Money Market Pressure and the Determinants of Banking Crises*

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Abstract

This paper develops an index of money market pressure to identify banking crises based on the ratio of borrowed reserves to deposits in the banking sector and the short-term interest rate. We define banking crises as periods in which there is excessive demand for liquidity in the money market. Empirically, we identify banking crises as periods in which the index of money market pressure exceeds the 98.5 percentile of its empirical distribution. This results in a more objective identification than using market events such as large government interventions in the banking sector to identify banking crises. Our approach facilitates the use of high frequency data in empirical work. Comparing the crises dates we identify with existing research indicates that the new method is able to identify banking crises more accurately than the events method. While our method is able to identify crises that were successfully managed, i.e., that did not lead to large interventions, it does not identify events that involved mainly state-owned institutions or a few small banks as crisis episodes.

With the newly defined crisis episodes, we examine the determinants of banking crises using data complied from 47 countries. We estimate conditional logit models that include macroeconomic, financial, and institutional variables in the explanatory variables. We find that severe recessions, high inflation, large fiscal deficits, and over-valued exchange rates tend to precede banking crises. Furthermore, the existence of explicit deposit insurance systems raises the likelihood of banking crises.

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Key words: identification of banking crises, events method, and index of money market pressure, conditional logit model

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1. Introduction

The financial crises of the past decade, and the IMF's initiative to build an early warning system against such crises, have stimulated a wave of research into the empirical determinants of banking crises; e.g. Bordo et al. (2001), Borio and Lowe (2004), Caprio and Klingebiel (1996ab, 2002, 2003), Demirgüc-Kunt and Detragiache (1998, 2002), Demirgüc-Kunt et al (2000), Drees and Pazarbasioglu (1995), Flannery (1996), Gavin and Hausman (1996), Glick and Hutchison (2001), Goldstein and Turner (1996), Goldstein et al. (2000), Kaminsky and Reinhardt (1996, 1999), Lindgren et al. (1996, 1999). A common methodological challenge facing empirical research in this area is the identification of crises events. Existing studies rely on the observation of exceptional events or very visible policy interventions, such as forced mergers, bank closures, or bailouts by the government. This can be misleading for a number of reasons. First, such interventions may occur even in the absence of an acute crisis in the banking sector, e.g., when unresolved structural problems in the banking sector have been lingering for some time. Second, deciding whether a particular intervention is large enough to be called a crisis of the banking system and not just an individual institution involves a subjective judgment. Third, policy interventions typically occur when the crisis has already fully developed. Finally, recent literature on currency crises (Eichengreen, Rose, and Wyplosz, 1995, 1996ab) argues that not every crisis leads to a visible policy intervention of this kind, as central banks and regulators may be able to fend off the crisis successfully with less spectacular means. Focusing on crises that trigger policy interventions thus creates a selection bias in the empirical work.

The purpose of this paper is to propose an alternative method to identify banking crises. We follow the ideas of Eichengreen, Wyplosz and Rose (1995, 1996ab) and propose an index of money market pressure. We take extreme values of this index as signals of banking crises. We develop this indicator and discuss its empirical application. Using it to identify the dates of banking crises in a sample of 47 countries covering the period 1980-2001, we investigate what are the main empirical determinants of banking crises.

2. Identifying Banking Crises

2-1. Events method

The IMF (1998) defines a banking crisis as a situation, in which bank runs and widespread failures induce banks to suspend the convertibility of their liabilities, or which compels the government to intervene in the banking system on a large scale. To identify banking crises, existing empirical studies rely on the observation of certain events, such as

forced bank closures, mergers, runs on financial institutions and government emerging measures, to identify banking crises. We call this the *events method*. Demirgüc-Kunt and Detragiache (1998), for instance, identify an episode as a crisis, when at least one of the following conditions holds:

- *The ratio of non-performing assets to total assets in the banking system exceeded 10 percent.*
- *The cost of the rescue operation was at least 2 percent of GDP.*
- *Banking sector problems resulted in a large-scale nationalization of banks.*
- *Extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were enacted by the government in response to the crisis.*

This has several shortcomings. First, it tends to identify banking crises too late. For example, the cost of a bailout (criterion 2) is available only after a crisis and with a time lag. Events such as the nationalization of banks and bank holidays are likely to occur only when a crisis has already spread to the whole economy.[1] Governments may provide hidden support to banks at the early stages of a crisis for political reasons, i.e. early policy interventions may not be observable. Second, there are few objective standards for deciding whether a given policy intervention is "large." Third, the timing of crisis periods on this basis is difficult because the exact date of policy interventions is often uncertain or unclear (e.g., Caprio and Klingebiel, 1996a.) Fourth, the events method identifies crises only when they are severe enough to trigger market events. Crises successfully contained by prompt corrective policies are neglected. This means that empirical work suffers from a selection bias.

These problems of the events method are illustrated by comparing the crises identified in different studies. Table 1 reproduces the dates of banking crises from seven studies: Lindgren, Garcia, and Saal (1996), Caprio and Klingebiel (1996a), Demirgüc-Kunt and Detragiache (1998), Glick and Hutchison (2001), Kaminsky and Reinhart (1999), Bordo and Schwarz (2000), and Bordo, Eichengreen, Klingebiel, and Martinez-Peria (2001). Even with overlapping sources, there are large differences in the timing of crises between these studies. Different studies sometimes identify the onset of a same crisis with a difference of more than two years.[2] Countries recorded to have a crisis in one study are recorded with no crisis in other studies.[3] These difficulties pose obvious problems for empirical research into the determinants of banking crises. In view of these problems, we propose an alternative approach to identifying banking crises in the next section.

[1] Kaminsky and Reinhart (1999) argue that the events method could identify the crisis *too early* because the worst of the crisis may come later.
[2] See for example Bolivia, Cameroon, France, India, Israel, New Zealand, Nigeria, Senegal, Uganda, and United States.
[3] See for example Chile, Denmark, Ecuador, Egypt, France, Germany, Greece, Ireland, New Zealand, Paraguay, Peru, Singapore, Thailand, and United Kingdom.

2-2. An index of money market pressure

Our approach is motivated by the literature on currency crises (Eichengreen, Rose and Wyplosz 1995, 1996ab). It starts from the conventional assumption that the banking sector's aggregate demand for central bank reserves depends negatively on the short-term interest rate, the immediate opportunity cost of holding reserves. Our main conjecture is that a banking crisis is characterized by a sharp increase in the banking sector's aggregate demand for central bank reserves. This may be due to three reasons: First, a sharp decline in the quality of bank loans or an increase in non-performing loans, causing a loss of liquidity in the banking sector. This would lead to an increase in banks' reserve demand to maintain liquidity. Second, sudden withdrawals of deposits by the non-bank public, forcing banks to turn to the interbank market and the central bank to refinance themselves. Third, a drying-up of interbank lending, as financial institutions prefer to hold government bonds and other, safer assets to lending to troubled institutions (Furfine, 2002). The central bank, as a monopolistic supplier of bank reserves, can react to this increase in the demand for reserves in two basic ways. If bank reserves are the operating target, the total supply of bank reserves is kept constant and the short-term interest rate will rise. If, instead, the central bank targets the short-term interest rate, it must inject additional reserves into the banking system through open market operations or discount window lending. Thus, a banking crisis is characterized by a sharp increase in the short-term interest rate, a large increase in the volume of central bank reserves, or a combination of both, indicating a high degree of tension in the money market.

Based on this reasoning, we build the following *index of money market pressure*, IMP. We define the *reserves to bank deposits ratio*, γ, as the ratio of total reserves held by the banking system to total non-bank deposits in the banking sector. In a period of high tension in the money market, this ratio increases either because the central bank makes additional reserves available to the banking system, or because depositors withdraw their funds from the banks. We define the index of money market pressure as the weighted average of changes in the ratio of reserves to bank deposits and changes in the short-term real interest rate.[4] The weights are the sample standard deviations of the two components. Thus, the index is defined as:

$$IMP_t = \frac{\Delta\gamma_t}{\sigma_{\Delta\gamma}} + \frac{\Delta r_t}{\sigma_{\Delta r}}., \qquad (1)$$

[4] We use real interest rate instead of nominal interest rate because changes in nominal interest rate that simply keep up with inflation rate do not indicate liquidity shortage in money market.

where Δ is the difference operator, and $\sigma_{\Delta\gamma}$ and $\sigma_{\Delta r}$ are the standard deviations of the two components respectively.[5] Subsequently, we take large values in this indicator as signals of banking crises.[6] More specifically, we compute the IMP for a given country and define the beginning of a banking crisis as a period in which the in IMP meets two criteria: First, it exceeds the 98.5 percentile of the sample distribution of the IMP for the country under consideration, and, second, the increase in the IMP from the previous period is by at least five percent. The first condition assures that only exceptional events are identified as crises. However, since every empirical distribution must have a 98.5 percentile, we use the second condition to allow for the possibility that countries had no banking crisis during the sample period. Note that relaxing the first condition and using a lower percentile increases the risk of calling too many episodes crises, while tightening it increases the risk of missing true crises. The empirical analysis below indicates that raising the threshold to the 99.5 percentile does not change the results significantly, while lowering it to the 95 percentile causes our regressions to loose explanatory power. Similarly, tightening the second condition increases the risk of missing true crisis episodes. In the empirical work, using a 10 percent minimum increase would exclude some well-known crisis episodes in the data.

Our definition implies that the conditions defining banking crises are country-specific. The alternative would be to pool the data from all countries and use the same for all of them. Due to the differences in the volatility of IMP across countries, we would miss true crises in countries with relatively low IMP volatility that way. Finally, we define the first condition in terms of percentiles rather than multiples of standard deviations, because the empirical distributions of the IMP are non-normal.

A possible objection against this method is that modern banking crises are asset-side rather liability-side crises. An example is that a banking crisis caused primarily by a collapse in real estates prices or a wave of corporate bankruptcies. But, if the demand for reserves increases when the quality of bank assets deteriorates, this dichotomy is irrelevant for the purposes of this paper. A second objection is that our method is not applicable to

[5] As pointed out to us by the referee, changes in monetary policy regimes could lead to changes in the relative volatility of the components of the IMP over time, which could reduce the power of our index in detecting banking crises. Therefore, in sufficiently large sample, it would be preferable to use variable weights, e.g. from rolling sub-samples. In more limited samples, however, this could also reduce the power of the methodology, since such estimates would be rather imprecise given the sample size. In the empirical work below, we use constant weights, since, from preliminary data inspection, we had no reason to assume that a regime shift occurred during the sample period under consideration.

[6] Demirgüc-Kunt, Detragiache, and Gupta (2000) examine the macroeconomic performance in the aftermath of a banking crisis for 36 banking crises over the period 1980-85. The authors define a variable named *central bank funds to bank assets ratio*, which is defined as loans from the monetary authorities to deposit money banks divided by total assets of deposit money banks. The authors find that there is a rise in real interest rate and a rise in central bank funds to bank assets ratio in the crisis year. This gives support to our index. But the authors also find that such increase is not statistically significant. It is quite possible that the usage of annual data has made

environments where interest rates are controlled by the central bank. But the index of money market pressure has the advantage that its quality does not depend on the flexibility of interest rates, as long as the central bank's interest rate management relies on market measures to control the interest rate. A third objection is that, using the IMP, we can identify the beginning but not the end of a banking crisis. This is true, but not specific to our method. As Goldstein, Kaminsky and Reinhart (2000) put it, identifying the end of a banking crisis is "one of the more difficult unsolved problems in the empirical crisis literature," since there is no consensus on what kind of criteria one should use to declare that a crisis is over.[7] In the empirical work below, we follow standard practice and disregard all observations in a fixed time window starting with the first period in which the index signals a crisis and then apply the index again to look for additional crisis episodes. This reduces the likelihood of counting the same crisis twice, while setting the window width too large would make us miss subsequent crises. Our empirical results turn out to be robust against variations of the window length.

3. Empirical Applications

In this section, we compare the results of our method with a number of existing studies of banking crises. We use monthly data provided by IMF International Financial Statistics CD-ROM, spanning from 1980 to 1996. Total deposits are calculated as the sum of demand deposits (line 24), time and saving deposits (line 25), and foreign liabilities (line 26C) of deposit money banks. We use borrowed reserves, defined as loans from monetary authorities to financial institutions (line 26G), instead of total reserves as the reserves aggregate.[8] Nominal interest rates are money market rates (line 60B).[9] The inflation rate is calculated from consumer price index (line 64). In this section, we compare the crisis identification derived from our index with that of existing research.

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the two variables become less informative. For example, liquidity support from monetary authorities tends to last for several months and less than a year.

[7] For example, Goldstein, Kaminsky and Reinhart (2000) define the end of a banking crisis to be the end of heavy government financial interventions, while IMF (1998) and Bordo, Eichengreen, Klingebiel, and Martinez-Peria (2001) defines the end of a banking crisis as the time when annual output growth returns to its trend.

[8] We have experimented with bank reserves. We find that the information content of bank reserves is less satisfactory than the borrowed reserves so we decide to use borrowed reserves in our analysis.

[9] For countries in which money market rates are not available, we use (in sequence) Treasury bill rate, government bond yield, deposit rate, lending rate, and discount rate as substitutions.

3-1. Developing and Emerging Economies

The first application compares our method with the study of Caprio and Klingebiel (1996a). We exclude transition economies and countries with incomplete data from their sample of 26 countries.[10] The reduced sample includes 15 countries, for which the authors identify 17 banking crises. Figure 1 plots our index for these countries. Table 2 shows the results from Caprio and Klingebiel (1996a) and our index method. Our index picks out eight of the 17 crises (47 percent) identified by Caprio and Klingebiel. Among them, five coincide with those found by these authors, two have a two-year-lead, and one of them has a one-year lag compared to Caprio and Klingebiel. We are able to identify the Turkish 1982-85 crisis if the condition of a minimum size of the IMP is dropped. But we do not identify eight crises found by these authors, even when we use the 97 percentile instead of the 98.5 percentile to define crisis episodes. These are Argentina (1980-82 and 1995), Brazil (1994), Cote d'Ivoire (1988-91), Indonesia (1992-94), Kenya (1986-89), Senegal (1988-91), and Venezuela (1994/95).

A suggestive explanation for these differences is that our index does not select banking crises of small magnitude, because they may not induce a sufficiently large increase in the aggregate demand for central bank reserves. Caprio and Klingebiel (1996) report that while the troubled banks accounted for 50% of total bank deposits in 1989-90 crisis in Argentina, the 1995 crisis involved only 11 out of 205 financial institutions. The 1986-89 crisis in Kenya involved mainly non-bank financial institutions and accounted for only 15% of total liabilities of financial system. The 1994 crisis in Brazil did not involve a large part of the banking sector and was not classified as a crisis by Lindgren et al. (1996). Thus, these three episodes seem to have been less severe in magnitude.

Another reason for the discrepancy between our and Caprio and Klingebiel's identification is the involvement of state-owned institutions. If governments provide implicit guarantees or direct financial support, depositors may not withdraw deposits from, and other banks may continue lending to such at these institutions expecting that the government will bail them out. As a result, state-owned banks may not have to raise their demand for central bank reserves even in an acute liquidity shortage. In fact, what Caprio and Klingebiel identify as a crisis may be a bailout anticipated by the market. Caprio and Klingebiel (1996) report that the 1994 crisis in Brazil involved mainly two big state-owned banks, Banespa and Banerj, which accounted for 20% of financial system assets. Similarly, in the 1988-91 crisis in Cote d'Ivoire and the 1992-94 crisis in Indonesia, troubled banks were overwhelmingly public banks.

[10] The countries excluded are Benin, Colombia, Estonia, Guinea, Hungary, Latvia, Madagascar, Malaysia, Philippines, Poland, and United States.

This leaves us with two severe crisis cases identified by Caprio and Klingebiel but not by our index. One is the 1994-95 crisis in Venezuela, for which we only find a period of high tension in the money market several years before the time identified by Caprio and Klingebiel, suggesting that perhaps the crisis was kept lingering for several years before the government decided to resolve the problem. For Senegal, our index finds no evidence for a banking crisis.

We identify additional crises which Caprio and Klingebiel do not report as banking crises, but other researchers do. The IMP signals a banking crisis around 1990 in Brazil. This crisis is reported in Glick and Hutchison, Bordo and Schwarz, and Bordo et al. We identify a banking crisis in Kenya in 1993. This is also reported in Lindgren et al, Glick and Hutchison, Bordo and Schwarz, and Demirgüc-Kunt et al. We find a banking crisis in Turkey in 1996. This timing is close to Lindgren et al, Glick and Hutchison, Demirgüc-Kunt et al, and Bordo and Schwarz. Finally, we find periods of high tension in the money market in Cote d'Ivoire (1980 and 1995), Indonesia (1984), and Venezuela (1988). For these episodes, existing research does not report banking crises.

To examine whether our index is dominated by one of its two components, we calculate the correlation between changes in the index and changes in each component. Table 3 shows that the unconditional correlation between the index and its two components across all periods and countries is about the same, while the two components are uncorrelated. Table 4 reports the relative weight of individual component in each identified crisis. On average, the first component accounts for 43 percent of the index values during crisis periods, while the second component accounts for 57 percent. These results suggest that the index is not dominated by one if its components. Finally, Table 3 also reports the conditional correlation between the index and its components and between the two components in crisis episodes across the sample countries. Here, we find that only the conditional correlation between the index and the second component is significantly positive, while the conditional correlation between the two components is significantly negative. The latter indicates that, among developing and emerging countries, banking crises tend to come either with large interest rate hikes and a low reserves-deposit ratio, or a high-reserves deposit ratio and small changes in the interest rate. This suggests that central banks in these countries have to make stark choices between interest-rate targeting or reserves targeting.

3-2. Industrialized Countries

Our second application includes 14 industrialized countries from 1980 to 1996.[11] Figure 2 plots the index of money market pressure of the individual country. Table 5 reports the crises we identify using the IMP. We compare our results with those compiled from several existing studies, namely, Lindgren et al, Bordo and Schwarz, Caprio and Klingebiel, Demirgüc-Kunt and Detragiache, Glick and Hutchison, Kaminsky and Reinhardt, and Bordo et al. Our method identifies seven of the twelve crises (58 percent) recorded by existing research. We are able to identify the Iceland 1985-86 crisis if the condition of a minimum increase in the IMP is dropped. Among the eight crises, four coincide with existing research, two have a two-year-lead, one has a one-year-lead, and one has a one-year-lag.

We fail to identify three banking crises identified by others: Greece in 1991-95, Iceland in 1995, Ireland in 1985, and Japan in the 1990s.[12] Lindgren et al. (1996) show that the banking problems in Greece were relatively small and confined to specialized lending institutions, and that the banking problems in Iceland in 1995 involved only one state-owned bank, while the Irish case involved only the insurance subsidiary of one bank. Similarly, the banking problems in Iceland in 1985-86 involved only one insolvent state-owned bank that was eventually merged with private banks. Again the discrepancy between our method and the existing literature seems to be due to the relatively small size and the involvement of state-owned banks in these cases.

Turning to Japan, the country's stock market collapsed in December 1989. The Bank of Japan responded by expanding credit to the banking sector, which reached a record high in December 1991 and remained at very high levels during 1992 and the first few months of 1993. Japan's IMP was very large during this period indicating strong money market pressure, but it did not cross the 98.5 percentile. During the 1990s, the Japanese banking sector continued to suffer from severe structural weaknesses. However, the combination of implicit government guarantees for bank liabilities and repeated recapitalizations of troubled banks by the government was sufficient to avoid a crisis in the sense of an acute collapse of a large number of financial institutions and the reemergence of large money market pressure.

Table 5 indicates that several crisis episodes identified by our method are related to the 1992-93 crisis in the European exchange rate system, i.e., Denmark in 1993, Ireland in 1992, Italy in 1992, Spain in 1993, and Sweden in 1992. Since the interest rate hikes could reflect the authorities' attempts to defend their exchange rates pegs, one might wonder

[11] Australia, Belgium, Canada, France, Luxembourg, New Zealand, Norway, the United Kingdom, and the United States were excluded because monthly data are not available.
[12] The index method does not identify these crises even using the 97 percentile.

whether these episodes are currency crises rather than banking crises.[13] However, we observe from Table 7 that, in Italy and Spain, changes in the reserves-to-deposits ratio accounted for a larger portion of the index than the changes in real interest rates. In Sweden, a large increase in this ratio occurred together with an increase in the real interest rate. Even in the cases of Denmark and Ireland, changes in the reserves to deposits ratio explain over 30% of the index value. Thus, the large values of the IMP in these countries do not seem to be entirely due to exchange rate policies.[14]

We report in Table 6 the correlations between the index and each component. Again, the index is equally correlated with both components. Table 7 shows that, on average, the reserves ratio accounts for roughly 40 percent of the index values during crisis periods, while the real interest rate accounts for 60 percent.[15] Again, our index is not dominated by either component. The conditional correlations between the index and its components in periods of high money market pressure, reported in Table 6, are stronger than in the previous example and about equal, while the conditional correlation of the two components is positive but not significant. Since the latter, again, is a cross-country result, it suggests that central banks in industrialized countries can choose to respond to banking crises by increasing both the reserves-deposit ratio and the interest rate.

4. Determinants of Banking Crises

In this section, we use our method to study the empirical determinants of banking crises. Several recent studies point to three main groups of factors: domestic macro economic disturbances, shocks from the external sector, and institutional factors. Regarding the first, Honohan (2000) finds that crises often occur in the latter part of boom-bust cycles. Caprio and Klingebiel (1996b) argue that crises are more likely in countries with higher volatility of output growth and inflation. Demirgüc-Kunt and Detragiache (1998), Hardy and Pazarbasioglu (1999), and Kaminsky and Reinhart (1999) show that banking crises tend to occur in times of weak or negative real growth. This is also consistent with Gorton (1988). Demirgüc-Kunt and Detragiache (1998) and Hardy and Pazarbasioglu (1999) also find that high real interest rates and high inflation raise the likelihood of banking crises. Gavin and Hausman (1996), Honohan (2000), Demirgüc–Kunt and Detragiache (1998), and Hardy and Pazarbasioglu (1999) find that banking crises are often preceded by high growth rates of real bank credit. Goldstein (1998) reports that the ASEAN economies that suffered banking

[13] See Buiter, Corsetti, and Pesenti (1998) for an account of the foreign exchange crisis in the aftermath of the Danish Referendum on the Maastricht Treaty.

[14] Note that, if the standard deviation of the reserves to bank deposits ratio is relatively small, the relative weight and hence the contribution of this component to the IMP will be large even without much underlying change. We have checked the details and found that this is not a concern for our cases.

crises in the late 1990s experienced large credit expansions in the years before. Borio and Lowe (2004) conclude that credit and equity price gaps (i.e., deviations from trend) outperform output and money gaps as indicators of banking distress. These results suggest that poor domestic macro economic policies are a main cause of banking crises. In particular, a pattern of large monetary or fiscal expansions fuelling large credit expansions and issuing in contractions to contain the resulting inflationary pressures seem to be conducive to banking crises.

Caprio and Klingebiel (1996b) find that a sharp deterioration of a country's terms of trade induces banking crises. Goldstein, Kaminsky and Reinhart (2000) find that an overvaluation of the real exchange rate is the best leading indicator of banking crises. Hardy and Pazarbasioglu (1999) find that large swings in the real exchange rate tend to precede banking crises. These results suggest that problems in the banking sector can be due to losses of international competitiveness of domestic industries. Since inconsistencies between exchange rate pegs and domestic inflationary trends often lead to overvalued real exchange rates, the results also point to the importance of consistent internal and external macro economic policies for the stability of the financial sector.

Demirgüc-Kunt and Detragiache (1998) find that the likelihood of banking crises is larger in countries with explicit deposit insurance. This indicates that deposit insurance can give rise to moral hazard problems weakening financial system stability. Furthermore, they show that countries with better law-enforcement quality have fewer banking sector problems. Kaminsky and Reinhart (1999) find that financial liberalization helps to predict the occurrence of banking crises. This points to the importance of proper sequencing and management of financial liberalization.

In the remainder of this section, we estimate a conditional logit model explaining the incidence of banking crises in a large sample of countries. Since we are mainly interested in testing the quality of our index method to identify banking crises, we follow the study of Demirgüc-Kunt and Detragiache (1998) in the empirical application.

4-1. Empirical Specification

Our sample period covers 1980 to 2001. We include 47 countries in our sample.[16] The choice of countries is mainly determined by data availability, but we exclude Argentina and Brazil, because they are outliers with respect to inflation and real interest rates. The data are from the IMF's International Financial Statistics. Depending on the explanatory variables

[15] The results remain similar if we exclude the five identified crises related to 1992 EMS crisis.
[16] For the sample countries included see Table 9.

included, the sample consists of 697 to 726 observations, including 34 to 38 crises periods. Thus, the sample rate of incidence of banking crises is about five percent.

Due to data availability, we use the IMP in quarterly frequency to identify banking crises. For each country, we eliminate the eight observations following a period identified as a crisis.[17] Since the independent variables are available only in annual frequency, we translate the crises episodes thus identified into a crisis dummy in annual frequency. The dependent variable in the subsequent estimates is a binary index of banking crises. Table 8 reports the crises identified using the IMP.[18]

Our choice of explanatory variables is guided both by existing literature and data availability. A list of the variables and their sources is in reported in Table 9. We use the rate of growth of the real GDP, and the rate of inflation to capture domestic macroeconomic developments. To allow for the possibility of nonlinear effects, i.e. severe recessions and bouts of high inflation having more than proportional effects, we include interactive dummies for severe recessions and large inflation rates, respectively. To proxy domestic macro economic policies, we include the short-term real interest rate and the government budget surplus relative to GDP. We use the growth rates of the monetary base and the growth rate of real domestic credit as indicators of monetary expansions and credit growth.

Furthermore, we include a number of variables characterizing the financial sector and its ability to cope with macro economic shocks. The ratio of credit to the private sector to GDP captures the degree of financial sector development. We use the ratio of bank cash and reserves to bank assets for the banking system as a whole to capture the liquidity of the banking sector, which provides a buffer against unexpected shocks. We add a stock market price change variable to address the possible role of asset-focused banking crises, which, however, is available only for industrialized countries. External factors are captured by the rate of depreciation of the nominal exchange rate and the deviation of the real exchange rate from its trend. To test for the effects of financial liberalization, we include a dummy variable taking the value of one in periods during which interest rates were liberalized.[19]

Regarding institutional variables, we hypothesize that countries lacking sound legal systems have more fragile banking sectors and proxy the quality of the institutional environment using real GDP per capita in dollars. Following Demirgüc-Kunt Detragiache (1998), we use a dummy variable for the existence of explicit deposits insurance schemes.

[17] Demirgüc-Kunt and Detragiache (1998) eliminate all observations following a crisis, resulting in relatively few observations for estimation.

[18] Results using a 97.5 percentile threshold are very similar and can be obtained from the authors.

[19] We have tried the Freedom House country ratings for political freedoms and civil liberty as indicators of governance and institutional quality. We have also tried an OECD dummy that takes the value of one only in OECD countries and only in 1991-92 to examine whether the introduction of the Basle capital requirements that became binding starting in 1993 had led to tensions in the banking system in 1991-92. These two variables are omitted in the subsequent analysis since they are not significant.

Since many of the explanatory variables used have been found to help predict currency crises, and in order to address the question of whether taking account of the simultaneous occurrence of currency crises will affect our results, we also add a currency crisis dummy as an explanatory variable together with interactive terms of this dummy and the macroeconomic variables.

Finally, we include a dummy for the crises identified by the events method compiled from Caprio and Klingebiel (2002, 2003), who record systematic, borderline and smaller banking crises. These two studies are the most extensive and updated surveys of banking crises. Using the IMP, we identify most of these crises in addition to others, not reported in Caprio and Klingebiel (2002, 2003). Suppose that this dummy or its interaction effects with the macroeconomic variables were significant in the models estimated below. This would imply that the incidence of crises identified by means of the event method carries information for predicting the incidence of crises identified by means of the IMP. This would suggest that the likelihood of crises identified by the event method differs systematically from the likelihood of crises identified by our method.

4-2. Results

We estimate the model using a conditional fixed-effects logit estimator, see Chamberlain (1980). The model can be interpreted as explaining the likelihood of a banking crisis to occur for given values of the explanatory variables. To avoid problems of simultaneity, all explanatory variables are used with a lag of one year. Table 10 reports the results.[20] We estimate five specifications of the model. The first includes all macroeconomic and financial sector variables as explanatory variables. The second one adds the institutional variables. The third one adds the currency crisis dummy and its interaction effects with the macroeconomic variables. The fourth specification adds the events crisis dummy and its interaction effects with the macro economic variables. The last one retains only those variables that are statistically significant.[21]

Table 10 indicates that the properties of the empirical models are quite satisfactory. The explanatory power, measured by the likelihood ratio statistic, is significant for all specifications. A natural way to judge the performance of models is by considering their ability to predict the incidence of banking crises. This requires us to determine a cut-off value

[20] Results with different windows and a 97.5 percentile threshold value are basically the same and are not reported here in order to save space. They can be obtained from the authors upon request. The main qualitative difference between estimates with and without country fixed effects is that the deposit insurance dummy is not significant in the latter estimates, while the ratio of bank cash reserves to bank assets is significant.

[21] Some crises are dropped because of lacking data for the explanatory variables. This concerns Jamaica, Japan, Niger, Senegal, Seychelles, Spain, Sri Lanka, Togo, and Uganda in models 1-4, plus Turkey in model 3 and 4. In model 5, we lose the crises in Jamaica, Japan, Niger, Senegal, Seychelles, Sri Lanka, and Togo.

such that we say that the model predicts a crisis if the estimated probability of a crisis exceeds this value. Setting the cut-off value at 10 percent, i.e., twice the unconditional crisis incidence rate in the sample, the models yield correct predictions in 88 to 90 percent of all cases, including 89 to 91 percent of all non-crisis periods and 58 to 71 percent of all crisis periods. Note that the simplest alternative, which is to never predict a crisis, would predict 95 percent of all non-crisis periods and no crisis periods correctly. Thus the models have considerable information concerning crisis periods. The signal-to-noise ratios vary between 5.61 and 7.43, confirming that the models provide useful information to predict banking crises. Setting to cut-off value equal to the unconditional incidence rate of five percent, the models predict 75 to 78 percent of all crisis and non-crisis episodes correctly, but the signal-to-noise ratios are about half of what they are with the higher cut-off value.

Table 10 shows that the macroeconomic and financial market variables do most of the work predicting banking crises. A decline in the real GDP growth rate causes an increase in the likelihood of banking crises. This effect is re-enforced in times of severe recessions as indicated by the interactive dummy DGROWTH. These results are consistent with earlier findings. In contrast to the results of Demirgüc-Kunt and Detragiache (1998), rising inflation rates per se do not seem to contribute significantly to the likelihood of banking crises, but the dummy variable DINFLATION suggests that the latter is significantly higher during bouts of high inflation. Surprisingly, low short-term real interest rates seem to raise the crisis probability. One interpretation is that periods of high low interest rates tend to be followed by monetary contractions to combat inflation, which may then induce a higher probability of banking crises in the same year. Large fiscal deficits (negative surpluses) increase the likelihood of banking crises, a result which is not found in earlier studies. The coefficient on credit growth has a positive sign as expected, but in no case is it significant. Similarly, the effects of monetary base growth on the probability of banking crises are negligible.

Exchange rate depreciations have only insignificant effects on the probability of a banking crisis. In contrast, crises are strongly associated with over-valued real exchange rates. This is consistent with Goldstein, Kaminsky and Reinhart (2000) who find that appreciation of real exchange rate to be the best leading indicator of banking crises.

None of the financial-market variables turn out to be significant. Periods of financial deregulation are associated with a higher probability of banking crises, but the effect is not statistically significant. Turning to the institutional variables, we find that the coefficient on GDP per capita is not significant. In contrast, we find that the presence of an explicit deposit insurance scheme significantly raises the likelihood of a banking crisis. This is consistent with the results in Demirgüc-Kunt and Detragiache (1998).

The dummy variable for currency crises and its interactive effects strongly increase the signal-to-noise ratio of the model, mostly because it raises the model's ability to predict

banking crises correctly. Thus, although this dummy is not statistically significant, the incidence of currency crises is strongly associated with the incidence of banking crises. Note that variables such as real over-valuation, severe recession, and high inflation turn insignificant when the currency crisis dummy is included, suggesting that these macroeconomic factors affect both the likelihood of banking crises and the likelihood of currency crises.

Finally, the events dummy and its interactive effects are not statistically significant. We conclude from this that the likelihood of banking crises identified by the event method is not systematically different from the likelihood of crises identified by our method.

Next, we divide our sample of countries into advanced economies and emerging and developing countries. This allows us to examine whether there are any systematic differences in the results for these two groups of countries. Following the IMF World Economic Outlook, we take Austria, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Korea, Netherlands, New Zealand, Portugal, Spain, Sweden, Switzerland, and the United States as advanced economies and the rest as emerging and developing economies. The results are reported in Table 11. To economize on space, we only report results for specifications 1, 2, and 5 for each group.

The table shows that there are some interesting differences between the two groups of countries. In advanced economies, banking crises are strongly associated with the incidence of currency crises. In developing countries, the currency-crisis dummy is not significant. However, overvalued exchange rates and strong credit expansions have significant coefficients in the model for developing countries, and these variables are also commonly found to help predict currency crises in developing countries and emerging markets. The presence of an explicit deposit insurance scheme significantly raises the likelihood of a banking crisis in advanced economies but not so in developing and emerging economies. The effect of stock market price changes on the probability of banking crises has the expected negative sign in the model for advanced economies, but is insignificant. Banking crises in emerging and developing countries are associated with large fiscal deficits. In sum, the banking sectors in emerging and developing economies seem to be more vulnerable by undisciplined fiscal and bad monetary policies than in advanced economies.

To examine the predictive power of the model further, we estimate model (2) of Table 10 with either one or two lags of the explanatory variables and use the fitted values to predict the incidence of banking crises. Figure 3 shows how these predicted probabilities develop over time for six countries together with the period in which the IMP indicates a crisis. For the three Asian countries, Indonesia, Korea, and Thailand, this is the first quarter of 1998. Using again a cut-off value of ten percent for predicting crises, the figure shows that the models estimated with a one-year lag of the explanatory variables predict a crisis to hit

closely around that quarter. Even the models estimated with a two-year lag suggest a crises quite close to that. Thus, one could have predicted empirically that a banking crisis was likely to hit once data from 1996 was available. For Denmark and Italy, the model does similarly well. For Finland, the model based on a one-year lag predicts the crisis in the fourth quarter of 1989 correctly, and both estimates indicate the crisis in 1993.

5. Conclusion

Identifying banking crises is the first step in all research on banking crises. The prevailing practice is to employ market events to identify a banking crisis. However, as many authors admit, this method suffers from severe shortcomings. In this paper, we propose and alternative method to identify banking crises. Our method is based on an empirical index of money market pressure. It avoids the subjective judgments involved in the events method and yields a more objective way to identify crisis episodes. Furthermore, it avoids the selection bias in favor of crises not successfully managed that the events method creates, and it allows for a more timely identification of crises episodes, as the data required for our index are available without long time lags. Finally, our approach facilitates the use of quarterly and monthly data and thus a more accurate identification of the timing of banking crises. We compare our method to the traditional one in two examples of banking crises in developing and advanced economies. Our index misses several crises identified by the events method that were small or involved primarily state-owned institutions, and finds additional crisis episodes not reported in earlier studies.

Furthermore, we estimate empirical models explaining the likelihood of banking crises in a data set of 47 countries ranging from 1980 to 2001. We show that severe recessions, bouts of high inflation, large fiscal deficits, over-valued real exchange rates and the existence of an explicit deposit insurance scheme can explain the incidence of banking crises. We also find that the incidence of currency crises raises the likelihood of banking crises, especially so in advanced economies. We leave the question of how these two types of financial crises interact as an object for further study.

6. References

Bordo, Michael and Anna J. Schwartz (2000), "Measuring Real Economic Effects of Bailout: Historical Perspectives on How Countries in Financial Distress Have Fared with and without Bailouts," Carnegie-Rochester Conference Series on Public Policy, Vol. 53, pp. 81-167.

Bordo, Michael, Barry Eichengreen, Daniela Klingebiel and Maria Soledad Martinez-Peria (2001), "Is the Crisis Problem growing more Severe?" Economic Policy, 32, pp.51-75.

Borio, Claudio and Philip Lowe (2004), "Securing Sustainable Price Stability: Should credit come back from the wilderness?" BIS Working Papers No. 157.

Buiter, Willem H., Giancarlo Corsetti and Paolo A. Pesenti (1998), Financial Markets and European Monetary Cooperation: The Lessons of the 1992-93 Exchange Rate Mechanism Crisis, Cambridge University Press.

Caprio, Gerard and Daniela Klingebiel (1996a), "Bank Insolvencies: Cross Country Experience," World Bank Working Papers No. 1620.

Caprio, Gerard and Daniela Klingebiel (1996b), "Bank Insolvency: Bad Luck, Bad Policy, or Bad Banking?" Annual World Bank Conference on Development Economics 1996.

Caprio, Gerard and Daniela Klingebiel (1999), "Episodes of Systematic and Borderline Banking Crises," Mimeo.

Caprio, Gerard and Daniela Klingebiel (2002), "Episodes of systematic and borderline financial crises," in Daniela Klingebiel and Luc Laeven (eds.), Managing the Real and Fiscal Effects of Banking Crises, World Bank Discussion Paper No. 428.

Caprio, Gerard and Daniela Klingebiel (2003), "Episodes of systematic and borderline financial crises," January 2003, downloaded from the World Bank web site.

Chamberlain, Gary (1980), "Analysis of Covariance With Qualitative Data," Review of Economic Studies 47, 225-38.

Demirgüc-Kunt, Asli and Enrica Detragiache (1998), "The Determinants of Banking Crises in Developing and Developed Countries," IMF Staff Papers, 45(1), pp.81-109.

Demirgüc-Kunt, Asli and Enrica Detragiache (2002), "Does Deposit Insurance Increase Banking System Stability: An Empirical Investigation," Journal of Monetary Economics, Vol. 49(7), pp. 1373-1406.

Demirgüc-Kunt, Asli, Enrica Detragiache and Poonam Gupta (2000), "Inside the Crisis: An Empirical Analysis of Banking Systems in Distress," IMF Working Papers No. 00/156.

Drees,-Burkhard and Ceyla Pazarbasioglu (1995), "The Nordic Banking Crises: Pitfalls in Financial Liberalization?" IMF Working Papers No. 95/61.

Eichengreen Barry, Andrew K. Rose and Charles Wyplosz (1995), "Exchange Market Mayhem: The Antecedents and Aftermath of Speculative Attacks," Economic Policy, 21, pp.249-96.

Eichengreen Barry, Andrew K. Rose and Charles Wyplosz (1996a), "Speculative Attacks on Pegged Exchange Rate: An Empirical Exploration with special Reference to the European Monetary System," in Canzoneri, Matthew B., Ethier, Wilfred J., Grilli, Vittorio (eds.), The new transatlantic economy, pp. 191-228, Cambridge; New York and Melbourne: Cambridge University Press.

Eichengreen Barry, Andrew K. Rose and Charles Wyplosz (1996b), "Contagious Currency Crises: First Tests," Scandinavian Journal of Economics, Vol. 98(4), pp. 463-84.

Flannery, Mark J. (1996), "Financial Crises, Payments System Problems, and Discount Window Lending," Journal of Money, Credit, and Banking, 28(4), pp.804-831.

Furfine, Craig (2002), "The Interbank Market during a Crisis," European Economic Review, Vol. 46(4-5), pp. 809-20.

Garcia, Gillian G.H. (1999), "Deposit Insurance: A Survey of Actual and Best Practices," IMF Working Papers No. 99/54.

Gavin, Michael and Ricardo Hausman (1996), "The Roots of Banking Crises: The Macroeconomic Context," in Ricardo Hausman and Liliana Rojas-Suarez, eds., Banking Crises in Latin America, Baltimore, Md.: John Hopkins Press.

Glick, Reuven and Michael M. Hutchison (2001), "Banking and Currency Crises: How Common Are Twins?" in Reuven Glick, Ramon Moreno and Mark M. Spiegel (eds.), Financial Crises in Emerging Markets, Cambridge University Press.

Goldstein, Morris (1998), The Asian Financial Crisis: Causes, Cures, and Systematic Implication, Institute for International Economics.

Goldstein, Morris, G.L. Kaminsky and C.M. Reinhart (2000), Assessing Financial Vulnerability: An Early Warning System for Emerging Markets, Institute for International Economics

Goldstein, Morris and Philip Turner (1996), "Banking Crises in Emerging Economies: Origins and Policy Options," BIS Economic Papers No. 46.

Gorton, Gary (1988), "Banking Panics and Business Cycles," Oxford Economic Papers, 40(4), pp.751-81.

Hardy, Daniel and Ceyla Pazarbasioglu (1999), "Determinants and Leading Indicators of Banking Crises: Further Evidence," IMF Staff Papers, Vo. 46, No.3, pp. 247-258.

Honohan, Patrick (2000), "Banking System Failures in Developing and Transition Countries: Diagnosis and Prediction," Economic Notes, Vol. 29(1), pp.83-109.

IMF (1998), "Chapter IV, Financial Crises: Characteristics and Indicators of Vulnerability," in World Economic Outlook, May.

Kaminsky, Graciela and Carmen M. Reinhart (1996), "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems," International Finance Discussion Papers, No. 544, Board of Governors of the Federal Reserve System.

Kaminsky, Graciela and Carmen M. Reinhart (1999), "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems," American Economic Review, 89(3), pp.473-500.

Lindgren, Carl-Johan, Gillian Garcia and Matthew I. Saal (1996), Bank Soundness and Macroeconomic Policy, International Monetary Fund, Washington.

Lindgren, Carl-Johan, Tomás J. T. Balino, Charles Enoch, Anne-Marie Gulde, Marc Quintyn and Leslie Teo (1999), "Financial Sector Crisis and Restructuring: Lessons from Asia," IMF Occasional Papers No. 188.

Sheng, Andrew ed. (1996), Bank Restructuring: Lessons from the 1980s. Washington, D.C.: World Bank.

Sundararajan, Vasudevan and Tomas Jose T. Balino ed. (1991), Banking Crises: Structural Weakness, Support Operations, and Economic Consequences. Washington, D.C.: IMF.

Table 1: Comparison of banking crises dates of selected studies

	Lindgren, Garcia, and Saal (1996)	Caprio and Klingebiel (1996)	Demirgüc-Kunt and Detragiache (1998)	Glick and Hutchison (2001)	Kaminsky and Reinhart (1999) (Beginning)	Kaminsky and Reinhart (1999) (Peak)	Bordo and Schwarz (2000)	Bordo, Eichengreen, Klingebiel, and Martinez-Peria (2001)
Covered Period	1980-96	Late 1970s-1995	1980-94	1975-97	1970-95	1970-95	1973-99	1972-98
ARGENTINA	1980-82 1989-90 1995	1980-82 1989/90 1995		1980-82 1989-90 1995-97	March 1980 May 1985 December 1994	July 1982 June 1989 March 1995	1980 1985 1989 1995	1980 1985 1989 1995
BOLIVIA	1986-87 1994-present	1986-87		1986-87 1994-97	October 1987	June 1988	1985	
BRAZIL	1994-present	1994/95		1990 1994-97	November 1985 December 1994	November 1985 March 1996	1990 1994	1990 1994
CAMEROON	1989-93 1995-present	1987-		1987-93 1995-97				
CHILE	1981-87	1976 1981-83	No	1976 1981-83	September 1981	March 1983	1976 1981	1976 1981
COLOMBIA	1982-85	1982-87	1982-85	1982-87	July 1982	June 1985	1982	1982
COTE D IVOIRE	1988-90	1988-91						
DENMARK	1987-92		No	1987-92	March 1987	June 1990		1987
ECUADOR	1995-present	Early 1980s	No	1980-82 1996-97			1981	1981
EGYPT	1991-95	Early 1980s 1990-91	No	1980-85 1991-95				1981 1990
FINLAND	1991-94	1991-93	1991-94	1991-1994	September 1991	June 1992		1991
FRANCE	1991-95	1994/95	No	1994-95				1994
GERMANY	1990-93	Late 1970s	No	1978-79				1977
GHANA	1983-89	1982-1989		1982-89 1997				
GREECE	1991-95		No	1991-1995				
ICELAND	1985-86 1993			1985-86 1993				

	Lindgren, Garcia, and Saal (1996)	Caprio and Klingebiel (1996)	Demirgüc-Kunt and Detragiache (1998)	Glick and Hutchison (2001)	Kaminsky and Reinhart (1999) (Beginning)	Kaminsky and Reinhart (1999) (Peak)	Bordo and Schwarz (2000)	Bordo, Eichengreen, Klingebiel, and Martinez-Peria (2001)
INDIA	1991-present	1994/95	1991-94	1993-97				
INDONESIA	1992-present	1994	1992-94	1994 1997	November 1992	November 1992	1992 1997	
IRELAND	1985		No	No				
ISRAEL	1983-84	1977-83	1983-84		October 1983	June 1984	1977	
ITALY	1990-95		1990-94	1990-95				
JAMAICA	1994-present		No	1994-97				
JAPAN	1992-present	1990s	1992-94	1992-1997				1992
KENYA	1993	1985-89 1992 1993-95	1993	1985-89 1992-97				
MALAYSIA	1985-88	1985-88	1985-88	1985-88 1997	July 1985	August 1986	1985	1985 1998
MEXICO	1982 1994-present	1981/82 1995	1982 1994	1981-91 1995-97	September 1982 October 1992	June 1984 March 1996	1981 1994	1981 1994
NEPAL	Late 1980s-present	1988	1988-94	1988-94				
NEW ZEALAND	1989-90	1987-90	No	1987-90			1987	1987
NIGERIA	1991-95	1990s	1991-94	1993-97				1991
NORWAY	1987-93	1987-89	1987-93	1987-93	November 1988	October 1991		1987
PARAGUAY	1995-present	1995	No	1995-97			1995	1995
PERU	1983-90		No	1983-90	March 1983	April 1983	1983	1983
PHILIPPINES	1981-87	1981-87	1981-87	1981-87 1997	January 1981	June 1985	1981	1981 1998
PORTUGAL			1986-89	1986-89				No
SENEGAL	1983-88	1988-91	1983-88					
SINGAPORE		1982	No	1982			1982	1982
SOUTH AFRICA	1985 1989-present	1977	1985	1977 1985 1989			1977	1977 1985
SPAIN	1977-85	1977-85		1977-85	November 1978	January 1983		1977
SWEDEN	1990-93	1991	1990-93	1990-93	November 1991	September 1992		

	Lindgren, Garcia, and Saal (1996)	Caprio and Klingebiel (1996)	Demirgüc-Kunt and Detragiache (1998)	Glick and Hutchison (2001)	Kaminsky and Reinhart (1999) (Beginning)	Kaminsky and Reinhart (1999) (Peak)	Bordo and Schwarz (2000)	Bordo, Eichengreen, Klingebiel, and Martinez-Peria (2001)
THAILAND	1983-87	1983-87	No	1983-87 1997	March 1979 October 1983	March 1979 June 1985	1983 1997	
TURKEY	1982 1991 1994	1982-85	1991 1994	1982-85 1991 1994-95	January 1991	March 1991	1982 1991 1994	
UGANDA	1990-present	1994	1990-94	1994-97				
UNITED KINGDOM		1974-76	No	1975-76 1984				
UNITED STATES	1980-92	1984-91	1981-92					
URUGUAY	1981-85	1981-84	1981-85	1981-84	March 1971 March 1981	December 1971 June 1985	1981	
VENEZUELA	1994-present	1980? 1994/95	1993-94	1978-86 1994-97	October 1993	August 1994	1980 1993	

Note: "present" means the last year of the study. "No" means that no crisis is identified. Caprio and Klingebiel (1996a) compile their dataset by using published sources or interviews with experts familiar with individual episodes. Demirgüc-Kunt and Detragiache (1998) use the following sources: Caprio and Klingebiel (1996a), Drees and Pazarbasioglu (1995), Kaminsky and Reinhart (1996), Lindgren, Garcia, and Saal (1996), and Sheng (1996). Glick and Hutchison (2001) use the following sources: Caprio and Klingebiel (1996a) and Demirgüc-Kunt and Detragiache (1998). Bordo and Schwarz (2000) compile the crises dates from IMF World Economic Outlook (1998) Chapter IV. Bordo, Eichengreen, Klingebiel, and Martinez-Peria use the following sources: Caprio and Klingebiel (1996a, 1999) and IMF (1998). They correct a number of anomalies in the crisis chronology before proceeding. Kaminsky and Reinhart use the following sources: American Banker, various issues; Caprio and Klingebiel (1996a); New York Times, various issues; Sundararajan et al. (1991); Wall Street Journal, various issues.

Table 2: Comparison of banking crises timing, developing and emerging economies

Country	CK (1996)	Window=12M	Window=18M	Window=24M	Window=30M	Window=36M	Window=42M	Window=48M
Argentina	1980-82	1989M6	1989M6	1989M6	1989M6	1989M6	1989M6	1989M6
	1989-90	1990M10						
	1995							
Brazil	1994	1989M12	1989M12	1989M12	1989M12	1989M12	1989M12	1989M12
Chile	1981-83	1984M10	1984M10	1984M10	1984M10	1984M10	1984M10	1984M10
Cote d'Ivoire	1988-91	1980M8	1980M8	1980M8	1980M8	1980M8	1980M8	1980M8
		1995M11	1995M11	1995M11	1995M11	1995M11	1995M11	1995M11
Finland	1991-93	1989M12	1989M12	1989M12	1989M12	1989M12	1989M12	1989M12
Ghana	1982-89	1984M6	1984M6	1984M6	1984M6	1984M6	1984M6	1984M6
		1989M10	1989M10	1989M10	1989M10	1989M10	1989M10	1989M10
Indonesia	1992-94	1985M1	1985M1	1985M1	1985M1	1985M1	1985M1	1985M1
Kenya	1986-89	1993M3	1993M3	1993M3	1993M3	1993M3	1993M3	1993M3
Nigeria	1990s	1989M12	1989M12	1989M12	1989M12	1989M12	1989M12	1989M12
		1996M2	1996M2	1996M2	1996M2	1996M2	1996M2	1996M2
Senegal	1988-91	1995M10	1995M10	1995M10	1995M10	1995M10	1995M10	1995M10
Spain	1977-85	1983M8	1983M8	1983M8	1983M8	1983M8	1983M8	1983M8
		1993M4	1993M4	1993M4	1993M4	1993M4	1993M4	1993M4
Thailand	1983-87	1981M6	1981M6	1981M6	1981M6	1981M6	1981M6	1981M6
Turkey	1982-85	1996M1	1996M1	1996M1	1996M1	1996M1	1996M1	1996M1
Uruguay	1981-84	1983M1	1983M1	1983M1	1983M1	1983M1	1983M1	1983M1
Venezuela	1994/95	1988M11	1988M11	1988M11	1988M11	1988M11	1988M11	1988M11
		1990M10	1990M10					

Note: CK denotes Caprio and Klingebiel (1996a). We mark the crisis when the timing of our index method coincides, or falls within two years prior to or after the timing of Caprio and Klingebiel (1996a).

Figure 1: Index of money market pressure, developing and emerging economies

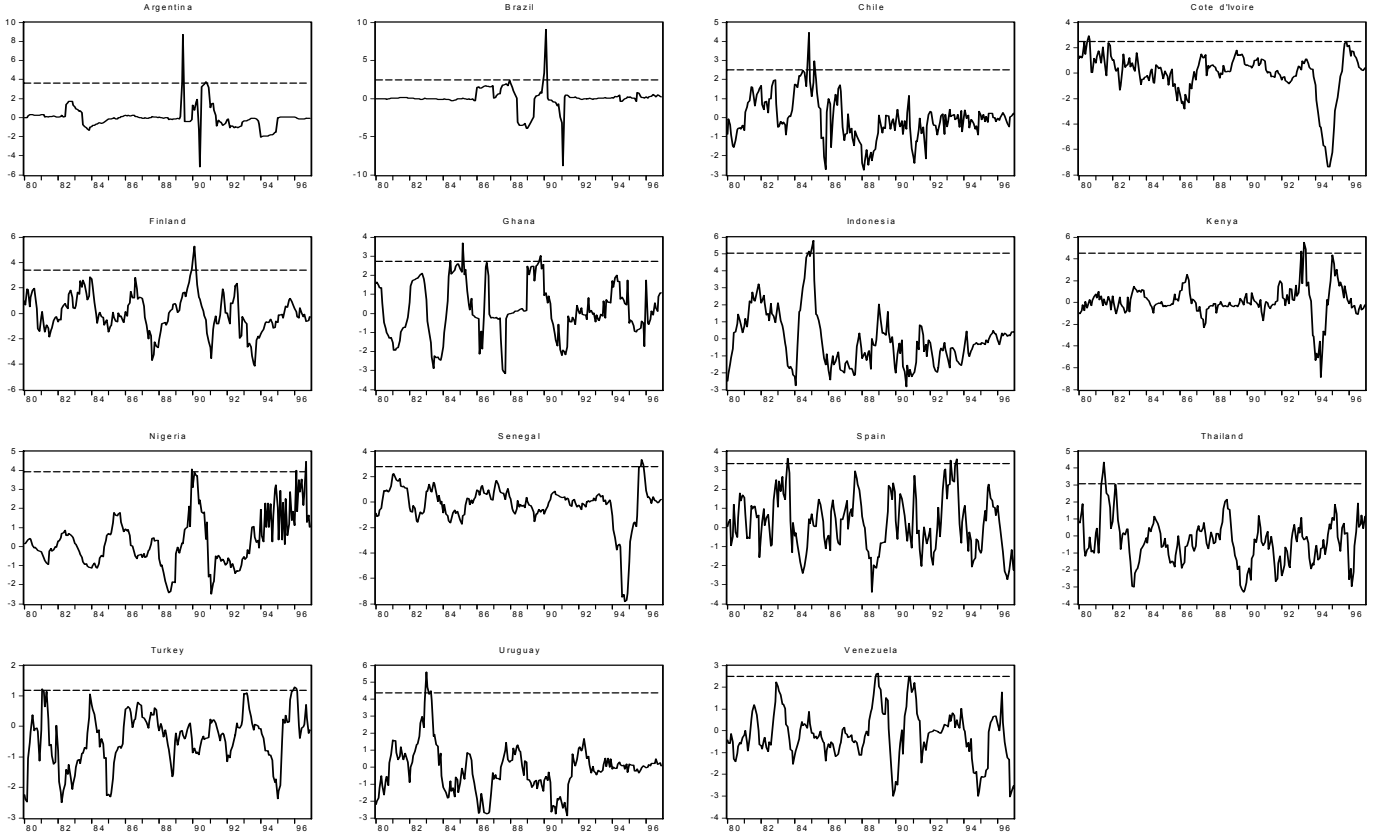


Table 3: Correlations between the index of money market pressure and its components, developing and emerging economies

	Index	Component 1	Component 2
	Unconditional correlations		
Index	1.00	0.69	0.69
		(5.98)	(5.98)
Component 1		1.00	-0.02
			(-0.08)
Component 2			1.00
	Conditional correlations, crisis periods		
Index	1.00	0.21	0.66
		(0.89)	(3.61)
Component 1		1.00	-0.59
			(-3.01)
Component 2			1.00

Note: Component 1 is changes in the reserves to bank deposits ratio and component 2 is changes in real interest rates. T-ratios in parentheses.

Table 4: Relative weights of components in crisis periods, developing and emerging economies

Country	Crises dates	Index value	Component 1 (%)	Component 2 (%)
Argentina	1989M6	8.68	-0.19 (2.1)	8.87 (97.9)
Brazil	1989M12	2.53	0.06 (2.4)	2.46 (97.6)
Chile	1984M10	2.55	1.10 (43.1)	1.45 (56.9)
Cote d'Ivoire	1980M8	2.92	1.34 (45.9)	1.58 (54.1)
Cote d'Ivoire	1995M11	2.50	0.14 (5.6)	2.36 (94.4)
Finland	1989M12	3.51	2.31 (65.8)	1.20 (34.2)
Ghana	1984M6	2.76	0.00 (0.0)	2.76 (100.0)
Ghana	1989M10	3.02	2.94 (97.4)	0.08 (2.6)
Indonesia	1985M1	5.31	2.22 (41.8)	3.09 (58.2)
Kenya	1993M3	4.70	4.21 (89.6)	0.49 (10.4)
Nigeria	1989M12	4.06	3.16 (77.8)	0.90 (22.2)
Nigeria	1996M2	4.01	2.78 (69.5)	1.22 (30.5)
Senegal	1995M10	3.32	0.02 (0.6)	3.30 (99.4)
Spain	1983M8	3.62	0.60 (16.6)	3.02 (83.4)
Spain	1993M4	3.53	2.58 (73.3)	0.94 (26.7)
Thailand	1981M6	3.77	0.43 (11.4)	3.34 (88.6)
Turkey	1996M1	1.28	-0.12 (7.9)	1.40 (92.1)
Uruguay	1983M1	5.63	4.07 (72.3)	1.56 (27.7)
Venezuela	1988M11	2.62	2.37 (90.5)	0.25 (9.5)
AVERAGE			(43.0)	(57.0)

Note: Component 1 is changes in central banks funds to bank deposits ratio and component 2 is changes in real interest rates. Figures in parentheses are percentage weights.

Table 5: Banking crises in industrialized countries

Country	Existing research	Window=12M	Window=18M	Window=24M	Window=30M	Window=36M	Window=42M	Window=48M
Austria								
Denmark	1987-92	1982M11 1993M2	1982M11 1993M2	1982M11 1993M2	1982M11 1993M2	1982M11 1993M2	1982M11 1993M2	1982M11 1993M2
Finland	1991-94	1989M12	1989M12	1989M12	1989M12	1989M12	1989M12	1989M12
Germany	1990-93	1988M12	1988M12	1988M12	1988M12	1988M12	1988M12	1988M12
Greece	1991-95	1984M5	1984M5	1984M5	1984M5	1984M5	1984M5	1984M5
Iceland	1985-86 1995							
Ireland	1985	1992M11	1992M11	1992M11	1992M11	1992M11	1992M11	1992M11
Italy	1990-95	1992M7	1992M7	1992M7	1992M7	1992M7	1992M7	1992M7
Japan	1992-present	1980M7 1985M12	1980M7 1985M12	1980M7 1985M12	1980M7 1985M12	1980M7 1985M12	1980M7 1985M12	1980M7 1985M12
Netherlands		1981M8 1986M12	1981M8 1986M12	1981M8 1986M12	1981M8 1986M12	1981M8 1986M12	1981M8 1986M12	1981M8 1986M12
Portugal	1986-89	1985M7 1991M12	1985M7 1991M12	1985M7 1991M12	1985M7 1991M12	1985M7 1991M12	1985M7 1991M12	1985M7 1991M12
Spain	1977-85	1983M8 1993M4	1983M8 1993M4	1983M8 1993M4	1983M8 1993M4	1983M8 1993M4	1983M8 1993M4	1983M8 1993M4
Sweden	1990-93	1992M9	1992M9	1992M9	1992M9	1992M9	1992M9	1992M9
Switzerland		1983M5 1989M8	1983M5 1989M8	1983M5 1989M8	1983M5 1989M8	1983M5 1989M8	1983M5 1989M8	1983M5 1989M8

Note: We mark the crisis when the timing of our index method coincides, or falls within two years prior to or after the timing of existing research.

Figure 2: Index of money market pressure, industrialized countries, threshold=98.5 percentile

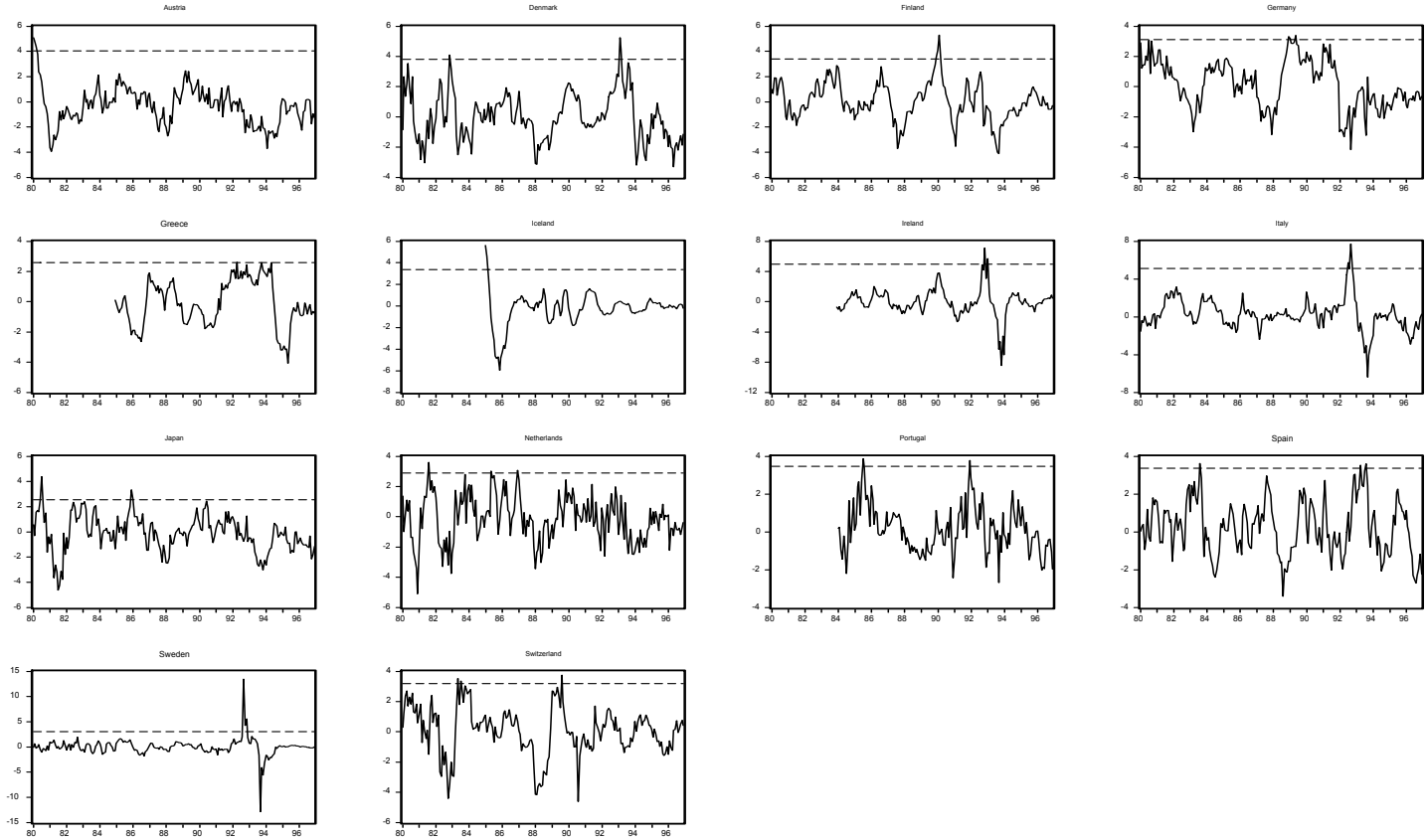


Table 6: Correlations between the index of money market pressure and its components, industrialized countries

	Index	Component 1	Component 2
	Unconditional correlations		
Index	1.00	0.76	0.79
		(11.24)	(13.04)
Component 1		1.00	0.21
			(1.30)
Component 2			1.00
	Conditional correlations for crisis episodes		
Index	1.00	0.61	0.90
		(3.08)	(8.61)
Component 1		1.00	0.21
			(0.86)
Component 2			1.00

Note: Component 1 is changes in central banks funds to bank deposits ratio and component 2 is changes in real interest rates. T-ratios in parentheses.

Table 7: Relative weights of components in crisis periods, industrialized countries

Country	Crises dates	Index value	Component 1(%)	Component 2(%)
Denmark	1982M11	4.08	0.79 (19.3)	3.29 (80.7)
Denmark	1993M2	5.24	1.79 (34.2)	3.45 (65.8)
Finland	1989M12	3.51	2.31 (65.7)	1.20 (34.3)
Germany	1988M12	3.32	2.71 (81.7)	0.61 (18.3)
Greece	1984M5	3.74	2.55 (68.3)	1.18 (31.7)
Ireland	1992M11	7.11	2.54 (35.7)	4.57 (64.3)
Italy	1992M7	5.74	3.54 (61.7)	2.20 (38.3)
Japan	1980M7	4.40	1.39 (31.7)	3.01 (68.4)
Japan	1985M12	3.35	1.09 (32.5)	2.26 (67.5)
Netherlands	1981M8	3.59	1.88 (52.5)	1.71 (47.5)
Netherlands	1986M12	3.07	1.90 (61.8)	1.17 (38.2)
Portugal	1985M7	3.87	0.11 (2.8)	3.76 (97.2)
Portugal	1991M12	3.77	0.77 (20.5)	3.00 (79.5)
Spain	1983M8	3.62	0.60 (16.7)	3.02 (83.3)
Spain	1993M4	3.53	2.58 (73.2)	0.94 (26.8)
Sweden	1992M9	13.46	4.17 (31.0)	9.29 (69.0)
Switzerland	1983M5	3.52	1.53 (43.4)	1.99 (56.6)
Switzerland	1989M8	3.74	0.62 (16.7)	3.12 (83.3)
AVERAGE			(41.6)	(58.4)

Note: Component 1 is changes in central banks funds to bank deposits ratio and component 2 is changes in real interest rates. Figures in parentheses are percentage weights.

Table 8: Banking crises dates of 47 countries

Country	Window width=8Q	Country	Window width=8Q
Austria	NO CRISIS	Mexico	1989Q2
Burundi	1998Q4	Nepal	NO CRISIS
Chile	1984Q4	Netherlands	1986Q4
Cyprus	1986Q1	New Zealand	1983Q1
Denmark	1993Q1	Niger	1982Q3
Ecuador	1984Q2	Nigeria	1996Q3
Egypt	1990Q4	Papua New Guinea	1981Q2
El Salvador	1987Q4	Peru	1990Q2
Finland	1989Q4	Portugal	1985Q3
France	1981Q3	Senegal	1995Q4
Germany	1988Q4	Seychelles	1982Q2
Greece	1981Q2	South Africa	1990Q1
Guatemala	1991Q4	Spain	1983Q3
Honduras	1985Q4	Sri Lanka	1983Q3
India	1999Q4	Swaziland	1982Q1
Indonesia	1998Q1	Sweden	1992Q3
Ireland	1992Q4	Switzerland	1998Q4
Israel	1984Q3	Thailand	1998Q1
Italy	1992Q3	Togo	1980Q3
Jamaica	1997Q1	Turkey	2001Q1
Japan	1998Q3	Uganda	1989Q3
Kenya	1993Q2	United States	1981Q3
Korea	1998Q1	Uruguay	1983Q1
		Venezuela	1997Q4

Table 9: Explanatory Variables and Data Sources

Variable Name	Definition	Sources
	MACROECONOMIC VARIABLES	
GROWTH (%)	Growth rate of real GDP	IFS line 99bvp or 99b.p
DEPRECIATION (%)	Changes of nominal exchange rates	IFS line RF
OVERRER (%)	Overvaluation of real exchange rate (An increase in number means a real depreciation)	Deviation from H-P filter
RLINTEREST (%)	Real interest rates	Nominal interest rates are from IFS line 60b; Inflation rates are from IFS line 64
INFLATION (%)	Inflation rates	IFS line 64
SURPLUS/GDP (%)	Ratio of budget surplus to GDP	Surplus from IFS line 80; GDP from line 99b
DGROWTH (dummy)	Dummy for severe recession	GROWTH<-5%
DINFLATION (dummy)	Dummy for high inflation	INFLATION>20%
MBGRO (%)	Growth rate of monetary base	IFS line 14
CREDITGRO (%)	Growth rate of real domestic credit	IFS line 32d ÷ line 64
	FINANCIAL VARIABLES	
PRIVATE CREDIT/GDP	Ratio of domestic credit to private sector to GDP	Domestic credit to private sector from IFS line 32d
CASH/BANK (%)	Ratio of bank liquid reserves to bank assets	Bank liquid reserves from IFS line 20; Bank assets from IFS line 21 plus lines 22a to 22f
CSMP (%)	Changes in stock market price	Share prices are from IFS line 62
	INSTITUTIONAL VARIABLES	
GDP/CAP (1000 dollars/person)	Real GDP per capita	Population is IFS line 99z
DEPOSITINS (dummy)	Dummy variable for existence of explicit deposit insurance	Garcia (1999), Demirgüc-Kunt and Detragiache (2002)
FL (dummy)	Dummy variable for financial liberalization	Demirgüc-Kunt and Detragiache (1998), Glick and Hutchison (2001)

Note: Countries included in the sample are Austria, Burundi, Chile, Cyprus, Denmark, Ecuador, Egypt, El Salvador, Finland, France, Germany, Greece, Guatemala, Honduras, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Kenya, Korea, Mexico, Nepal, Netherlands, New Zealand, Niger, Nigeria, Papua New Guinea, Peru, Portugal, Senegal, Seychelles, South Africa, Spain, Sri Lanka, Swaziland, Sweden, Switzerland, Thailand, Togo, Turkey, Uganda, United States, Uruguay, and Venezuela. Argentina and Brazil are excluded because they are outliers with respect to inflation and real interest rates.

Table 10: Conditional logit regressions, all countries

	Model 1	Model 2	Model 3	Model 4	Model 5
GROWTH (-1)	-0.25***	-0.27***	-0.28***	-0.28***	-0.26***
	(-3.28)	(-3.44)	(-2.95)	(-2.94)	(-3.73)
DEPRECIATION (-1)	0.01	0.01	0.00	-0.001	
	(1.00)	(0.92)	(0.00)	(-0.09)	
OVERRER (-1)	-0.05**	-0.05**	-0.01	-0.02	-0.04*
	(-2.51)	(-2.56)	(-0.51)	(-0.79)	(-2.39)
RLINTEREST (-1)	-0.03	-0.03	-0.12**	-0.09**	-0.05**
	(-1.20)	(-1.02)	(-2.51)	(-2.14)	(-2.42)
INFLATION (-1)	0.02	0.02	0.04	0.04	
	(0.83)	(0.59)	(0.90)	(1.05)	
SURPLUS/GDP (-1)	-0.07*	-0.05	-0.10	-0.09	-0.06**
	(-1.70)	(-1.26)	(-1.47)	(-1.34)	(-2.32)
DGROWTH (-1)	-2.58**	-2.55*	-0.98	-2.55	-1.88
	(-1.96)	(-1.90)	(-0.61)	(-1.64)	(-1.45)
DINFLATION (-1)	1.18	1.59*	0.37	1.38	1.93***
	(1.55)	(1.92)	(0.35)	(1.38)	(2.60)
MBGRO (-1)	-0.0002	0.003	-0.006	0.007	
	(-0.02)	(0.31)	(-0.42)	(0.61)	
CREDITGRO (-1)	0.01	0.01	0.02	0.01	
	(1.08)	(1.09)	(1.64)	(0.87)	
PRIVATE CREDIT/GDP (-1)	0.57	0.79	2.96	0.68	
	(0.41)	(0.54)	(1.47)	(0.29)	
CASH/BANK (-1)	-0.05	-0.04	-0.05	-0.07	
	(-1.19)	(-0.96)	(-0.90)	(-1.15)	
FL (-1)	0.80	0.50	0.62	0.74	
	(1.12)	(0.66)	(0.75)	(0.82)	
GDP/CAP (-1)		-0.06	-0.08	-0.07	
		(-0.95)	(-1.28)	(-1.05)	
DEPOSITEX (-1)		1.58*	2.54**	2.25**	1.47**
		(1.75)	(2.25)	(2.07)	(2.04)
C_CRISIS			-1.06		
			(-0.62)		
C_CRISIS*GROWTH			0.09		
			(0.46)		
C_CRISIS*DEPRECIATION			0.03		
			(1.44)		
C_CRISIS*OVERRER			-0.06		
			(-1.45)		
C_CRISIS*RLINTEREST			0.12		
			(1.52)		
C_CRISIS*INFLATION			0.08		
			(1.14)		
DEVENT				1.05	
				(1.37)	
DEVENT*GROWTH				-0.20*	
				(-1.87)	
DEVENT*DEPRECIATION				0.02	
				(1.40)	
DEVENT*OVERRER				-0.01	
				(-0.27)	
DEVENT*RLINTEREST				0.01	
				(0.63)	
DEVENT*INFLATION				-0.03	
				(-1.41)	
Number of crises	36	36	34	34	38
Number of observations	716	716	697	703	726
LR statistic	61.07***	64.31***	82.74***	81.97***	58.82***
Predictive power, cutoff value = 10%					
% Total correct	89	89	90	88	88
% Crises correct	58	58	71	65	58
% Non-crisis correct	90	91	91	89	90
Signal-to-noise ratio	6.10	6.40	7.43	6.01	5.61
Predictive power, cutoff value = 5%					

% Total correct	75	76	79	78	74
% Crises correct	78	75	76	76	74
% Non-crisis correct	75	76	79	78	73
Signal-to-noise ratio	3.13	3.13	3.60	3.43	2.74

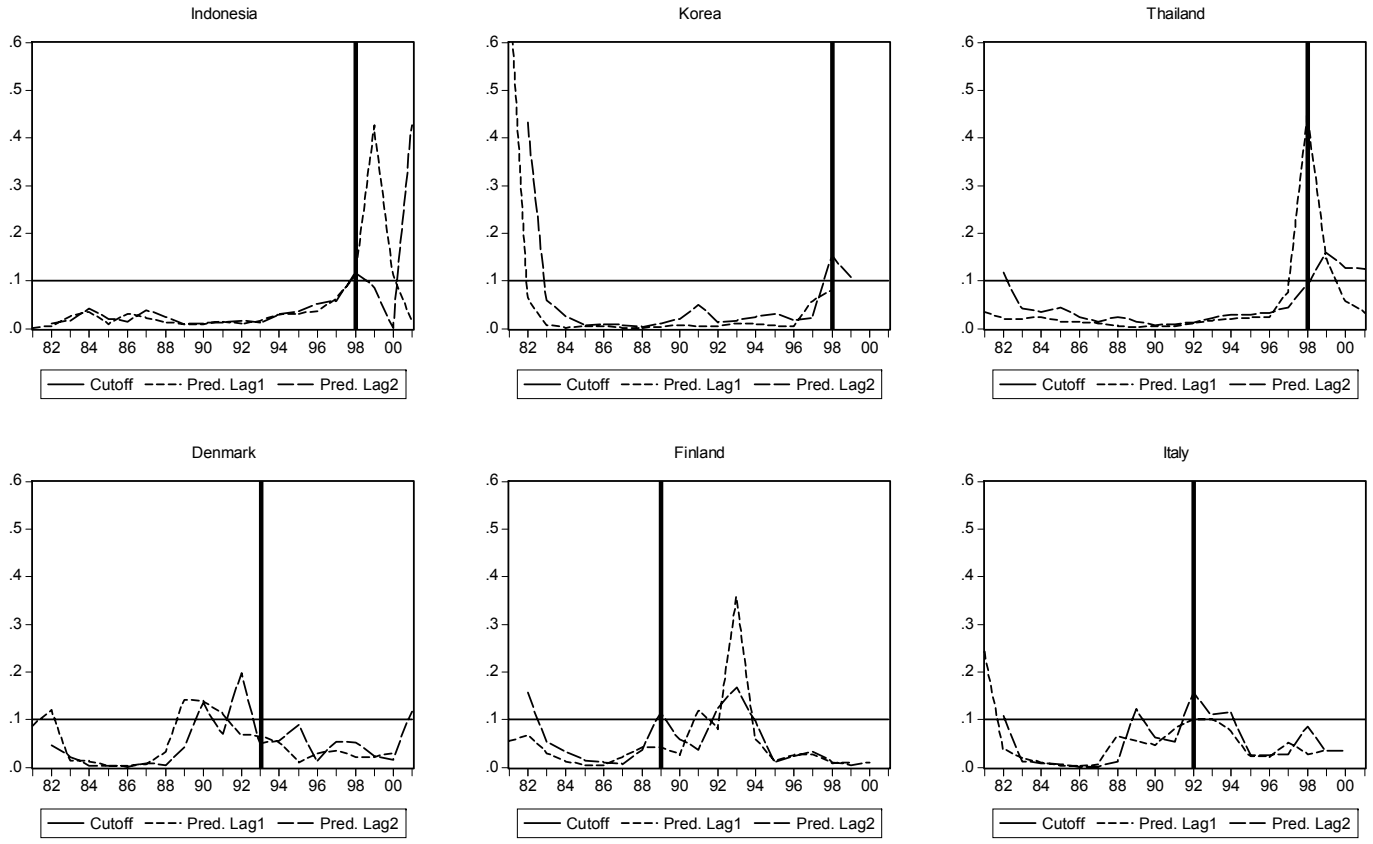
Note: Numbers in parentheses are z-statistics. *, **, and *** indicate significance levels of 10, 5, and 1 percent respectively.

Table 11: Conditional logit regressions

	Advanced Economies			Emerging and Developing Economies		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
GROWTH (-1)	-0.55**	-0.35	-0.21*	-0.31**	-0.04	-0.30***
	(2.21)	(-1.17)	(-1.84)	(-2.35	(-0.19)	(-2.99)
DEPRECIATION (-1)	-0.04	-0.06		0.02	0.02	
	(-0.73)	(-1.19)		(1.37)	(0.88)	
OVERRER (-1)	0.01	0.03		-0.11***	-0.10	-0.08***
	(0.35)	(0.76)		(-2.95)	(-1.53)	(-3.06)
RLINTEREST (-1)	-0.11	-0.23		-0.08*	-0.30**	-0.12***
	(-0.71	(-0.74)		(-1.79)	(-2.42)	(-3.89)
INFLATION (-1)	0.23*	-0.03	0.18***	0.02	0.12	
	(1.86)	(-0.14)	(2.64)	(0.54)	(1.31)	
SURPLUS/GDP (-1)	0.15	0.06		-0.10	-0.44*	-0.16***
	(1.11)	(0.28)		(-1.04)	(-1.88)	(-3.83)
DGROWTH (-1)	-36.67	-38.90		-3.87*	-0.23	-2.96
	(0.00)	(-0.00)		(-1.93)	(-0.07)	(-1.49)
DINFLATION (-1)	-10.95	-5.00		1.37	-3.72	
	(-0.82)	(-0.00)		(1.13)	(-1.35)	
MBGRO (-1)	-0.004	-0.02		-0.01	-0.03	
	(-0.21)	(-0.44)		(-0.65)	(-0.74)	
CREDITGRO (-1)	-0.005	0.007		0.07**	0.12**	0.06**
	(-0.14	(0.21)		(2.31)	(2.20)	(2.09)
PRIVATE CREDIT/GDP (-1)	0.02	-0.54		2.44	15.33**	
	(0.00)	(-0.09)		(0.81)	(2.36)	
CASH/BANK (-1)	0.12	0.27		-0.08	-0.18	
	(0.52)	(0.62)		(-1.21)	(-1.42)	
CSMP(-1)	-0.12	-0.01				
	(-1.06)	(-0.37)				
FL (-1)	1.33	0.13		1.27	1.64	
	(0.78)	(0.06)		(1.02)	(1.28)	
GDP/CAP (-1)	0.02	-0.12		-1.50	-2.77	-0.60
	(0.21)	(-0.99)		(-1.23)	(-1.28)	(-1.04)
DEPOSITEX (-1)	3.31*	41.79	3.04**	-1.68	0.19	
	(1.83)	(0.00)	(2.45)	(-0.94)	(0.03)	
C_CRISIS		-155.79	1.42**		-8.44	
		(-0.00)	(2.17)		(-1.51)	
C_CRISIS*GROWTH		-4.25			0.48	
		(-0.00)			(0.95)	
C_CRISIS*DEPRECIATION		1.48			0.06	
		(0.00)			(1.54)	
C_CRISIS*OVERRER		-18.73			-0.13	
		(-0.00)			(-1.03)	
C_CRISIS*RLINTEREST		-1.61			0.28	
		(-0.00)			(1.49)	
C_CRISIS*INFLATION		1.75			0.29	
		(0.00)			(1.63)	
Number of crises	13	13	18	19	18	19
Number of observations	255	255	360	402	378	403
LR statistic	27.55**	43.58***	29.40***	62.97***	78.14***	50.74***
	Predictive power, cutoff value = 10%					
% Total correct	86	89	89	92	94	90
% Crises correct	54	77	39	84	89	68
% Non-crisis correct	88	90	91	93	94	9191
Signal-to-noise ratio	4.49	7.76	4.43	11.52	15.24	7.8651

Note: Numbers in parentheses are z-statistics. *, **, and *** indicate significance levels of 10, 5, and 1 percent respectively.

Figure 3: Predicted probability of banking crises in selected countries



Note: The vertical lines show the crises periods identified in Table 8.