

PREDICTING BANKING CRISES: JAPAN'S FINANCIAL CRISIS IN INTERNATIONAL COMPARISON

This article compares features of Japan's banking crisis with the experiences of other industrial economies. Using a probit statistical prediction model, we find that Japan's banking crisis follows a pattern found in many other industrial countries, i.e. formal tests do not distinguish Japan as a special case. Our model predicts that Japan was particularly "vulnerable" to a banking crisis in the early 1990s. That is, the model indicated that there was a 50 percent probability of a banking crisis in Japan in 1992 given the configuration of asset prices, credit conditions and other economic factors prevailing at the time. The main factor distinguishing Japan from other industrial countries is the slow and largely ineffectual policy response by the Ministry of Finance to resolve the country's financial crisis.

Introduction

Japan's financial system is at a juncture today which is not comparable to any other episode during the past 45 years. Stress in the Japanese financial system, especially failure to resolve the non-performing loan and bank problems, continues to hold back the economy and has stagnated a large part of the real estate market. New measures announced this year to deal with insolvent financial institutions - the latest in a series of moves taken since the early 1990s - include a large commitment of public funds (passed by the Diet in March) and the creation of a new 'bridge bank' to take over the assets of failed banks (announced in July).

Several industrial countries have faced banking crises over the past two decades but nowhere have the effects on the economy been so severe and the intensity of the problem so prolonged as in Japan. What makes Japan special? Why is Japan still saddled with banking problems when other industrial economies, facing similar or even worse situations, resolved them years ago? Is Japan's seeming inability to resolve its banking crisis and restore confidence in its banking system related to almost a decade of a weak economy and rising unemployment with few signs of improvement (e.g. an 'official' recession was declared in June 1998)?

The general features of the banking crisis in Japan are by now well recognised (see Cargill, Hutchison and Ito 1997, 1998; Hutchison 1997; OECD, 1998), and in many respects resemble banking crises experienced by other industrial countries - booming economies and sharply rising asset prices, followed by recession, severe asset price declines and banking problems. In the second half of the 1980s asset inflation was evident in many countries - though not of the same order of magnitude as in Japan. The international character of the asset price boom, and subsequent collapse, suggests common explanatory factors.

The coincidence of financial liberalisation and asset inflation and deflation has led a number of observers to argue liberalisation played a major role in the financial disruptions of the 1980s, and the subsequent banking problems in the 1990s inherited from the boom-and-bust period. In the context of liberalisation, the removal of binding portfolio constraints legally permitted banks and other depositories to adopt riskier investment and loan portfolios, including the adoption of high loan-to-value ratios. Banks also had incentives to adopt riskier loan and investment portfolios. Banks, directly or indirectly, provided imprudent levels of credit to real estate and equity markets in an effort to offset declining profit margins and declining market shares and to maintain the franchise value of commercial bank charters (supported in the past by a regulated and administratively controlled financial environment).

The existing literature investigating banking crises, however, consists for the most part of qualitative case studies and international comparisons.¹ Few quantitative studies or formal testing of hypotheses of the determinants and consequences of bank crises have been undertaken, and none focusing on Japan. To this end, this paper investigates the Japanese banking crisis using a more quantitative approach, identifying common characteristics of the economy, public policy, and institutional features leading up to and following the onset of the banking crisis in the early 1990s.

The main objective is to compare features of Japan's banking crisis with the experiences of other industrial economies, empirically identifying the special (idiosyncratic) features of the Japanese case which have led to the present circumstances. We review some of the basic statistical contours of bank crises in industrial countries, highlighting Japan, and also design empirical tests of several propositions on the determinants of banking problems. Our major finding is that Japan's banking crisis follows a pattern found in many other industrial countries, and formal tests do not distinguish Japan as a special case. Our model predicts that

Japan was particularly 'vulnerable' to a banking crisis in the early 1990s. That is, the model indicated that there was a 50 per cent probability of a banking crisis in Japan in 1992 given the configuration of asset prices, credit conditions and other economic factors prevailing at the time. The main factor distinguishing Japan from other industrial countries is the slow and largely ineffectual policy response by the Japanese government, and the Ministry of Finance in particular, to resolve the country's financial crisis.

We review the literature on banking crises, and compare the general characteristics of Japan's banking crisis with those in other industrial countries, then undertake a statistical analysis of the economic and institutional characteristics distinguishing those countries which have experienced banking crises from those that have not. We report the results from an event study analysis considering the characteristics of economies in the lead-up to and aftermath of the banking crises, and then undertake a more formal probit analysis of the causes of bank crises in the industrialised countries and consider the predictions of the model for Japan. We also report results using a broader sample of countries (industrial and developing economies) and somewhat different definitions of bank crises. We conclude by considering Japan's regulatory response to the crisis.

Characterising banking crises

In the 1980s and 1990s a number of industrialised and developing countries experienced severe bank crises similar to that of Japan. The recent financial crises in a number of East Asian countries, formerly viewed as models of economic development and good macroeconomic management, have sparked renewed interest in this area of research. Recent reports by the International Monetary Fund (IMF 1998) and the Organisation of Economic Cooperation and Development (OECD 1998), for example, have highlighted the topic of financial crises.

The IMF and OECD reports, and a number of other studies (for example, Caprio and Klingebiel 1996; Kaminsky and Reinhart 1996; Demirgüç-Kunt and Detragiache 1997; and Eichengreen and Rose, 1998), have attempted to identify characteristics common to countries experiencing bank crises and investigate whether there are signs or indicators suggesting particular vulnerability to a major financial problem. In a number of respects, the general conclusions from these studies fit the Japanese experience remarkably well.

Identifying bank crises

A bank crisis may be defined in a variety of ways, but generally refers to a situation in which '...actual or potential bank runs or failures induce banks to suspend the internal convertibility of their liabilities or compels the government to intervene to prevent this by extending assistance on a large scale' (IMF 1998: 74-5).

Banking crises are usually difficult to identify empirically, however, because of data limitations. The potential for a bank run is not directly observable and, once either a bank run or large-scale government intervention has occurred, the situation most likely will have been preceded by a protracted deterioration in the quality of assets held by banks. That is, there is a risk of dating the crises too late in that financial problems usually begin well before government intervention. But there is also a risk that the crisis date is set too early in that the peak of the crisis is often reached much later than the initial government intervention.

Identifying bank crises by the deterioration of bank asset quality is also difficult since direct market indicators of asset value are usually lacking. This is an important limitation since most banking problems in recent years are not associated with bank runs (liability side of the balance sheet) but with deterioration in asset quality and subsequent government intervention. Government intervention usually follows a sustained build-up of non-performing loans in banks' portfolios, large fluctuations in asset prices (real estate and stocks), and indicators of business failures. Moreover, it is often laxity in government analysis of banking fragility, and slow follow-up action once a problem is recognised, that allows the situation to deteriorate to the point of a major bank crisis involving large-scale government intervention.

Given these conceptual and data limitations, most studies have employed a combination of events to identify and date the occurrence of a bank crisis. Institutional events usually include forced closure, merger, or government intervention in the operations of financial institutions, runs on banks, or the extension of large-scale government assistance. Other indicators frequently include measures of non-performing assets, problem loans, and so on. Case studies are frequently relied upon in dating the onset of a banking crisis because institutional setups and financial structures differ so much across countries. The dating of the beginning of the Japanese banking crisis, for example, is usually 1992 or 1993 - the years of substantial government attention to the problem (1992) and the first plans for restructuring a significant part of the financial sector (1993). Using realistic estimates of non-performing loans as an indicator, however, might date the beginning of Japan's banking crisis in 1991.

General characteristics of bank crises

Despite the difficulties of identifying and measuring the magnitude of banking crises, several common features of countries experiencing banking crises emerge from the literature. The IMF study (1998), drawing on previous work, identified 54 banking crises in both industrial and developing countries between 1975 and 1997. Most of these crises were concentrated in the second half of the sample period, and the incidence was greater among the developing countries (42 crises) than the industrial countries (12 crises). The fiscal and quasi-fiscal costs of restructuring financial institutions to resolve the banking crisis were often large, reaching over 40 per cent of GDP in some case (Argentina and Chile in the early 1980s), as were the real output costs associated with the failure of financial institutions and markets to function effectively.

The IMF report identifies several general categories of problems which are frequently associated with financial crises (both banking and currency crises): unsustainable macroeconomic policies, weaknesses in financial structure, global financial conditions, exchange rate misalignments, and political instability.

Macroeconomic instability, particularly expansionary monetary and fiscal policies spurring lending booms and asset price bubbles, has been a factor in many bank crises, including most experienced by the industrial countries in the postwar period. External conditions, such as large shifts in the terms of trade and world interest rates, have played a significant role in financial crises in emerging market economies. By affecting the profitability of domestic firms, sudden external changes can adversely impact banks' balance sheets.

Weakness in financial structure refers to a variety of circumstance ranging from the maturity structure and currency composition of international portfolio investment flows to the allocation and pricing of domestic credit through banking institutions. These weaknesses oftentimes arise in times of rapid financial liberalisation and greater market competition, when banks are taking on new and unfamiliar risks on both the asset and liability side of balance sheets. Weak supervisory and regulatory policies under these circumstances have also increased moral hazard by giving an incentive for financial institutions with low capital ratios to increase their risk positions in newly competitive environments, and allowing them to avoid full responsibility for mistakes in monitoring and evaluating risk. Further, deficiencies in accounting, disclosure, and legal frameworks add to the problem by allowing financial institutions (or financial regulators) to disguise the extent of their difficulties. Governments

have frequently failed to identify problem institutions in a timely way, or to take prompt correct action when a problem arises, resulting in larger and more difficult crisis situations.

A general interpretation of these stylised features, put forward by the IMF report (1998), is that a prolonged period of macroeconomic overheating – high inflation, large current account deficits, rapid credit growth, increased short-term capital inflows – together with recently liberalised financial systems, makes the financial system vulnerable. An adverse economic development – such as a rise in world interest rates or fall in the terms of trade, capital inflows, or asset prices – then strikes an already vulnerable financial system. If the weakened financial situation is also faced with serious deficiencies in the institutional and regulatory environment, there is an increased likelihood that a banking crisis will develop. Deficiencies in the institutional and regulatory environment, in turn, are often associated with recent liberalisation of the financial system undertaken without prior strengthening of the regulatory and accounting framework and bank supervision.

Japan's experience seems to fit with this general characterisation of the causes of banking crises in at least two ways: macroeconomic instability and weakness in financial structure. As discussed earlier, an expansionary monetary and credit policy was clearly evident in Japan in the latter 1980s and contributed to the boom and bust cycle of asset prices. Equally important, financial liberalisation was undertaken against the background of a 'weak financial structure' – an increasingly competitive financial environment, shifts in the flows of funds, inadequate supervisory oversight, incentives to take on increased risk, deficiencies in accounting and financial disclosure frameworks and failure of the governmental action to identify and manage the problem. Cargill, Hutchison and Ito (1997, 1998) and Hutchison (1997) discuss these aspects of Japan's financial crisis in detail.

Specific indicators of vulnerability

Beyond these general qualitative features of banking crises, a few specific indicators which appear to precede banking crises emerge from the literature. Few of these warning signs consistently predict crises, however, and oftentimes give false signals (such as predicting a crisis during a tranquil period). The wide range of experiences surrounding banking crises, in terms of institutional and economic environments, belies any simple characterisation.

The IMF report (1998), using simple plots of the data, finds a number of characteristics which are broadly consistent with other studies. A rising ratio of broad money to narrow

money (interpreted as an indication of financial liberalisation) and rapid domestic credit growth (reflecting expansionary macroeconomic policies) often precede banking crises. Deposit growth and high real interest rates also tend to peak around the time of the banking crisis. The report finds that stock markets often decline, and real activity tends to show a falling trend, about a year prior to a banking crisis. Stock market declines in these instances are accompanied by falling real estate prices. By the time crises are underway, the report finds that output growth is significantly lower than its average during tranquil periods and stock prices are also significantly lower.

Caprio and Klingebiel (1996) find that some set of macroeconomic factors were at least a contributing factor in all of the bank crises in their sample (29 cases). Adverse terms of trade movements of at least 10 per cent preceded the bank crisis in most countries, as did a rapid and sometimes explosive loan growth. They also find that weakness in financial structure - incentives for banks to assume excess risk, lax accounting standards and regulations about reporting problem loans, weak supervision of banking institutions (often politically motivated), and political or other non-economic (e.g. fraud) factors in lending decisions - also played a prominent role in most banking crises.

In their descriptive empirical work, Kaminsky and Reinhart (1996) argue that the asymmetric theory of banking crises - crises are most likely when bad news immediately follows a period of sustained high loan demand and sanguine expectations - is supported by the data. In particular, they present summary statistics which suggest that output growth and the stock market peak about a year before the beginning of a banking crisis. The stock market (and real estate market) falls about a year prior to the banking crisis and continues a long and protracted decline. By the time the crisis begins, output growth slows significantly and a recession ensues. Real exchange rate appreciation and lending booms also tend to precede the onset of banking crises. A rising money multiplier and high real interest rates are also associated with banking crises, perhaps reflecting financial liberalisation.

In summary, these studies suggest the following variables are correlated with banking crisis at different lags.

One year or more prior to bank crisis:

- rapid domestic credit growth (IMF)
- rise in ratio of broad to narrow money (IMF)
- real exchange rate appreciation (Kaminsky and Reinhart)
- stock market peak (Kaminsky and Reinhart)

- business cycle peak (Kaminsky and Reinhart)
- high real interest rates (Kaminsky and Reinhart)
- rising money multiplier (Kaminsky and Reinhart)
- financial structure weakness (Caprio and Klingebiel)

One year or less before the bank crisis:

- stock market and real estate market decline (IMF, Kaminsky and Reinhart)
- fall in economic activity relative to trend (IMF)
- rapid growth in bank lending (Caprio and Klingebiel)
- adverse movement in terms of trade (Caprio and Klingebiel)

Contemporaneous with the bank crisis:

- peak in deposit growth (IMF)
- peak in high real interest rates (IMF)
- output significantly below trend growth (IMF)
- stock market significant below peak (IMF)

Indicators of banking crises for industrial countries: where does Japan fit in?

In this section we identify the key institutional and economic features of countries experiencing severe bank crises which distinguish them from other industrial countries. We compare these summary statistics with Japan, attempting to identify general and idiosyncratic features associated with the Japanese case. In our search for these key variables, we are guided by the findings of other studies (discussed earlier).

Identifying bank crises

We have identified and dated episodes of banking sector distress following the criteria of Demirgüç-Kunt and Detragiache (1997), updated using data from the Bank for International Settlements (1997).² Banking crises are defined as a situation where one of the following conditions hold: ratio of non-performing assets to total assets is greater than 2 per cent of GDP; cost of the rescue operation was at least 2 per cent of GDP; banking sector problems resulted in a large scale nationalisation of banks; and extensive bank runs took place or

emergency measures such as deposit freezes, prolonged bank holidays, or generalised deposit guarantees were enacted by the government in response to the crisis.

We investigate 20 industrial countries over the 1980–97 period using annual data. The countries investigated are all OECD members: Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Finland, France, Great Britain, Greece, Ireland, Italy, Japan, the Netherlands, Norway, New Zealand, Portugal, Sweden and the United States. Using the four bank crisis indicators, seven countries are identified as having bank crises since 1980: Finland (1991–94), Italy (1990–94), Japan (1992–97), Norway (1987–93), Portugal (1986–89), Sweden (1990–93), and the United States (1984–91).

Economic characteristics

The variables considered are real GDP growth (GDP), the change in the spot exchange rate against the US dollar (domestic currency price of the US dollar; *ex-rate*), the rate of inflation (INF) and the real interest rate (RINT). To capture the degree of foreign exchange exposure, we consider the ratio of a broad money aggregate to international reserves (*m2ratio*). To investigate whether excessive money and credit growth and asset price bubbles are associated with banking crises, we consider the rate of credit growth (*credit*) and the rate of change in stock prices (*stock*). The data is taken from IMF International Financial Statistics and various other sources.

Table 1 shows the differences in these economic characteristics between the two sets of countries – the average values of these indicator variables are calculated over the full sample period for those countries which have not experienced a banking crisis, and the average values of these variables are calculated over the period leading up to the banking crisis in our focus group (bank crisis) of countries. The objective is to identify different movements in these variables which distinguish the crisis and non-crisis countries during the periods of relative tranquillity, that is, before banking problems become critical.

The first column of statistics show the mean values for the countries not experiencing a banking crisis and the second column shows the mean values for the bank crisis countries. The third column shows the mean difference (*t*-statistic) tests, and the fourth column presents the corresponding value for Japan over the period prior to the banking crisis.

The mean difference tests indicate that the average rate of inflation, increase in stock prices, and the *m2ratio* are significantly higher in countries struck by severe banking

Table 1 Economic characteristics of industrial countries experiencing banking crises

	Countries Not Experiencing Bank Crisis	Countries Experiencing Bank Crisis ¹	Difference in Mean Values (Pr> t)	Japan
Real GDP Growth	2.27	2.72	0.11	3.97
Exchange Rate Depreciation	2.04	2.92	0.68	-5.41
Inflation	5.57	8.66*	0.00	2.12
Real Interest Rate	3.33	1.91*	0.00	2.55
M2/Reserve Ratio	13.39	28.97*	0.00	44.26
Credit Growth	5.91	5.10	0.41	6.46
Stock Price Change	11.62	23.16*	0.01	13.90
Budget Surplus	-3.96	-5.12	0.12	-4.25

Note: 1 Values prior to banking crisis.

Source: Identification of banking crises from Demirgüç-Kunt and Detragiache (1997).

problems. Average real GDP growth and average budget deficits also appear marginally higher (statistically significant at the 11 and 12 per cent level, respectively) in the crisis countries. By contrast, the average level of real interest rates (short term) is lower in industrial countries experiencing banking crises – at least in the period prior to the crisis – than in the industrial countries not experiencing a banking crisis. No statistically significant difference between the two groups of countries is found in the pattern of credit growth or exchange rate change. By contrast with conventional wisdom, credit growth in the industrial countries experiencing banking crises was somewhat lower, on average, than in the non-crisis industrial countries.

Where does Japan fit in this general pattern distinguishing economic developments in the crisis countries from the non-crisis countries? No clear picture emerges. Similar to other bank-crisis countries, Japan's average real GDP growth and rise in stock prices was faster than the group of industrial countries not experiencing severe financial problems. The M2/reserve ratio was also substantially greater. The similarities end at this point, however, as prior to the start of the crisis Japan experienced less exchange rate depreciation (indeed, strong appreciation), lower inflation, and somewhat higher real interest rates and credit growth than even the non-crisis countries. The Japanese average budget deficit during this period was between the sample means of the crisis and non-crisis countries.

Economic developments before and after banking crises

Table 2 shows the economic characteristics of the industrial countries experiencing banking crises at different periods: prior to the banking crisis, the first year of the onset of the crisis, during the banking crisis, and after the crisis. The number in parenthesis is the probability that the mean value indicated is the same as the previous value. For example, real GDP growth following crisis episodes averaged 3.53 per cent per annum, a significant jump (less than 1 per cent probability that the values are the same) from the 1.47 per cent average recorded during the crisis episodes.

The 'asymmetric' information explanation for bank crises, expressed for example by Kaminsky and Reinhart (1996), would suggest that a booming economy and sanguine views of the future (e.g. strong stock markets and rapid credit growth) would tend to be followed by a slowdown in economic activity and fall in stock values and credit growth.

The basic time-series statistics support the 'asymmetric view'. The four variables which indicate a distinct shift over crisis episodes are real GDP growth, exchange rate depreciation,

Table 2 Economic development prior to, during and after bank crises

	Seven Crisis Countries				Japan		
	Prior to Crisis	First Year of Crisis	During Crisis	After Crisis	1980-91	1992	1993-97
Real GDP Growth	2.72	1.32	1.47	3.53*	3.97	1.02	1.45
Pr> t		(0.42)	(0.93)	(0.00)			
Exchange Rate Depreciation	2.92	-4.68*	3.56*	-1.69*	-5.41	-0.36	0.82
		(0.10)	(0.08)	(0.06)			
Inflation	8.66	9.71	4.09	4.13	2.12	1.73	0.06
		(0.84)	(0.29)	(0.97)			
Real Interest Rate	1.91	0.80	3.73	4.09	2.55	1.52	1.07
		(0.78)	(0.48)	(0.74)			
M2/Reserve Ratio	28.97	34.50	28.64	24.41	44.26	56.72	32.27
		(0.76)	(0.75)	(0.65)			
Credit Growth	5.10	2.77	-1.078	2.97*	6.46	1.17	0.83
		(0.59)	(0.39)	(0.01)			
Stock Price Change	23.16	-6.21*	11.21*	10.15	13.90	-25.95	0.99
		(0.01)	(0.01)	(0.85)			
Budget Surplus	-5.12	-4.59	-5.62	-4.75	-4.25	0.31	-1.54
		(0.81)	(0.65)	(0.49)			

Source: Identification of banking crises from Demirgüç-Kunt and Detragiache (1997).

credit growth and stock price rises. Real GDP growth drops during the crisis episode and rises significantly following the crisis. Credit decreases during the crisis and jumps markedly following the crisis.

Perhaps the most striking feature is the development of stock markets: booming prior to the crisis (23 per cent annual rise), sharply declining in the first year of the crisis (average 6 per cent drop), and rising around 10–11 per cent per annum on average during the remaining years of the bank crisis episode as well as following the crisis episode. The 11 per cent per annum stock price rise is the same as the average for the non-crisis countries over the full 1980–97 sample period. Although not statistically significant, inflation and real interest rates also tend to decline after the onset of banking crises.

Japan experienced a similar pattern over time to other countries experiencing bank crises: a booming economy (rapid real GDP and credit growth and rising inflation) and strong asset markets (rapid stock price increase) prior to the bank crisis, followed by a sharp slowdown and falling asset prices. All of these indicators suggest that recessionary conditions and asset price deflation typically characterise banking crises, and that Japan fits clearly with this pattern.

Predicting banking crises

This section estimates a model that may be used to predict banking crises. We investigate whether the primary economic and institutional characteristics of countries are useful as leading indicators of banking crisis, and use the model to see if Japan's banking problems were in some sense predictable. Our objectives are both to investigate the general characteristics associated with banking crisis, and to determine whether Japan's experience (or circumstances surrounding the banking crisis) is idiosyncratic. Using a panel data encompassing 20 industrial countries over the 1980–97 period, we use a multivariate probit analysis to estimate how a particular variable changes the probability of the occurrence of a banking crisis holding constant the other explanatory factors. This is the relevant question for policy analysis, and it can not be addressed using simple univariate descriptive analysis.

Three previous empirical studies of which we are aware have formally addressed this issue. Kaminsky and Reinhart (1996) use a probit model, associating banking crises with two explanatory factors: the incidence of financial liberalisation (measured by a dummy variable taking a value of unity if 'financial markets are deregulated' and zero otherwise) and the

previous occurrence of a balance of payments crisis. Only the financial liberalisation dummy variable is statistically significantly and positively associated with banking crises.

Demirgüç-Kunt and Detragiache (1997) also use probit analysis in their investigation of the determinants of banking crises. However, they consider a larger number of potential explanatory factors (using annual data) than Kaminsky and Reinhart (1996). They find that low real GDP growth is contemporaneously associated with banking crises. They do not find that rapid real GDP growth is a leading indicator of banking crises, however. They also find that (i) high real interest rates, (ii) high inflation, (iii) external vulnerability (measured by a high ratio of broad money to international reserves), (iv) low values of a 'law and order' index (a proxy for a weaker regulatory and supervisory structure), and (v) the existence of an explicit deposit insurance scheme (increasing moral hazard) are significantly associated with banking crises. By contrast, they find little evidence that terms of trade deterioration, rapid credit growth, or the exchange rate also are systematically associated with banking crises.

Eichengreen and Rose (1998) also estimate probit models to estimate the probability of a banking crisis, but focus on developing countries. They find that external factors, especially increases in world interest rates, are an important determinant of banking crises in developing countries. Overvalued real exchange rates and slowing output growth also play a role. However, differing exchange rate regimes and domestic credit booms do not add predictive power to the model.

Following these studies and the descriptive studies of the earlier section, we estimate the probability of a banking crisis using a multivariate probit model estimated using maximum likelihood. In each period the country is either experiencing a crisis, or it is not. Our dependent variable takes on a value of zero if there is no crisis, and a value of unity if there is a crisis. The probability that a crisis will occur (at a particular time in a particular country) is modeled as a function of a vector of explanatory variables $X(i,t)$, where i denotes country i and t denotes the time period. Our panel data set in this section has 237 observations.

We employ two categories of explanatory variables in the analysis: institutional variables (that do not vary over time but show significant differences across countries) and macroeconomic variables (which vary substantially over time and across countries). The institutional variables we consider are the average number of strikes and riots per year and a measure of central bank independence. Relatively high frequency of strikes and riots indicate a substantial degree of social unrest and could indicate greater vulnerability to a banking crisis. A more independent central bank, on the other hand, might indicate greater

supervisory control, less political intervention, and less vulnerability to a banking crisis. The macroeconomic variables employed are standard: stock price change, exchange rate depreciation, real GDP growth, inflation and credit growth.

Table 3 reports the results with all contemporaneous values of the explanatory values and Table 4 reports the results with the explanatory variable lagged one year (annual data is employed). The contemporaneous results indicate that two of the institutional variables and two of the macroeconomic variables are statistically significant. The 'pseudo' R^2 is .38, suggesting a moderate degree of explanatory power for the model.

A large number of riots indicate that a country is particularly vulnerable to a banking crisis and a high degree of central bank independence decreases the probability of a banking crisis. A fall in stock prices and currency depreciation is associated with an increased likelihood of a banking crisis. By contrast with the conclusions of many individual case studies and descriptive international comparison studies, we find that rapid real GDP and credit growth do not significantly add explanatory power to the model. That is, these variables do

Table 3 Probit estimates: contemporaneous, excluding all years after first crisis year

Bank Crisis	Coefficient	Standard Error	z	P > z	Derivative Adjustment Factor
Strike	-0.898	0.856	-1.049	0.294	0.001322
Riot	0.419	0.188	2.231	0.026	0.001322
Central Bank Independence	-6.869	3.934	-1.746	0.081	0.001322
Stock Price Change	-0.036	0.018	-2.078	0.038	0.001322
Exchange Rate Depreciation	-0.043	0.025	-1.679	0.093	0.001322
GDP Growth	-0.149	0.104	-1.435	0.151	0.001322
Inflation	0.005	0.066	0.079	0.937	0.001322
Credit Growth	0.005	0.016	0.278	0.781	0.001322
Constant	-0.166	0.935	-0.177	0.859	0.001322

Note: Number of observations = 225 Pseudo R^2 = .380

The effect of a 1 unit increase in an independent variable on the crisis probability can be calculated by multiplying the coefficient on that variable by the derivative adjustment factor, (that is the same as dF/dx).

Source: Identification of banking crises from Demirgüç-Kunt and Detragiache (1997).

Table 4 Probit estimates: lagged 1 year, excluding years during crisis

Bank Crisis	Coefficient	Standard Error	z	P> z	Derivative Adjustment Factor
Strike	-0.507	0.727	-0.698	0.485	0.022266
Riot	0.237	0.122	1.934	0.053	0.022266
Central Bank Independence	-4.477	2.609	-1.716	0.086	0.022266
Stock Price Change	-0.01	0.010	-0.620	0.535	0.022266
Exchange Rate Depreciation	-0.014	0.017	-0.838	0.402	0.022266
GDP Growth	-0.019	0.117	-0.160	0.873	0.022266
Inflation	-0.025	0.061	-0.420	0.674	0.022266
Credit Growth	0.004	0.014	0.270	0.787	0.022266
Constant	-0.616	0.824	-0.748	0.455	0.022266

Note: Number of observations = 237 Pseudo $R^2 = .168$
 The effect of a 1 unit increase in an independent variable on the crisis probability can be calculated by multiplying the coefficient on that variable by the derivative adjustment factor (that is the same as dF/dx).

Source: Identification of banking crises from Demirgüç-Kunt and Detragiache (1997).

not help predict the occurrence of a banking crisis after controlling for the movement in stock prices, exchange rates and institutional factors.

The model estimates reported in Table 3 cover all the industrial countries and may or may not do well in predicting the likelihood of a banking crisis in a specific country at a particular point in time. That is, the model could have relatively high predictive accuracy in general but do rather poorly in predicting the actual occurrence of any particular banking crisis. Our question is whether the general statistical characteristics of bank crises identified by the model help to explain the timing and likelihood of the bank crisis that occurred in Japan.

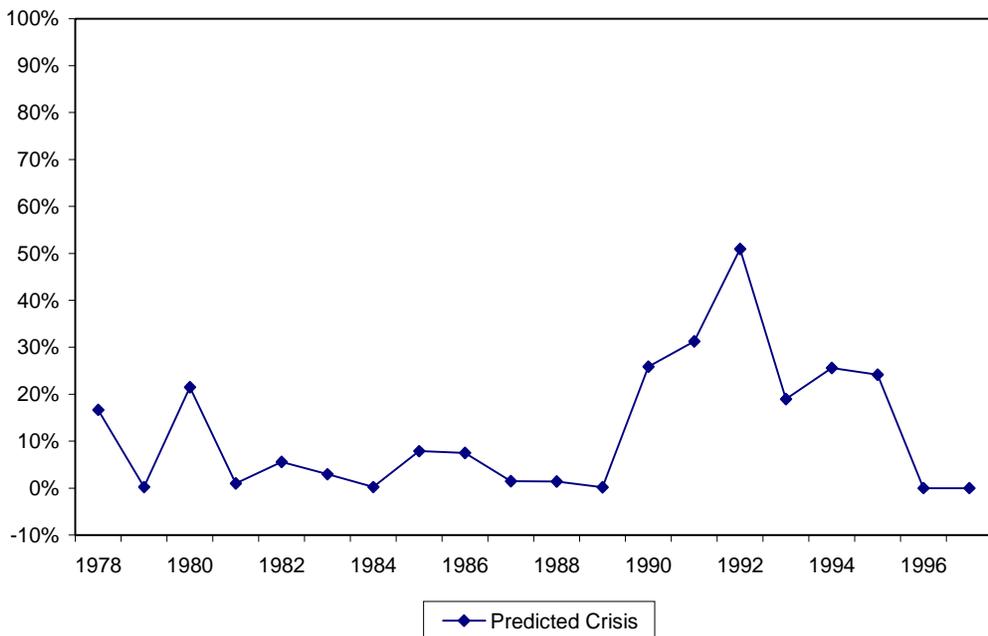
To this end, Figure 1 reports the predicted probability of a banking crisis occurring in Japan during the 1978-95 period. The probability is very low until 1990, at which time it jumps to almost 30 per cent. The probability climbs further to over 30 per cent in 1991 and peaks at 50 per cent in 1992. The estimated probability then drops to around 20 per cent during 1993-95. These results indicate that the model does quite well in predicting the occurrence of the Japanese banking crisis which is dated from 1992. Since the institutional

variables are quite stable, the results are driven by the collapse in stock prices in 1990–92 and shift from strong currency appreciation to exchange rate depreciation.

It is noteworthy that the model estimates reported in Table 3 and Figure 1 indicate that strong contemporaneous correlations exist between our explanatory variables and the timing of banking crises. Some caution should be exercised in interpreting these as causal relationships since it is possible that the onset of a banking crisis, for example, may in turn trigger a fall in stock prices or currency depreciation. In Japan's case, however, we know that the fall in the stock market (which peak on 31 December 1989) preceded the banking crisis by a full two years, indicating a causal link running from a collapsing stock market to the onset of a banking crisis.

Several studies, reviewed above, suggest that some variables may be useful leading indicators (as opposed to contemporaneous) of bank crises. The descriptive statistics reported in Table 2 also suggest a similar pattern of macroeconomic developments prior to the onset of a banking crisis. To test for predictive power of this sort, in Table 4 we report results from

Figure 1 Predicted probability of a banking crisis in Japan



a probit model where all the explanatory variables are lagged one year (one period). As expected, the same institutional variables (which do not change significantly over time) are statistically significant. However, none of the macroeconomic variables appear to help systematically lead the onset of a banking crisis. By contrast with conventional wisdom, we do not find that rapid GDP and credit growth, or a run up in stock prices, systematically help predict banking crises in the industrial countries. We also estimated the model with two year lags of the explanatory variables (results omitted for brevity) and obtained the same basic results.

Extensions

One problem with the proceeding analysis is that there are relatively few observations in the industrial countries of banking crises. In this subsection we extend our results to a broader sample of countries – industrial and developing countries – and use slightly different criteria to date the occurrence of banking crises. The objective is to check the robustness of our results to changes in sample size and variable definitions.

The definition of banking crises we employ in this part of the paper is based on the work of Caprio and Klingebiel (1996), and is also used in Eichengreen and Rose (1998). The OECD countries (and starting dates) experiencing banking crises by Caprio and Klingebiel's measure were Australia (1989), Germany (1975), Spain (1977), Finland (1991), France (1994), United Kingdom (1975), Japan (1990), Norway (1987), New Zealand (1987), Sweden (1991) and the United States (1984). All of the countries experiencing multiple banking crises outside the OECD were Argentina (1980, 1989 and 1995), Brazil (1990 and 1994), Central African Republic (1980 and 1994), Chile (1976 and 1981), Egypt (1980 and 1990), Kenya (1985 and 1992), Mexico (1981 and 1995), Philippines (1981 and 1997), Tanzania (1987 and 1995) and Venezuela (1980 and 1994).

We maintain the 1980–97 data range and, by including developing countries with the industrial countries, expand the data set to a total of 130 countries. Of this set, 62 countries experienced banking crises and a few experienced multiple banking crises (total of 73 banking crises observed). The banking crises occurred primarily in the developing countries (51 non-OECD countries and 11 OECD countries). Using this data set we have 261 observations.

Tables 5, 6, 7 report the probit estimation results using observations on, respectively, (i) the set of OECD countries, (ii) the full set of countries (OECD and non-OECD), and (iii) the full set of countries but allowing different coefficients on the OECD and non-OECD countries

(i.e. using intercept and slope dummy variables). Figure 2 reports the predicted values for Japan derived from the three models estimated.

Table 5 reports the estimates for the OECD countries, and largely replicates the results from Table 3. Stock price data is available for most OECD countries and this is included in Table 5. The only difference between this model and the base model of Table 3 is the use here of the variable M2 to international reserves (ratio of money to reserves) and the use of Caprio and Klingebiel's measure of crisis episodes. However, Tables 6 and 7 using the full data set do not include the stock price as this is only available over the data period for a few developing countries.

The results from Table 5, not surprisingly, are similar to the base line results reported in Table 3. We have more observations but lower explanatory power. Central bank independence, stock price changes and exchange rate depreciation are significant at the 90 per cent confidence level or better. Unlike Table 3, the 'riot' variable is no longer significant in this larger data set.

Results from the full sample, reported in Table 6, are much weaker. This expanded data set includes developing and industrial countries but excludes stock price changes. The only

Table 5 Probit: contemporaneous using only OECD countries

Bank Crisis	Coefficient	Standard Error	z	P> z	Derivative Adjustment Factor
Riot	-0.038	0.197	-0.192	0.848	0.01550
Strike	-0.664	0.808	-0.822	0.411	0.01550
Central Bank Independence	-3.726	1.929	-1.932	0.053	0.01550
Stock Price Change	-0.029	0.014	-2.032	0.042	0.01550
Exchange Rate Depreciation	-0.034	0.018	-1.927	0.054	0.01550
GDP Growth	-0.102	0.083	-1.237	0.216	0.01550
Inflation	0.030	0.050	0.610	0.542	0.01550
Ratio of Money to Reserves	0.022	0.015	1.404	0.160	0.01550
Credit Growth	0.017	0.011	1.488	0.137	0.01550
Constant	-0.969	0.718	-1.348	0.178	

Note: Number of observations = 261 Pseudo R² = .279

Source: Identification of banking crises from Caprio and Klingebiel (1996).

Table 6 Probit: contemporaneous using full sample (OECD and non-OECD)

Bank Crisis	Coefficient	Standard Error	z	P> z	Derivative Adjustment Factor
Riot	0.023	0.055	0.409	0.682	0.09116
Strike	-0.008	0.275	-0.028	0.978	0.09116
Central Bank Independence	-0.649	0.667	-0.972	0.331	0.09116
Exchange Rate Depreciation	0.001	0.002	0.336	0.737	0.09116
GDP Growth	-0.033	0.019	-1.729	0.084	0.09116
Inflation	0.000	0.000	-0.488	0.626	0.09116
Ratio of Money to Reserves	-0.002	0.004	-0.451	0.652	0.09116
Credit Growth	-0.006	0.005	-1.314	0.189	0.09116
Constant	-1.329	0.264	-5.038	0.000	

Note: Number of observations = 775 Pseudo R² = .028

Source: Identification of banking crises from Caprio and Klingebiel (1996).

Figure 2 Predicted banking crisis for Japan

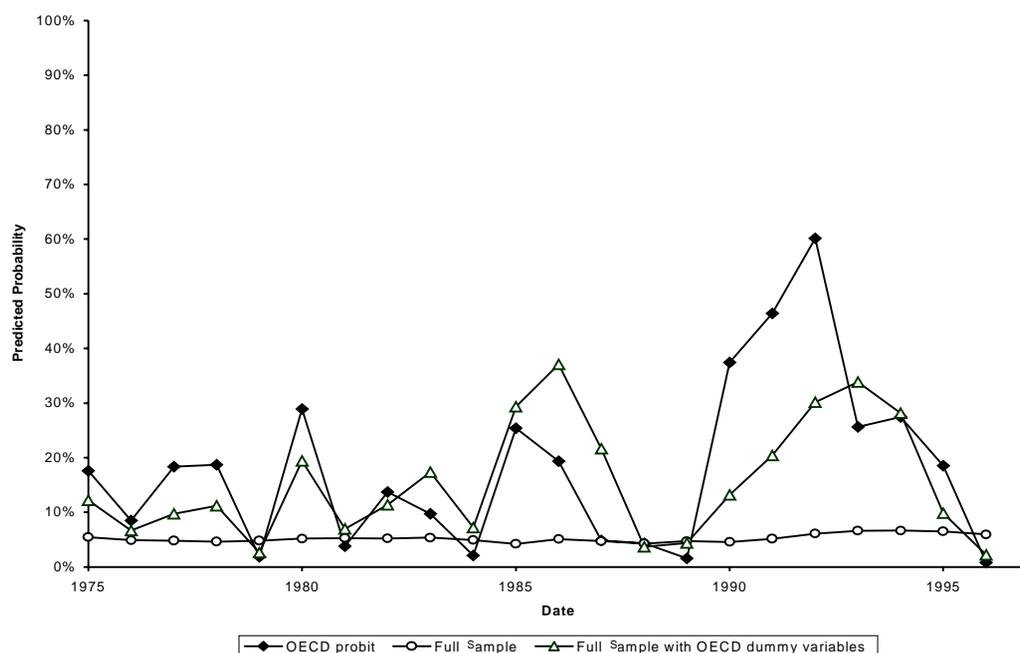


Table 7 Probit: contemporaneous using full sample (OECD and non-OECD)

Bank Crisis	Coefficient	Standard Error	z	P> z	Derivative Adjustment Factor
Riot	-0.020	0.066	-0.302	0.763	0.06211
Strike	0.249	0.309	0.806	0.420	0.06211
Central Bank Independence	0.471	0.980	0.481	0.631	0.06211
Exchange Rate Depreciation	0.000	0.002	-0.285	0.776	0.06211
GDP Growth	-0.034	0.020	-1.736	0.083	0.06211
Inflation	0.000	0.000	-0.457	0.648	0.06211
Ratio of Money to Reserves	-0.006	0.006	-0.921	0.357	0.06211
Credit Growth	-0.008	0.005	-1.655	0.098	0.06211
O E C D	0.507	0.756	0.671	0.502	0.06211
Riot*	-0.040	0.196	-0.203	0.839	0.06211
Strike*	-0.761	0.816	-0.933	0.351	0.06211
Central Bank Independence*	-3.931	1.999	-1.967	0.049	0.06211
Exchange Rate Depreciation*	-0.022	0.015	-1.475	0.140	0.06211
GDP Growth*	-0.129	0.080	-1.609	0.108	0.06211
Inflation*	0.009	0.044	0.191	0.848	0.06211
Ratio of Money to Reserves*	0.029	0.016	1.826	0.068	0.06211
Credit Growth*	0.024	0.012	1.986	0.047	0.06211
Constant	-1.518	0.374	-4.056	0.000	

Note: Number of observations = 775 Pseudo R² = .105

* indicates the OECD interaction variable.

Includes OECD dummy variable and interaction variables.

Source: Identification of banking crises from Caprio and Klingebiel (1996).

variable which is statistically significant is the change in real GDP (higher GDP growth decreases the probability of a banking crisis). The explanatory power is low and the results unsatisfactory. Pooling developing and industrial countries does not appear appropriate.

To work around this problem, we included slope and intercept dummies (for the OECD countries) in the probit model. These results are reported in Table 7. The explanatory power of the model is somewhat higher and several additional variables are significantly different from zero. Real GDP growth is again significantly negative. Other significant variables are credit growth (higher credit growth is negatively associated with a banking crisis) and the slope dummy variables on: (i) central bank independence (central bank independence is significantly negatively correlated with banking crises in the OECD countries, but not in the developing countries), (ii) real GDP growth (rapid growth leads to an even lower probability

of banking problems in OECD than non-OECD countries), (iii) ratio of money to reserves (a high ratio of money to international reserves helps predict the onset of a banking crisis in the OECD area but not in other countries), and (iv) credit growth (rapid credit growth helps predict banking crises in the OECD area but not in other countries).

The predicted values for Japan from each of these estimated models is shown in Figure 2. The model using the OECD sample only (Table 5) predicts the banking crisis in Japan quite well. The model with the slope and intercept dummy terms (Table 7) also indicates that the probability of banking crisis in Japan was much greater in the 1990s than in the 1980s. However, the unadjusted pooled model (Table 6) does not indicate a banking crisis was imminent in Japan during the 1990s. In summary, these results support our contention that Japan followed a very similar pattern to other industrial countries experiencing banking crises. However, it is clear that different patterns are found in the developing and emerging market economies.

Concluding observations

The previous sections indicate that, in most dimensions, the Japanese banking crisis is similar to those experienced in other industrial countries. The analysis of macroeconomic developments before and after bank crises indicates that Japan followed a pattern similar to many countries facing bank crises, and our model successfully predicts the increased likelihood of a banking crisis in Japan in the early 1990s.

The factors leading up to the Japanese banking crisis were not unique: financial liberalisation, expansionary credit growth, rapid real GDP growth and an asset price bubble. The immediate aftermath also followed a pattern seen in other industrial economies experiencing severe bank crises: recession and deflation, falling asset prices, and a credit 'crunch'.

At this point, however, the similarities end. Japan's banking crisis has had greater adverse effects than those in other countries. The duration of the banking crises in other industrial countries in some cases was as long as Japan (Italy continued for eight years; Norway for seven years; the United States for seven years). And in several cases the magnitude of the problem, measured at the peak in terms of non-performing loans as a per cent of GDP, was substantially greater than Japan (Italy, Finland, Norway and Sweden). But in no case was the falloff in real output growth (relative to trend), collapse in asset prices, decline in credit growth, and general malaise over the economy felt greater than in Japan.

That is, the intensity and severity of the crisis has been felt longer in Japan than other countries.

If the determinants and timing of the bank crisis in Japan seems to conform to experiences elsewhere, why has the Japanese problem been so severe and the sense of a crisis situation so prolonged? There is a growing consensus that the slow policy response and, to date, largely ineffectual attempts to resolve the banking crisis are the main factors setting the Japanese experience apart from bank crises experienced in other industrial countries.

A voluminous literature has studied this issue (see Cargill, Hutchison, and Ito 1997; and Hutchison 1997). The proximate causes of the problem are clear: (i) the failure by the regulatory authorities to early recognise the full magnitude and implications of the banking crisis, (ii) the delayed response of the regulatory authorities, especially the failure to deal decisively with bankrupt institutions, and (iii) the inability of the political process in Japan to confront the problem and commit public funds to major financial restructuring. Commitment of sizable public funds to restructure financial institutions and establish a new 'bridge bank' in 1998 are encouraging developments. But one needs to draw on deeper political economy arguments as to why these new initiatives are so late in coming, and why Japan was apparently not able to draw on the lessons from other industrial countries (such as the United States, Finland, Norway, Sweden and others) facing similar problems.

Notes

Michael Hutchison is also Research Associate at the Center for Pacific Basin Monetary and Economic Studies (Federal Reserve Bank of San Francisco) and the Economic Policy Research Unit (University of Copenhagen). The authors thank the UC Pacific Rim Research Program, the International Centre for the Study of East Asian Development and the UCSC Committee on Research and Division of Social Sciences for financial support.

- 1 See International Monetary Fund (1998) for a review of the literature.
- 2 This selection criteria, in turn, is based on studies by Caprio and Klingebiel (1996), Drees and Pazabasioglu (1995), Lindgren et. al. (1996), and Sheng (1996).

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