastating effects on the economy. In particular, the capital flight may create liquidity problems in the banking sector and generate runs by domestic savers. The ensuing breakdown of bank lending can lead to a collapse of trade and production, and a “*macroeconomic overshooting*” (page 1).

McKinnon and Pill (1996) investigate the sources of the 1996-97 Asian twin crises. For the authors, the core of the crises lies in the banking system. In the model, a small economy undertakes a series of economic reforms. Because of information asymmetries (and the failure of commercial banks to serve as “*efficient information conduits*” between lenders and borrowers), excessively optimistic expectations about the success of the reforms are first created among domestic residents, international investors and the policy authorities (page 7). This optimism is fueled by improved economic performances and growing inflows of foreign capital. In the early stage of the reforms, capital inflows “*feed off themselves in a sort of self-sustaining cycle*” (page 11). This “*investment mania*” is also encouraged by domestic banks, which take advantage of government’s implicit (or explicit) guarantees and engage in large moral hazard lending.²⁹ As reality kicks in, however, poor investment returns, defaults and losses become apparent and lead the government to withdraw its implicit guarantees; the economy collapses into a financial crisis, a capital flight, and a recession. This is the “*over-borrowing*” syndrome. The distinguishing features of an over-borrowing episode, therefore, include: rapid growth of domestic credit, widening

²⁹ As explained by Krugman (1999), “moral hazard lending by banks provides a sort of hidden subsidy to investment,” page 460

of the current account deficit, weaker domestic monetary control and rising domestic inflation, appreciation of the real exchange rate, a large proportion of capital inflows in the form of overseas deposits placed with the domestic banking system, greater vulnerability to adverse shocks, and culmination in a financial crisis and economic collapse (page 13).³⁰

Blejer, Feldman and Feltenstein (1997) develop a general equilibrium macroeconomic model to demonstrate how an unanticipated exogenous shock can provoke a flight from bank deposits, a “*genuine*” solvency crisis, and a severe economic downturn. In the model, an exogenous shock (a shock external to the banking system) causes the general public to anticipate a surge in inflation. A contraction in money demand follows, as the public “*flies to quality*,” i.e., withdraws its bank deposits in order to acquire foreign exchange, or other hedges against inflation. If the loss of liquidity is significant, commercial banks may be forced to reduce their lending and call-in loans to replenish their reserves. Real interest rates go up, and the resulting “*credit crunch*” leads to a contraction of economic activity (by affecting both consumer credit and working capital). Some borrowers are forced into bankruptcy. The resulting deterioration of banks’ portfolio further increases depositors’ anxiety and exacerbates the run. Policy simulations indicate that i) compensatory monetary policy (liquidity injections) reduces the initial bank run, limiting the rise in real interest rates and the deterioration of banks portfolio, but at the cost of higher inflation and external imbalances; ii) tighter fiscal policies can be used

³⁰ Paradoxically, capital inflows themselves lead to greater systemic risk and vulnerability: large inflows of foreign capital may encourage investment in risky projects, increase the foreign exchange exposure of domestic banks, create bubbles in the domestic real estate and equity markets, and increase settlement risks (difficulties associated with large cross-border settlements).

to mitigate the side-effects of liquidity injections; and iii) a devaluation has little positive impact, as the resulting increase in budget deficit (due to larger foreign debt payments) raises the real interest rate, causing more insolvencies among enterprises, i.e., more non-performing loans (page 25).

Goldfajn and Valdés (1997) look at the interactions between capital flows and the twin crises with a view to provide a framework where “*both crises occur together in a fully rational setup,*” (page 4). The paper starts with highlighting three features of recent exchange rate collapses: i) exchange rate crises tend to be preceded by banking crises; ii) capital inflows increase steadily before the crisis and fall sharply during the crisis; and iii) banking activity increases some time before the collapse. For the authors, “intermediation” (the transformation of liquid deposits into illiquid assets) is at the core of those collapses: intermediation, by offering assets that pay a better return in the case of early withdrawal, can generate runs and large capital outflows, “*amplifying initial shocks that otherwise would not have generated crises,*” (page 5). In other words, the root of those crises is a shock to fundamentals (e.g., a productivity shock) magnified by intermediation, by the banking system. In this framework, the banking system itself is not the source of the crisis, but it makes the crisis possible. Goldfajn and Valdés’ model is a two-period model, where early (period 1) and late (period 2) consumers invest, through domestic banks, in a technology with uncertain return. Return in period 2 depends on the amount withdrawn in period 1. A run happens when all investors (early and late consumers) decide to withdraw in period 1. Late consumers choose to withdraw in period 1 if the payoff of waiting is lower than the payoff to immediate withdrawal (page 15). Clearly, if all the other investors withdraw, it is optimal for a specific investor to withdraw,

opening the door to runs on the intermediaries (i.e., bank runs). With exchange-rate risk, the authors further demonstrate that there will be more runs, “*in more states of nature*” (page 23) as the risk of devaluation adds-up to the technology risk. In other words, expected devaluation increases the probability of runs against the intermediaries. In addition, runs can generate “*abnormal*” capital outflows that, with low foreign exchange reserves, may precipitate the collapse of the exchange rate.

Chang and Velasco (1998a) provide a *somewhat* similar framework. In the model, currency crises are the byproduct of bank runs. Bank runs occur when the financial system becomes illiquid, i.e., when the system’s *potential* short-term obligations exceed the liquidation value of its assets. This “*financial fragility*” may precipitate a self-fulfilling loss of confidence, pushing late consumers to withdraw prematurely and forcing banks to liquidate their investment. Adverse expectations (Jeanne’s “animal spirits”) are not, by themselves, sufficient for a crisis to occur; fundamentals must also be fragile (page 13). As in Goldfajn and Valdés (1997), the financial system acts as a “multiplier mechanism,” magnifying the effects of shocks to fundamentals: “*if a bad shock brings the economy to the region where runs are possible, the harmful effects of the bad shock will be multiplied when, in addition, a run actually takes place,*” (page 31). Financial fragility, and the likelihood of runs, is enhanced by large capital inflows and financial liberalization (as in Kaminsky and Reinhart, 1996). “Crazy policies” (such as tax-transfer policies aimed at encouraging long-term investment) may also be detrimental, in that they make banks less liquid, and hence more vulnerable to runs (page 32). Finally, under a fixed exchange rate regime, if the central bank acts as lender of last resort, commercial banks may be insulated from crises, but balance-of-payment crises become possible: “*the difference*

is whether the crisis is expressed as a bank run or a balance-of-payments crisis, but this has no economic importance,” (page 38). With no domestic credit (under a currency board arrangement, for example), commercial banks may be subject to runs because they cannot borrow money to back their liabilities. Similarly, with domestic credit, a central bank acting as lender of last resort may be subject to runs, because it cannot print the dollars needed to back the full amount of demand deposits (page 39). The exact same mechanisms are at work.

Chang and Velasco (1998b) further demonstrate that flexible exchange rates, coupled with a central bank acting as a lender of last resort in local currency, can reduce financial fragility. In this framework, commercial banks are protected against “*self-fulfilling pessimism*” on the part of domestic depositors, whose claims are in local currency. Panics by external creditors holding short-term claims denominated in foreign currency, however, are still possible.

1.4 Classification of the Bulgarian Crisis

The literature on financial crises, summarized *briefly* in this chapter, provides a number of insights for understanding the Bulgarian crises. Some of these insights are discussed more extensively in the rest of the paper.

First-generation models of currency crises provide the basic mechanisms³¹ through which monetary disequilibria lead to the depletion of foreign exchange reserves, and to speculative attacks on fixed exchange rate regimes. This mechanism can be expanded to the analysis of managed exchange rates (or dirty floats), and is

³¹ The classical model has been described as a “*mechanical seignorage and reserve exhaustion model of currency crises.*”

important for understanding the rapid depletion of BNB's reserves in the spring of 1996, and the ensuing depreciation of the Lev.

Second-generation models provide, *possibly*, an explanation for the dramatic deterioration of the Bulgarian economy from late 1996 through February 1997. Bulgaria probably entered a crisis zone in May 1996, when foreign exchange reserves hit a low. As explained by Sachs (1998), or Jeanne (1997), when the economy is in a crisis zone, self-fulfilling crises become possible, and exchange rate realignments may be much larger than "necessary." Whether the near-hyperinflation experienced by Bulgaria in early 1997 was larger than necessary is an empirical question to which we return later in the paper.

Third generation models of currency crises, and the literature on the "Twin Crises," provide several hypotheses concerning the links between banking and balance-of-payments crises. We have argued that the financial crisis in Bulgaria *appears to have originated* in the banking sector, spreading to the foreign exchange market (as depositors were fleeing to quality and trying to protect the real value of their savings), and leading eventually to large monetary disequilibria and price adjustments. These hypotheses are further discussed in Chapter 3, through a careful review of the timing of events, from late 1995 through early 1997.

In a recent working paper, Berlemann, Hristov and Nenovsky (2002) try to explain the crisis in Bulgaria with models from the literature on financial crises. They argue that the crisis can be explained with a third generation model of currency crises, focusing on moral hazard problems in the banking sector. They also mention Dooley's 1997 insurance model as a possible contender for explaining the crisis. Finally, they argue that the root of the financial crisis was the role of the BNB as

lender of last resort before and during the crisis, and the impact of this policy on the behavior of commercial banks and investors.³² The paper, however, avoids a number of important issues.

In third generation models (and Krugman's 1998 model, in particular), the run on domestic banks leads to a currency crisis as *foreign* investors, when liquidating their investment, convert the proceeds of these investments into foreign currency, creating pressures in the foreign exchange market. In those models, the currency crash can be viewed as a byproduct of the crisis in the financial sector. This framework, however, cannot be applied to the Bulgarian twin crises, where capital flight abroad was limited, and where residents held most of the deposits.³³

The authors further argue that the banking crisis was set off by the end (actual or perceived) of the central bank's lender of last resort function. As investors (depositors) realized that their investments were no longer guaranteed, they rapidly withdrew their funds, leading to the observed bank runs. However, if the BNB was not willing, or able, to use its reserves to assist the banking sector, why did the run on the currency occur? In other words, the end of the central bank's lender of last resort function severed the link between the run on commercial banks and the run on central bank's reserves. In Dooley's 1997 model, it is precisely because the central bank is ready to deplete its reserves that the runs on commercial banks and international reserves occur simultaneously. If the run on commercial banks occurs *after* the depletion of international reserves (as argued by the authors), then the depletion of international reserves has to be explained in the first place. A revised interpretation

³² They argue in fact that the BNB had become the "Lender of First Resort."

³³ The conversion of withdrawn bank deposits into foreign currency remains to be explained.

might be: the financial crisis (banking and currency crises) started as depositors believed that the central bank would run out of reserves in defending the banking sector in case of an attack. If so, this is equivalent to a *first generation model* of currency crises. And there is no banking crisis per se: the run on banks is, in a sense, just a vehicle for the run on central bank's reserves. There is *one* speculative attack, on central bank's reserves. Developments in the banking sector, and the timing of the twin crises in Bulgaria, however, seem to invalidate this hypothesis (see Chapter 3).

Overall, key insights from the paper can be summarized as follows: i) the banking crisis was caused by moral hazard problems, due in part to excessive lending from the lender of last resort as highlighted in a number of other papers (Dobrinsky (1997), or Koford and Tschoegl (1997));³⁴ ii) bank runs started as investors expected that the BNB would not be able (or willing) to exercise its role as lender of last resort (but why would a protected depositor run otherwise?); and iii) the banking crisis, somehow, caused the currency crisis.

There are, *to our knowledge*, no other explicit attempts at classifying or modeling the Bulgarian crisis.³⁵

³⁴ Documented in Chapter 2

³⁵ Except a few theoretical elements provided in Dobrinsky (1997), and discussed in Chapter 2