Financial Crisis Identification: A Survey

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June 1, 2004

1 Introduction

Financial crises have a long history, as documented in Bordo and Eichengreen (2000) and Bordo, Eichengreen, Klingebiel and Martinez-Peria (2001). This includes the Mexican and Argentinian currency and debt crises of 1973-1982 and 1978-1981 respectively, the exchange rate crises following the abandonment of the European Exchange Rate Mechanism in 1992, the Tequila Effect resulting from the Mexican peso devaluation in 1992, the Asian Flu of 1997 resulting after Thailand’s devaluation and the Russian Cold which arose from the collapse of the rouble in 1998. These episodes of international financial turmoil attracted worldwide attention and their causes, impact and policy implications have been studied extensively.

Both theoretical and empirical research has been put forward to understand the causes of financial crises. Some theoretical studies focus on fundamentals (Krugman, 1979; Blanco and Garber, 1986; Corsetti, Pesenti and

*We would like to thank Mardi Dungey, Elmer Sterken and Demosthenes N. Tambakis for helpful comments and suggestions.
Roubini, 1999a and 1999b) while others move to non-fundamentals stories, such as self-fulfilling expectations (Obstfeld, 1995 and 1996; Morris and Shin, 1998; Cole and Kehoe, 2000) and financial panics (Radelet and Sachs, 1998; Chang and Velasco, 1998a and 1998b). Statistical and econometric models have been developed to test the relationship between crisis events and (non-)fundamental factors including the development of early warning systems designed to prevent and manage crises, such as surveyed in Abiad (2003) and the models performance assessed by Berg, Borensztein and Pattillo (2004). Other models look for evidence of the propagation of crises by tracking shifts in correlations and test contagion channels, denoted in this literature as contagion.\footnote{See Rigobon (2002) and Dungey \textit{et al.} (this volume) for overviews.}

For all empirical studies, dating the occurrence of crises is crucial to distinguish between tranquil periods and crisis episodes. This chapter therefore first discusses how to measure and date three types of financial crises: currency crises, banking crises and debt crises. The second major choice facing researchers is that of the control variables, or fundamentals, in examining financial crises. In the second part of this chapter we examine a wide selection of studies for choice of indicator and their significance in empirical applications.
2 Dating financial crises

2.1 Currency crises

This section considers the different methods used in the existing literature for identifying currency crises. These can be broadly classified as either event studies or studies based on some form of threshold criteria, often applied to an exchange market pressure index (abbreviated as EMPI). We briefly discuss various currency crises dating methods that transform EMPI into a binary crisis variable by means of exogenous thresholds. These dating schemes have in common that they are sensitive to different values of the threshold, to the time period considered, and to different exclusion window widths. The last methods we distinguish use the exchange rate market pressure index, but identify crises without setting an arbitrary threshold.

Many studies on contagious currency crises use event-based definitions. Currency crises are identified qualitatively, by simply plotting the exchange rate series and picking up the high volatility, or by relying on the records of well-documented event chronologies from newspapers and journals, academic reviews and reports of international organizations. Examples of events are abandonment of exchange rate peg, devaluations, and suspension of convertibility. Granger, Huang, and Yang (2000) and Ito and Hashimoto (2002) use extreme jumps in exchange rates to determine events. Examples for news-based currency crisis dating are Kaminsky and Schmukler (1999), Glick and Rose (1999), Baig and Goldfajn (1999), Nagayasu (2001), and Dungey and Martin (2002). Bordo, Eichengreen, Klingebiel and Martinez-Peria (2001)

\[\text{See Lestano and Jacobs (2002) and Dungey \textit{et al.}, (this volume).}\]
identifies a currency crisis by combining event studies with index of speculative pressure exceeds a certain sample dependent threshold.

Eichengreen, Rose, and Wyplosz (1995 and 1996, hereinafter referred to as ERW) made an important early effort to develop a method to measure currency pressure and to date currency crises. Their definition of exchange rate pressure is inspired by the monetary model of Girton and Roper (1977): a speculative attack exists only in the form of extreme pressure in the foreign exchange market, which usually results in a devaluation (or revaluation), or a change in the exchange rate system, i.e. to float, fix or widen the band of the exchange rate. However, speculative attacks on exchange rates can also be unsuccessful. When facing pressure on its currency, the authorities have the option to raise interest rates or to run down international reserves. Hence, speculative pressure is measured by an index \( (EMPI) \) that is a weighted average of normalized changes in the exchange rate, the ratio of gross international reserves to M1, and the nominal interest rates. All variables are relative to a reference country with a strong currency that serves as an anchor to other countries. This measure is intuitively appealing. In case of speculative pressure, the index captures changes in the domestic exchange rate if the attack is successful and changes in international reserves or nominal interest rates if the speculative attack does not lead to a devaluation. A period of speculative attack is identified when the index exceeds some upper bound. In their 1995 paper, ERW arbitrarily set a threshold of two standard deviations above the mean, while in ERW (1996) they set the threshold at 1.5 standard deviations above the mean. This threshold is based on news reports. If two or more potential crises occur closely together, the second
and subsequent observations are excluded. So, an exclusion window is set to avoid counting the same crisis twice or more. ERW (1995) use a window width of 12 months, whereas in their 1996 paper they change the window to 6 months.

Frankel and Rose (1996) exclude unsuccessful speculative attacks from the exchange rate pressure concept. In their opinion international reserves are too rough a proxy to measure policy actions in defense of the currency. In addition, they argue that raising interest rates and exhausting international reserves is not standard practice to deal with speculative attacks in most of the developing countries. Therefore, they use only nominal exchange rates and define a currency crash as a nominal depreciation of the currency of at least 25 percent which is accompanied by an increase in the rate of depreciation of at least 10 percent. The latter cut-off point is used to avoid registering periods with high inflation, which are usually followed by high depreciation. Moreover, they use a three year crisis window in order to avoid that a currency crash is counted twice. Esquivel and Larrain (1998), Bussière and Mulder (2000) and Mulder, Perrelli and Rocha (2002) follow the framework of Frankel and Rose (1996) by focusing on successful speculative attacks to date currency crises. Differences in the specification exist however in the choice of real versus nominal exchange rate depreciations and the magnitude and speed of the deprecation to qualify as a crisis.

Kaminsky, Lizondo and Reinhart (1998), Kaminsky and Reinhart (1999, 2000) and Goldstein, Kaminsky and Reinhart (2000) modify the exchange market pressure index by dropping the interest rate differentials, since in their sample—the 1970s and 1980s—interest rates were controlled by central
banks. They also drop the reference country. In addition, foreign reserves are no longer scaled by money supply (M1). Also, the variables are not normalized. To avoid the problem that currency crises are associated with high inflation, the sample is split into periods with hyperinflation and low inflation; separate indexes are constructed for each subsample. The definition of a currency crisis is the same as in ERW, but the threshold to define a currency crisis is set to three standard deviations above the mean.

Many studies (Berg and Pattillo (1999), Caramazza, Ricci and Salgado (2000), Weller (2001), Edison (2003) and Lestano, Jacobs and Kuper (2003)) follow Kaminsky, Lizondo and Reinhart (1998), although considerable variations exists with respect to the inclusion of interest rate changes, the weighted used to the threshold and the treatment of high inflation periods. Other studies use variants of the speculative pressure index approach. Kamin, Schindler and Samuel (2001), for instance, construct the exchange rate pressure variable as a weighted average of two-month percentage changes in the real bilateral exchange rate against the dollar and in international reserves, with the weights being proportional to the inverse of the standard deviation of these series. Declines in these weighted averages in excess of 1.75 standard deviations signal a crisis month. Zhang (2001) suggests decomposing the exchange rate market pressure index into its components and to use time-varying thresholds for each component. Interest rate variables are excluded and the link to the reference country is dropped. The thresholds are arbitrarily set to three standard deviations above and below the mean.

The final group of currency crises dating methods does not rely on arbitrarily set thresholds to date currency crisis episodes. Some authors argue
that potentially valuable information on the dynamics of \textit{EMPI} is lost when the index is transformed into a binary variable. Therefore, Kwack (2000) and Vlaar (2000) simply use the \textit{EMPI} itself as dependent variable. Pozo and Amuedo-Dorantes (2003) and Haile and Pozo (2003) suggest exploiting the information in the tails of the distribution.\textsuperscript{3} The reason for doing so is that the dating schemes discussed above are based on the arbitrary assumption that the index follows a well-behaved normal distribution. However, the normality condition need not necessarily hold due to fat tails in the data, skewness, or infinite second moments. In a study of the Asian crisis, Abiad (2003) proposes a Markov-switching model with time-varying probabilities extending the work of Martinez-Peria (2002).\textsuperscript{4} The model treats the states of tranquility or speculative pressure as latent variable and assumes that \textit{EMPI} (or its components) is dependent on the latent variable. In addition, it is assumed that there is a certain probability of being in the same state or of moving from one state to the other. The strength or weakness of a country’s fundamentals determine the transition probabilities. By estimating transition in a maximum likelihood framework, the crisis episodes are identified and characterized.

2.2 Banking crises

The definition of banking crises is less precise than the definition of a currency crisis and hence more difficult to implement. Consequently, most of existing methods that are widely used to dates banking problem episodes are

\textsuperscript{3}Compare also Koedijk, Schafgans and De Vries (1990).

\textsuperscript{4}See Jeanne and Masson (2000) and Cerra and Saxena (2002) for different Markov-switching model specifications to date currency crises.

Caprio and Klingebiel (2000) start from a sample of 69 countries for which information on bank crises is available since the mid-1970s to 1998. The banking crisis episodes are distinguished into the episode to be appeared systemic or borderline episodes. Systemic periods are characterized by events when the entire banking system has zero or negative net worth. Borderline episodes are defined as evidence of significant bank problems, such as bank runs, forced bank closures, mergers or government takeovers. Their data are based on news and interviews with country economists. Their observations show that banking crises are more costly in the emerging markets in which losses tend to be larger relative to income than in the industrial countries. Recently, Caprio and Klingebiel (1999) have corrected some discrepancies in their earlier list and updated it through 1998.

Lindgren, Garcia and Saal (1996) draw a distinction between banking crises (systemic episodes - bank insolvency) and banking problems, defined as “significant extensive unsoundness short of crisis” (localized crises or non-systemic episodes - bank illiquidity). Banking crises refer to evidence of bank runs or other substantial portfolio reallocations, collapsing financial firms, or massive government intervention. Their list of banking problems includes episodes from 1980 to mid-1996 and covers 181 IMF-member countries of which about three quarters of them suffered from banking crises. They ac-
knowledge the difficulty in assessing whether or not a bank is solvent. Bank loans, the primary asset of a banking system, are difficult to value and bank managers have an incentive to show loans as performing to accrue income. Lack of transparency in the provision of information and the existence of off-balance sheet investments further complicate the analysis. Solvency only characterizes a bank at a point in time; a more forward-looking analysis would provide insight into the determinants of insolvency, including poor asset quality and earnings, management weakness and insufficient oversight. Other traditional measures such as capital adequacy, asset quality, earnings and liquidity offer some indication of solvency.

Dermirgüç-Kunt and Detragiache (1998) define a banking crisis as an episode of banking distress in which the ratio of non-performing assets to total bank assets exceeds 10 percent and the costs of rescue operations exceed 2 percent of GDP. Banking crises are also frequently identified by events such as bank failure, large scale bank nationalization, deposit freezes, prolonged bank holidays and bank shutdowns or mergers. They use a sample of 65 countries from 1980 to 1995.

Dziobek and Pazarbasioglu (1997) focus on systemic banking problems which are defines as situations where distresses affect banks that hold at least 20 percent of total deposits of the banking system. Their total sample consists of 24 countries for the period 1991–1995. The sample countries are divided into countries that recently completed their bank restructuring efforts, or where the restructuring is still ongoing. Banking problem events are collected through questionnaires sent to country authorities, and IMF or World Bank staff specialized in banking sector distresses.
Finally, Kaminsky and Reinhart (1999) mark the start of banking crises by events that point at bank runs that lead to closure, merger or takeovers by the public sector of one or more financial institutions, or a large-scale government bail-out of one or more financial institutions that is followed by more bail-outs. A banking crisis ends when government assistance stops. Their sample includes 20 countries for the period 1970–1995. Their banking crisis identification relies heavily on existing studies of banking distress and on the financial news around the time of the crisis.

The first three studies specify both the beginning and the end of crises on an annual basis, but Kaminsky and Reinhart (1999) list crises at the monthly frequency. All of these studies register events for crisis dates, except Dermirguc-Kunt and Detragiache (1998) who try to include quantitative measures. However, measurement problems exist. Central bank’s quasi-fiscal operations for rescue purposes are difficult to quantify. In some respects, this is simply because the central bank’s accounting conventions differ from those of the government and the distinction between monetary and fiscal activities of the central bank is blurred. In addition, the main banking problems observed in recent years do not stem from the liabilities side of bank balance sheets. Since the introduction of deposit insurance, it is no longer possible to date a banking crisis on the basis of changes in bank deposits. The assets side of banks’ balance sheets, indicators such as changes in prices in the real estate sector and non-performing assets are becoming more and more important. Unfortunately, both indicators are not available in a timely manner or systematically distorted (Hawkins and Klau, 2000).

Banking crises may be associated with currency crises through a number of
channels of causation: a bank crisis may lead to a currency crisis or the other way round\textsuperscript{5} or common factors may cause both types of crisis. The last type of crisis is the so-called twin crises phenomenon. Twin crises were initially analyzed by Kaminsky and Reinhart (1999). They identify banking and currency crises in a restricted sample of 20 industrial and developing countries for the period 1970 until the mid-1990s and observe that there is no apparent link between currency and banking crises in the 1970s. However, the past two decades have witnessed that banking crises are closely associated with currency crises. They define twin crises as episodes in which the beginning of a banking crisis is followed by a balance of payments crisis within 48 months. Thereafter, the literature follows their definition but slightly adapts the time dimension. Glick and Hutchison (2001), for instance, identify the incidence of twin crises as instances in which a bank crisis is accompanied by a currency crisis in either the previous, the current, or the following year. In contrast, Bordo, Eichengreen, Klingebiel and Martinez-Peria (2001) define twin crises as episodes in which currency crises and banking crises occur in the same or adjoining years.

2.3 Debt crises

Since the onset of debt crises in the 1980s and 1990s, an extensive theoretical and empirical literature has dealt with the determinants of sovereign default and sovereign risk. Most of these studies have in common that they start from

\textsuperscript{5}For instance, Eichengreen and Rose (1998) focus on the possible causal links from currency crises to banking crises, while Rossi (1999) studies the opposite causality effect, from banking to currency crises. See also Miller (1998) on the relationship between banking and currency crises.
a definition of a debt crisis or a debt service difficulty or default. Typically, the incidence of a debt crisis is interpreted as a debt rescheduling agreement or negotiation, arrears (amounts past due and unpaid) on principal repayments or interest payments and an upper-tranche IMF agreement. Other studies use corporate default rates collected by commercial rating agencies, such as Standard and Poor’s and Moody’s Investors Service,\textsuperscript{6} as proxy for sovereign default events.

Some papers use combinations of debt crisis definitions, others simply make use of single events or measurement of either debt rescheduling or arrears. For instance Berg and Sachs (1988), Lee (1991), Balkan (1992), Lanoie and Lemarbre (1996), and recently, Marchesi (2003) and Lestano, Jacobs and Kuper (2003), have a common definition of a debt crisis using only the concept of debt rescheduling. All studies aim at selecting years in which countries reschedule their external debt. Broadly speaking, debt rescheduling is defined as a mechanism whereby the debtors offer the creditors (commercial banks and governments of industrial countries) a revised contract that enables debtors not to default on their loans. The contract arrangements include an actual reduction of the principal and service of the debt and the postponement of payment.\textsuperscript{7}

The approach of Eckaus \textit{et al.} (1985) and Hajivassiliou (1989, 1994) comprises all three elements in their debt default definition. They consider

\textsuperscript{6}See Moodys Investors Service (2000, 2003), Standard and Poor’s (1999), and Chambers and Alexeeva (2002) for details on the definition of default rates associated with the sovereign credit ratings and Bhatia (2002) for an evaluation of sovereign credit rating methodologies.

\textsuperscript{7}Oka (2003) focuses on arrears to the IMF. Hajivassiliou (1987) and Li (1992) add the upper-tranche IMF agreement to their debt crisis definition. See International Monetary Fund (2001) for details on the upper-tranche agreement.
the presence of arrears on interest or principal as an additional expression of a debt servicing problem. Overall, they define a country as experiencing a debt crisis in a given year if there is an event of debt rescheduling with commercial or official creditors, an upper-tranche IMF agreement is underway, or the amount of accumulated arrears on interest payments or principal repayments exceeds some minimum threshold. Detragiache and Spilimbergo (2001) adopt another approach and define a debt crisis if either or both of the following conditions occur: (i) arrears of principal or interest on external obligations toward commercial creditors (banks or bondholders) exceed 5 percent of total commercial debt outstanding and (ii) a rescheduling or debt restructuring agreement with commercial creditors exists as listed in the World Bank’s Global Development Finance. Aylward and Thorne (1998) looks whether a country has external debt repayment problems and checks a country was in arrears to the IMF or other creditors. Recently, Manasse, Roubini, and Schimmelpfennig (2003) define a country to experience a debt crisis if Standard and Poor’s classifies it as being in default or it receives a large non-concessional IMF loan in excess of 100 percent of its quorum. Sy (2003) proposes to identify debt crises as sovereign bonds distress events. The sovereign bonds are classified as distressed securities if secondary market bond spreads are higher than a critical threshold. The threshold is set at 1,000 basis points or more above U.S. Treasuries.\footnote{Using extreme value theory and kernel density estimation suggested by Pozo and Amuedo-Dorantes (2003), Pescatori and Sy (2004) confirm that the 1,000 basis points threshold corresponds to significant tail events.}

The interrelation between sovereign debt variables and currency and banking crises has also been studied. After assessing various currency crisis predic-
tion models, Berg, Borensztein and Pattillo (2004) emphasize that sovereign and domestic debt dynamics play a central role. They argue that debt and currency crises are related but distinct: most debt crises are associated with currency crises, but the reverse is not true. Reinhart (2002) explores the relationship between sovereign default and currency crises. Standard and Poor’s sovereign credit ratings are used to define the default. She finds that 84 percent of the defaults in the emerging markets sample are linked with currency crises and almost half of the currency crises in the total sample are associated with defaults and concludes that in addition to their exchange rate disturbances countries such as Mexico, South Korea, Thailand and Turkey would most likely have experienced a sovereign default as well if they had not obtained vast international rescue packages. Goldstein, Kaminsky and Reinhart (2000) study the connections between currency and banking crises and changes in sovereign credit ratings issued by Moody’s Investors Service. They find mixed evidence on the ability of the sovereign ratings to explain financial crises. There is evidence that the ratings have very low predictive power for currency crises, but this does not hold for banking crises. In contrast, Sy (2003) concludes that currency crises are not linked to the probability of sovereign default.

3 Indicators of financial crises

This section discusses potential indicators that have been employed in the empirical literature to describe the probability of financial crises. A comprehensive survey of various types of financial indicators can be found in

The choice of financial indicators as predictors of financial crises is generally based on economic reasoning but often limited by the availability of data. The studies summarized in Tables 1-5 share the idea that it is possible to identify a number of domestic and external macroeconomic fundamental variables as the main determinants of financial crises. Some explanatory variables are exclusive for currency crises, banking crises or debt crises; others are informative for more than one type of crisis. The first two columns in the tables list the indicator variable and give a brief economic interpretation of the mechanism by which they are anticipated to affect financial markets. The next three columns report the hypothesized sign of each indicator in each of the three types of crisis, currency crisis (CC), banking crisis (BC) and debt crisis (DC); a plus (minus) sign indicates that a high (low) value of the indicator reflects a high probability of a crisis. The final column lists the corresponding references which use this particular indicator.

The variables can be classified into several groups: the external sector (split by whether they pertain to either the current or capital account), the financial sector, the domestic real and public sectors and finally global in-
fluences. In the first group there are 7 variables, 5 of which are related to the current account and 2 to the capital account. These variables are certainly affected not only by domestic economic conditions and policies, but also by global conditions such as fluctuations in the bilateral dollar exchange rate, international capital flows and commodity prices. The indicators in Table 1 relate to changes in international competitiveness and changes in the current account of the balance of payments. Worsening of international competitiveness and a deterioration of the current account may lead to a higher probability of financial crises either directly or through overvalued exchange rates. Table 2 focuses on the capital account. With increasing globalization and financial integration, capital account problems make a country highly vulnerable to shocks. Manifestations of capital account problems could include declining foreign reserves and liabilities of the banking system and foreign reserves mismatches.

The second group contains 16 indicators, 9 financial indicators and 7 domestic variables that are partly or fully driven by economic policy. Table 3 lists various financial variables which affect financial crises via different mechanisms. Many of these indicators indicate possible currency crises through excess liquidity. The cause of excess liquidity range from monetary policy, to financial liberalization to weak banking systems. The domestic variables in Table 4 include debt and deficit. High debt and deficits increase the vulnerability of the economy, especially in low-income countries and in countries with low national savings. Also low production growth, high inflation rates and a bust in asset price bubbles often precede financial crises.

Finally, the global indicators in Table 5 reflect major economic shifts in
industrial countries and movements of oil prices. External events, such as a sharp increase in US interest rates and recessions in industrial countries may contribute to a crisis. High world interest rates often induce capital outflows. For many East Asian countries, the depreciation of the Japanese yen against the US dollar puts other regional currencies under pressure. A pronounced fall in the price of a commodity, such as oil, may have adverse effects on a country’s trade balance and government revenue. Such factors can increase the likelihood of a currency crisis. Conversely, sharp increases in commodity prices may lead to a rise in imports and in the prices of non-traded goods. If the nominal exchange rate remains fixed, the real exchange rate can rise significantly, undermining the competitiveness of domestic industry.

It is important to note that some indicators are transformed to ensure that they are stationary and free from seasonal effects. Two types of transformations are applied, i.e. first differencing or percentage changes, and deviations from linear trends. In case the indicator has no visible seasonal pattern and is non-trending, its level form is maintained. Some unavailable indicators are proxied by closely related indicators, for example OECD GDP is substituted by industrial production. Certain scale factors for different indicators are used. For example, domestic credit, current account and public debt is scaled by GDP.

Some indicators are multiple crises indicators in the sense that the same indicator hints at more than one type of financial crises. However, it is not certain whether such a multiple crises indicator affects the probability of two or more types of financial crises simultaneously, or whether it triggers one type of crisis which in turn rolls over to a second type of crisis, and a
third. For instance, a drop in international competitiveness may result in a currency crises as a result of which a banking crisis evolves. Kaminsky and Reinhart (1999) point out that the existence of a vicious cycle where banking sector problems lead currency crises and these, in turn, have a negative feedback on banks. Ultimately, they show that twins share some common determinants. Theoretical and empirical studies confirm that twin crises have been characterized by financial sector liberalization (Glick and Hutchison, 2001), easing of capital account restrictions (Goldfajn and Valdes, 1997; Calvo and Mendoza, 2000; Calvo and Reinhart, 2000), the financial fragility (Chang and Valesco, 2000; Allen and Gale, 2000) and market overreaction (Corsetti, Pesenti and Roubini, 1999a). Calvo and Reinhart (2000) and Burnside, Eichenbaum and Rebelo (2001), observe that the effects of twin crises are more severe than pure banking and currency crises in terms of cost of bailout, loss of reserves and real depreciation. In addition, the recovery of the domestic economy are more sluggish.
Table 1: Explanatory variables for the external sector (current account)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Interpretation</th>
<th>CC</th>
<th>BC</th>
<th>DC</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real exchange rate</td>
<td>A measure for the change in international competitiveness and a proxy for over(under)valuation. Overvalued real exchange rate is expected to produce higher probability of financial crisis.</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Kamin et al. (2001); Edison (2003); Dermirgüç-Kunt and Detragiache (2000); Eichengreen and Arteta (2000)</td>
</tr>
<tr>
<td>Export growth</td>
<td>An indicator for a loss of competitiveness in international good market. Declining export growth may be caused by an overvalued domestic currency and is hence a proxy for currency overvaluation. On the other hand, if export growth slows due to reasons unrelated to the exchange rate, this may cause devaluation pressure. In both cases, declining export growth can be a leading indicator for a sizeable devaluation.</td>
<td>-</td>
<td>-</td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003); Marchesi (2003)</td>
</tr>
<tr>
<td>Import growth</td>
<td>Weak external sector is part of currency crises. Enormous import growth could lead to worsening in the current account and have been often related with currency crises.</td>
<td>+</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003)</td>
</tr>
<tr>
<td>Terms of trade</td>
<td>Increases in terms of trade strengthen a country’s balance of payments position and hence lower the probability of crisis. Terms of trade deteriorations may precede currency crisis.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Kamin et al. (2001); Dermirgüç-Kunt and Detragiache (2000); Lanoie and Lemarbre (1996)</td>
</tr>
<tr>
<td>Ratio of the current account to GDP</td>
<td>A rise in this ratio is generally associated with large external capital inflows that are intermediated by the domestic financial system and could facilitate asset price and credit booms. Increases in the current account surplus are expected to indicate a diminished probability to devalue and thus to lower the probability of a crisis.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Berg and Pattillo (1999); Kamin et al. (2001); Eichengreen and Arteta (2000); Lanoie and Lemarbre (1996); Marchesi (2003)</td>
</tr>
</tbody>
</table>

Notes: CC, BC and DC represent currency crisis, banking crisis, and debt crisis, respectively. Positive (negative) expected sign means that a high (low) value of the indicator causes a higher probability of a crisis.
Table 2: Explanatory variables for the external sector (capital account)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Interpretation</th>
<th>CC</th>
<th>BC</th>
<th>DC</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of M2 to foreign exchange reserves</td>
<td>Captures to what extent the liabilities of the banking system are backed by foreign reserves. In the event of a currency crisis, individuals may rush to convert their domestic currency deposits into foreign currency, so that this ratio captures the ability of the central bank to meet their demands.</td>
<td>+</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Kamin et al. (2001); Edison (2003); Dermirguc-Kunt and Detragiache (2000); Eichengreen and Arteta (2000)</td>
</tr>
<tr>
<td>Growth of foreign exchange reserves</td>
<td>Declining foreign reserves is a reliable indicator that a currency is under devaluation pressure. A drop in reserves is not necessarily followed by devaluation, central bank may be successful in defending a peg, spending large amounts of reserves in the process. On the other hand, most currency collapses are preceded by a period of increased efforts to defend the exchange rate, which are marked by declining foreign reserves. Total value of foreign reserves are also used as indicators of a country’s financial difficulty dealing with debt repayment.</td>
<td>-</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003); Marchesi (2003)</td>
</tr>
</tbody>
</table>

Notes: CC, BC and DC represent currency crisis, banking crisis, and debt crisis, respectively.
Positive (negative) expected sign means that a high (low) value of the indicator causes a higher probability of a crisis.
Table 3: Explanatory variables for the financial sector

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Interpretation</th>
<th>CC</th>
<th>BC</th>
<th>DC</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1 and M2 growth</td>
<td>These indicators are measures of liquidity. High growth of these indicators might indicate excess liquidity which may fuel speculative attacks on the currency thus leading to a currency crisis.</td>
<td>+</td>
<td></td>
<td></td>
<td>Kamin et al. (2001)</td>
</tr>
<tr>
<td>M2 money multiplier</td>
<td>An indicator associated with financial liberalization. Large increases in the money multiplier can be explained by draconian reductions in reserve requirements.</td>
<td>+</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003)</td>
</tr>
<tr>
<td>Ratio of domestic credit to GDP</td>
<td>Very high growth of domestic credit may serve as a crude indicator of the fragility of the banking system. This ratio usually rises in the early phase of the banking crisis. It may be that as the crisis unfolds, the central bank may be injecting money to the bank to improve their financial situation.</td>
<td>+ +</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003); Dermirguc-Kunt and Detragiache (2000); Eichen green and Arteta (2000)</td>
</tr>
<tr>
<td>Excess real M1 balance</td>
<td>Loose monetary policy can lead to currency crisis.</td>
<td>+</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003)</td>
</tr>
<tr>
<td>Domestic real interest rate</td>
<td>Real interest rate can be considered as proxy of financial liberalization, in which the liberalization process itself tends to lead to high real rates. High real interest rates signal a liquidity crunch or have been increased to fend off a speculative attack.</td>
<td>+ +</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003); Dermirguc-Kunt and Detragiache (2000)</td>
</tr>
<tr>
<td>Lending and deposit rate spread</td>
<td>An increase of this indicator above some threshold level possibly reflects a deterioration in credit risk as banks are unwilling to lend or decline in loan quality.</td>
<td>+</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003)</td>
</tr>
<tr>
<td>Commercial bank deposits</td>
<td>Domestic bank run and capital flight occur as crisis unfolds.</td>
<td>-</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003)</td>
</tr>
<tr>
<td>Ratio of bank reserves to bank assets</td>
<td>Adverse macroeconomic shocks are less likely to lead to crises in countries where the banking system is liquid.</td>
<td>-</td>
<td></td>
<td></td>
<td>Dermirguc-Kunt and Detragiache (2000)</td>
</tr>
</tbody>
</table>

Notes: CC, BC and DC represent currency crisis, banking crisis, and debt crisis, respectively.
Positive (negative) expected sign means that a high (low) value of the indicator causes a higher probability of a crisis.
Table 4: Explanatory variables for the domestic real and public sector

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Interpretation</th>
<th>CC</th>
<th>BC</th>
<th>DC</th>
<th>Reference(s)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of fiscal balance to GDP</td>
<td>Higher deficits are expected to raise the probability of crisis, since the deficits increase the vulnerability to shocks and investor’s confidence.</td>
<td>+</td>
<td></td>
<td></td>
<td>Dermirgüç-Kunt and Detragiache (2000); Eichengreen and Arteta (2000)</td>
<td></td>
</tr>
<tr>
<td>Ratio of public debt to GDP</td>
<td>Higher indebtedness is expected to raise vulnerability to a reversal in capital inflows and hence to raise the probability of a crisis.</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Kamin et al., (2001); Lanoie and Lemarbre (1996); Eichengreen and Arteta (2000)</td>
<td></td>
</tr>
<tr>
<td>Growth of industrial production</td>
<td>Recessions often precede financial crises.</td>
<td></td>
<td>-</td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003)</td>
<td></td>
</tr>
<tr>
<td>Changes in stock prices</td>
<td>Burst of asset price bubbles often precede financial crises.</td>
<td>-</td>
<td></td>
<td></td>
<td>Kaminsky et al. (1998); Berg and Pattillo (1999); Edison (2003)</td>
<td></td>
</tr>
<tr>
<td>Inflation rate</td>
<td>The inflation rate is likely to be associated with high nominal interest rates and may proxy macroeconomic mismanagement which adversely affects the economy and the banking system.</td>
<td>+</td>
<td></td>
<td>+</td>
<td>Dermirgüç-Kunt and Detragiache (2000); Lanoie and Lemarbre (1996); Marchesi (2003)</td>
<td></td>
</tr>
<tr>
<td>GDP per capita</td>
<td>High income countries may be less likely to reschedule their debt than poorer countries since the costs of rescheduling would tend to be more onerous for more advanced economies. Deterioration of the domestic economic activity are expected to increase the likelihood of a banking crisis.</td>
<td>-</td>
<td></td>
<td>-</td>
<td>Dermirgüç-Kunt and Detragiache (2000); Eichengreen and Arteta (2000); Lanoie and Lemarbre (1996); Marchesi (2003)</td>
<td></td>
</tr>
<tr>
<td>National saving growth</td>
<td>High national savings may be expected to lower the probability of debt rescheduling.</td>
<td>-</td>
<td></td>
<td></td>
<td>Lanoie and Lemarbre (1996)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: CC, BC and DC represent currency crisis, banking crisis, and debt crisis, respectively. Positive (negative) expected sign means that a high (low) value of the indicator causes a higher probability of a crisis.
Table 5: Explanatory variables for the global economy

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Interpretation</th>
<th>CC</th>
<th>BC</th>
<th>DC</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of world oil prices</td>
<td>High oil prices are associated with recessions.</td>
<td>+</td>
<td></td>
<td></td>
<td>Edison (2003)</td>
</tr>
<tr>
<td>US interest rate</td>
<td>International interest rate increases are often associated with capital outflows.</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Edison et al. (2003); Kamin et al. (2001); Eichengreen and Arteta (2000)</td>
</tr>
<tr>
<td>OECD GDP growth</td>
<td>Higher foreign output growth should strengthen exports and thus reduce the probability of a crisis.</td>
<td>-</td>
<td>-</td>
<td></td>
<td>Edison (2003); Kamin et al. (2001); Eichengreen and Arteta (2000)</td>
</tr>
</tbody>
</table>

Notes: CC, BC and DC represent currency crisis, banking crisis, and debt crisis, respectively.
Positive (negative) expected sign means that a high (low) value of the indicator causes a higher probability of a crisis.
Table 6 summarizes nine empirical studies on financial crises. These studies differ in the set of indicators, the transformations of the indicators, crisis definition and approach to assessing the outcomes. The first column of Table 6 lists all indicators that are used in the empirical studies. The final four rows of the table describe the sample period, time span, number of countries covered, and the method used.

The table allows the following conclusions. Berg and Pattillo (1999) and Edison (2003) augment the set of currency crisis indicators of Kaminsky et al. (1998) with global economy indicators which are included to capture external shocks. All studies find that real exchange rates, export growth, and the ratio of M2 to international reserves are the most important indicators to explain the probability of currency crises. Moreover, Kaminsky et al. (1998) and Berg and Pattillo (1999) observe that stock prices, industrial production and international reserves are also statistically significant predictors of currency crisis occurrence. On the other hand, Kamin, Schindler and Samuel (2001) find that the contribution of external balance and external shock indicators to the average probability of crisis is not high, but explain a significant share of the increases in the probability during the crisis years themselves. They interpret this as evidence that the domestic indicators are still the key determinants of vulnerability to crisis, but that external sectors often push vulnerable countries over the edge.

Dermitguc-Kunt and Detragiache (2000) consider the role of macroeconomic variables, deposit insurance and law enforcement in determining the likelihood of banking failure. They observe that the risk of a banking crisis becomes higher the lower output growth and the higher inflation, the
Table 6: Explanatory variables: empirical results

<table>
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<td>CC</td>
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<td>*</td>
<td>*</td>
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<td>CC</td>
<td>CC</td>
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<td>CC</td>
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<td>BC</td>
<td>BC</td>
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<td>26</td>
<td>28</td>
<td>65</td>
<td>78</td>
<td>91</td>
<td>87</td>
<td>6</td>
</tr>
</tbody>
</table>

Notes: CC, BC and DC represent currency crisis, banking crisis, and debt crisis, respectively. The mark o and * denote insignificant and significant indicators, respectively. The papers included in this table are KLR: Kaminsky, Lizondo and Reinhart (1998); BP: Berg and Pattillo (1999); KSS: Kamin, Schindler and Samuel (2001); E: Edison (2003); DKD: Dermirguc-Kunt and Detragiache (2000); EA: Eichengreen and Arteta (2000); LL: Lanoie and Lemarbre (1996); M: Marchesi (2003); LJK: Lestano, Jacobs and Kuper (2003).
domestic real interest rate, the ratio of M2 to international reserve, and domestic credit per GDP. They also find weak evidence that adverse terms of trade shocks increase the probability of a banking crisis. The size of the fiscal deficit and the rate of depreciation of the exchange rate do not seem to have an independent impact. A interesting finding is that a weak macroeconomic environment is not the sole indicator behind banking sector fragility; structural characteristics of the banking sector and the economy also play a role. The authors conclude that the presence of an explicit deposit insurance scheme makes bank unsoundness more likely.

Using annual data on 78 countries in the periods of 1975-1997 to investigate the influence of domestic and external factors in bringing about banking problems, Eichengreen and Arteta (2000) find that domestic credit booms and government fiscal balance are strongly associated with banking crises. They also look at institutional explanations of banking crises and find that few of them yield robust results. More specifically, they find that domestic financial liberalization increases the probability of a banking crisis but that international financial liberalization (i.e., capital account liberalization), the presence of deposit insurance, and binary measures of institutional quality have unpredictable outcomes.

The recent study of Marchesi (2003) on the probability of debt crises concludes that none of the indicators listed in Table 6 is significant. However, the study finds weak evidence that a debt rescheduling has a close relation with investments, the level of a country’s indebtedness and the existence of arrears in the payment of interest. Lanoie and Lemarbre (1996) do not support this result. They observe that the lower the rate of growth of GDP
per capita and the large external capital inflows, the higher the probability of
debt rescheduling and debt crises. Marchesi (2003) also studies the relation
between debt rescheduling and the adoption of IMF programs. The program
consists of a set of policies in order to improve the economic condition of
the debtor country, to enable the country to service its external debt better.
The presence of an IMF program serves as a signaling device of a country’s
willingness and ability to undertake substantive economic reform, which is
thus rewarded with the debt relief. The author find that participation in an
IMF program lowers the expected probability of debt default.

Lestano, Jacobs and Kuper (2003) analyze the significance of all indica-
tors listed in Tables 1-5. Their empirical results suggest that rates of growth
of money (M1 and M2), bank deposits, GDP per capita and national savings
correlate with all three types of financial crises, whereas the ratio of M2 to
foreign reserves, and the growth of foreign reserves, the domestic real interest
rate and inflation play an additional role in banking crises and some varieties
of currency crises. Moreover, based on an in-sample experiment using mul-
tivariate logit models they prefer the currency dating method of Kaminsky,
Lizondo and Reinhart (1998) over other currency dating schemes.

It is difficult to assess these outcomes. The empirical papers deal with
single crises only and differ in the types of analysis that have been used and
employ different analytical methodologies. Some use signal extraction models
others use qualitative response models. Also the time span, the frequency
of the data and the number of countries included in the analysis differs.
Some papers use a short time span and cover a lot of countries—especially
Lanoie and Lemarbre (1996)—while others cover a longer time span at the
expense of a smaller country coverage. The studies also differ with respect to how they define a financial crises. A general conclusion might be that the real exchange rate and the ratio of M2 to foreign exchange reserves are found to be significant in many empirical studies of currency crises, except in Lestano, Jacobs and Kuper (2003). For banking crises, Dermirgüç-Kunt and Detragiache (1998) and Lestano, Jacobs and Kuper (2003) found that the ratio of M2 to international reserves, domestic real interest rate, inflation rates and GDP per capita play an important role. GDP per capita explains the probability of debt crises, except in Marchesi (2003).

To improve on the explanatory power of these models it might be useful to include measures of political instability \(^9\) and of trade and equity market linkages to capture the idea of contagion. Another idea might be to link the various types of crises in one model. Finally, it may help to include not only the indicators themselves in the model which take the form of levels, ratios or growth rates, but also changes in these variables. It can be argued that the way these factors develop over time has important consequences for the probability of a currency crisis to occur.

4 Conclusions

This chapter reviews the literature that focuses on the measurement and dating of financial crises. Three types of crises are distinguished: currency crises, banking crises and debt crises. Event studies use a qualitative approach to identify currency crises dates. Alternative currency crises dating

\(^9\)Bussière and Mulder (2000) for instance suggest political indices, which measure political indecision and politically induced uncertainty.
schemes rely on the calculation of an exchange rate market pressure index. Most methods use a more or less arbitrary threshold to identify crises. These are the methods by Eichengreen, Rose, and Wyplosz (1995, 1996), Kaminsky, Lizondo and Reinhart (1998), Frankel and Rose (1996), and Zhang (2001). Other methods for finding currency crises dates are based on extreme values or Markov-switching models and do not employ arbitrary thresholds.

The definition of banking crises is more difficult to implement. Different studies show different crisis episodes. Debt crises studies have in common that they start from a definition of a debt crisis or a debt service difficulty or default. Differences arise from the fact that some papers use combinations of debt crisis definitions, whereas others simply make use of single events or measurement of either debt rescheduling or arrears.

In addition, we examine a wide selection of the studies for the link between macroeconomic fundamentals and crisis episodes. Examining a panel of six Asian countries (Indonesia, Malaysia, Philippines, Singapore, South Korea and Thailand) covering the period January 1970–December 2002 reveals that differences in currency crises chronologies can indeed be large. The outcomes of Eichengreen, Rose and Wyplosz, Kaminsky, Lizondo and Reinhart, and Frankel and Rose are more or less similar; the other two, Zhang, and the extreme value approach, differ.

In related work (Lestano, Jacobs and Kuper, 2003) we explore the crisis dating outcomes for a common sample of countries and period and find that the different methodologies can reveal substantial differences in currency crisis chronologies. The heterogeneity in both crisis dating and findings on the fundamental indicators of financial crises makes it difficult for analysts...
and policy makers to proceed with general recommendations on how to ei-
ther detect or defer financial crises. Perhaps this indicates that all crises
are different, and sufficiently so to defy generalisations. More likely, we re-
quire further research to more fully understand the linkages between financial
markets and the real economy.
References


