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Identifying and Dating Systemic Banking Crises Using Incidence and Size of Bank Failures

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Abstract

We analyse three databases of banking crises and investigate their consistency in the identification and timing of crises. We find that there are large and statistically significant discrepancies between the three datasets. We also compare the dating of banking crises according to these databases using information on the number and size of bank failures for four crises for which the timing strongly differs across these databases. We conclude that information on these variables allows determining the timing of banking crises more precisely. On the basis of our findings, we consider the database compiled by Laeven and Valencia to be the most accurate.

Keywords: systemic banking crises, dating of crises, bank failures, monetary statistics, financial accounts.

JEL classification: G01, G21, N20

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1. Introduction

Due to the worldwide financial crisis there is renewed interest in the causes and consequences of banking crises. In contrast to economic recessions for which a precise definition exists (i.e. two consecutive quarters of negative growth in real GDP), a widely accepted definition of a (systemic) banking crisis is lacking. Most recent research on banking crises uses the following three sources for dating banking crises: Caprio et al. (2005), Reinhart and Rogoff (2009) and Laeven and Valencia (2008; 2013).¹ These databases employ different definitions of a banking crisis. Consequently, there are large and statistically significant differences between these sets of crisis dates. The databases provide different start and/or end dates and as a consequence come up with different lengths of the crises. Events identified as a crisis by one database are frequently not considered a banking crisis by another database. Also the concordance with economic cycles differs considerably. Low GDP growth sometimes precedes the crisis, sometimes follows the crisis or coincides with the crisis. Even though the crisis dates of Reinhart and Rogoff are to a large extent based on those of Caprio et al. there are large differences between both datasets. An example is the dating of the savings and loan crisis in the US, which we will analyse in more detail in this paper (along with three other banking crises). Caprio et al. date this crisis from 1988 to 1991. According to Reinhart and Rogoff, this crisis runs from 1984 to 1991, while Laeven and Valencia limit the crisis to 1988.

These differences in identifying and dating banking crises have potentially significant consequences. The timing of crises is, for instance, instrumental in estimating output losses caused by banking crises. It may also cause ambiguity in determining the causes of crises. For instance, differences in timing may lead to different conclusions regarding the question of whether a crisis was caused by factors within the financial sector or by factors external to it (e.g., a worsening of general economic conditions). Another possible consequence is that early warning models to predict crises may provide unreliable signals if imprecise and inconsistent dates are used.

Authors rely on multiple criteria to determine the occurrence of a banking crisis often in combination with expert judgement. Some have even gone so far as to state that classifying and dating (systemic) banking crises is inherently subjective (Frydl, 1999). Authors rely on expert judgement in the absence of an independent arbiter, a role the National Bureau of Economic Research plays in identifying economic recessions. When comparing the main databases referred to above, it becomes clear that these expert judgments differ considerably.

¹ These databases employ the so-called events methodology to identify banking crises. Von Hagen and Ho (2007) argue that this events methodology may be biased for several reasons. First, such interventions may refer to a few banks having problems rather than the whole banking sector. Second, policy interventions mostly occur when a crisis has a significant impact on the financial system or the economy, which implies that the start of the banking crisis may be identified too late. Finally, not each crisis leads to government interventions as central banks sometimes solve financial problems successfully. Therefore, there may be a selection bias when banking crises are identified based on interventions by government authorities.

The fact that definitions and dates of banking crises differ across studies has been discussed before (cf. Frydl, 1999; Boyd et al. 2009; Babecký et al., 2012). However, most empirical studies on banking crises have merely noted the differences and opted for one or the other database. Alternatively, some authors avoid relying on existing indicators of banking crises altogether and introduce alternatives. For instance, Von Hagen and Ho (2007) propose an index based on money market pressure to identify banking crises. Boyd et al. (2009) construct systemic bank shock indicators derived from a theoretical model. Instead, we try to improve on existing databases by introducing quantitative information which allows to reduce subjectivity in identifying crises. For this purpose we use data sources which have not been widely employed in the literature. From these sources we construct time series for what we consider the most important characteristics of banking crises, namely the number of bank failures and the relative size of bank losses. Using this information may shed new light on the differences between the most widely used databases of banking crises and enable to date banking crises more precisely. To illustrate our argument, we analyse four banking crises for which the timing strongly differs across these databases.

The remainder of this paper is structured as follows. Section 2 summarises the definitions used in the literature on banking crises and compares three widely used databases. Section 3 confronts these sets of crisis dates with data on bank failures and bank losses for four crises: the savings and loan crisis in the United States, the banking crisis during the 1990s in Japan, the banking crisis in Norway, and the crisis in Turkey during the late 1990s. The final section offers our conclusions.

2. Comparing databases of banking crises

The definition of a systemic banking crisis varies considerably across studies. There are common elements to most definitions, such as widespread bank insolvency, but there is no agreement on a precise definition. Caprio and Klingebiel (1996) define a banking crisis as a situation of "... financial distress, in which the banking system has negative net worth." This is a somewhat restrictive definition as most crises rarely affect all banks to the same extent. Their list of banking crises ultimately takes into account the extent of the crisis to distinguish between systemic and non-systemic crises. But it relies very much on expert judgement, in particular with respect to the timing of bank insolvency. No specific measure for the proportion of the banks' equity that is destroyed is used to make this distinction. Caprio and Klingebiel (1996) point to a lack of information in general and specifically on the mark-to-market balance sheets of banks for this. These authors do not provide a specific criterion to determine the end of a crisis.

Reinhart and Rogoff (2009) base their identification of banking crises on certain events. Similar to Caprio and Klingebiel (1996), they point to a lack of data which prevents the use of a

formal definition.² Relative stock prices of banks cannot be used as not all banks are listed. Using changes in deposits would miss crises which do not involve bank-runs, while non-performing loans are deemed too unreliable for lack of harmonised accounting rules. Reinhart and Rogoff (2009, p. 10) therefore settle on two events: “(1) bank runs that lead to the closure, merging or takeover by the public sector of one or more financial institutions ... and (2) if there are no runs, the closure, merging, takeover or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions.” They denote these banking crises by type I (systemic) and type II (financial distress), respectively. However, they do not use this distinction in their classification of crises nor do they indicate what an important financial institution is.

Laeven and Valencia (2008, p. 5) state that “... in a systemic banking crisis, a country’s corporate and financial sectors experience a large number of defaults and financial institutions and corporations face great difficulty repaying contracts on time. As a result, non-performing loans increase sharply and *all or most of the aggregate banking system capital is exhausted*” (emphasis added). The dates included in the most recent version of their database, however, do not exclusively relate to “signs of financial distress in the banking system” (2013, p. 228), which is their first condition for identifying a banking crisis. Banking crises are also identified by the institution of “significant banking policy intervention measures” of which they identify six (such as a deposit freeze or nationalizations). At least three of these measures need to have been implemented for a crisis to be classified as systemic. This condition is supplemented with three other criteria, namely that the share of nonperforming loans exceed 20 percent, bank closures make up least 20 percent of banking assets and fiscal restructuring costs exceed 5 percent of GDP.

In order to assess the correspondence of the three separate definitions, we compare the dates of (systemic) banking crises for the years 1976 to 2004 between the three studies for the 99 countries which are included in all three databases. Also, the comparison is limited to the years 1976 to 2004, i.e. the years covered by all three studies. The recent worldwide financial crisis of 2007/2008 is therefore excluded.

The database of Caprio and Klingebiel (1996) has been updated a couple of times. We have chosen the most recent version of their database, published as an annex in Honohan and Laeven (2005), referred to here as Caprio et al. (2005). Laeven and Valencia have also published an updated list in 2013. For details regarding certain crises, we rely on the data file accompanying the 2012 version of their study (Laeven and Valencia, 2012). Laeven and Valencia only identify systemic banking crises, while Reinhart and Rogoff identify banking crises without distinguishing between systemic and non-systemic crises in their crises list as published in appendix A.4 in their book. Caprio

² See Reinhart and Rogoff (2009), p.8.

et al. (2005) list all crises but make a distinction between systemic and non-systemic crises. This may explain some of the differences across these studies. For instance, both Caprio et al. and Reinhart and Rogoff identify a (non-systemic) banking crisis in Canada in 1983-85, whereas this crisis does not appear in the list of Laeven and Valencia. There are, therefore, two comparisons to be made: Reinhart and Rogoff with the complete list of Caprio et al. and the systemic crises of Caprio et al. with those of Laeven and Valencia. In order to examine the magnitude of error in comparing two inconsistent crisis definitions – one for banking crises in general and one for systemic banking crises – we also make the comparison between Laeven and Valencia and Reinhart and Rogoff. The start and end dates of the crises of the three studies are listed in Appendix 3. Caprio et al. and Reinhart and Rogoff do not provide precise start and end dates for certain crises. In order to make the comparison, we have substituted dates from the other studies for the missing dates, although this will produce some bias in the comparison presented below. This mostly affected the Caprio et al. database, since this list of banking crises is the least complete.

Figures 1 to 3 present graphical summaries of the data for each of the comparisons. The figures display the number of countries experiencing a (systemic) crisis according to each of the three studies. Figure 1 compares the incidence of all banking crises according to Caprio et al. and Reinhart and Rogoff. Figure 2 compares the incidence of systemic banking crises according to Caprio et al. and Laeven and Valencia, while Figure 3 presents the comparison between the systemic crises of Laeven and Valencia and all crises identified by Reinhart and Rogoff.

Tables 1 to 3 below present pair-wise contingency tables for the data for countries present in all three studies classified by each of the studies as crisis years. The tables summarise the number of years each of the studies classifies as a crisis-year in comparison to one of the other studies. Apart from relative frequencies, the tables show the phi-coefficient (equal to the correlation coefficient on the binary data for crisis years) and Cohen's kappa coefficient. Kappa measures the agreement between two ratings on a nominal scale, where a value of 0 indicates complete disagreement and 1 complete agreement. It is a more robust measure than simple percent agreement calculation since kappa takes the agreement occurring by chance into account. It has the advantage that it also provides standard errors for the point estimate which allows calculating a confidence interval (see Fleiss et al., 1969).

The comparison of the Caprio et al. and Reinhart and Rogoff databases produces a phi-coefficient of 0.8301 (see Table 1). The kappa for the comparison of the Caprio et al. and Reinhart and Rogoff databases is 0.8299 with a standard error of 0.0141, giving a 95%-confidence interval of 0.8022 to 0.8576. From these measures, it is clear that the databases of Caprio et al. and Reinhart and Rogoff have fairly similar classifications of crisis years (which is to be expected, since Reinhart and Rogoff make extensive use of Caprio et al. as a source for crises dates), but nevertheless they differ

significantly. Remarkably, each study identifies a roughly equal incidence of crisis years – 16.9% for Caprio et al. and 16.3% for Reinhart and Rogoff – but the studies agree on just 14.2% of the cases.

Figure 1. Number of countries in crisis by reference, 1976 - 2004

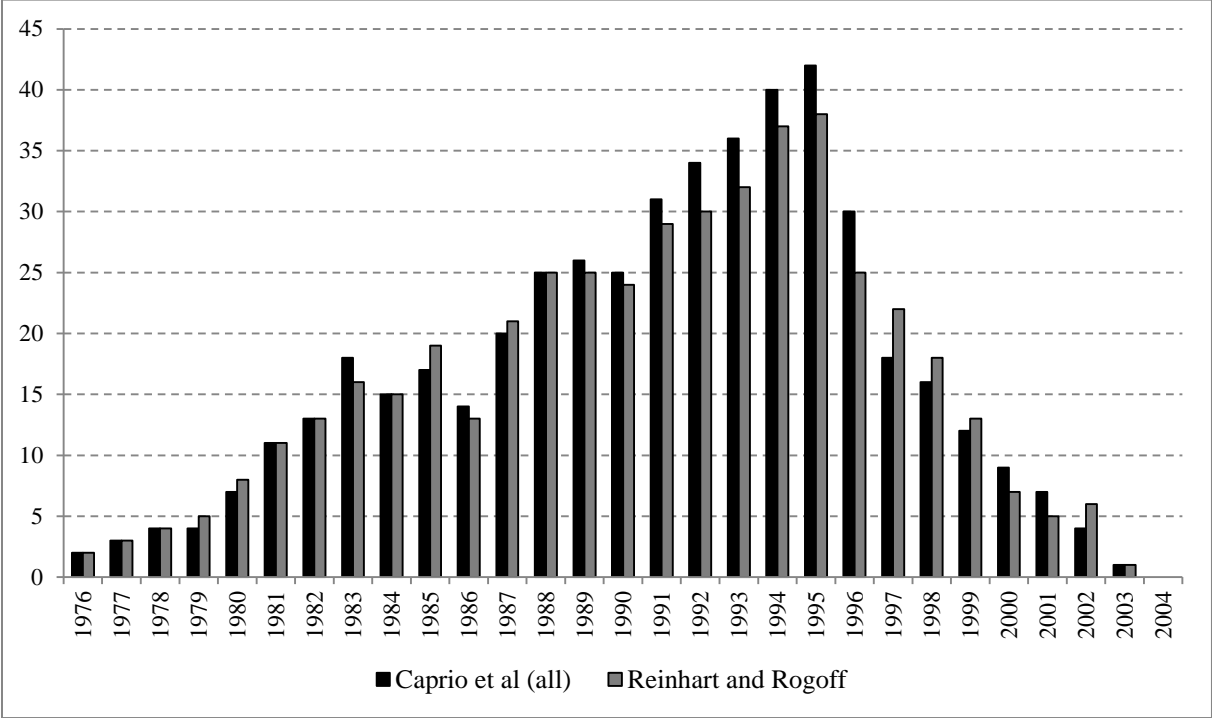


Figure 2. Number of countries in systemic crisis by reference, 1976 - 2004

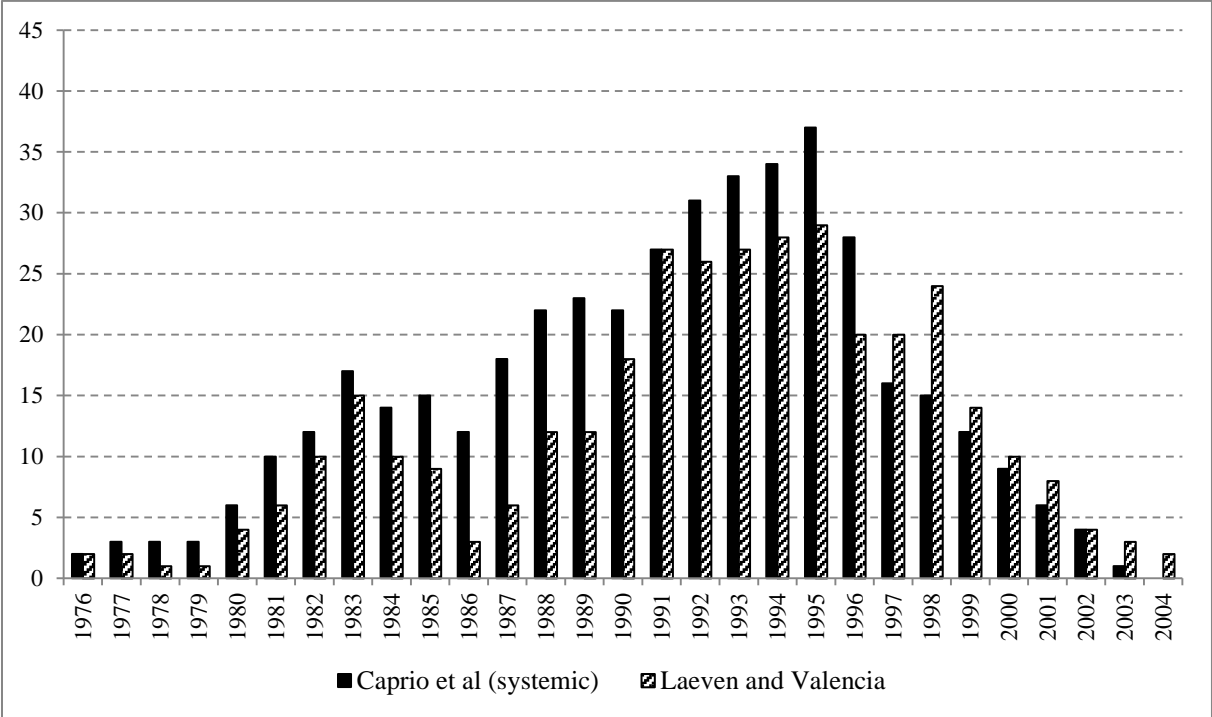


Figure 3. Number of countries in (systemic) crisis by reference, 1976 - 2004

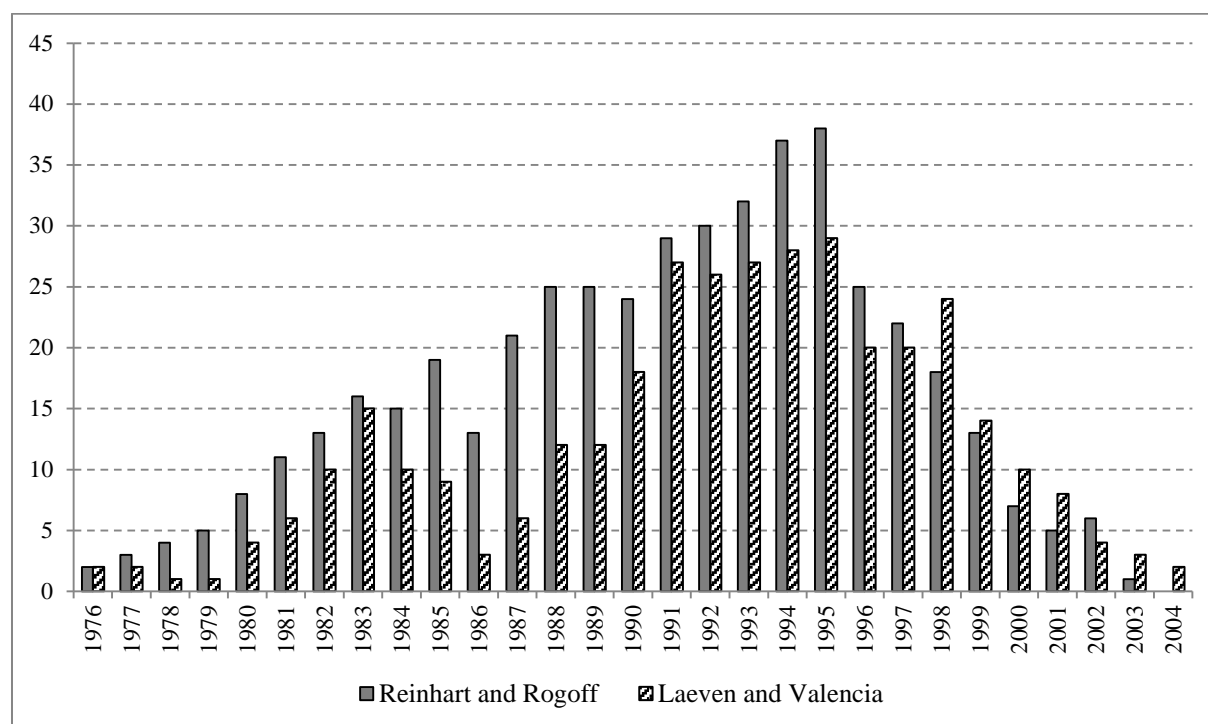


Table 1. Cross-table of crisis years identified by Caprio et al. versus Reinhart and Rogoff, 1976-2004

		Reinhart and Rogoff (2009)			
		Crisis years	Non-crisis years	Total	
Caprio et al. (2005)	Crisis years	Absolute frequency	408	76	484
		Relative frequency	0.142	0.026	0.169
		Expected frequency	0.027	0.141	-
	Non-crisis years	Absolute frequency	59	2328	2387
		Relative frequency	0.021	0.811	0.831
		Expected frequency	0.135	0.696	-
	Total	Absolute frequency	467	2404	2871
		Relative frequency	0.163	0.837	1.000
		Expected frequency	-	-	-

Note: For each of the 99 countries common to all three studies, every year from 1976 to 2004 was rated by each of the three studies as either a crisis year or a non-crisis year. The four inner data-cells of the table present the absolute and relative frequencies of the possible combinations, as well as the expected frequencies under independence. The outer cells contain row and column totals. If the relative frequencies in the inner cell are represented by the symbol p_{ij} where i and j = crisis year (C) or non-crisis year (N), and the row and column totals by p_i and p_j respectively, then the expected frequencies equal $p_{ij}^e = p_j \cdot p_i$. Let $p^o = p_{CC} + p_{NN}$ and $p^e = p_{CC}^e + p_{NN}^e$, then kappa = $(p^o - p^e)/(1 - p^e)$.

The second comparison is for years classified as systemic crisis years by Caprio et al. on the one hand and Laeven and Valencia on the other (see Table 2). There is again a high degree of association, but much less so than for the comparison between Caprio et al. and Reinhart and Rogoff. The correlation between the crises dates according to Caprio et al. and those of Laeven and Valencia is only 0.5488. The kappa is 0.5448 with a standard error of 0.0227 for a 95%-confidence interval of 0.5003 to 0.5893. We can therefore conclude that both databases come up with very different classifications of systemic crises. Caprio et al. classify 15.2% of years as a systemic crisis, whereas for Laeven and Valencia the proportion is just 12.3%. The studies agree on 8.3% of the crises. As mentioned, Laeven and Valencia limit the length of a systemic crisis to a maximum of 5 years. Casual inspection of the Laeven and Valencia data reveals that their crises episodes are often shorter than those of Caprio et al.

As pointed out before, the final comparison is intended solely to show the danger of comparing crises dates based on two different definitions: all crises as defined by Reinhart and Rogoff and the systemic crises from Laeven and Valencia. This comparison has the lowest correlation coefficient (0.4931). The kappa for this comparison, presented in Table 3, is also the lowest at 0.4866, although still significantly different from zero (its standard error is 0.0229). The difference in the proportion of crisis years is similar to the previous comparison with 12.3% in the Laeven and Valencia database and 16.3% in that of Reinhart and Rogoff, but they agree on only 8.0% of the cases.

Table 2. Cross-table of systemic crisis years identified by Caprio et al. versus Laeven and Valencia, 1976-2004

			Laeven and Valencia (2013)		
			Crisis years	Non-crisis years	Total
Caprio et al. (2005)	Crisis years	Absolute frequency	239	196	435
		Relative frequency	0.083	0.068	0.152
		Expected frequency	0.019	0.133	-
	Non-crisis years	Absolute frequency	114	2322	2436
		Relative frequency	0.039	0.809	0.848
		Expected frequency	0.104	0.744	-
	Total	Absolute frequency	353	2518	2871
		Relative frequency	0.123	0.877	1.000
		Expected frequency	-	-	-

Note: for an explanation of this table, see the note to Table 1.

Table 3. Cross-table of all vs. systemic crisis years identified by Laeven and Valencia versus Reinhart and Rogoff, 1976-2004

			Reinhart and Rogoff (2009)		
			Crisis years	Non-crisis years	Total
Laeven and Valencia (2013)	Crisis years	Absolute frequency	229	124	353
		Relative frequency	0.080	0.043	0.123
		Expected frequency	0.020	0.103	-
	Non-crisis years	Absolute frequency	238	2280	2518
		Relative frequency	0.083	0.794	0.877
		Expected frequency	-	-	-
Total	Absolute frequency	467	2404	2871	
	Relative frequency	0.163	0.837	1.000	
	Expected frequency	-	-	-	

Note: for an explanation of this table, see the to Table 1.

In conclusion, while consistent definitions matter when comparing crisis dates between different studies (as shown in the comparison of the Laeven-Valencia and Reinhart-Rogoff databases), the extent to which the crisis dates differ even if the databases refer to the same type of crisis is remarkable. Despite the use of expert judgement, the databases considered give very different assessments of the start and length of banking crises. The following part of this study therefore investigates these differences in more detail by zooming in on four specific banking crises.

3. Dating banking crises on the basis of bank failures and bank losses

3.1 Data

In order to investigate the accuracy of the crisis dates from the three databases compared above, we have compiled data to reconstruct what in our view are the most important aspects of a systemic banking crisis, namely that a significant number or proportion of the banks fail and/or that a significant proportion of the banking's sector equity is destroyed by losses. Bank failures materialise in a number of ways. Banks either fail and are liquidated completely or the bank or its assets are in some form assimilated (merged or taken over) by either a special purpose 'bad bank', such as the Resolution and Collection Corporation in Japan, or by another commercial bank with or without government assistance. If banks are liquidated, merged or taken over, we rely on the estimates of the losses provided as share of the banking sector's equity. Another related measure is the proportion of the banking sector's assets represented by the failed banks. In discussing the crises, we apply a threshold for the latter two measures, but readers may apply other thresholds if they prefer to do so.

The threshold used is 10% for both the losses of failed banks as a proportion of the banking sectors' equity and the proportion of the banking sectors' assets represented by failed banks.

The banking sector does not always consist of uniform types of institutions. We try to adhere as much as possible to a definition of a bank as a depository institution, in the sense that it takes deposits from the general public. This implies that our analysis does not cover other financial institutions when they are not considered depository institutions. Investment banks are, for instance, not included, as they are not depository institutions or bank holding companies (although after the sub-prime crisis most investment banks converted to banks). Our analysis also does not cover specialised lending institutions, such as the Jusen, which played an important role in the crisis in Japan, and the mortgage companies which played a similar part in Norway's crisis. We have not limited our analysis to domestic banks, but include foreign banks in our analysis as most banking sectors have both domestic and foreign banks. Finally, most countries' banking sectors consist of a wide variety of general banks and specialised banks with either a regional or a national presence. In our analysis, we only consider the banking sector as a whole even though a crisis may disproportionately affect a subsector (as was the case in the savings and loan crisis in the US).

We rely on datasets which have not yet been widely used in analysing banking crises: financial accounts data for the banking sector as a whole or aggregate balance sheet data either drawn from monetary statistics or provided by the supervisory authorities³. Both sources provide macro-economic data encompassing the whole banking sector of a country. The main difference between both sources is that the financial accounts data are part of a fully consistent economy-wide data set and monetary statistics are an independent set of data. Monetary statistics are, however, usually the most important source for the compilation of the bank data in the financial accounts. They can therefore be regarded as a valuable substitute if financial accounts data is absent. Another advantage of these sources is that data are compiled according to internationally harmonised guidelines. The availability and the comparability of data between countries has greatly improved in recent years, especially in Europe as harmonised data was a prerequisite for the preparation of monetary policy under EMU. Increased cooperation between countries under the direction of international organisations, such as the UN, the IMF, the OECD, Eurostat and the ECB, has greatly increased the acceptance of common statistical standards. However, the historical data is often less harmonised but for the purpose of our study international comparability is not a particular problem, since we combine data from one and the same country only and not across countries.

³ There are two basic forms of (supervisory) banking statistics: on a locational basis and on a consolidated basis. Locational banking statistics cover the whole banking sector located in a particular country, disregarding the nationality of banks. Local branches and subsidiaries of foreign banks are included in this dataset, while foreign branches and subsidiaries of local banks are excluded. Consolidated statistics cover banks by nationality, i.e. according to where the headquarters are located. Monetary and financial accounts statistics are always compiled on a locational basis. We use both forms in our study, depending on which of the two is available. Although this might influence the results somewhat, we believe the effects are limited.

3.2 The savings and loan crisis of the 1980s in the United States

We analyse the savings and loan (S&L) crisis in the United States during the 1980s first. Savings and loan associations are depository institutions as documented by the Federal Deposit Insurance Act and are thus considered banks. The three databases examined strongly disagree in dating and classifying this crisis. Caprio et al. (2005) date the American S&L crisis from 1988 to 1991 but classify it as a non-systemic crisis. No explanation is given why the crisis ends in 1991. The authors comment that: “More than 1,400 savings and loan institutions and 1,300 banks failed. Cleaning up savings and loan institutions cost \$180 billion, or 3 percent of GDP.” But this does not explain the dates chosen.

Reinhart and Rogoff (2009) date the savings and loan crisis from 1984 to 1991. The only explanation provided is given in annex A.4: “There were 1,400 savings and loan and 1,300 bank failures.” This is exactly the same explanation given by Caprio et al. (2005), even though the crisis dates differ. There is neither any indication of the losses incurred nor of their timing. Reinhart and Rogoff, as mentioned before, do not distinguish between systemic and non-systemic crises.

Laeven and Valencia (2013) limit the S&L crisis to 1988, but they consider it a “borderline case”. In summary, two out of the three each agree on either the start date or the end date. According to Caprio et al. and Laeven and Valencia, non-performing loans as a share of total loans outstanding peaked at 4.1%. However, data from the FDIC as used in our calculations presented below show that non-performing loans for the whole banking sector reached a maximum of 2.5% in 1990. It is not clear to us where the number of 4.1% originates from (Laeven and Valencia cite “IMF Staff reports and Financial Soundness Indicators” in their downloadable dataset) and why 1988 was chosen as the crisis date.

We construct our measures on the basis of monthly time series from the historical data on failures of banks and savings and loan associations in the US compiled by the Federal Deposit Insurance Corporation FDIC, the organisation responsible in the US for deposit insurance. We combine these data with the FDIC’s data on the balance sheets of both types of institutions. The first time series constructed is the simple number of failures (see Figure 4). The second time series is the aggregate estimated loss for failed institutions as a proportion of equity, shown in Figure 5. Unfortunately, the FDIC only provides data on estimated losses from 1986 onwards for commercial banks while the data is sketchy for savings and loan associations before 1989 when the Federal Savings and Loan Insurance Corporation (FSLIC) itself became insolvent and was replaced by the Resolution Trust Corporation (RTC). We have extended the time-series on estimated losses backwards for both commercial banks and savings and loan associations to 1980 by taking the average loss per failed institution over the period January 1986 to December 1992 for commercial banks and from February 1989 to December 1992 for savings and loan associations, and multiplying the average loss

by the number of failures per month. Our estimated total loss for savings and loan associations during the years 1986-1988 of USD 26 billion is slightly higher than the estimate by the FDIC which amounts to USD 22 billion (see Curry and Shibut, 2000). For the commercial banks, we made an exception in the compilation of the estimate of losses in May 1984 for the failure of the Continental Illinois National Bank and Trust Company. Information on the cost of the rescue was made public and because of its exceptional size – capital support amounted to USD 2 billion – we substituted this figure for the estimate of the losses for May 1984.

Our figures raise the question of why 1984 should be considered as the start date, as chosen by Reinhart and Rogoff (2009). There were actually more failures in 1982 (119 against 106) than in 1984. We suspect that the sources used by Reinhart and Rogoff have taken the failure of the Continental Illinois National Bank and Trust Company in May 1984 as the event by which to mark the beginning of the crisis. However, the failure of the Continental Illinois National Bank and Trust Company was a fairly isolated event not related to losses on mortgage investments which caused the large number of failures among the savings and loan associations, but on loans made to the energy sector and to developing countries (FDIC, 1997).

Figure 4. Number of failed depository institutions in the US, 1980 – 1995

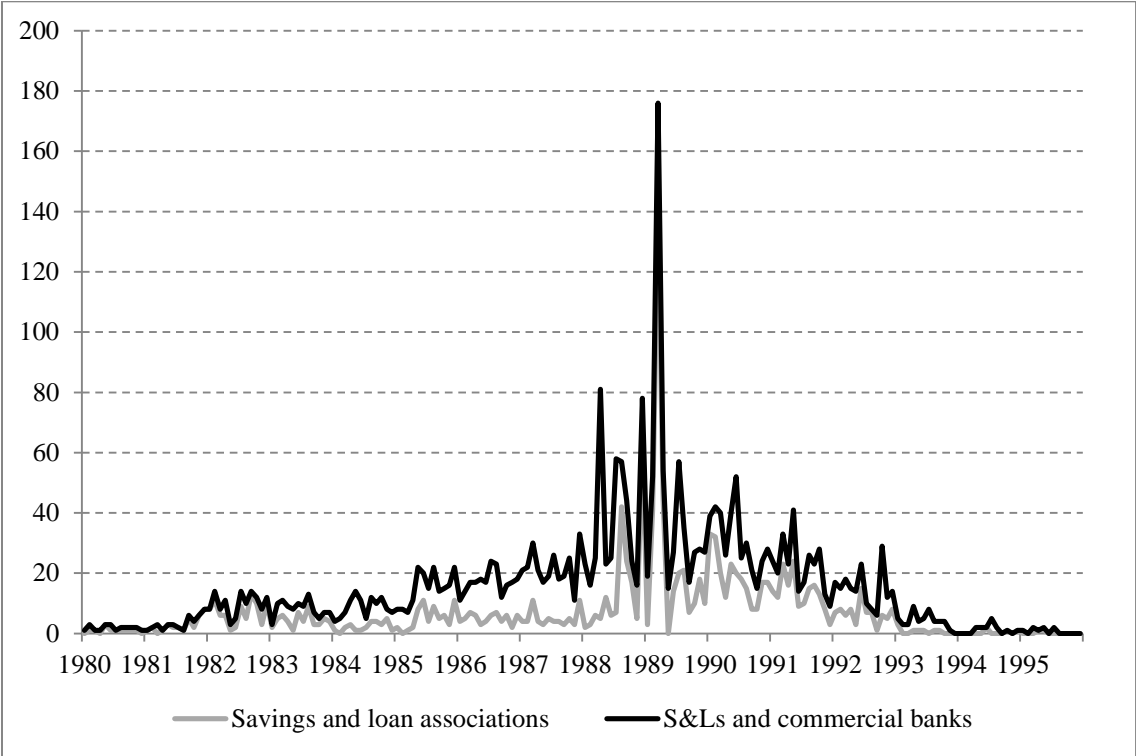


Figure 5. Losses incurred by failed depository institutions in the US as a proportion of equity, 1980 – 1995

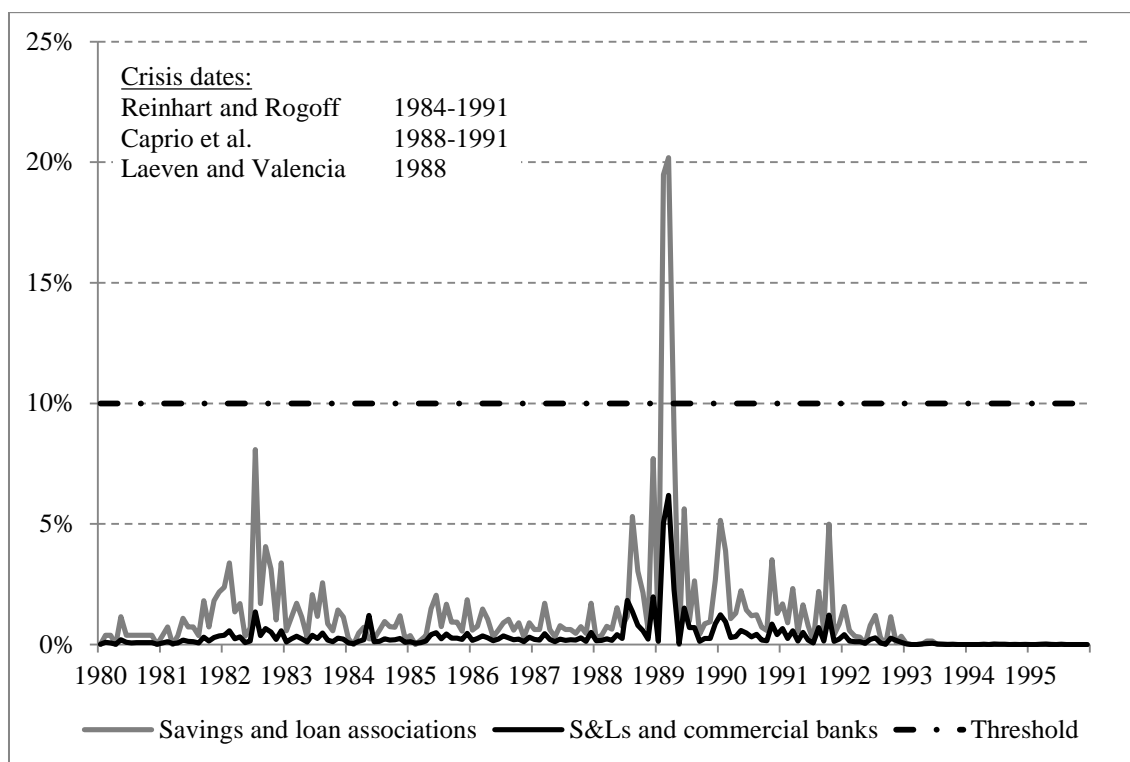
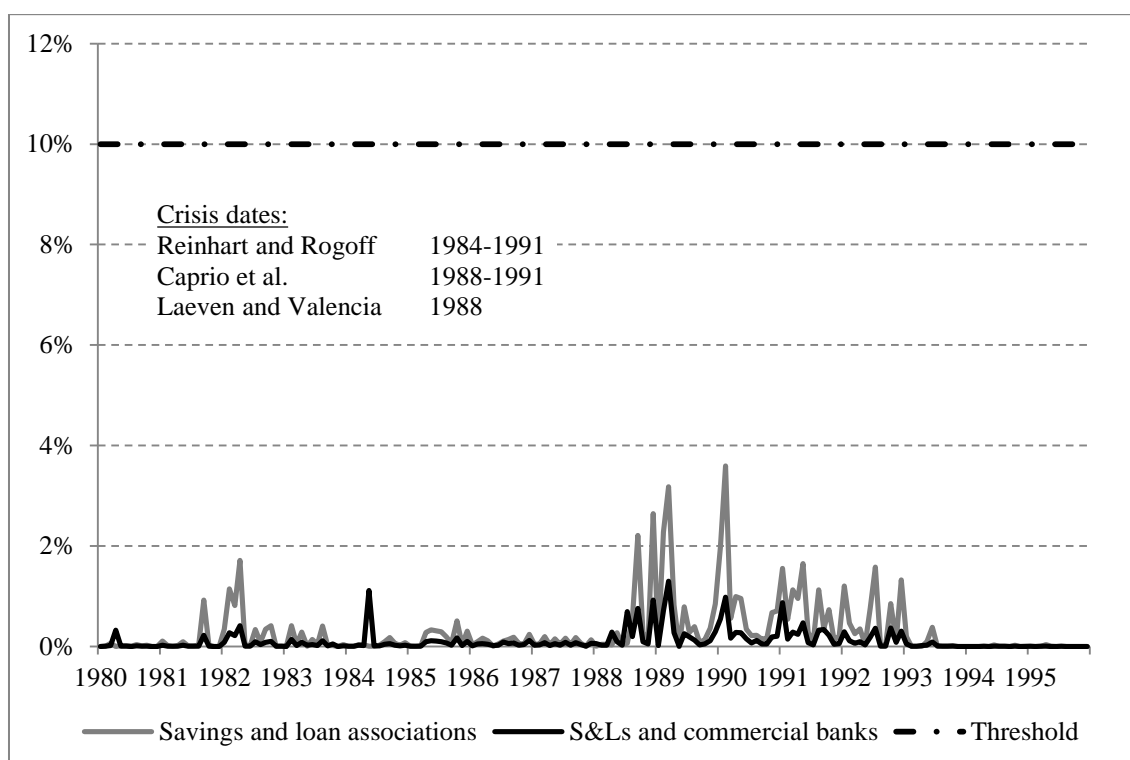


Figure 6. Assets of failed depository institutions in the US as a proportion of total assets, 1980 – 1995



In late 1988 and 1989 the S&L losses increased dramatically (see Figure 5). During both February and March 1989, 20% of the equity of savings and loan institutions (expressed as percentage of total equity of the S&L sector) was destroyed by failures. But since the savings and loan sector made up only a quarter of the equity of all depository institutions, in terms of equity of the banking sector as a whole the effects were more limited and never reached our indicative threshold of 10% of equity per month.

The analysis of the assets of failed institutions as a proportion of the total banking sectors' assets, as presented in Figure 6, suggests that failures were at no time pervasive enough for the crisis to qualify as systemic. To begin with, most of the failures were limited to savings and loan institutions. Additionally, at the height of the crisis, in March 1989, the failure of 176 banks and savings and loan associations represented USD 61.3 billion, or just 1.3% of total assets of the banking sector. Even among the savings and loan associations, our indicator reaches a maximum of only 3.6% in February 1990.

We conclude that the S&L crisis should not be considered as a systemic banking crisis. Comparing our analysis with the dating of the S&L crisis in the three databases considered, our analysis is closest to that of Laeven and Valencia, who date the crisis to 1988 only, although our analysis suggests that the height of the crisis was in 1989.

3.3 Japan's banking crisis of the 1990s

We next apply our method to probably one of the most often investigated crises, the banking crisis in Japan of the 1990s. The three databases again differ markedly in their classification and timing of the crisis in Japan. Caprio et al. (2005) document a systemic banking crisis starting in 1992, but provide no end date. In the comments accompanying their classification they mention that "By 2002, fiscal cost estimates rose to 24 percent of GDP" (p. 323), which would suggest that they have the crisis last at least to 2002, an assumption often made in other studies (see e.g. Demirgüç-Kunt and Detragiache 2005). Reinhart and Rogoff (2009) also have 1992 as start date, but they date the end of the crisis in 1997. Laeven and Valencia consider the crisis systemic and date it from 1997 to 2001. Their end date is determined by their decision to truncate the length of a crisis to five years.

Caprio et al. seem to have dated the crisis on the basis of the fact that 1992 was the year with the lowest growth rate of real GDP (0.9%). As with the US savings and loan crisis, this is not consistent with current official economic data as GDP growth in 1993 was lower at 0.2%; in 1998 and 1999 growth rate even turned negative, at -2.1% and -0.1% respectively. In their explanation, Caprio et al. (2005, p. 323) mention that "In 1999 Hakkaido Takoshodu bank was closed, the Long Term Credit Bank was nationalized, Yatsuda Trust was merged with Fuji Bank, and Mitsui Trust was

merged with Chuo Trust. In 2002 nonperforming loans were 35 percent of total loans; with a total of 7 banks nationalized, 61 banks financial institutions closed and 28 institutions merged.” While these institutions were certainly among the largest that needed official assistance, the amounts involved represent only about a fifth of the total support provided to banks from 1992 to 2003.

While Reinhart and Rogoff (2009) also start the Japanese crisis in 1992, this year does not appear in their historical summary (appendix A.4, page 371) at all. In contrast to their own definition, government assistance to banks in 1992, 1993 and 1994 does not exceed 50 billion yen. Reinhart and Rogoff mention estimates of nonperforming loans for 1995, 1998 and 2002, but it is not clear how this relates in any way to their crisis dates of 1992 – 1997.

Laeven and Valencia (2013) start the crisis in November 1997, coinciding with the decision of the Japanese Ministry of Finance and the Bank of Japan to issue a blanket guarantee on deposits. However, they do not provide an explanation for ending the crisis in 2001 other than their rule to truncate a crisis after five years. Laeven and Valencia (2012, Data file – Additional details – Brief description of the crisis) argue that, while there had already been problems in the banking sector since 1989, “it wasn't until 1997 that the systemic proportions of the problem became evident when high profile financial institutions failed.” We may therefore conclude that from the three studies considered, only Laeven and Valencia consistently apply their own definition for identifying the start of the banking crisis in Japan. The systemic nature of the crisis though, is exclusively founded on the introduction of policy measures by authorities without any reference to the size of losses in relation to banks' equity.

For our analysis we have taken information from the annual reports of the Deposit Insurance Corporation of Japan (DICJ) and compiled a list of failed institutions along with the financial assistance they received for the years 1991 to 2010. Somewhat different from the US data, the data from the DICJ concerns the amount of assistance and not the losses estimated. Nevertheless, as the assistance is aimed at covering losses and replenishing equity capital, the method applied to the US data is applicable here as well. We collected data on the number of failed institutions (see Figure 7) and the losses (proxied by the financial assistance provided) as a proportion of equity of the whole banking sector (see Figure 8). Unfortunately, the DICJ does not provide information on the total assets of the failed banks. We therefore could not analyse failures by the proportion of assets represented by failed banks. Equity for the whole banking sector is taken from the monetary statistics of the Bank of Japan. Unfortunately, this series only starts in October 1993. As there were only two small failures in the years 1991 and 1992, this arguably will not affect the outcomes of our analysis.

Figure 7. Number of failed depository institutions in Japan, 1994 – 2004

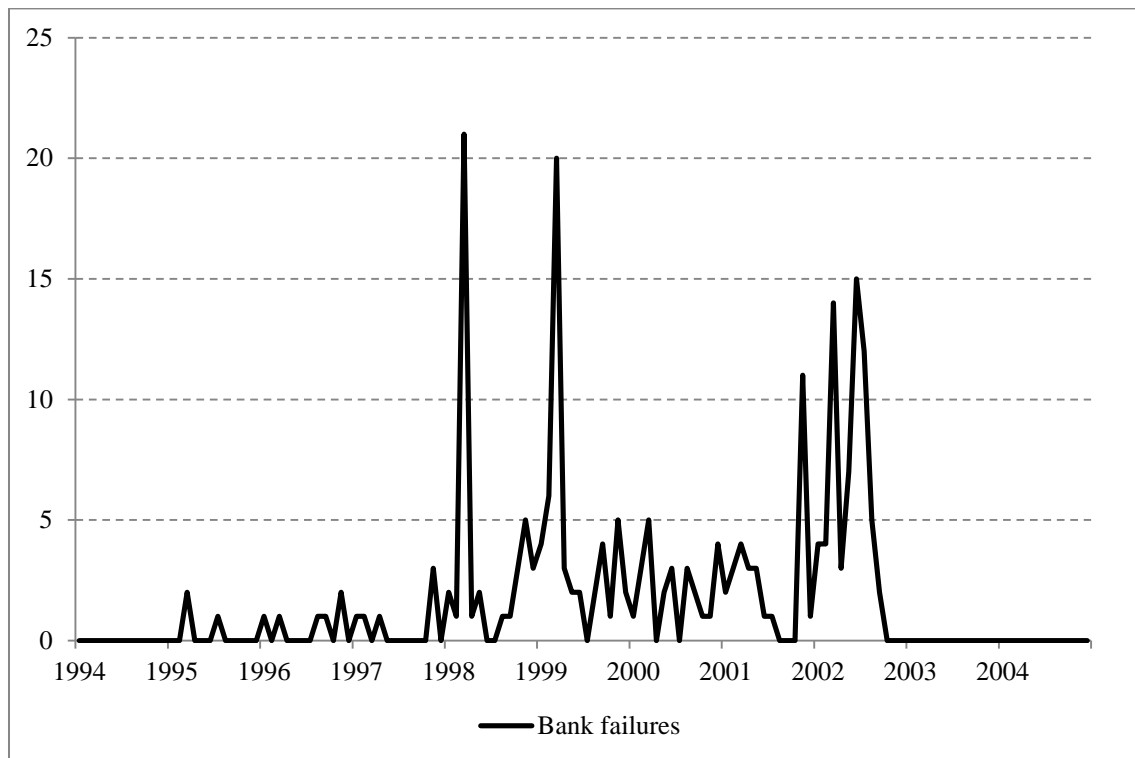
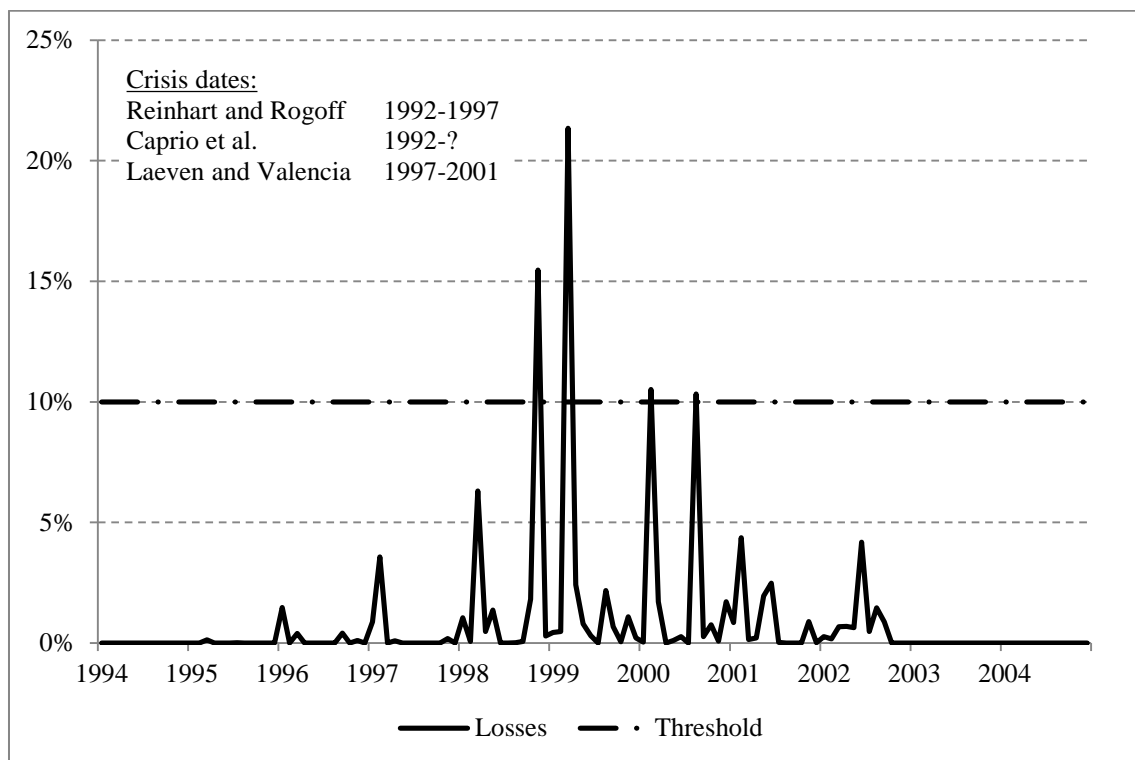


Figure 8. Losses incurred by failed depository institutions in Japan as a proportion of equity, 1994 – 2004



The time series for losses incurred by failed banks as a proportion of the equity of the whole banking sector, as shown in Figure 8, suggests that there were four crises-months: November 1998, March 1999, February 2000 and August 2000. Over the period from November 1998 to August 2000, 69% of equity was destroyed. The first year of this period, 1998, is also the first year with negative GDP growth (-2.0%, the lowest growth rates throughout the 1990s). Our crisis dating analysis tallies best with that of Laeven and Valencia, who consider the crisis as systemic from 1997 to 2001. Reinhart and Rogoff and Caprio et al. start the crisis five years earlier, when there are actually hardly any failures yet as shown in Figure 7. Reinhart and Rogoff end the crisis in 1997, when most of the failures have yet to occur.

3.4 Norway's crisis in the 1980s and 1990s

While the United States and Japan have large banking sectors with a large number of banks, many European countries have more concentrated banking sectors. In order to investigate how our method works out in these countries, we also investigate the Norwegian banking crises during the 1980s. Again, the three databases differ in dating this crisis. Caprio et al. (2005) date the crisis from 1990 to 1993 and classify it as systemic. According to Reinhart and Rogoff (2009), the crisis runs from 1987 to 1993, while Laeven and Valencia (2013) argue that this (systemic) crisis runs from 1991 to 1993. So the three studies agree on 1993 as the end date of the crisis, but the start dates range between 1987 and 1991. In 1993 the Norwegian government provided support for banks for the last time. Since all studies agree on the end date and since this date seems consistent with events, we focus primarily on the differences in starting dates.

Caprio et al. provide no detailed explanation for their timeframe of 1990 to 1993. They mention (government and) central bank intervention, but this had already started – although on a more limited scale – in the fall of 1988 (Moe et al. 2004, p. 5) and the bank failures were not yet of systemic proportions. The failures in the years from 1988 and 1990 were resolved through mergers of failed institutions with larger banks along with additional financing from the banks' own guarantee funds and liquidity support from the central bank. Caprio et al. (2005, p. 328) mention that “(t)he state took control of the three largest banks ...”, certainly an event that would indicate a crisis of systemic proportions. This, however, did not occur until the second half of 1991. Caprio et al. list 1989 as the year with the lowest GDP growth, but it was lowest in 1988 (-0.2%).

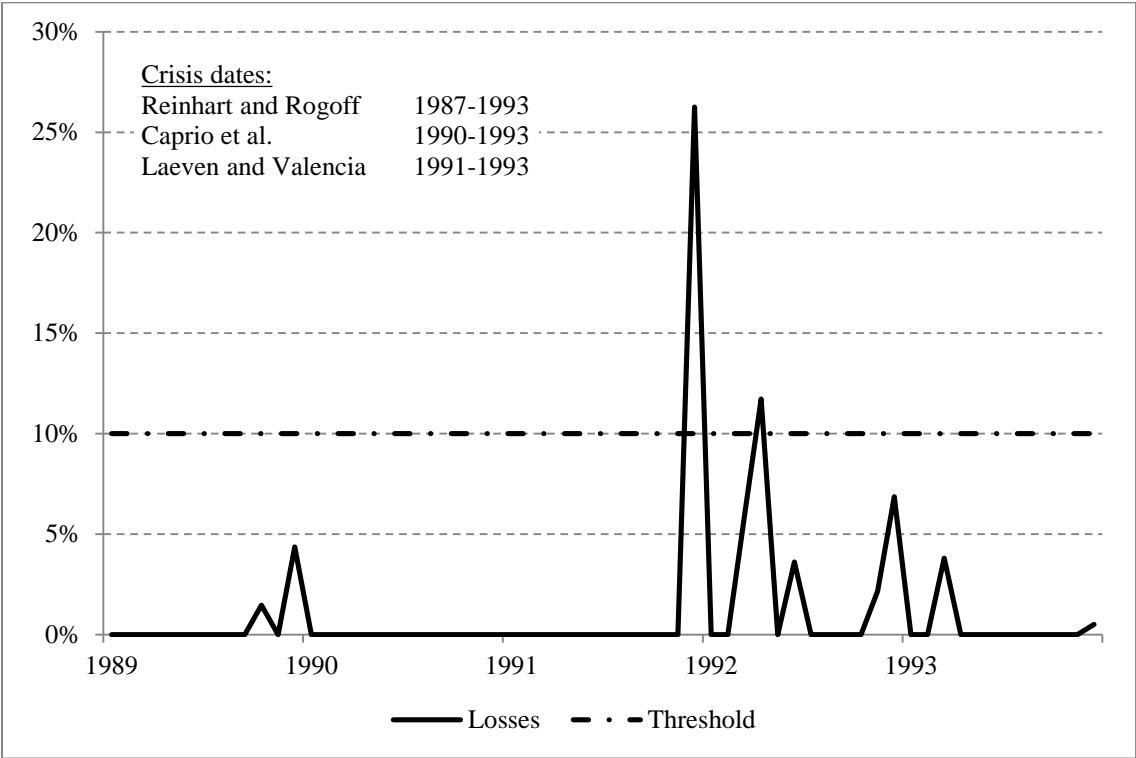
Reinhart and Rogoff use much of the information compiled by Caprio et al. but date the start of the Norwegian crisis in 1987, a year before the first failures. Surprisingly, one of the other sources they refer to is the seminal article by Kaminsky and Reinhart on twin crises, which lists the beginning of Norway's banking crisis as November 1988 (Kaminsky and Reinhart 1999, table 2). Laeven and

Valencia start the crisis in October 1991, which is consistent with the announcement of support measures as documented by Moe et al. (2004).

For our own analysis, we could not rely on data on losses or failures from an official supervisory agency as Norway’s banks had instituted a private deposit insurance fund. We therefore rely on studies documenting the crisis extensively, such as Moe et al. (2004), specifically their appendix B. We have taken the data on official support, like in the case of Japan, as a proxy for the losses of banks receiving the support. We compared losses with equity using data for commercial and savings banks from the statistical office of Norway. We have not found data on the 13 bank failures that occurred between 1988 and 1990. According to Moe et al. (2004, p. 5), in those years “13 small and some regional medium-sized banks failed, mostly savings banks. The size of these banks did not yet qualify to call it a systemic crisis.”

The results of our analysis are presented in Figure 9. We refrained from presenting a figure on the number of failures, since after 1990 only four banks were involved. Applying the same method as for the US and Japan suggests a crisis from December 1991 to April 1992. That we find a start date two months later than that of Laeven and Valencia is explained by the fact that we use the date the actual support measures were executed instead of the announcement date.

Figure 9. Losses incurred by failed depository institutions in Norway as a proportion of equity, 1989 – 1993



3.5 Turkey's crisis in the late 1990s

As we also wanted to apply our approach to an emerging market economy, we chose the crisis in Turkey at the beginning of this century as our final case study. Caprio et al. (2005) identify 2000 as the start date of this crisis but have no end date and classify the crisis as systemic. Reinhart and Rogoff (2009) limit the crisis to 2000 and Laeven and Valencia (2013) date the crisis from 2000 to 2001.

Caprio et al. only provide the explanation that two banks closed and 19 banks were taken over by the Savings Deposit Insurance Fund. No further reference to the timing of these events is given. The year with lowest GDP growth rate is once again not corroborated by official statistics. Caprio et al. list 1999 as the year with the lowest growth rate of -4.7%, while official data (after revision) give a figure of -3.4% for 1999, while growth was lowest in 2001 (at -5.7%). Reinhart and Rogoff refer to the Caprio et al. dataset and provide no further explanation. Laeven and Valencia seem to have adopted 2000 as the starting year of the crisis from earlier studies and extended the crisis to include 2001 as the year when the government recapitalized the banks. No exact explanations are provided.

We have taken data on bank failures from a number of reports produced by the Banking Regulation and Supervision Agency (BRSA) and the Savings Deposit Insurance Fund (SDIF). Data on the balance sheet for the banking sector as a whole come from the Central Bank of Turkey (Deposit Money, Investment and Development and Participation Banks' Aggregated Balance Sheet). The data on bank failures contains information on accumulated losses at the moment of take-over by the SDIF for commercial banks⁴ and on the value of securitised 'duty losses' by the Treasury for State Banks. As for the other countries, this data was then compiled into a monthly time-series for losses.

Besides capital injections to replenish capital, most banks were temporarily exempted from certain capital and reserve requirements, while some were also refinanced by issuing bonds. In other cases, deposits at the central bank were released and reserve requirements suspended. This complicates the assessment of the official support measures, since they are a mix of recapitalisations and provision of additional 'emergency' liquidity. The documentation of the SDIF also does not provide sufficiently detailed information on these liquidity measures to include them in our calculations. We have thus concentrated on the accumulated losses. The results for Turkey are presented in Figures 10 and 11.

⁴ For two banks, we used capital support from the SDIF as a proxy since no data was provided for losses at the moment of takeover.

Figure 10. Number of failed depository institutions in Turkey, 1997 – 2002

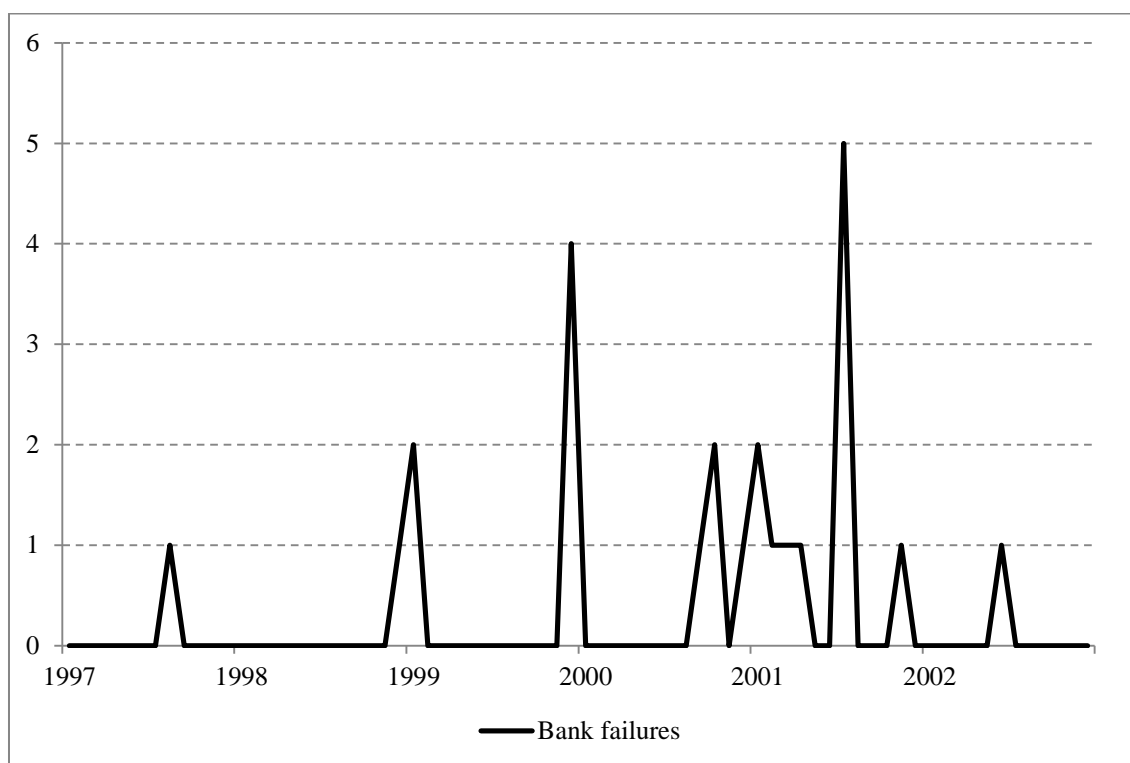


Figure 11. Losses incurred by failed depository institutions in Turkey as a proportion of equity, 1997 – 2002

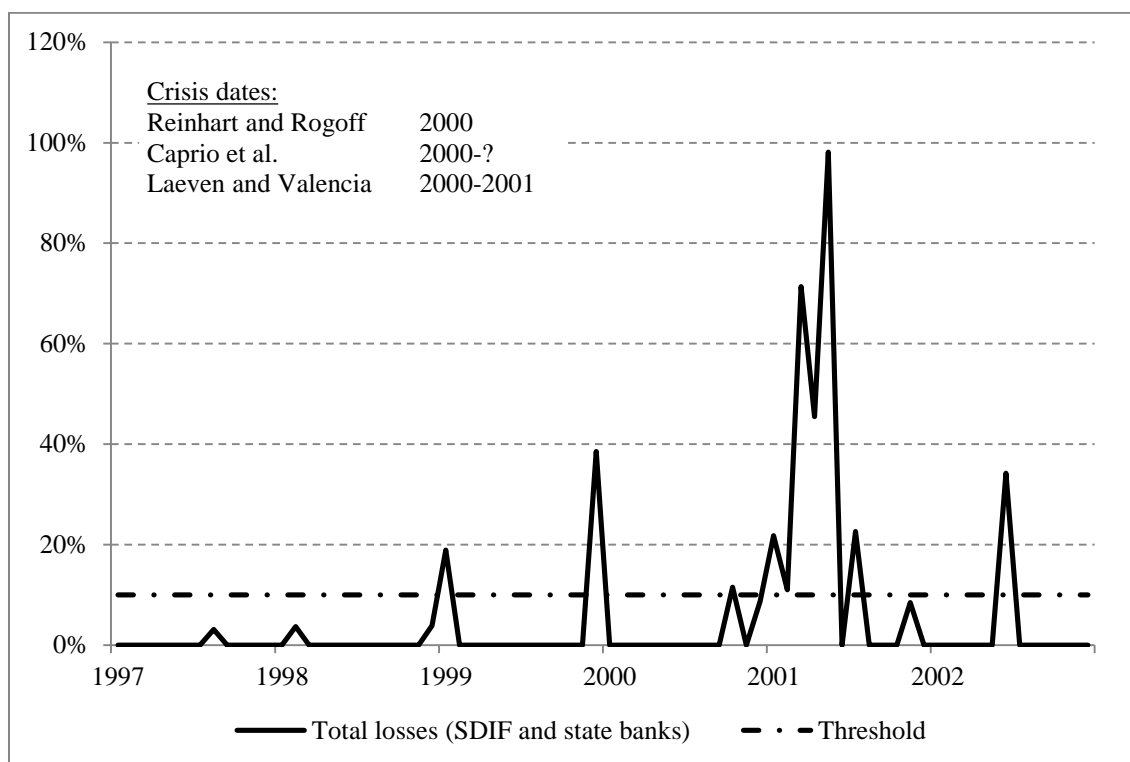


Figure 10 presents the number of failed banks in the period 1997 to 2002, while Figure 11 depicts the losses of banks taken over by the SDIF and the value of securitised ‘duty losses’ by the Treasury for State Banks as a percentage of the banking sector’s equity. On four occasions, the losses exceeded the indicative threshold of 10%: in January 1999, in December 1999, from October 2000 to July 2001 and in June 2002. It is somewhat puzzling that none of the earlier studies have taken along the failures in January and December 1999, but start the crisis in 2000. Similarly, none of the studies seems to take into account the failure of Pamukbank in June 2002, even though it was the largest loss due to the failure of an individual commercial bank.

4. Conclusions

Our comparison of three widely used databases on banking crises has shown that these databases differ significantly from each other. Consistent definitions matter when comparing crisis dates between different studies as shown in the comparison of the Laeven-Valencia database of systemic crises and the Reinhart-Rogoff database which does not make a distinction between systemic and non-systemic crises. Still, the extent to which the crisis dates differ even if the databases refer to the same type of crisis is remarkable. Despite the use of expert judgement, the databases considered give very different assessments of the start and length of banking crises.

Our investigations of four crises – the United States savings and loan crisis during the 1980s, Japan’s banking crisis of the 1990s, Norway’s banking crisis during the early 1990s and Turkey’s crisis around the turn of the century – have shown that quantitative data on bank failures and losses suffered by failed banks (or alternatively on official assistance provided) can help to identify and date these crises more precisely. Our evidence suggests the database of banking crises compiled by Laeven and Valencia is the most accurate.

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Appendix 1. Sources for information on bank failures and assistance

Country	Data on bank failures	Website
Japan	Deposit Insurance Corporation of Japan	www.dic.go.jp
Norway	Moe et al. (2004)	-
United States	Federal Deposit Insurance Corporation	www.fdic.gov
Turkey	Banking Regulation and Supervision Agency (Savings Deposit Insurance Fund)	www.bddk.org.tr

Appendix 2. Sources for information on the banking sectors' balance sheet

Country	Data on the banking sector's balance sheet	Website
Japan	Assets and liabilities of domestically licensed banks, Bank of Japan	www.boj.or.jp
Norway	Banking and credit statistics, Statistics Norway	www.ssb.no
United States	Historical Statistics on Banking (HSOB), Federal Deposit Insurance Corporation	www.fdic.gov
Turkey	Monthly Money and Banking Statistics, Central Bank of the Republic of Turkey	www.tcmb.gov.tr

Appendix 3. Overview of (systemic) banking crises years by reference for countries which appear in all three references

Country	Reinhart & Rogoff		Caprio et al.			Laeven & Valencia	
	Start	End	Start	End	Syst	Start	End
Albania	1992	1992	1992	1996	Y	1994	1994
Algeria	1990	1992	1990	1992	Y	1990	1994
Argentina	1980	1982	1980	1982	Y	1980	1982
Argentina	1985	1985	-	-	-	-	-
Argentina	1989	1990	1989	1990	Y	1989	1991
Argentina	1995	1995	1995	1995	Y	1995	1995
Argentina	2001	2001	2001	?	Y	2001	2003
Armenia	1994	1996	1994	1996	Y	1994	1994
Azerbaijan	1995	1995	1995	1996	Y	1995	1995
Bangladesh	1987	1996	Late 1980s	1996	Y	1987	1987
Belarus	1995	1995	1995	?	N	1995	1995
Benin	1988	1990	1988	1990	Y	1988	1992
Bolivia	1987	1988	1986	1988	Y	1986	1986
Bolivia	1994	1994	1994	?	Y	1994	1994
Bosnia-Herzegovina	1992	?	1992	?	Y	1992	1996
Brazil	1985	1985	-	-	-	-	-
Brazil	1990	1990	1990	1990	Y	1990	1994
Brazil	1994	1996	1994	1999	Y	1994	1998
Bulgaria	1995	1997	1996	1997	Y	1996	1997
Burkina Faso	1988	1994	1988	1994	Y	1990	1994
Burundi	1994	1995	1994	?	Y	1994	1998
Cameroon	1987	1993	1987	1993	Y	1987	1991
Cameroon	1995	1998	1995	1998	Y	1995	1997
Cape Verde	1993	1993	1993	?	Y	1993	1993
Central African Republic	1976	1982	1976	1992	Y	1976	1976
Central African Republic	1988	1999	1995	1999	Y	1995	1996
Chad	1980	1989	1980s		Y	1983	1983
Chad	1992	1992	1992	1992	Y	1992	1996
Chile	1976	1976	1976	1976	Y	1976	1976
Chile	1980	1980	1981	1983	Y	1981	1985
China, People's Republic	1997	1999	1990s	?	Y	1998	1998
Colombia	1982	1987	1982	1987	Y	1982	1982
Colombia	1998	1998	-	-	-	1998	2000
Congo, Dem Republic	1982	1982	1980s		Y	1983	1983
Congo, Dem Republic	1991	1992	1991	1992	Y	1991	1994
Congo, Dem Republic	1994	?	1994	1996	Y	1994	1998
Congo, Republic	1992	?	1992	?	Y	1992	1994
Costa Rica	1987	1987	-	-	-	1987	1991
Costa Rica	1994	1997	1994	1996	Y	1994	1995
Cote d'Ivoire	1988	1991	1988	1991	Y	1988	1992
Croatia	1996	1996	1996	1996	Y	1998	1999

Country	Reinhart & Rogoff		Caprio et al.			Laeven & Valencia	
	Start	End	Start	End	Syst	Start	End
Czech Republic	1991	?	1989	1991	Y	1996	2000
Denmark	1987	1992	1987	1992	N	-	-
Djibouti	1991	1993	1991	1993	Y	1991	1995
Dominican Republic	1996	1996	-	-	-	-	-
Dominican Republic	2003	2003	2003	?	Y	2003	2004
Ecuador	1981	1981	Early 1980s		Y	1982	1986
Ecuador	1994	1994	-	-	-	-	-
Ecuador	1996	1996	1996	1997	Y	-	-
Ecuador	1998	1999	1998	2001	Y	1998	2002
Egypt	1980	1981	Early 1980s		Y	1980	1980
Egypt	1990	1995	1991	1995	N		
El Salvador	1989	1989	1989	1989	Y	1989	1990
El Salvador	1998	1998	-	-	-	-	-
Equatorial Guinea	1983	1985	1983	1985	Y	1983	1983
Eritrea	1993	1993	1993	1993	Y	1993	1993
Estonia	1992	1995	1992	1995	Y	1992	1994
Estonia	1998	1998	1998	1998	N	-	-
Finland	1991	1994	1991	1994	Y	1991	1995
Georgia	1991	1991	1991	1996	Y	1991	1995
Ghana	1982	1989	1982	1989	Y	1982	1983
Ghana	1997	1997	1997	?	N	-	-
Guinea	1985	1985	1985	1985	Y	1985	1985
Guinea	1993	1994	1993	1994	Y	1993	1993
Guinea-Bissau	1995	1995	1995	1996	Y	1995	1998
Hungary	1991	1995	1991	1995	Y	1991	1995
India	1993	1996	1993	?	N	1993	1993
Indonesia	1992	1992	-	-	-	-	-
Indonesia	1994	1994	1994	1994	N	-	-
Indonesia	1997	2002	1997	2002	Y	1997	2001
Israel	1977	1983	1977	1983	Y	1977	1977
Jamaica	1994	1997	1994	1994	N	1996	1998
Jamaica	1995	2000	1996	2000	Y	-	-
Japan	1992	1997	1992	?	Y	1997	2001
Jordan	1989	1990	1989	1990	N	1989	1991
Kenya	1985	1989	1985	1989	Y	1985	1985
Kenya	1992	1996	1992	1992	Y	1992	1994
Kenya	-	-	1993	1995	Y	-	-
Kenya	-	-	1996	?	N	-	-
Korea	1986	1986	-	-	-	-	-
Korea	1997	1997	1997	2002	Y	1997	1998
Kuwait	1983	1983	1980S		Y	1982	1985
Kyrgyz Republic	1993	1993	1990S		Y	1995	1999
Latvia	1994	1999	1995	1996	Y	1995	1996
Lebanon	1988	1990	1988	1990	Y	1990	1993

Country	Reinhart & Rogoff		Caprio et al.			Laeven & Valencia	
	Start	End	Start	End	Syst	Start	End
Liberia	1991	1995	1991	1995	Y	1991	1995
Lithuania	1995	1996	1995	1996	Y	1995	1996
Macedonia, FYR	1993	1994	1993	1994	Y	1993	1995
Madagascar	1988	1988	1988	1988	Y	1988	1988
Malaysia	1985	1988	1985	1988	N	-	-
Malaysia	1997	1997	1997	2001	Y	1997	1999
Mali	1987	1989	1987	1989	Y	1987	1991
Mauritania	1984	1993	1984	1993	Y	1984	1984
Mexico	1981	1992	1981	1991	Y	1981	1985
Mexico	1994	1997	1994	2000	Y	1994	1996
Morocco	1983	1983	Early 1980s		Y	1980	1984
Mozambique	1987	1995	1987	?	Y	1987	1991
Nepal	1988	1988	1988	1988	Y	1988	1988
Nicaragua	1987	1996	Late 1980s	?	Y	1990	1993
Nicaragua	2000	2002	-	-	-	2000	2001
Niger	1983	?	1983	1996	Y	1983	1985
Nigeria	1992	1995	1991	1995	Y	1991	1995
Nigeria	1997	1997	1997	1997	N	-	-
Norway	1987	1993	1990	1993	Y	1991	1993
Panama	1988	1989	1988	1989	Y	1988	1989
Paraguay	1995	1999	1995	2000	Y	1995	1995
Paraguay	-	-	2001	?	N	-	-
Paraguay	2002	2002	-	-	-	-	-
Peru	1983	1990	1983	1990	Y	1983	1983
Peru	1999	1999	-	-	-	-	-
Philippines	1981	1987	1983	1987	Y	1983	1986
Philippines	1997	1998	1998	?	Y	1997	2001
Poland	1991	1991	1992	1995	Y	1992	1994
Romania	1990	1990	1990	1996	Y	1990	1992
Russia	1995	1995	1995	1995	Y	-	-
Russia	1998	1999	1998	1999	Y	1998	1998
São Tomé & Príncipe	1991	1991	1980s and 1990s		Y	1992	1992
Senegal	1988	1991	1988	1991	Y	1988	1991
Sierra Leone	1990	1990	1990	1996	Y	1990	1994
Slovak Republic	1991	1991	1991	1995	Y	-	-
Slovak Republic	-	-	-	-	-	1998	2002
Slovenia	1993	1994	1992	1994	Y	1992	1992
Spain	1977	1985	1977	1985	Y	1977	1981
Sri Lanka	1989	1993	1989	1993	Y	1989	1991
Swaziland	1995	1995	1995	?	Y	1995	1999
Sweden	1991	1994	1991	1994	Y	1991	1995
Tanzania	1987	1987	Late 1980s; 1990s		Y	1987	1988
Thailand	1979	1979	-	-	-	-	-
Thailand	1983	1987	1983	1987	Y	1983	1983

Country	Reinhart & Rogoff		Caprio et al.			Laeven & Valencia	
	Start	End	Start	End	Syst	Start	End
Thailand	1996	1996	1997	2002	Y	1997	2000
Togo	1993	1995	1993	1995	Y	1993	1994
Tunisia	1991	1995	1991	1995	N	1991	1991
Turkey	1982	1985	1982	1985	Y	1982	1984
Turkey	1991	1991	-	-	-	-	-
Turkey	1994	1994	1994	1994	N	-	-
Turkey	2000	2000	2000	?	Y	2000	2001
Uganda	1994	2002	1994	1996	Y	1994	1994
Ukraine	1997	1998	1997	1998	Y	1998	1999
United States	1984	1991	1988	1991	N	1988	1988
Uruguay	1981	1984	1981	1984	Y	1981	1985
Uruguay	2002	2002	2002	?	Y	2002	2005
Venezuela	1978	1986	Late 1970s and 1980s		N	-	-
Venezuela	1993	1995	1994	1995	Y	1994	1998
Vietnam	1997	?	1997	?	Y	1997	1997
Yemen	1996	?	1996	?	Y	1996	1996
Zambia	1995	1995	1995	?	Y	1995	1998
Zimbabwe	1995	1995	1995	1996	Y	1995	1999

