B INDICATORS OF FINANCIAL DISTRESS IN MATURE ECONOMIES

This special feature analyses the indicator properties of macroeconomic variables and aggregated financial statements from the banking sector in providing early signals of distress in the banking sector. Identifying leading indicators of financial distress is important when assessing systemic risk within a broader financial stability analysis. An empirical model is estimated using data for 15 mature countries over the period 1980-2001. The analysis suggests that low economic activity, high domestic credit growth, rapid growth in property prices, as well as low profitability and low liquidity in the banking sector, have good properties as leading indicators of financial distress.

INTRODUCTION

The series of costly banking crises that occurred in mature economies in the 1980s and 1990s revealed the need to formalise a framework for analysing the current condition and risk absorption capacity of the banking system as a whole. The indicators that have emerged for this type of analysis in the ESCB are known as macro-prudential indicators.[1] In order to take full advantage of these indicators in empirically assessing the degree of systemic risk in the banking sector, it is essential to identify those economic variables that can warn of impending distress in advance. This special feature aims at assessing the leading indicator properties of a range of macroeconomic variables and aggregate information extracted from bank financial statements in order to predict the likelihood of financial distress in the banking sectors of mature economies.

In assessing the properties of leading indicators, the main objective of the analysis is to highlight some common factors that have been observed prior to the emergence of distress in the banking sector. The analysis focuses on episodes of distress that occurred in the 1980s and 1990s in 11 selected mature economies. Due to the relatively short time series available, the limited number of countries considered and the structural changes in the analysed countries in this period, the findings should be interpreted with caution. In particular, there is no guarantee that the set of explanatory factors or their reaction pattern will remain constant over time.

DATING EPISODES OF FINANCIAL DISTRESS

The approach taken to defining and dating episodes of financial distress in the banking sector can be subject to some degree of individual judgement. For instance, financial distress could be defined as a full-blown banking crisis involving many or all banks in the financial system of a given economy (i.e. a systemic crisis). The definition could be extended to include more borderline events and non-systemic crises such as those involving only some institutions, with the banking system as a whole remaining solvent. However, such restricted definitions would not necessarily capture the systemic nature of crisis that is the focus of macro-prudential analysis. Due to the difficulties in dating the financial crises, the setting up of a single measure for financial distress poses some challenges.[2]

The most commonly used method of identifying financial distress in the literature is the event method.[3] This method identifies and classifies certain events in the economy on the basis of some predefined criteria. These events are then mapped into a binary variable. For instance, for conditions of distress in the banking system, a simple measure could be classified as 0, indicating no distress, or 1, indicating distress. For practical

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1 For further information on the macro-prudential analyses performed by the ECB, see L. Mörttinen, P. Poloni, P. Sandars and J. Vesala (2005), "Analysing Banking Sector Conditions – How to Use Macro-prudential Indicators", ECB Occasional Paper, No 26.
2 See A. Houben, J. Kakes and G. Schinasi (2004) "Towards a framework for financial stability", De Nederlandsche Bank Occasional Studies, Vol. 2(1).
3 Another approach using information about banks' demand for central bank reserves in the money market is suggested by T. Ho and J. von Hagen (2004), "Money Market Pressure and the Determinants of Banking Crises", Centre for Economic Policy Research, Discussion Paper, No 4651.

implementation, the most common approach used to define events of financial distress is based on the use of indicators such as high levels of non-performing loans to total assets in the banking sector, bank runs that lead to bank closures, mergers or takeovers by the public sector of one or more financial institutions, deposit freezes, prolonged bank holidays and the high cost of rescue operations.[4]

In the empirical estimation conducted for this special feature, a panel of 15 mature countries was used.[5] Four of the included countries did not experience a period of severe financial distress, and thus serve as a control group. A broad range of macroeconomic variables describing the general economic environment is analysed. As for the banking sector, annual aggregate financial statements are used. The choice of an annual data frequency for the empirical work reflects the difficulty of obtaining aggregate banking sector financial statements at a higher frequency.

IDENTIFYING LEADING INDICATORS OF FINANCIAL DISTRESS

STYLISED FACTS OF DISTRESS

The first step towards identifying leading indicators of financial distress is to examine the stylised facts of potential indicators around distress periods. The variables chosen for this analysis are those commonly considered in the literature. Many economic variables show distinct patterns in the run-up to and during episodes of financial distress. Charts B.1 to B.4 show the evolution of various indicators prior to, during and after episodes of distress. Only the 11 countries that experienced distress – as defined by the event method – are used for this analysis.

Adverse developments in the real economy have in the past tended to precede episodes of distress. In particular, real GDP growth declined on average prior to episodes of distress (see Chart B.1).

Most of the countries in the sample experienced high growth rates in real credit and rising property prices prior to episodes of financial distress (see Chart B.2).[6] Crises tend to erupt, on
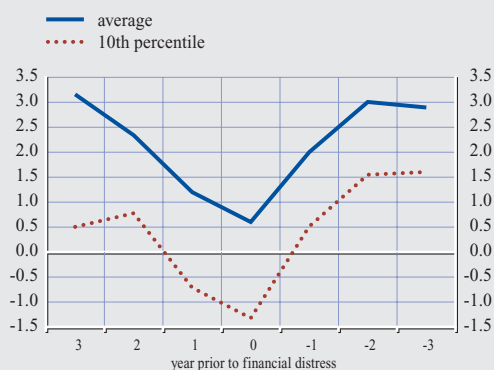
4 A list of periods of financial distress and the dating of these using the event method can be found in G. Caprio and D. Klingebiel (2003), "Episodes of Systemic and Borderline Financial Crises", World Bank.
5 The countries included with distress periods denoted in parenthesis are Belgium (no distress), Denmark (1990-92), Finland (1991-94), France (1994-95), Germany (no distress), Greece (1991-95), Italy (1992-95), Japan (1991-01), the Netherlands (no distress), Norway (1988-93), Portugal (no distress), Spain (1993), Sweden (1990-93), the UK (1990-92) and the US (1984-91).
6 The chart shows growth rates in excess of estimated trends.

Chart B.1 Real GDP per capita growth around periods of financial distress

(% per annum)

- average
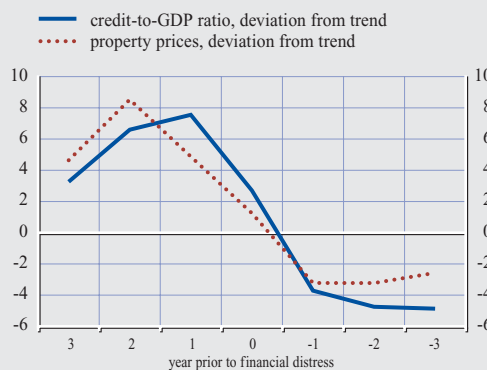- 10th percentile

year prior to financial distress

Sources: OECD, IMF and ECB.
Note: The chart shows the average of the 11 countries in the panel that experienced financial distress.

Chart B.2 Domestic credit growth and residential property price changes around periods of financial distress

(% points)

- credit-to-GDP ratio, deviation from trend
- property prices, deviation from trend

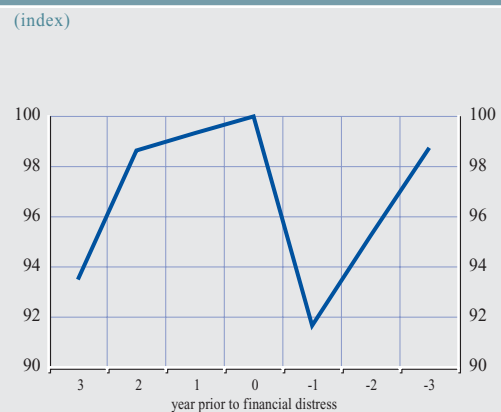year prior to financial distress

Sources: IMF, BIS and ECB.
Note: The trends in the time series were calculated using a Hodrick-Prescott filter. The chart shows the average of the 11 countries in the panel that experienced financial distress.

Chart B.3 Banking sector return on equity (ROE) around periods of distress

(%)

— average
····· 10th percentile

year prior to financial distress
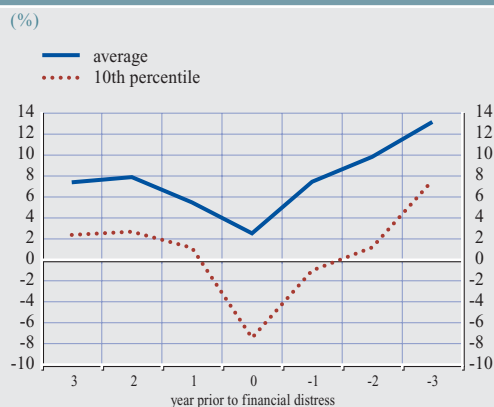
Sources: OECD and ECB.
Note: The chart shows the average of the 11 countries in the panel that experienced financial distress.

Chart B.4 Banking sector loans to non-bank deposits around periods of financial distress

(index)

year prior to financial distress

Sources: OECD and ECB.
Note: The ratio of non-bank loans to non-bank deposits has been set to 100 in the first year with financial distress. The chart shows the average of the 11 countries in the panel that experienced financial distress.

average, two (one) years after deviations from trend in property prices (credit growth) have peaked. It therefore seems that the financial sector is most vulnerable to developments in credit and property prices after the turning point in these indicators has been passed. This is very much in line with the findings of previous studies. Some of the banking crises experienced in the 1980s and 1990s, such as those in the Nordic countries, were characterised by lending booms following a widespread deregulation of the banking sector, surges in asset prices and over-expansion of credit. As asset prices started to correct, typically amid an economic slowdown, banks tended to be hit by rapidly deteriorating asset quality and credit losses.

To account for conditions within the banking sector, aggregate financial statement information of banks on profitability, liquidity and capital adequacy were also used. Prior to distress, patterns in the aggregate ROE in particular have tended to be consistent across the analysed countries. On average the ROE declined prior to episodes of distress, even turning negative in some countries (see Chart B.3).

Liquidity conditions in the banking sector can be gauged using the ratio of non-bank loans to non-bank deposits. This indicator covers the banking sector's dependency on funding lending activities. An increasing gap between funding needs and the availability of customer deposits tends to show that the banking sector is becoming more dependent on alternative, more expensive, funding sources such as the interbank market. On average, this gap increased in the three years prior to episodes of distress in the 11 countries (see Chart B.4).

IDENTIFYING LEADING INDICATORS

To investigate whether the variables described above can effectively capture the build-up of crises and are capable of providing an early signal of distress, a standard logistic regression model was specified (see Box B.1). In the regressions, the four countries that did not experience episodes of distress were included as a control group.

Table B.1 shows the variables included in the estimated model, together with the signs and significance of the estimated coefficients. A positive sign indicates an increased likelihood of experiencing an episode of distress for higher values of the explanatory variable in question. Five variables were identified in the model as providing significant indications of

Box B.1

METHODOLOGY

In order to conduct the empirical work, a panel of 15 countries was set up with annual data from 1980 to 2001. A standard logistic regression model was estimated. In these models, the endogenous variable is binary (0 or 1). In each year the country is either experiencing an episode of distress, in which case the endogenous variable in this model takes the value 1, or 0 if not. Only the first year of distress in a country is recorded as an episode of distress, even if the crisis lasts longer. This procedure is performed in order to avoid the risk of potential feedback effects on the indicators: during episodes of distress, some of the variables might be affected by the distressed period itself. The probability of a future episode of financial distress is assumed to be a function of different explanatory variables. These variables are lagged by one year to investigate whether they are capable of producing satisfactory signals of future distress in the banking sector. Apart from capturing leading indicator properties, lagged explanatory variables also alleviate the potential endogeneity problems typically present in regressions with simultaneous variables. Different techniques were applied to account for structural differences between countries and to highlight the build-up of financial imbalances in the banking sector. The model estimation can be interpreted as the probability of experiencing financial distress within the following year. Such probabilities have to be interpreted with care; the analysis should focus on the trends rather than on absolute measures.

financial distress. These estimations broadly support the empirical findings in the previous section.

First of all, the model estimations confirm that the risk of severe problems in the banking sector increases at times of low real economic activity as measured by growth in real GDP. In addition, high credit to GDP and high real property prices both increase the likelihood of financial distress in the banking sector. It is

important to note that increasing credit activity or rising property prices need not per se necessarily constitute a threat to the stability of the banking sector. However, the literature emphasises that fast credit growth combined with rapid increases in asset prices might increase the vulnerability of banks to crises.[7]

Variables that capture banks' profitability, liquidity and capital adequacy were included as explanatory variables of financial distress. Low profitability in the banking sector, measured by ROE, proved to be significant as a leading indicator of episodes of financial distress.[8] As a measure of banking sector liquidity conditions, the ratio of non-bank loans to non-bank deposits was found to be significant with a positive sign in the model.[9]

Table B.1 Leading indicators of distress

Indicators	Sign	Significance
Growth in GDP per capita (real)	-	significant
Domestic credit to GDP (real)	+	significant
Residential property prices (real)	+	significant
Banking sector return on equity	-	significant
Banking sector loans to non-bank deposits	+	significant
Banking sector lending rate	+	insignificant
Banking sector capital adequacy	+	insignificant

Sources: IMF, OECD, BIS and ECB.
Note: Domestic credit to GDP and residential property prices are jointly included in the model.

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7 See C. Borio and P. Lowe (2002), "Asset Prices, Financial and Monetary Stability: Exploring the Nexus", BIS Working Paper, No 114.
8 It should be highlighted that ROE does not take into account the level of risk associated with the generated income.
9 Several indicators covering the direct liquidity (i.e. liquid assets to total assets) in the banking sector were analysed, but no general pattern was discovered.

To capture the banking sector's assessment of credit risk, the spread between the banking sector's lending rate and a proxy for the risk-free rate was analysed. This indicator tends to increase prior to episodes of financial distress, possibly reflecting a deterioration in the credit quality of borrowers; however, it was not found to be statistically significant in the empirical estimations. *A priori*, it might be expected that low levels of capital adequacy in the banking sector would be observed prior to periods with financial distress, yet this effect was, in general, not supported by the empirical evidence in the analysed sample. However, this does not mean that capital adequacy should not be monitored on an ongoing basis. This is because banks' earnings affect capital adequacy, and it cannot be ruled out that the effect could be accounted for through the profitability measure.

In the sample considered, exchange rate regimes have often played an important role, and in some cases currency crises and banking crises have erupted simultaneously. Sharp moves in the exchange rate, particularly devaluations of exchange rate pegs, could thus work as a leading indicator of financial distress. Estimations corroborate the fact that currency crises and banking crises often coincide. However, there was no evidence that sharp moves in the exchange rate were leading indicators of financial distress for the mature economies considered.

CLASSIFYING PERIODS OF DISTRESS
The estimated coefficients of the model can be interpreted as probability measures. To distinguish between situations of distress and no distress in the banking sector, it is necessary to determine a threshold for the estimated probability. If the estimated probability is higher (lower) than a predetermined threshold probability, a signal (no signal) is provided. Determining the threshold naturally involves a trade-off. On the one hand, setting the threshold too low produces many false signals, whereas most periods of distress are captured. On the other hand, setting the threshold higher

Chart B.5 Trade-off between classifying as distress and misclassifying as no distress

(probability of an episode of distress)
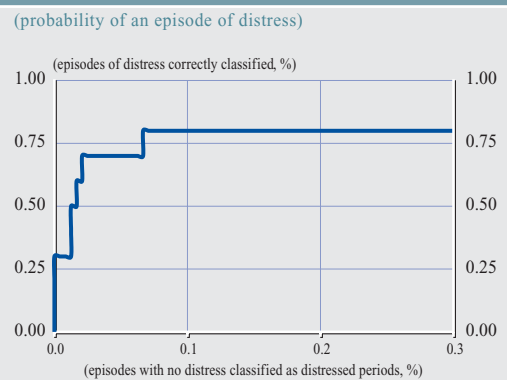
Source: ECB calculations.

reduces the number of false alarms, but with the risk that some of the episodes are missed. Chart B.5 illustrates this trade-off in the estimated model. The proportion of distress episodes that the model captures is measured on the vertical axis. The horizontal axis shows the proportion of years where the model signals distress but no distress was in fact observed. The curve depicts the relationship for the range of thresholds.

In practice, policymakers will put different weights on the two types of misclassification. In the data considered, a neutral threshold would be 4%, which is the frequency of distress periods in the sample. Based on this threshold, the model correctly classifies 84% of the observations in the sample. Decomposing this for the different states, the model correctly predicts 80% of episodes of distress and 84% of the years where no distress occurred.

CONCLUDING REMARKS

Combining analyses of macroeconomic imbalances together with information on the condition of balance sheets in the banking sector can provide early warnings of impending financial distress. The implications of these findings are clear. In particular, they underline the importance of central banks carrying out periodic macro-prudential analyses. Even though distress in the banking sector to some

extent can and has been triggered by idiosyncratic incidents, several common factors in the countries examined can be observed. This calls for these factors to be analysed on a systematic basis when assessing the degree of systemic risk facing the banking sector. This notwithstanding, it cannot be excluded that the set of indicators that drive banking sector crises could change over time. Structural changes such as the development of risk management techniques and increased activity in derivatives markets by financial institutions might have changed the importance of some of the identified variables as leading indicators.