

Monitoring Banking Sector Fragility

By Aykut Kibritçioğlu*

Introduction

The last two decades of the 20th century are mainly characterized by currency and banking crises. Particularly the 1994–95 Mexican, 1997–98 Asian and 1998 Russian financial crises seem to have strongly stimulated academic research on the timing, duration, causes, effects, and cures of both currency and banking crises. As also defined in the International Monetary Fund's *World Economic Outlook* (May 1998, p. 74), a currency crisis may be said to occur when a speculative attack on the exchange value of a national currency results in a devaluation (or sharp depreciation) of the currency, or forces the authorities to defend the currency by expending large volumes of international reserves or by sharply raising interest rates. Accordingly, many researchers construct a monthly or quarterly index, which is called a foreign-exchange-market pressure (FEMP) index, to identify and predict currency crisis episodes. Typically, a FEMP index is calculated as the weighted average of (1) percentage changes in nominal exchange rates, (2) negative of percentage changes in foreign exchange reserves, and (3) international interest rate differential.¹ A crisis is then said to arise when the index value exceeds an arbitrarily determined threshold value. In this sense, the identification of currency crisis episodes using the so-called FEMP index is an easy and highly mechanical task, and it is highly useful in empirical research.

A bank failure, on the other hand, refers to a situation in which the excessively rising liquidity, credit, interest-rate, or exchange-rate risk pushes the bank to suspend the internal convertibility of its liabilities. If the bank failure problem undermines an entire banking system, the crisis turns out to be systemic. Potential or actual difficulties in the domestic banking sector sometimes may force the government to intervene into the market to prevent their far reaching adverse effects, such as that on the corporate sector and foreign exchange market. The exact timing of government intervention and the extent of the possible bailout costs obviously vary according to time and space.

The last two decades have seen a dramatic increase of systemic banking crises, as documented mainly by the comprehensive studies of Caprio and Klingebiel (1996, 1999, 2002 and 2003)² and Lindgren *et al.* (1996). The identified domestic crisis

episodes are recently reviewed and discussed by Frydl (1999), Eichengreen and Arteta (2000) and Boyd *et al.* (2001), among others. In the literature, it is usually argued that, contrary to the case of currency crises, building a time series index to identify banking crisis episodes is highly difficult, particularly because of the lack of reliable sectoral data on banks' financial activities. It is frequently stressed that the data on non-performing loans in many countries are either not available or are systematically distorted (see Hawkins and Klau, 2000). Consequently, existing methods that are widely used to pinpoint banking crisis episodes are generally *event-based*. That is to say, they usually are based on the available *ex-post* figures, which are related to banks' losses and governments' bailout costs. The years attached to crises reviewed in the literature are those, which are more or less generally accepted by finance experts familiar with the countries (Caprio and Klingebiel, 2003). Furthermore, in many studies, the crisis episodes are also identified with the help of the country-specific banking information that is available in the databases of some international financial organizations (e.g., Bank for International Settlements, the International Monetary Fund, and the World Bank) or that is published in major daily newspapers or popular economy journals (e.g., *Wall Street Journal*, *New York Times*, and *American Banker*).

Table 1

Comparison of Different Methods to Identify Episodes of Banking Crises and High Banking Fragility

	Event-Based Approach	Statistical Approach Employed in This Study
Advantages	<ul style="list-style-type: none"> - It is relatively easy to find information on the date of both government intervention and change in banking regulations. 	<ul style="list-style-type: none"> - The banking-sector-fragility (BSF) index is very useful to monitor and interpret the developments in the sector by using <i>monthly</i> banking data. - The monthly BSF index can easily be employed within a <i>single-country</i> framework. - One can easily define criteria to differentiate between systemic and non-systemic crises or fragility, based on the fluctuations in the BSF index.
Disadvantages	<ul style="list-style-type: none"> - Pinpointing the dates of crises is possible only for the <i>annual</i> data frequency. Therefore, it is not useful to apply it to predict and discuss banking crises within the framework of <i>monthly</i> data frequency. - In general, the usage of crisis years is restricted to limited dependent variable models (logit, probit, etc.). Hence, it usually requires a <i>multi-country</i> framework to increase the number of crises considered. - The date of government intervention, which is used to pinpoint crisis dates, does not necessarily reflect the actual <i>beginning</i> date of a particular crisis. - It is not always easy to judge whether a crisis is systemic or not, particularly if one uses information only on government intervention. - For an individual researcher, it is not easy to collect event-based information on banking sector difficulties across the world. 	<ul style="list-style-type: none"> - Reliable and continuous monthly banking sector <i>data</i> for every country in the world is not available. - Some of the data may be <i>biased</i> because of the wrong reporting practices (as in the case of non-performing loans or interest rates) or country-specific legal regulations. - The data, and hence, the BSF index do not necessarily reflect the exact date of government intervention.

The event-based mainstream approach, however, clearly has some disadvantages against the statistical approach that may be employed by constructing a banking sector fragility (BSF) index using the available monthly time-series data. Table 1 summarizes and compares both the advantages and disadvantages of these two methods. Apparently, the statistical approach has some overwhelming advantages with respect to the widely used event-based approach. Particularly, the measurement of banking sector vulnerability by using "monthly" data is a highly attractive feature of the time-series-based statistical approach. A monthly BSF index may significantly contribute to policy makers' efforts towards early detection of approaching banking sector difficulties. It also can be used as a reliable method to identify crisis episodes, even though it cannot completely substitute the event-based approach. Departing from this idea, this paper attempts to propose a weighted BSF index to measure and monitor changes in the banking sector fragility by using monthly data for selected countries. Despite the above-mentioned arguments on the scarcity of some relevant banking sector data, we aim to show that even the existing data for national banking sectors definitely allows us to work with "monthly statistics" instead of "events", if one intends to pinpoint banking crisis episodes in different countries.

The rest of the paper is organized as follows. In section 2, the need for and possibility of constructing an index to measure

the tendency towards crisis in the banking system are demonstrated in detail. The discussions there are primarily based on a brief literature review. Conceptually, section 2 focuses on the various financial risks that banks face. An empirically functional BSF index is then explicitly formulated in section 3. Section 4 covers both the statistical details of calculations and visual presentations of the BSF indices for each of the selected 22 countries. Finally, in section 5, the results of the current study are briefly evaluated with respect to previous, i.e. event-based studies, such as Caprio and Klingebiel (2003) and Lindgren *et al.* (1996).

Banks' Net Worth, Economic Risks, and Potential Fragility-Indicators

Banks are intermediaries, which aim to earn profits in financial markets by acquiring funds, and investing these funds or lending them to borrowers. Banks' liabilities are the funds that they acquire from savers in the form of deposits or as borrowings, while their assets mainly include reserves, marketable securities, and loans. The difference between the assets and liabilities of a bank equals its net worth, which in fact shows the bank's remaining value, or equity capital, after it has met all of its liabilities.³ When the net worth of a bank turns into negative, the bank becomes insolvent.

Explicitly, a bank is exposed to the risk that the values of its assets and/or liabilities change in financial markets. That is, all banks are potentially exposed to different types of economic risks, such as (i) liquidity risk (i.e., massive bank runs), (ii) credit risk (i.e., rising non-performing loans), and (iii) exchange-rate risk (i.e., banks' increasing unhedged foreign currency liabilities).

Therefore, a bank's net worth, and hence, a bank failure basically can be associated with excessive risk-taking of bank managers. In fact, several empirical studies in the literature show that massive bank runs and withdrawals, enormous lending booms, and/or high increases in the foreign liabilities of the banking sector are among the major leading indicators of impending banking crises.⁴

1. Bank Runs and Liquidity Risk

No matter what the reason, savers' massive run on deposits may indeed trigger a new (or accelerate the ongoing) increase in the fragility of the banking sector to crisis. However, it should be noted that the presence of a so-called deposit insurance system may prevent depositors from withdrawals, and hence, this may significantly weaken the potential link between bank runs and bank insolvency. Furthermore, Kaminsky and Reinhart (1999) argue that "recent" banking problems worldwide do arise from the assets side (i.e., increases in non-performing loans) instead of the liability side (i.e., bank runs).

2. Lending Boom, Non-Performing Loans, and Credit Risk

A lending boom on the assets side of a bank's balance sheet is likely to be caused by the bank's poor, or over-optimistic, evaluation regarding the investors' credit applications. Moreover, a bank can credit risky projects (and thus, it may contribute to a possible credit-boom process in the country), if the borrower is an economic unit, which actually is somehow connected with the bank. This is called insider, or connected, lending in the literature. Additionally, the existence of deposit insurance may encourage bank managers to take excessive risk (moral hazard problem) by loosening the credit taps further than expected. These considerations imply that credit booms easily may be linked to banking crises, at least at the theoretical level. However, Gourinchas et al. (2001) recently emphasized that, while most banking crises may be preceded by a lending boom, most lending booms are not followed by a banking crisis.⁵

3. Banks' Unhedged Foreign Liabilities, Devaluation, and Exchange-Rate Risk

Kaminsky and Reinhart (1999) present one of the broadest frameworks to discuss the potential links between banking and

currency crises. Referring to crises since the early 1980s, they briefly argue that problems in the banking sector typically precede a currency crisis but they are not necessarily the immediate cause of currency crises. In turn, however, the currency crisis deepens the banking crisis, activating a vicious spiral.

Obviously, in the absence of regulations limiting banks' open foreign currency positions and if the domestic currency is not expected to depreciate (or to be devaluated) in the near future, banks are likely to be motivated to take excessive risk by acquiring funds from international financial markets. If domestic banks have large amounts of unhedged foreign currency debt, then a sudden devaluation may cause a sharp fall in the net worth of banks thereby increasing the vulnerability of the domestic banking sector. Therefore, banks may try to reduce their foreign currency liabilities, if they foresee that the domestic currency will be devaluated soon. Accordingly, they also may attempt to reduce the high debt burden by increasing the credit interest rates.⁶ Hence, bank credits to the private sector may considerably decline in the aftermath of devaluation. Furthermore, devaluation expectations and/or rises (falls) in foreign (domestic) interest rates may trigger a massive bank run, as also discussed by Calvo *et al.* (1994) and Obstfeld and Rogoff (1995).

To examine the causes of banking crises empirically or to develop a model to monitor and predict impending banking sector problems, one first needs to be able to empirically identify the episodes and severity of previously occurred crises. Our discussions so far show that there is a strong motivation to design an empirically functional BSF index which is able to reflect the changes in the excessive risk-taking behavior of banks for monthly data frequency. Therefore, the next section is devoted to the creation of this type of index.

Construction of a Monthly Banking Sector Fragility Index

In this section, we begin to describe how a monthly BSF index can be constructed, and how it can be used to decide whether a national banking system is/was in crisis at a particular point in time. The brief discussions in the previous sections indicate that there are mainly three⁷ leading sectoral indicators of banking crises, which may be used in construction of a BSF index: (i) bank deposits, (ii) bank claims on (or credits to) the domestic private sector, and (iii) foreign liabilities of banks. These three variables are proxies, or indirect indicators, of changes in the liquidity risk, credit risk and exchange rate risk in the

banking sector, respectively. In other words, the fluctuations in these indicators are supposed to represent the changes in the fragility of banking sector in any country. Therefore, considering the economic risks related to banks' balance sheets, we propose the following general index (*BSF3*) to measure the fragility of banks to crisis by using monthly banking sector data:

$$BSF3_t = \frac{\left(\frac{CPS_t - \mu_{cps}}{\sigma_{cps}} \right) + \left(\frac{FL_t - \mu_{fl}}{\sigma_{fl}} \right) + \left(\frac{DEP_t - \mu_{dep}}{\sigma_{dep}} \right)}{3} \quad (1)$$

where

$$CPS_t = \left[\frac{(LCPS_t - LCPS_{t-12})}{LCPS_{t-12}} \right] \quad (2)$$

$$FL_t = \left[\frac{(LFL_t - LFL_{t-12})}{LFL_{t-12}} \right] \quad (3)$$

and

$$DEP_t = \left[\frac{(LDEP_t - LDEP_{t-12})}{LDEP_{t-12}} \right] \quad (4)$$

In equation (1), the *BSF3* index is defined as an average of standardized⁸ values of *CPS*, *FL* and *DEP*, where μ and σ stand for the arithmetic average and standard deviation of these three variables, respectively. In equations (2), (3) and (4), *LCPS*, *LFL* and *LDEP* represent banking system's total real claims on the private sector, the banks' real foreign liabilities, and the total real deposits on banks, respectively. That is, *CPS*, *FL* and *DEP* are simply the corresponding annual changes in each and every one of these three variables. By using 12-month percent changes in the monthly data instead of using monthly changes, we avoid any seasonality, which may be incorporated into the data. We also hope to be kept away from the risk of deriving misleading interpretations, if we would consider simply month-to-month changes. Indeed, banking crises should be those types of far reaching financial difficulties that cannot be signaled simply by "monthly" fluctuations in banking variables, such as the bank deposits, claims on private sectors, or foreign liabilities. They must be caused by longer term and powerful deteriorations in the banking sector.

The *BSF3* index is proposed to measure the ups and downs in the domestic banking sector.⁹ Its mean for the sample period is equal to zero, as implied by equation (1) above. As long as the *BSF3* does not deviate significantly from zero, historically there is no reason to expect a severe banking sector problem in the short run. Evidently every deep banking crisis is preceded by a relatively significant increase in the *BSF3* index, which

actually corresponds to a large extent to the excessive risk-taking behavior of banks, and hence, to an early period of increasing possibility of crisis in the banking sector. This early warning phase of any approaching crisis is then followed by a rapid decrease in the value of the *BSF3*, which in turn can be associated with substantial falls (*i*) in bank deposits (bank withdrawals), (*ii*) in claims to private sector (as a response to significant increases in non-performing loans), and/or (*iii*) in foreign liabilities (particularly in the face of an actual or potential depreciation in the domestic currency). In this sense, it is obvious that a coincidence of these three events would enhance the severity of the impending banking sector problem. The sudden change in the pattern of risk-taking behavior of banks, or the substantial fall in the *BSF3* following an enormous increase, may be triggered by a country-specific event, such as a political scandal or individual failure of a major bank.

Every fall in the *BSF* index, on the other hand, does not necessarily imply that a banking system is moving into a deep systemic crisis. Therefore, we differentiate here between *medium* and *high* fragility episodes by defining two arbitrary thresholds. In this study, a national banking system is supposed to be in a medium fragility period, if the value of the *BSF3* index is between 0 and -0.5:

$$0 > BSF3_t > -0.5 \quad (5)$$

If, however, the value of the *BSF3* index is equal to or lower than -0.5, we assume that the relevant banking sector is *highly* fragile to systemic crisis:

$$-0.5 \geq BSF3_t \quad (6)$$

Accordingly, a banking system is only accepted to be fully recovered from crisis when the *BSF* index reaches its sample period average (i.e., zero) again.

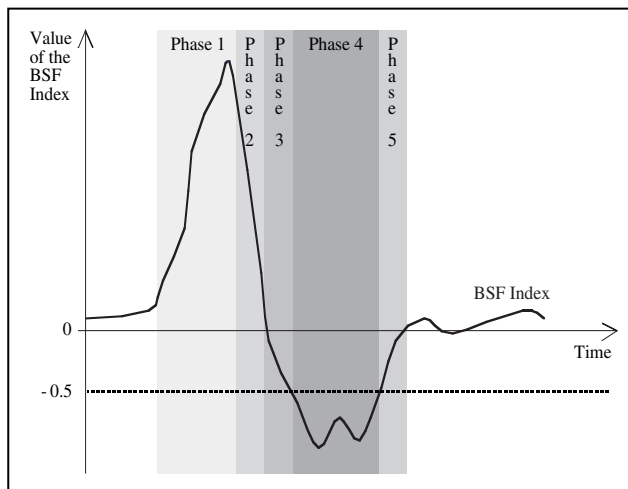
The cyclical time pattern of a hypothetical banking crisis and its five successive stages described above are summarized in table 2 and illustrated in figure 1. In terms of the thresholds defined in equations (5) and (6), we expect now that banking crises which are identified in event-based studies mentioned above occur in high fragility periods determined by our estimations given below.

Table 2
Changes in the BSF Index and the Five Phases of a Hypothetical Banking Crisis

	Banks' Behavior	Direction of the Change in the BSF Index	Banking Fragility Banking Crisis	Probability of Approaching
Phase 1	excessively risk taking	increases significantly above zero	falls * (optimistic, or boom, phase)	the probability starts to increase *
Phase 2	generally risk avoiding	suddenly begins to decrease	starts to increase	it increases furthermore (probably panic arises)
Phase 3	risk avoiding	falls below zero (but it's still above 0.5)	increases significantly (medium fragility)	system is approaching the borderline to crisis
Phase 4	risk avoiding	falls below -0.5	continues to increase (high fragility)	most probably, a crisis occurs in this phase
Phase 5	gradually they start to take risk again	increases towards zero	it falls again (recovery period)	crisis is over if the BSF is very close or equal to zero again

* Although increases in the BSF index imply a fall in fragility in the short run, it actually must be interpreted as an alarming indicator for impending crisis, if the increase in the index is significant and continues for a while. Hence, the probability of crisis starts to increase in this initial phase, since banks' take excessive risks during that period of time.

Figure 1
Time Path of the BSF Index and Five Phases of a Hypothetical Banking Crisis



Note: For interpretation of both changes in the BSF index and phases of crisis, see table 2 and the related part of the text. Clearly, it can be accepted that this recovery period starts in some cases as the BSF is increasing but is still below -0.5.

Before we proceed to the presentation of empirical results, we shortly define an alternative index of banking sector fragility, *BSF2*, to test the idea that bank runs do not play a major role in modern banking crises:

$$BSF2_t = \frac{\left(\frac{CPS_t - \mu_{cps}}{\sigma_{cps}} \right) + \left(\frac{FL_t - \mu_{fl}}{\sigma_{fl}} \right)}{2} \quad (1')$$

The *BSF2* index above is simply calculated by omitting the role of changes in real bank deposits on banks' financial fragility, and thus any deviation of the *BSF2* from the *BSF3* will help us in understanding the relative importance of bank runs in banking crises.

Empirical Results

The *BSF3* and *BSF2* indices proposed above are calculated for each of the selected 22 countries from which we know that they experienced systemic, or at least significant, banking sector problems within the last three decades. To ensure the international comparability we use the International Monetary Fund's *International Financial Statistics* (IFS) database (CD-ROM version, July 2003) as the common data source: *LCPS* is taken from IFS's line 22D, while *LFL* is taken from line 26C. Finally, *LDEP* is considered as the sum of lines 24 and 25 in the *IFS*. Notice that nominal series are deflated by using the corresponding domestic consumer price index (*CPI*). If the *CPI* data (IFS line 64), however, is not available for a particular country, the wholesale, or producer, price index (IFS line 63) is used to deflate the relevant nominal time series.

Table 3
Basic Characteristics of National Banking Systems According to the Components of the BSF Index

Country	Sample Period	Standard Deviations in:		Selected Banking		Sector Ratios (period averages)		
		12-Month Percent Change in Real Claims on Private Sector <i>(CPS)</i>	12-Month Percent Change in Real Foreign Liabilities <i>(FL)</i>	12-Month Percent Change in Real Total Deposits <i>(INF)</i>	12-Month Percent Change in the Consumer Prices Index <i>(LCPS / LFL)</i>	Real Claims on Private Sector / Real Foreign Liabilities <i>(LDEP / LCPS)</i>	Real Total Deposits / Real Claims on Private Sector <i>(LFL / (LCPS-LDEP))</i>	Real Foreign Liabilities/(Real Claims on Private Sector RealTotal Deposits)
1 Argentina	Jan. 1982 - Dec. 2002	17.7	35.8	25.2	2100.0	2.2	0.9	5.5
2 Bolivia	Jan. 1965 - Dec. 2002	42.3	77.2	48.3	2025.5	9.3	0.8	0.5
3 Brazil	June 1989 - Dec. 2002	23.7	85.6	20.6	1391.5	6.5	0.9	1.2
4 Chile	Dec. 1979 - Dec. 2002	14.2	51.3	9.8	9.8	13.9	0.6	0.2
5 Indonesia	Jan. 1981 - Dec. 2002	22.4	88.5	11.1	12.9	6.7	1.1	-1.4
6 Israel	Jan. 1982 - Dec. 2002	6.1	9.7	6.5	105.4	2.8	1.1	-5.2
7 Japan	Sep. 1968 - Dec. 2002	5.5	23.3	5.2	4.9	7.8	0.9	1.4
8 Jordan	Jan. 1977 - Dec. 2002	11.2	44.7	10.1	7.0	2.2	1.2	-2.2
9 Kenya	Jan. 1969 - Dec. 2002	13.1	45.3	11.9	10.1	16.3	1.3	-0.2
10 Malaysia	May 1965 - Dec. 2002	7.9	30.8	6.7	3.5	8.5	0.9	1.3
11 Malta	Jan. 1965 - Dec. 2002	14.8	98.5	6.6	3.8	1.4	1.4	-1.9
12 Mexico	Jan. 1983 - Dec. 2002	30.9	53.8	38.0	40.9	74.1	1.3	0.0
13 Pakistan	Jan. 1965 - Dec. 2002	8.5	33.4	9.3	6.0	7.4	1.2	-0.6
14 Peru	Jan. 1965 - Dec. 2002	25.2	100.3	21.5	1345.5	5.3	1.4	-0.5
15 Philippines	Dec. 1987 - Dec. 2002	15.5	34.6	7.8	3.7	2.9	1.3	-1.3
16 Poland	Jan. 1991 - Dec. 2002	12.6	28.4	7.6	21.5	7.4	1.3	-0.4
17 South Korea	Jan. 1968 - Dec. 2002	16.1	40.7	15.7	10.6	8.8	0.7	0.4
18 Sweden	Jan. 1971 - Dec. 2000	7.9	15.2	5.2	4.0	1.6	1.0	-14.3
19 Thailand	Jan. 1961 - Dec. 2002	11.0	33.8	8.7	7.8	5.7	0.9	2.2
20 Trinidad and Tobago	Dec. 1965 - Dec. 2002	11.4	42.3	9.4	5.3	16.3	1.3	-0.2
21 Turkey	Jan. 1979 - Dec. 2002	20.1	95.4	15.4	24.0	3.7	1.0	-23.6
22 Venezuela	Sep. 1968 - Dec. 2002	19.7	59.3	15.4	24.4	48.6	1.3	-0.1
Sample Average		16.3	51.3	14.4	325.8	11.8	1.1	-1.8

Source: IMF, *International Financial Statistics*, CD-ROM version, July 2003; author's own calculations.

The list of countries considered in this study, corresponding sample periods imposed by the availability of reliable country data, and country-specific standard deviations in *CPS*, *FL*, *DEP* and inflation rates are all given in table 3. Note that the standard deviation figures in this table show that, for each and every one of the countries covered here, the *FL* variable has the highest volatility among the three variables.

As also mentioned above, we use the standardized values of the three variables in construction of the *BSF3* to avoid the possibility that one of the three components dominates the *BSF3* index. Therefore, one may think that there is nothing wrong with the fact that the fluctuations in one of the variables are significantly higher than those of the others. However, after checking the three ratios calculated in the last three columns in table 3, we conclude that for some countries the absolute value

of *FL* is so low that we do not necessarily need to consider *FL* in the fragility index explicitly. Hence, we create a third version of the fragility index, *BSF2**, by excluding the *FL* from the *BSF3* index:

$$BSF2^*_t = \frac{\left(\frac{CPS_t - \mu_{cps}}{\sigma_{cps}} \right) + \left(\frac{DEP_t - \mu_{dep}}{\sigma_{dep}} \right)}{2} \quad (1'')$$

Note that the *BSF2** index is calculated only for those countries, which have relatively high *LCPS / LFL* and quite low *LFL / (LCPS - LDEP)* ratios (see table 3). These countries are Chile, Kenya, Mexico, Trinidad and Tobago, and Venezuela.

Figure 2
Banking Sector Fragility in Argentina

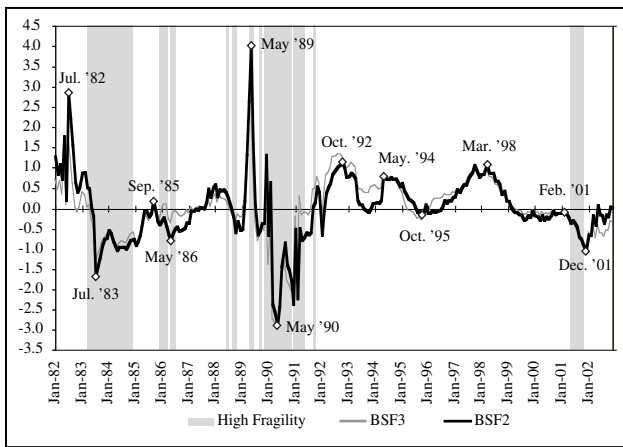


Figure 5
Banking Sector Fragility in Chile

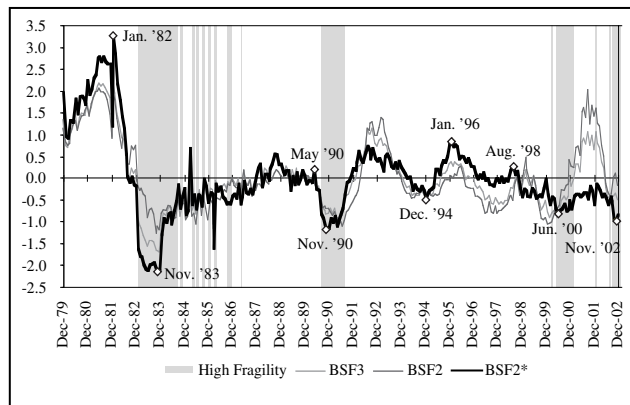


Figure 3
Banking Sector Fragility in Bolivia

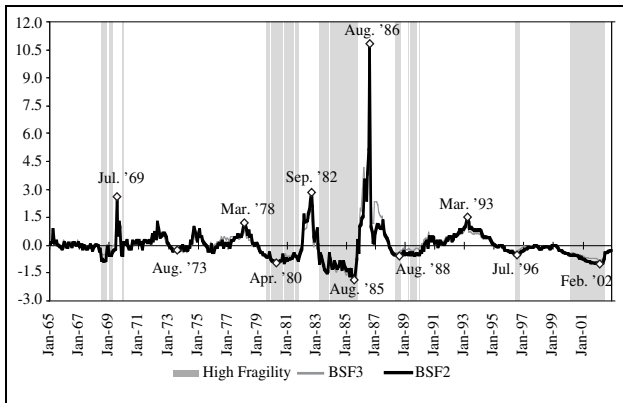


Figure 6
Banking Sector Fragility in Indonesia

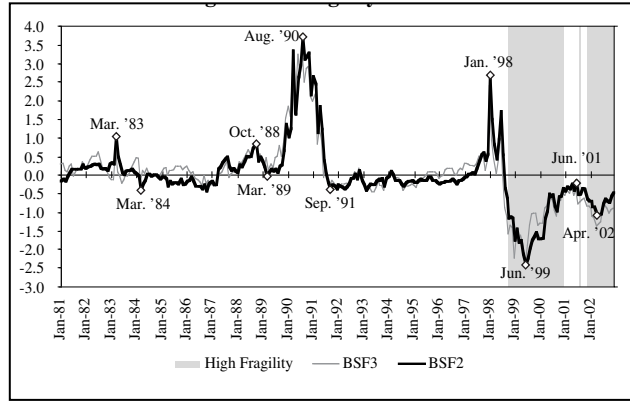


Figure 4
Banking Sector Fragility in Brazil

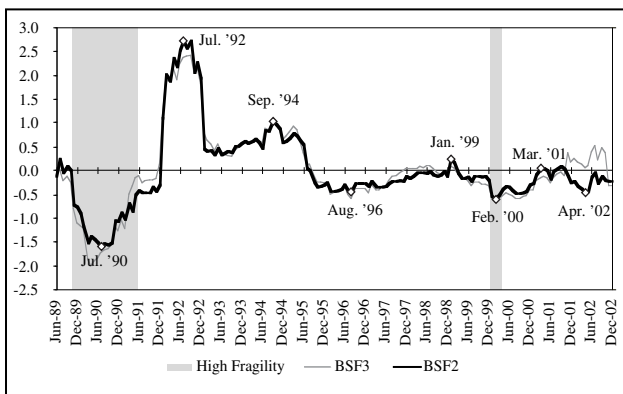


Figure 7
Banking Sector Fragility in Israel

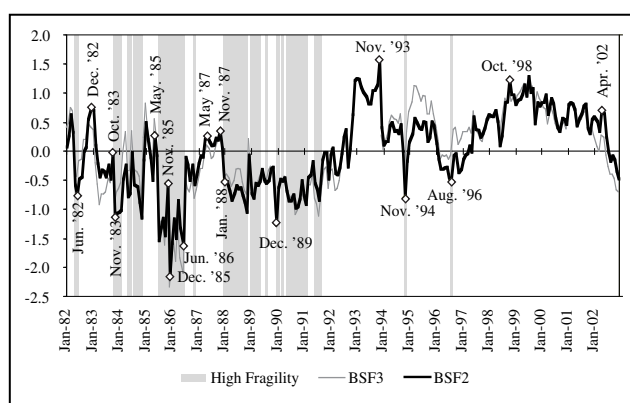


Figure 8
Banking Sector Fragility in Japan

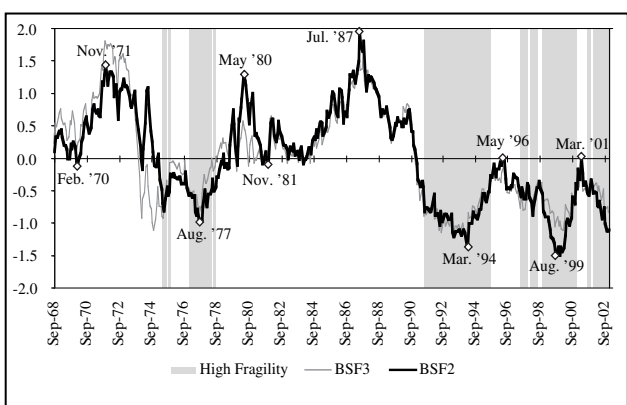


Figure 11
Banking Sector Fragility in Malaysia

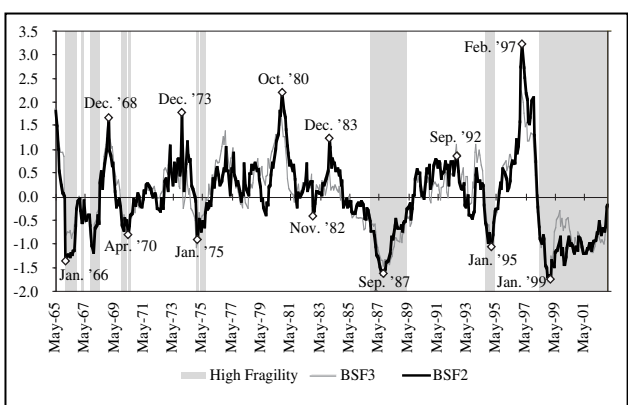


Figure 9
Banking Sector Fragility in Jordan

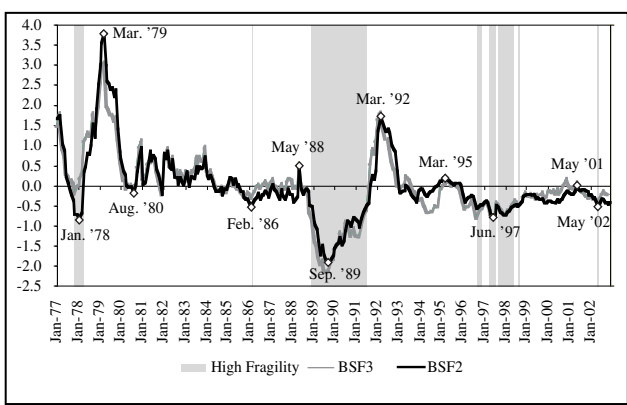


Figure 12
Banking Sector Fragility in Malta

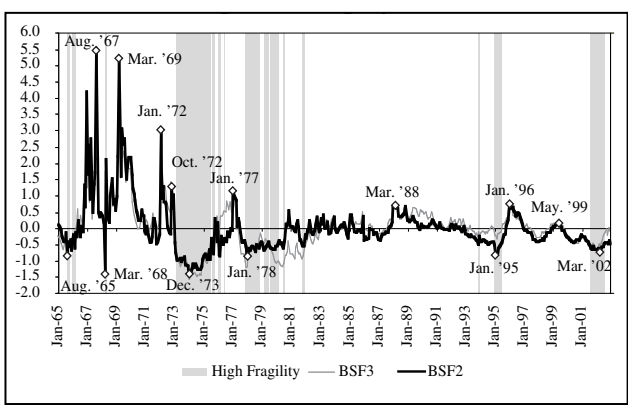


Figure 10
Banking Sector Fragility in Kenya

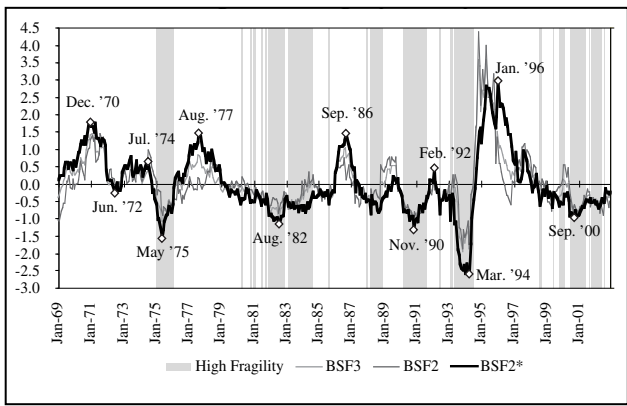


Figure 13
Banking Sector Fragility in Mexico

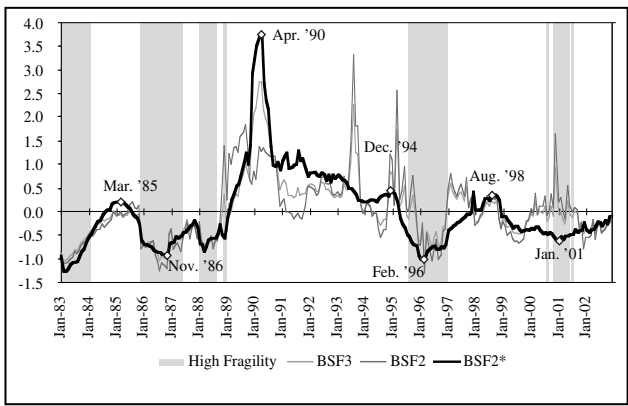


Figure 14
Banking Sector Fragility in Pakistan

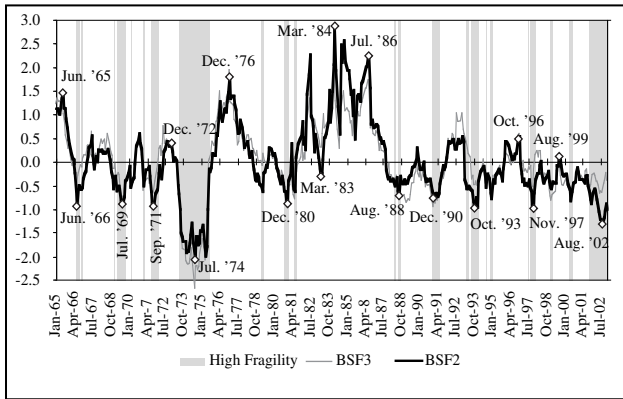


Figure 17
Banking Sector Fragility in Poland

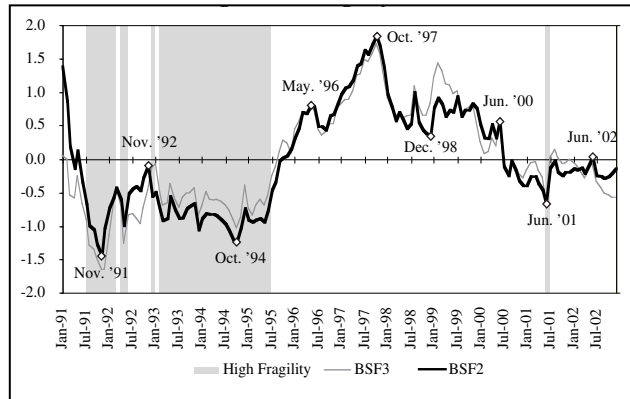


Figure 15
Banking Sector Fragility in Peru

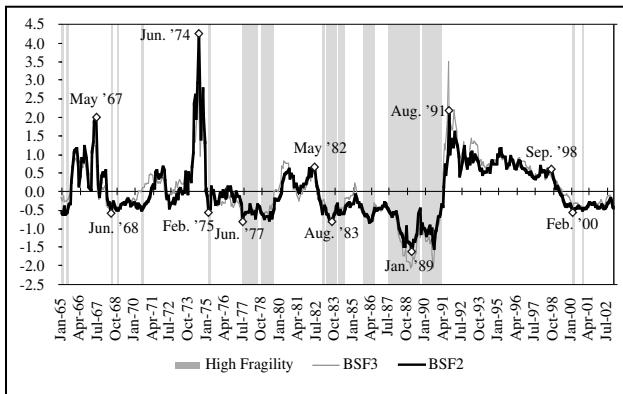


Figure 18
Banking Sector Fragility in South Korea

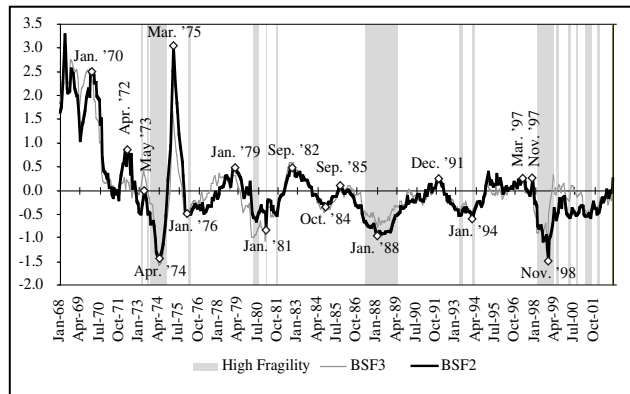


Figure 16
Banking Sector Fragility in Philippines

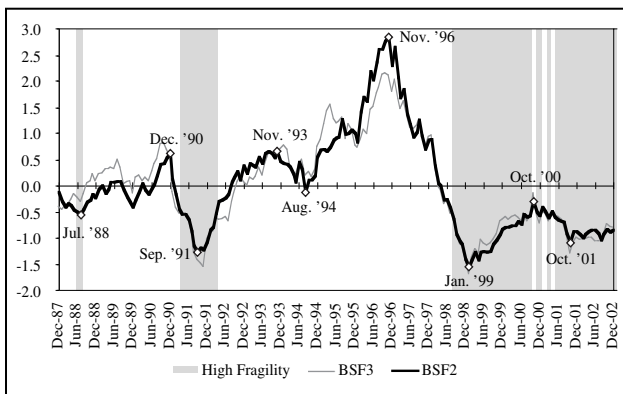


Figure 19
Banking Sector Fragility in Sweden

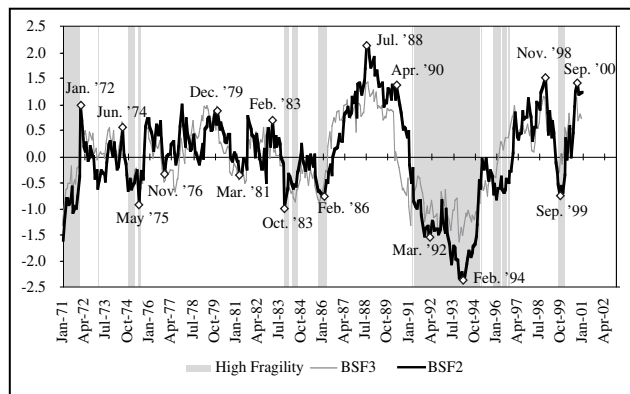


Figure 20
Banking Sector Fragility in Thailand

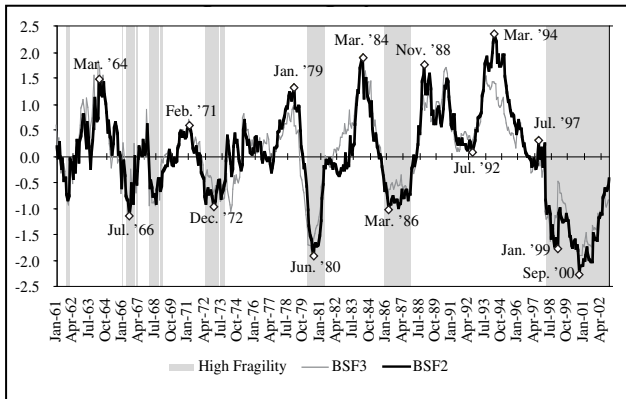
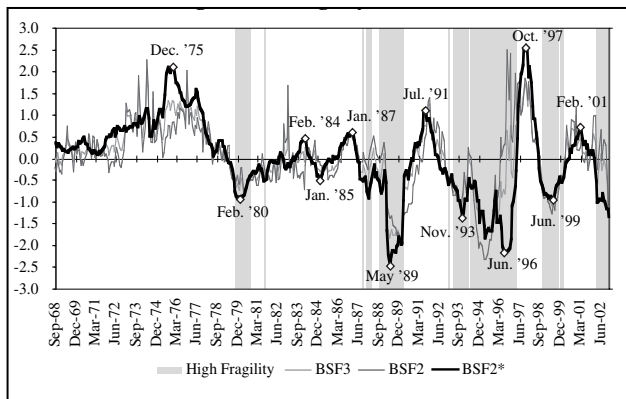
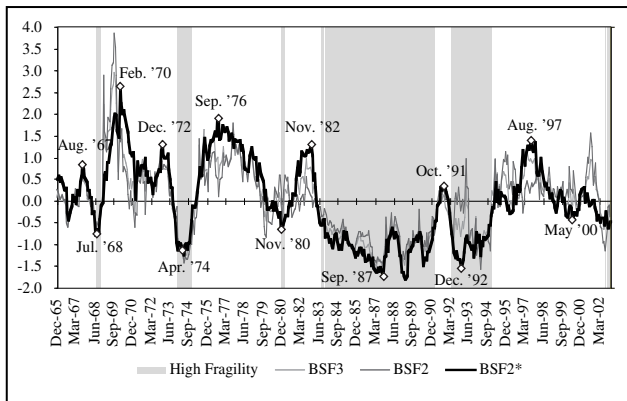


Figure 23
Banking Sector Fragility in Venezuela



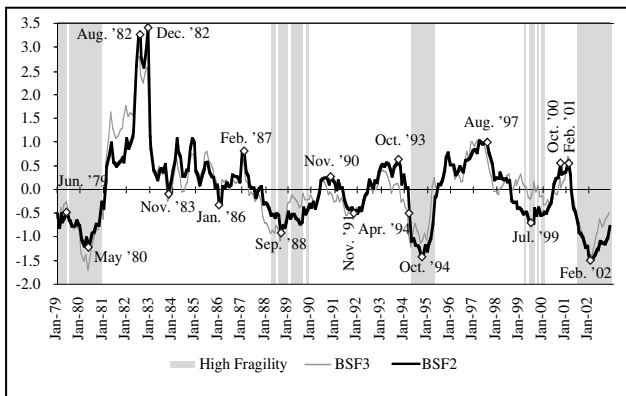
Source: IMF, International Financial Statistics, CD-ROM version, July 2003; author's own calculations.

Figure 21
Banking Sector Fragility in Trinidad & Tobago



Note: *BSF3* and *BSF2* are two alternative indices of banking sector fragility that are calculated as defined in equations (1) and (1'), respectively. For interpretation of changes in indices, please see table 2. Note that gray vertical bands in figures designate the periods of high fragility (see equation (6)) with respect to the *BSF2* index. For Chile, Kenya, Mexico, Trinidad and Tobago, and Venezuela, we consider *BSF2** instead of *BSF2*, as justified in section 4 above.

Figure 22
Banking Sector Fragility in Turkey



The national *BSF3* and *BSF2* indices - and if calculated, the *BSF2** index - are graphically shown in figures 2 to 23. The episodes of medium and high banking-sector fragility are calculated according to the above-described criteria by considering the *BSF2* (or *BSF2**) index. The country-specific high fragility periods determined according to equation (6) are marked by gray vertical bands in figures.

Concluding Comparison and Final Remarks

In recent years, there has been a high interest in research on the timing, duration, causes, effects, and cures of banking crises. In this paper, we proposed a monthly, weighted banking-sector fragility (*BSF*) index that may easily be used to measure and monitor the changes in the banking sector fragility to crisis. Apparently, this type of index is capable of providing more information about the ups and downs in the banking sector with respect to certain crisis-years in event-based studies. Table 4 compares our findings shown in figures 2-23 with the results of major studies in the event-based tradition.

Table 4
Episodes of Major Banking Crises and High Fragility in Selected Countries

	Caprio and Klingebiel (1996, 1999, 2002 and 2003)	Lindgren, Garcia and Saal, (1996)	Hardy and Pazarba?? ođlu (1998)	Demirgüç-Kunt and Detragiache (1997 and 1998)	Kaminsky and Reinhart (1996 and 1999)		Martinez Peria (2000)	Glick and Hutchison (2000)	Bordo and Eichengreen (2002)	Current Study (the <i>BSF2</i> , or <i>BSF2*</i> , index)		
					Beginning of the Crisis	Peak of the Crisis				Beginning of the Distress	Date of Highest Fragility	Episode of High Fragility (if applicable)
Argentina	1980-1982	1980-1982			Mar. 1980	July 1982		1980-1982	1980	d.n.a.	Jul. 1983	Jul. 1983 - Mar. 1985
					May 1985	June 1989				Oct. 1985	May 1986	Apr. 1986 - Nov. 1986
	1989-1990	1989-1990						1989-1990	1989	Jun. 1989	May 1990	Oct. 1988 - Jan. 1992
	1995				Dec. 1994	Mar. 1995		1995-1997	1995	Jun. 1994	Oct. 1995	medium fragility
	2001-present									Mar. 2001	Dec. 2001	Sep. 2001 - Feb. 2002
Bolivia										Apr. 1978	Apr. 1980	Aug. 1979 - Oct. 1981
										Oct. 1982	Aug. 1985	Mar. 1983 - Sep. 1985
	1986-1988	1986-1987**			Oct. 1987	June 1988		1986-1987		Sep. 1986	Aug. 1988	May 1988 - Dec. 1989
	1994-?	1994-pres.**						1994-1997		April 1993	Feb. 2002	Feb. 2000 - Jun. 2002
Brazil					Nov. 1985	Nov. 1985				d.n.a.	d.n.a.	
	1990							1990	1990	d.n.a.	July 1990	Nov. 1989 - Apr. 1991
	1994-1999	1994-pres.**			Dec. 1994	Mar. 1996		1994-1997	1994	Apr. 1995	Aug. 1996	medium fragility
										Feb. 1999	Feb. 2000	Jan. 2000 - Mar. 2000
Chile	1976							1976	1976	d.n.a.	d.n.a.	
	1981-1986	1981-1987		1981-1987	Sep. 1981	Mar. 1983	1981-1987	1981-1983	1981	Feb. 1982	Nov. 1983	Jan. 1983 - Apr. 1987
										June 1990	Nov. 1990	Aug. 1990 - July 1991
										Sep. 1998	June 2000	Feb. 2000 - Jan. 2001
									Mar. 2002	Nov. 2002	Jul. 2002 - Dec. 2002	
Indonesia	1994*	1994-pres.**	1992*	1992-1994	Nov. 1992	present		1994	1992	Sep. 1990	Sep. 1991	medium fragility
	1997-present		1997					1997	1997-1998	Feb. 1998	June 1999	Sep. 1998 - Dec. 2002
Israel	1977-1983								1977	d.n.a.	d.n.a.	d.n.a.
		1983-1984**		1983-1984	Oct. 1983	June 1984				Jan. 1983	Dec. 1985	Nov. 1983 - Jun. 1986
										Dec. 1987	Dec. 1989	Jan. 1988 - Aug. 1991
Japan										Dec. 1971	Aug. 1977	Dec. 1976 - July 1978
	1991-present	1992-pres.**	1992*	1992-1994			1992-pres	1992-1997	1992	Aug. 1987	Mar. 1994	July 1991 - July 1995
										June 1996	Aug. 1999	June 1997 - Dec. 2002
Jordan										Mar. 1977	Jan. 1978	Nov. 1977 - Mar. 1978
	1989-1990*		1989	1989-1990				1989-1990		Jun-88	Sep. 1989	Dec. 1988 - June 1991
										Apr. 1995	Jun. 1997	Sep. 1996 - Aug. 1998
Kenya										Aug. 1974	May 1975	Jan. 1975 - Jan. 1976
										Sep. 1977	Aug. 1982	Oct. 1980 - July 1984
	1985-1989						1985-1989	1985-1989		Oct. 1986	Nov. 1990	Mar. 1988 - Oct. 1988
	1992											see the next row
	1993-1995	1993*	1993*	1993			1993-1995	1992-1997		Mar. 1992	Mar. 1994	Mar. 1990 - June 1994
	1996-?*									Feb. 1996	Sep. 2000	Jun. 2000 - May 2001
Malaysia	1985-1988*	1985-1988	1985	1985-1988	July 1985	Aug. 1986	1985-1988	1985-1988	1985	Jan. 1984	Sep. 1987	Oct. 1986 - Mar. 1989
	1997-present				Sep. 1997	present		1997	1998	Mar. 1997	Jan. 1999	Apr. 1998 - Dec. 2002
Malta			no crisis between 1990-1995					no crisis between 1992-1997		Nov. 1972	Dec. 1973	Feb. 1973 - Sep. 1975
										Feb. 1977	Jan. 1978	Nov. 1977 - Jan. 1980
										Jun. 1999	Mar. 2002	Jul. 2001 - Jun. 2002
Mexico	1981-1991	1982	1982	1982	Sep. 1982	June 1984		1981-1991	1981	Apr. 1985	Nov. 1986	Dec. 1985 - Dec. 1988
	1994-1997	1994-pres.**	1994	1994-1995	Oct. 1992	Mar. 1996		1995-1997	1994	Jan. 1995	Feb. 1996	Aug. 1995 - Dec. 1996
										Sep. 1998	Jan. 2001	Aug. 2000 - Apr. 2001
Pakistan										Jan. 1973	July 1974	June 1973 - June 1975
		1980-pres.**								Aug. 1986	Aug. 1988	Apr. 1988 - Nov. 1988
										Sep. 1999	Aug. 2002	Sep. 2001 - Dec. 2002
Peru										June 1967	June 1968	June 1968 - Nov. 1968
										July 1974	June 1977	June 1977 - July 1979
	1983-1990	1983-1990**	1983*	1983-1990	Mar. 1983	Apr. 1983		1983-1990	1983	June 1982	Jan. 1989	July 1987 - Jan. 1991Philippines
	1981-1987	1981-1987	1981	1981-1987	Jan. 1981	June 1985		1981-1987	1981	d.n.a.	d.n.a.	
									Jan. 1991	Sep. 1991	Mar. 1991 - Mar. 1992	
	1998-present		1997*		July 1997	present		1997		Dec. 1996	Jan. 1999	Aug. 1998 - Dec. 2002

Table 4
Episodes of Major Banking Crises and High Fragility in Selected Countries (continued)

	Caprio and Klingebiel (1996, 1999, 2002 and 2003)	Lindgren, Garcia and Saal, (1996)	Hardy and Pazarba?? o?lu (1998)	Demirgüç-Kunt and Detragiache (1997 and 1998)	Kaminsky and Reinhart (1996 and 1999)		Martinez Peria (2000)	Glick and Hutchison (2000)	Bordo and Eichengreen (2002)	Current Study (the <i>BSF2</i> , or <i>BSF2*</i> , index)		
					Beginning of the Crisis	Peak of the Crisis				Beginning of the Distress	Date of Highest Fragility	Episode of High Fragility (if applicable)
Poland	1990s									d.n.a..	Nov. 1991	Jul. 1991 - Jun. 1995
South Korea										June 1973	Apr. 1974	July 1973 - Sep. 1974
										Feb. 1979	Jan. 1981	Mar. 1980 - June 1980
		mid-1980s**								Oct. 1985	Jan. 1988	Mar. 1987 - Apr. 1989
	1997-present		1997					1997	1997-1998	Apr. 1997	Nov. 1998	Mar. 1998 - Feb. 1999
Sweden										Mar. 1983	Oct. 1983	Oct. 1983 - June 1984
	1991	1990-1993	1992	1990-1993	Nov. 1991	Sep. 1992		1990-1993		Aug. 1988	Feb. 1994	Apr. 1991 - Feb. 1995
Thailand					Mar. 1979	Mar. 1979				Feb. 1979	June 1980	Dec. 1979 - Mar. 1981
	1983-1987	1983-1987	1983	1983-1987	Oct. 1983	June 1985		1983-1987	1983	Apr. 1984	Mar. 1986	Nov. 1985 - Nov. 1987
	1997-present		1997		May 1996	present		1997		Apr. 1994	Sep. 2000	Feb. 1998 - Dec. 2002
Trinidad & Tobago										Jan. 1973	Apr. 1974	Nov. 1973 - Oct. 1974
	1982-1993*	Early 1982-1993**						1982-1993		Dec. 1982	Sep. 1987	June 1983 - Feb. 1991
										Nov. 1991	Dec. 1992	Apr. 1992 - Nov. 1994
Turkey										July 1979	May 1980	Jan. 1979 - Nov. 1980
	1982-1985	1982	1982					1982-1985	1982	Sep. 1982	Nov. 1983	medium fragility
										Mar. 1987	Sep. 1988	Apr. 1988 - Oct. 1989
		1991		1991	Jan. 1991	Mar. 1991		1991		Dec. 1990	Nov. 1991	Nov. 1991 - Mar. 1992
	1994*	1994**		1994-1995				1994-1995		Nov. 1993	Oct. 1994	Apr. 1994 - Apr. 1995
										Sep. 1997	July 1999	Mar. 1999 - Mar. 2000
	2000-present									Nov. 2000	Feb. 2002	June 2001 - Dec. 2002
Venezuela	Late 1970s & 1980s*							1978-1986	1980	Jan. 1976	Feb. 1980	Oct. 1979 - Aug. 1980
										Feb. 1987	May 1989	Aug. 1987 - Mar. 1990
	1994-1995		1994	1993-1995	Oct. 1993	Aug. 1994		1994-1997	1993	Aug. 1991	June 1996	Jan. 1993 - Feb. 1997
										Nov. 1997	June 1999	Sep. 1998 - Jan. 2000
										Mar. 2001	Dec. 2002?	Feb. 2002 - Dec. 2002

* Borderline, or non-systemic, banking crisis.

** Significant, or extensive, unsoundness short of a crisis. d.n.a.: Data not available.

It should be noted that, in this table, we interpret the first month, when a country-specific fragility index started to decline before entering an episode of high fragility, as the first sign, or beginning date, of an approaching banking sector distress. Table 4 also shows both the specific months of highest fragility and episodes of high fragility, which are marked by gray vertical bands in figures from 2 to 23. Considering the comparative information presented both in figures 2-23 and in table 4, we briefly conclude that:

(a) Both the definition of banking crisis and the identification of crisis episodes are essential, if one attempts to predict and explain banking crises empirically. Depending on the timing and duration of a crisis that is to be explained, the result of the analysis is expected to vary remarkably. The crisis episodes in most of the subsequent studies are primarily adapted from the information given in Caprio and Klingebiel (1996 or 2003) and/or Lindgren *et al.* (1996). However, there are some important differences between the

crisis episodes given in these two studies and between the episodes considered in those studies that are also mentioned in table 4. The Mexican banking crisis in the 1980s, for example, is to be said by different researchers to occur in 1982, between 1982 and 1984, or in the 1981-1991 period. It is obvious that the result of an empirical analysis of the Mexican crisis will strongly depend on which year or years we initially assumed as crisis years.

(b) Many studies in the literature (see table 4) do not differentiate between systemic and non-systemic (borderline) crises. However, the analysis of a banking crisis must also be affected by the initial assumption on the extent of the crisis. The BSF index proposed here not only captures crisis times in terms of the defined high fragility periods in this study, but it also roughly describes the whole development process of a banking sector problem, even if it is only a significant unsoundness short of a crisis.

(c) Overall, the high fragility episodes determined according to the BSF calculations in this study overlap with the crisis episodes mentioned in those studies that are considered in table 4. Moreover, medium fragility episodes dated here are to a large extent in accordance with borderline-crisis episodes mentioned in the literature. Clearly, the information content of changes in a *monthly* BSF index is signifi-

cantly higher than that of the simple *years* of crisis that are identified based on country-specific information or relevant events. A monthly BSF index explicitly detects the ups and downs even within a single year, and hence, it eliminates the risk of labeling an entire year as crisis year even if the crisis has arisen, let's say, only on the last two months of that year.

Table 5
Country-Specific Literature on Banking Sector Performance and Fragility

Study	Country Coverage	Period	Major Issues
Drees and Pazarbaşıoğlu (1995)	Finland, Norway, and Sweden	1980s & 1990s	Macroeconomic determinants of banking crises; role of financial liberalization in financial crises
García-Herrero (1997)	Argentina, Paraguay, and Venezuela	1990s	Causes of banking crises stemming from both macroeconomic and bank-specific factors; macro economic effects of banking crises
Baliño and Ubide (1999)	South Korea	1993-1997	The sources of the 1997 Korean financial crisis, and the measures taken to deal with it
Englund (1999)	Sweden	1980s & 1990s	Discussion of the 1985 deregulation and other causes of the banking crisis in early 1990s; the relation between the European Exchange-Rate Mechanism (ERM) crisis in 1992 and Swedish banking crisis
Lindgren <i>et al.</i> (1999)	Indonesia, South Korea, Thailand, Malaysia, and the Philippines	1997-1999	Policy responses of Indonesia, Korea, and Thailand to the 1997 Asian crisis and comparison of their actions with those of Malaysia and the Philippines, which were buffeted by the crisis
Kanaya and Woo (2000)	Japan	1990s	Causes of banking crisis; reasons for the unnecessary prolongation of the recovery process
Kane and Rice (2000)	African countries	1980-1999	Effects of banks' unbooked losses on banking stress; government corruption and duration of banking crises
Levine (2000)	Chile	1980-1999	Possible effects of banking sector concentration on financial development, economic growth and banking sector fragility
Chang and Velasco (2001)	East Asian and Latin American countries	1997-1998	Macro- and microeconomic roots of international illiquidity in countries considered
Chopra <i>et al.</i> (2001)	South Korea	1997-1998	Korean stabilization and reform program implemented in response to the currency and banking crisis in 1997-98; recovery from deep recession; the lessons learned
Duvan (2001)	Turkey	1999-2001	Rapid growth of non-performing loans; debt restructuring between creditor banks and borrowing corporate sector companies
Enoch <i>et al.</i> (2001)	Indonesia	1988-1999	Chronological evaluation of developments in the weak of the 1997 banking crisis, and the effects of government policies on the recovery process
Gruben and Welch (2001)	Brazil	late 1990s	Brazil's January 1999 currency crisis; links between banking and currency crises
Hardy and Bonaccorsi di Patti (2001)	Pakistan	1980s & 1990s	The effects of the 1988-1992 financial sector reform Bonaccorsi di on the profitability and efficiency of the Pakistani banking system
Koo and Kiser (2001)	South Korea	1997-1998	The chronology and causes of currency and banking crises in South Korea; recovery from a twin crisis
Nakaso (2001)	Japan	1990s	The chronology of events and the policy responses by the authorities; identification of factors that explain why it has taken so long to bring the crisis under control; lessons learnt from the crisis
Worrell, Cherebin and Polius-Mounsey (2001)	Caribbean countries (incl. Trinidad and Tobago)	1990s	Review of financial sector performances and quantitative analysis of bank soundness in the Caribbean
Barajas and Steiner (2002)	Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela	1960-2000	Causes of the slowdown in bank credit to the private sector in the 1990s
Pangestu and Habir (2002)	Indonesia	1990s	Effects of currency and interest-rate shocks on the vulnerability of the Indonesian banking system, measures taken to deal with it, and the lessons learned
Ertuğrul and Yeldan (2002)	Turkey	2000-2001	Recent disinflation attempt in Turkey and its negative effects on the banking sector fragility

(d) For an individual researcher, the interpretation, or justification, of variations in large numbers of national BSF indices is not an easy undertaking because it requires some degree of country expertise as well as additional microeconomic information related to the relevant sector. Thus, a certain group of studies in the financial crises literature (see table 5) can be considered as a benchmark to examine the chronological and institutional background of changes in the BSF index. The country-specific chronological explanations in those studies, which are listed in table 5, strongly support both the results of and the main motivation behind the current study. To be more precise, let us consider the case of the Swedish banking crisis in the early 1990s. The total length of this crisis spans from one year to four years, depending on what study is considered as a reference for crisis episodes (see table 4). Even the timing of the same crisis varies across the different studies.¹⁰ Figure 19 however implies that, after 1985, real bank deposits, banks' foreign liabilities, and credits to the private sector all started to increase simultaneously, and that it reached a peak in July 1988. The BSF approach used here suggests that the following falls in the *BSF2* (or *BSF3*) after this date can be interpreted as a serious increase in the Swedish banks' vulnerability to crisis. The period from autumn of 1988 to autumn of 1990 is a period where all of the three components of the index were clearly decreasing. Now, according to Englund's (1999) comprehensive analysis of the Swedish banking crisis, these occurrences can be justified and understood as follows:

"Newly deregulated credit markets after 1985 stimulated a competitive process between financial institutions where expansion was given priority. Combined with an expansive macro policy, this contributed to an asset price boom. The subsequent crisis resulted from a highly leveraged private sector being simultaneously hit by three major exogenous events: a shift in monetary policy with an increase in pre-tax interest rates, a tax reform that increased after tax interest rates, and the ERM crisis. Combined with some overinvestment in commercial property, high real interest rates contributed to breaking the boom in real estate prices, triggering a downward price spiral resulting in bankruptcies and massive credit losses. The government rescued the banking system by issuing a general guarantee of bank obligations. The total direct cost to the taxpayer of the salvage has been estimated at around 2 per cent of GDP."

Englund's explanations, which are only partially quoted here, perfectly illustrate the macroeconomic background behind the time path of the Swedish BSF curve shown in

figure 19 in this study. Not to expand the extent of the current study unnecessarily, we prefer to restrict our country-specific remarks here to the case of Sweden. But interested readers easily may examine the reliability of the BSF index proposed here by considering the explanations in country-specific studies, such as those that are listed in table 5, among others.

(e) As shown in figures 1-23, for many countries, the *BSF3* and *BSF2* curves appear to have followed a very similar pattern, roughly implying that bank runs in many countries may not have an important role in triggering banking crises. Nevertheless, for particular countries, such as Mexico, the developments in bank deposits must be closely watched to detect possible banking sector problems.

To sum up, all of the discussions above show that the BSF index proposed in this study is highly helpful in monitoring and identifying the banking sector difficulties by using *monthly* data. Since the BSF index is reflecting the changes in the sectoral climate more precisely and timely, it significantly reduces the possibility that the crisis or high fragility episodes are misidentified, contrary to the case of event-based identification strategies. The BSF index presents the chance to be able to work with higher frequency data on banking crises. Its information content is significantly high. Therefore, in the future, studies that aim to empirically investigate the causes, timing and effects of banking crises can easily depart from the time-series-based statistical approach developed here.

Notes

¹ To construct an index of vulnerability to currency crisis, some researchers employ the difference between domestic and foreign interest rates, or percentage changes in domestic interest rates, while many others avoid using it because many developing countries do not have reliable interest-rate data.

² Caprio and Klingebiel frequently update their well-known table of episodes of systemic and borderline banking crises and publish it also on the web, i.e. <http://www.worldbank.org>. Note that some of the crises episodes mentioned in later versions of the table differ from those episodes which are given in earlier versions.

³ That is, the bank's net worth includes the capital contributed by the bank's shareholders and accumulated profits from doing business as intermediary in financial markets.

⁴ See Kaminsky and Reinhart (1996, 1999), Demirgüç-Kunt and Detragiache (1998, 1999, 2000), Kaminsky (1999), Hardy and Pazarba_10_lu (1998, 1999), the IMF's *World Economic Outlook* (May 1998, Ch. 4), Hutchison (1999), Goldstein *et al.* (2000), Martinez Peria (2000), Bordo and Schwartz (2000), Gourinchas *et al.* (2001), Hutchison and Neuberger (2002), and Bordo and Eichengreen (2002).

- ⁵ That means, credit overexpansions may reflect fundamental improvements in investing opportunities that are beneficial to output growth in the long run.
- ⁶ In this case, this may lead to output recession, if bank credit is the primary funding source of activities in the real economy as it is often observed in many developing economies (see Disyatat, 2001).
- ⁷ We neglect here (real) interest rates (or real interest rate differential) as the fourth component of the *BSF* index because many developing countries do not have internationally comparable and continuous time series on market-determined interest rates. One may also argue that interest-rate-risk (i.e., difficulties in maturity transformation) actually is indirectly considered in calculations here by the mean of deposits, claims, or foreign liabilities.
- ⁸ By using the standardized values of *CPS*, *FL* and *DEP*, we equalize the variance of the three components, and thus avoid the possibility that any one of three components dominates the *BSF3* index.
- ⁹ Apparently, Hawkins and Klau's (2000) index of banking system vulnerability is the most similar one to the *BSF* index proposed here. The authors use the following five proxies to measure the banking system vulnerability, by departing from the suggestion that banking crises are typically preceded by overvalued exchange rates, inadequate international reserves, recessions, high real interest rates, and excessive credit growth: (i) the rate of growth of domestic bank credit, (ii) the growth of borrowing from international banks, (iii) the external borrowing by banks as a percentage to domestic credit, (iv) the level of real interest rates, and (v) "stand-alone" credit ratings of the leading banks. Their index, however, differs from the *BSF3* index proposed here in many aspects. It is calculated for 24 emerging market economies but the sample period is limited to 1996-1998 for quarterly data frequency. The *BSF3* index, on the other hand, aims to cover a broader period of time for another set of 22 countries, including also a few developed market economies, and the data frequency is decided to be monthly. Furthermore, the Hawkins-Klau index is based on a weighted scoring methodology, contrary to the calculation methodology of the *BSF3* index, which is actually similar to that of the *FEMP* index that is used to measure the pressure in foreign currency market.
- ¹⁰ Note that Caprio and Klingebiel (2003) accept the Swedish banking crisis as occurred in 1991, although they considered the whole 1991-1994 period as the crisis episode in an earlier version of their useful table of banking crises.

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