Financial stability analysis using aggregated data

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1. Introduction

It is increasingly recognised that it is necessary to look at financial stability from a "macro" as well as a purely "micro" perspective which focuses on individual institutions' risks. Financial distress can result from a *concentration of exposures* of individual institutions or exposures of individual institutions to *common factors*. There are connections between the liquidity and solvency of individual institutions when their exposures are concentrated. Financial market prices and macroeconomic conditions represent the key common factors which may affect all institutions.

Structured monitoring of the concentration of exposures amongst financial institutions and of common factors may signal the emergence of important imbalances. First, *financial market stability indicators* allow monitoring of an important set of common factors. Second, the resilience of the banking sector is monitored through *regular macroprudential analysis of EU banking system stability*, which is undertaken by the Working Group on Macro-prudential Analysis (WGMA), reporting to the Banking Supervision Committee (BSC) of the ESCB.[2]

Section 2 of this paper describes the analytical frameworks in these two fields. Examples and data are provided to give a flavour of the analysis. Section 3 addresses the most important gaps in the data currently available at the international level. Section 4 deals with the enhancement of the analytical toolkit, focusing on the issue of establishing links between macro developments and the soundness of financial institutions. An analysis of the development of asset prices and their implications for financial stability is discussed as an important example of this approach. Finally, Section 5 concludes the paper by considering the limits of the analysis using aggregated data only.

2. Activities in monitoring financial stability

The analyses considered in this section are aimed at detecting and monitoring cyclical or structural *vulnerabilities* in the financial system. When these vulnerabilities are present, certain *destabilising events* (eg a stock market crash) may (rapidly) lead to financial instability, possibly producing adverse effects on the real economy. The analyses might warn of possible threats to financial stability, but the aim is not to forecast the occurrence of destabilising events.

The framework for financial market stability indicators addresses the potential for rapid price movements or liquidity shortages in the financial markets, which may have undesirable consequences for the financial system or the economy as a whole.

The macroprudential analysis deals with the soundness of the banking system as the key systemic component of the financial intermediaries sector. Banks in Europe continue to be the key intermediaries, notwithstanding the growing importance of financial markets, on account of their activities in syndicated loans, credit lines and securities underwriting.[3] They have also acquired a

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[2] The Banking Supervision Committee is composed of representatives of the banking supervisory authorities of the EU countries, which are either part of the respective national central banks or separate bodies, and of the European Central Bank. Its working groups have a similar membership structure.

[3] The focus on the banking sector is justified by the notion that banks continue to be crucial to financial stability, since they provide *liquidity on demand* for the other financial and non-financial sectors of the economy. To the extent that financial markets can substitute for disruptions in lending caused by bank capital shortages, the macroeconomic consequences of banking distress would be mitigated. However, there is some empirical evidence that reductions in bank lending may not be fully offset by increases in lending from other financial intermediaries or markets. See, for example, P Jackson et al (1999).

strong base in asset management because of their traditionally strong private banking activities and distribution networks. The soundness of the non-bank financial institutions is included in the framework adopted by the BSC only to the extent that non-bank financial institutions might have a destabilising impact on banks via group structures. Finally, non-financial sectors are considered so as to assess potential sources of financial market disturbances, and the debt servicing capability, leverage, and composition and development of the financial assets and liabilities of the private non-financial sectors of the economy (households and firms). The robustness of the payment and securities settlement infrastructure represents an important subject for financial stability analysis, but falls outside the scope of this paper.

2.1 Financial market stability indicators

A range of indicators based on financial market prices needs to be reviewed to assess tensions in financial markets both in the euro area and at the global level. Euro area-wide and even global views are important, since issuers, investors and intermediaries are already operating to a large extent on an international basis. The financial market tensions addressed in the analysis can be broadly defined as:

(i) departures from the usual pattern of linkages between various financial market prices;

(ii) a heightened degree of uncertainty as perceived by financial market participants;

(iii) long-lasting and sizeable divergences from the price levels which would appear to be consistent with fundamental determinants.

These tensions may reflect trends in the non-financial sector of the economy, or in foreign economies. Hence, the analysis also requires a good understanding of broader economic developments.

The monitoring exercise encompasses a wide range of indicators for *foreign exchange, interest rate, equity* (see also Section 4) and *commodity markets*. For each one of these markets, five main categories of indicators reflect, respectively:

(i) recent financial market developments;

(ii) size of price fluctuations (*measures of market volatility*);

(iii) degree of market activity (*measures of market depth and liquidity*);

(iv) credit conditions, in particular issuer or counterparty spreads (*measures of credit standing*);

(v) triggering or aggravating factors not falling into the above categories (*other measures*).

Recent financial market developments

The review of recent financial market developments forms the background for the analysis of possible tensions in financial markets. In this context, a wide array of financial market indicators need to be considered, including foreign exchange rates, interest rates and yield curves, stock price indices and commodity prices.

Measures of market volatility

These indicators focus on *historical volatility* and *implied volatility*, as well as on the *difference between them*.[4] In particular, the last type of indicator may serve as a guide to market expectations of future adjustment in financial market prices or their volatility.

Another important indicator is the *term structure of option prices*, as measured by the slope of the implied volatility curve, which may include information about how the distribution of price changes is expected to develop over time. A strongly positive slope would suggest that market participants expect increasing volatility in the future. A strongly inverted volatility curve and the forward implied volatilities

[4] Historical volatility is the square root of the variance of the past percentage changes in prices. Implied volatility is the volatility level consistent with option prices. It therefore reflects perceptions of future volatility among option traders as well as, to some extent, the simplifying assumptions in the option pricing models, which would tend to introduce a wedge between the measured implied volatility and the true expected volatility.

derived from this peculiar shape contain information about the pace at which market participants expect volatilities to return to their mean or long-term average. Because of uncertainty, term structures of volatility should be slightly positively sloped under "normal" circumstances, when there are no strong expectations of any particular change in the forward implied volatility.

In addition, a wide array of other measures of market volatility can be extracted from option prices. In particular, the prices of options on swap contracts (swaptions) or on money market futures can provide implied interest rate volatility curves.

Measures of market depth and liquidity

Although it is difficult to measure exactly the degree of market depth and liquidity, various indicators can help assess a possible build-up of imbalances in financial markets.

Bid-ask spreads provide indications of transaction costs. It is useful to complement the analysis of developments in bid-ask spreads by reviewing developments in transaction volumes, for two reasons. First, there may be cases where transaction volumes increase while transaction costs remain relatively high. Such situations could suggest a high level of uncertainty, inducing market participants to carry out a number of hedging or speculative transactions despite the transaction costs. Second, price shocks may occur in an environment of low trading activity. This could suggest that the shocks might be reversed once the more active trading conditions are restored.

Indicators of market activity also provide useful indicators of depth and liquidity; in particular the *daily traded volumes* and *aggregate end-of-day positions* ("open interest") on derivatives markets (see Box 1 for an example).

Other indicators include the *measures of the smoothness of the yield curve*. When government bond markets are very deep and liquid, arbitrageurs can take advantage of even very small pricing differences. This type of trading activity contributes to smoothing out pricing anomalies, and hence changes in the smoothness of the yield curve can provide an indication of the depth and liquidity of the government bond market. However, since this type of trading activity involves risks, the extent to which market participants engage in it will depend on their capital buffers and risk appetite.

Measures of credit standing

When financial market participants develop risk exposures which are excessive in relation to their capital buffers, it is likely that they will face tighter credit conditions if this becomes known in the marketplace. Measures of credit standing permit an assessment of such developments. The indicators monitored include various *interest rate spreads*, for example the spread between debt securities issued by banks or other firms and government debt securities.

The corporate bond market is becoming an increasingly important component of the markets for debt securities as there is a structural trend in borrowing activity away from central government to the private sector.[5] Moreover, the introduction of the euro has apparently led to a marked increase in corporate debt issuance in the euro area. As a result, a wide array of corporate bond indices has become available. Box 2 presents some newly collected data on euro area corporate bond indices and analyses the main factors which have affected developments in corporate bond yields in the euro area.

[5] In the euro area, as at end-1999, the corporate bond market still constituted a relatively unimportant source of financing, accounting for only 7% of all borrowing by the private non-financial sector, compared with 29% in the United States. See Rixtel et al (2000). This reflects the more important role played by the banking sector in the euro area financial structure.

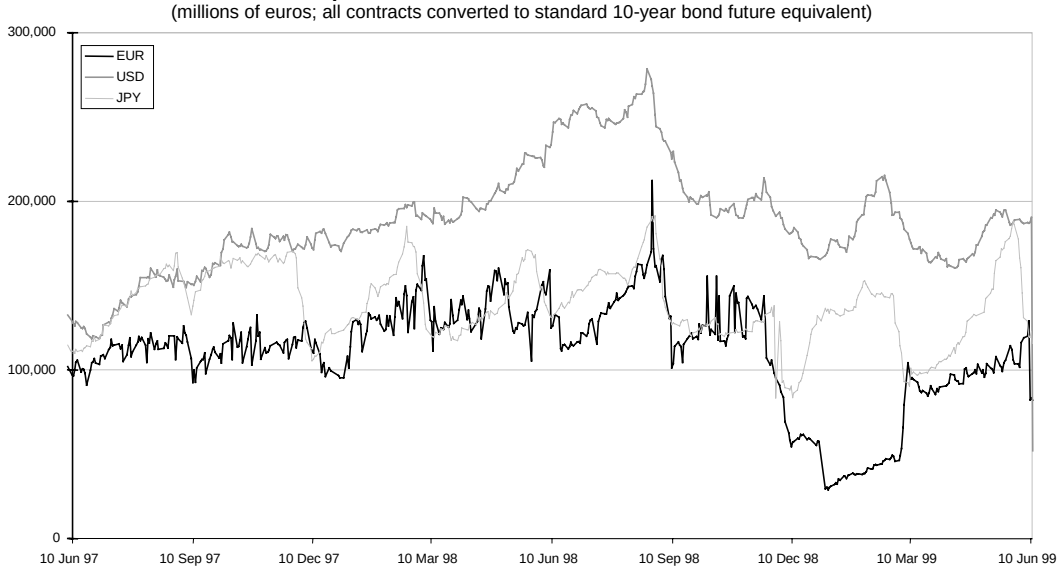
Box 1

An example of aggregated open interest in derivatives markets as a market activity indicator

Open interest on euro area government bond futures declined sharply around the end of 1998 at the time of the changeover to the euro, from around EUR 144 billion on 18 November 1998 to around EUR 29 billion on 4 January 1999. It remained subdued between EUR 30 and 50 billion in January and February 1999 and increased to over EUR 100 billion at the beginning of March 1999. Over the same period from December 1998 to March 1999, developments in open interest on Japanese government bond futures appeared to be a mirror image of those in the euro area (see chart).

Over this period, bond market interest seemed to switch from the euro area to Japan. The switch was reversed at the March 1999 rollover of positions, suggesting that it had been mainly related to a temporary attractiveness of Japanese government bond futures compared with euro area government bond futures during this period. This temporary switch of market interest may have been related to the marked increases in Japanese government bond yields towards the end of 1998, as well as to the relatively low liquidity of euro area bond markets at the end of 1998. (Japanese government bond yields increased from an average of 0.9% in November 1998 to over 2% by the end of December 1998.) Another explanation may have been that the levels reached by bond yields in the euro area at the beginning of 1999 may have been perceived by a number of market participants as being too low. Over the same period, there also seemed to be some interplay between changes in positions in bond futures and changes in positions in money market futures. In particular, open interest on yen money market futures declined sharply in December 1998. In part, this reflected the unwinding of "yen carry" positions combining short interest rate positions in Japanese yen and long interest rate positions in euros, US dollars or other currencies, which had been built up in particular by some hedge funds over preceding months.

Open interest on bond futures contracts
(millions of euros; all contracts converted to standard 10-year bond future equivalent)



Other measures

In addition, a number of ancillary financial market indicators can be quite useful, some of which are only relevant under certain special circumstances. One such indicator is the Japan premium, which has reflected market concerns about the soundness of certain Japanese financial institutions, particularly over recent years. Other indicators monitored include valuation indicators for stock prices (see Section 4).

Box 2

Analysis of corporate credit spreads

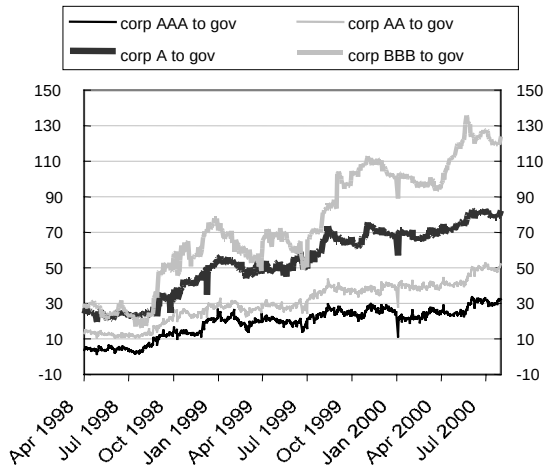
Corporate bond spreads can be broken down into three main components: (i) *market price of credit risk*; (ii) *credit risk uncertainty premium*; and (iii) *liquidity premium*. The first two components in particular depend on a number of factors. Notably, the market price of credit risk may increase when the economic outlook deteriorates but credit demand remains strong, or when firms become more highly leveraged. The credit risk uncertainty premium may increase when the volatility of earnings increases. The liquidity premium is likely to fall with the development of the corporate bond markets. However, on occasions, for example under a "flight to quality", investors may still suddenly and abruptly reorient their portfolios towards the safest and most liquid securities. This creates a temporary imbalance between the demand for and supply of both corporate and government bonds, which can lead to a temporary increase in corporate bond spreads. A spread widening can also happen for structural reasons. For example, when the government plans to reduce issuance and engage in buyback programmes (as in the United States and the United Kingdom, for example), this can push government bond prices higher and yields lower, and result in an increase in corporate bond spreads.

Merrill Lynch has recently started publishing bond indices for the euro area (available on Bloomberg), covering corporate and government bonds in euros (or legacy currencies), and in US dollars. A comprehensive range of indices exists, broken down according to sector, maturity and other characteristics of the instruments. Considering spreads based on corporate bond yields, it may be observed that spreads between corporate and government bond yields increased considerably between the second half of 1998 and end-July 2000. While there was an unclear trend in the fourth quarter of 1999 and the first quarter of 2000, there were renewed increases in the second quarter of 2000 (see charts). However, the possible existence of a "scarcity premium" complicates the interpretation of developments in spreads between corporate bond yields and government bond yields, as well as the interpretation of swap spreads. In particular, over recent months the declining supply of government bonds and government bond buybacks may have led to "scarcity premiums" tending to push government bond yields down relative to corporate bond yields or swap spreads, particularly in the United States. In the euro area, the evidence available so far suggests that this effect has remained limited in the first eight months of 2000.

In the euro area, the increases in credit spreads which occurred in the first eight months of 2000 have been relatively evenly distributed among financial and non-financial borrowers, although financial borrowers generally pay smaller spreads (see charts). All in all, the analysis suggests that credit conditions in the euro area corporate sector, in particular for debtors with lower credit ratings, have recently tightened more than the government bond yield curve would suggest.

Spreads between corporate bond yields and government bond yields in the euro area

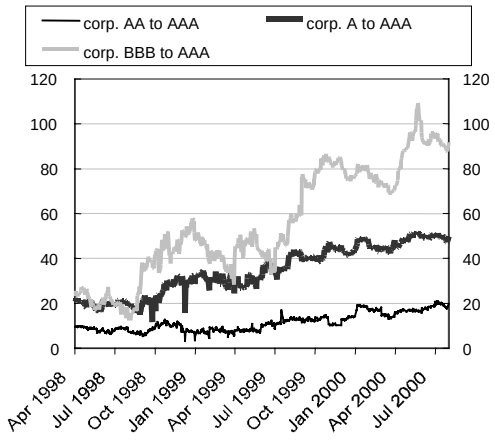
(basis points, all-maturity indices)



Sources: Bloomberg; Merrill Lynch.

Spreads between corporate bond yields in the euro area

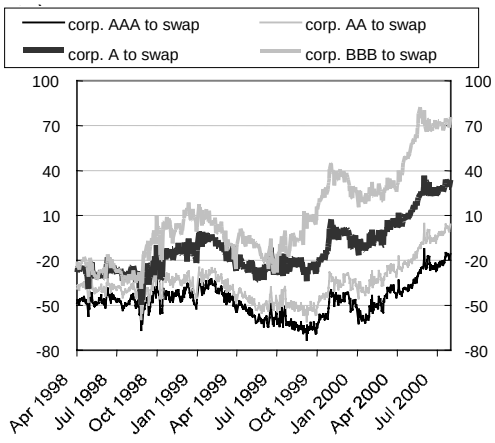
(basis points, all-maturity indices)



Source: Bloomberg and Merrill Lynch

Spreads between corporate bond yields and swap rates in the euro area

(basis points, all-maturity indices against seven-year swap



Source: Bloomberg and Merrill Lynch

2.2 Macroprudential analysis of banking system stability

The macroprudential analysis of EU banking sector stability covers both *national developments (EU 15) and those at EU/euro area level*, since both are relevant for the objective of assessing the stability of the banking system, although there is more focus on the latter. An area-wide view is necessary, since macroeconomic developments are gradually becoming more closely intertwined in the European Union and, in particular, the euro area. Major disruptions in the banking system typically stem from abrupt changes in the macroeconomic environment or in relevant sectors of the economy. Even though most retail markets are still segmented, common factors are more and more likely to affect the choices of financial institutions and their risk exposures. Moreover, elements of fragility may well arise from capital markets and especially interbank business in euros, which already have an area-wide dimension due to a significant extent to the single currency and common large-value payment system (TARGET). The area-wide perspective can also be a useful contribution for the national supervisory authorities.

However, the cyclical factors in economic growth and lending expansion, and also banks' margin and profitability developments, for example, show quite significant differences across countries. Regional imbalances, which are not detected at the area-wide level, may also arise and may generate spillover effects throughout the area. Hence, focusing only on area-wide developments would not be appropriate.

The macroprudential analysis encompasses:

(i) identification of significant exposure build-ups or fragilities *within* the banking system which could destabilise the banking system or make it vulnerable to disturbances from outside (*internal factors*);

(ii) identification of potential disturbances emerging from *outside* the banking system (*external factors)*.

The techniques which are used to conduct the analysis include:

(i) systematic and regular monitoring on the basis of the *quantitative macroprudential indicators (MPIs)* drawn from the data on the EU banking systems and macroeconomic and financial developments;

(ii) interpretation of these MPIs and the addition of relevant elements based on the *information and insight obtained through the supervisory process at the national level*.

The importance of the second aspect cannot be overstated. The feedback and additional information obtained from the EU supervisory authorities represented in the WGMA is in fact regarded as the main contribution stemming from this analysis.

Literature on MPIs

A large number of papers, especially by the IMF and World Bank suggest that severe banking distress can be associated with the following *macro-level disturbances* (some of which would most likely occur simultaneously): [6]

(i) a fall in real GDP growth;

(ii) substantial swings in inflation;

(iii) large capital inflows;

(iv) mounting foreign liabilities;

(v) rising real interest rates;

(vi) a declining capital-to-output ratio;

(vii) a fall in equity and/or real estate prices;

(viii) a substantial change in the real exchange rate;

(ix) an adverse trade shock;

(x) weak corporate (and household) balance sheets;

(xi) rapid changes in competition among banks.

A recent study also concludes that the inclusion of macroeconomic variables increases the explanatory power of those models based on micro-level information alone.[7]

There is less literature evaluating the predictive power of *aggregated supervisory information* based on profit and loss and solvency data. A recent survey suggests that these indicators have limited leading properties.[8] Nonetheless, it is clearly recognised that the degree of weakness of financial institutions with regard to withstanding shocks is a major determinant of financial crises and their timing. Studies also seem to support the idea that foreign exchange crises can provoke financial crises when the banking system is vulnerable, or when currency depreciation severely reduces the ability of banks' customers to service their debt.[9] Moreover, some other measures with more leading indicator properties, such as the deposit-to-M2 ratio, the interbank interest rate differential and bank share prices, have been found to be statistically significant.

These studies provide broad guidance for selecting MPIs for regular monitoring purposes. It is important to note, however, that the literature is not yet mature enough to make absolute choices among various indicators, and thus justifies a fairly open approach to selecting the MPIs. Some MPIs can be complementary, while also conflicting sometimes.

MPIs included in the monitoring exercise

A set of feasible MPIs has been established based on the identification of the *main risk factors* for EU banking systems stemming from internal and external elements. They are broadly (but not all explicitly) supported by the empirical literature. The main indicators are reported in Box 3, and the current data sources in Box 4. The MPIs are collected country by country and euro area/EU aggregates are provided. A major pending data issue is the lack of comparability of certain key bank profitability and balance sheet items across countries, such as provisioning and non-performing assets. A second gap is the data necessary to calculate financial fragility indicators and to evaluate financial flows (see Section 3). These data have to be considered purely on a country basis. In addition to the aggregated indicators presented, distributions of profitability, solvency and non-

6 For a useful summary see IMF (2000).

7 See Gonzales and Hermosillo (1999).

8 See Demirguc-Kunt and Detragiache (1999).

9 See Kaminsky, Lizondo and Reinhart (1998).

performing assets are monitored across the major banks (occupying more than 2% of the national market).

The following contains a brief outline of the reasons for using the selected MPIs. The indicators in Section 1 of Box 3 attempt to capture the accumulation of credit risks and other risks which could increase the vulnerability of the banking system. Both *on-balance-sheet and off-balance-sheet exposures* are included, and *sectoral credit expansion measures* are assessed. The *currency and maturity structures* are also monitored. *Global lending developments* and *exposures to emerging and developing countries* are assessed on a consolidated basis.

As for the *indicators on competitive conditions* (Section 2 of the box), shifts towards greater competition can lower profits. In response, banks may increase their risk-taking as a means of temporarily increasing profits. In particular, high lending growth together with tough competition can constitute a sign of harmful, short-sighted market share competition at the expense of long-term profitability.

Risks are one element of failure, but the degree to which banks are able to withstand pressures arising from realised risks is also important. It is important not only to measure the *capital adequacy ratio* of the banking system at any given point in time, but also to obtain an impression of the future development of capital adequacy as basically driven by *income, cost and asset quality developments* (Section 3). Information extracted from *market prices* is also used in this context. For example, the performance of financial sector shares relative to overall stock price indices can provide timely indications of earnings prospects as well as perceived soundness of financial sector firms.

The soundness of the banking system crucially depends on the sustainability of the level of corporate and personal debt as evidenced by past instances of banking problems (*financial fragility indicators*, Section 4). *Indebtedness and income-based financial fragility indicators* are recognised as key leading indicators pinpointing which financial systems could come under stress in the future. Combined with credit growth, external (non-deposit) funding of banks and asset prices, these indicators could help to detect dangerous *economy-wide leverage* in line with the debt-financial fragility theory. This area in particular entails significant pending data issues (as discussed in Section 3 of this paper).

Elevated *asset prices* (stock and commercial and residential estate prices) often lead banks to make lending decisions based on asset values which are unsustainable in the long run (Section 5 of the box), and asset price slumps following excessive asset price hikes affect banks in various ways. Hence, this area is an integral part of the macroprudential analysis.

Finally, *overall macroeconomic data* (both current figures and forecasts) on production, investment and consumption, interest rates and exchange rates provide information about the stage in the business cycle for individual countries and the European Union as a whole which is relevant to the assessment of banks' external environment (Section 6).

3. Gaps in the information base

Data on the exposures of banks are obviously very important for macroprudential analysis, and there is a need to enhance the data on *off-balance sheet credit exposures* in particular in order to provide a better overview of the direct exposures of banks.[10] Developments are taking place; for example the BIS's consolidated banking statistics are being enhanced so as to make the data reflect more closely the full magnitude of the exposures across relevant instruments and sectors of counterparties.[11] However, the supervisory and statistical authorities generally have difficulty linking the credit exposures with underlying collateral (apart from mortgages). This makes it difficult to analyse the impact of asset price declines on banks. Some efforts are also under way among EU supervisory authorities to collect more information on provisioning and on non-performing assets on a non-harmonised basis. Since the ties between banks and non-bank financial institutions are becoming stronger, patchy information on the latter can also be regarded as a major gap in the information base.

[10] See Uhl and Monet (2000).

[11] See BIS (2000); Committee on the Global Financial System (2000).

Box 3

Main macroprudential indicators

I. Internal factors	**Scope (1)**
1. Credit and liquidity risk concentrations	
Domestic credit growth and sectoral concentration (*GDP share and growth*)	
Aggregate lending	U
Aggregate new lending	U
Lending to households, concentrations	U
Lending to non-bank non-financial corporations	U
Lending to non-bank financial corporations	U
Residential mortgage lending (households)	U
Commercial mortgage lending	U
Aggregate fixed income securities holdings	U
Aggregate balance sheet total	U
Aggregate lending within the euro area	U
Currency and maturity structure of domestic lending	
Share of lending of less than one year (using the original maturities)	U
Share of lending in foreign currency (other than domestic currency)	U
Global credit exposures (*GDP share and growth*)	
Aggregate lending to the non-bank non-financial sector	C
Aggregate fixed income securities holdings	C
Aggregate balance sheet total	C
Aggregate credit equivalent of off-balance sheet items	C
Liquidity risk	
Ratio of non-bank deposits to M2	U
Ratio of total loans to non-bank deposits	U
Share of foreign short-term liabilities in total liabilities (BOP data on flows)	U
Range of interbank CD rates (highest to lowest, percentage points)	
Emerging and developing country exposures (*ratio to consolidated own funds of the exposed banks)*	
Aggregate gross credit exposure to BIS-defined emerging and developing countries	C
Aggregate gross credit exposure to Asian countries	C
Aggregate gross credit exposure to Latin American countries	C
Aggregate gross credit exposure to central and eastern European countries	C
2. Competitive conditions	
Average margin on new lending	
Average margin on new lending to households	
Average margin on new lending to non-bank corporations	
Average margin on retail deposits	
Overall margin (difference between new lending and deposit rates)	
3. Profitability and capital adequacy	
Income and cost development and profitability	
Aggregate net non-interest income per aggregate total income	C
Aggregate commissions (net) and fees per aggregate total income	C
Aggregate trading and forex results per aggregate total income	C
Aggregate operating costs (including depreciation) per total income	C
Aggregate provisioning per own funds	C
Aggregate bad debt charges per own funds	C
Aggregate profit after provisions, before tax per own funds (ROE)	C
Aggregate profit after provisions, before tax per total assets (ROA)	C

Asset quality	
Non-performing loans (net of provisions) per total loans	C
Non-performing loans (net of provisions) per total own funds	C
Capital adequacy	
Aggregate risk-based capital ratio	C
Aggregate tier one capital ratio	C
Own funds requirement under CAD	C
Market assessment	
All-bank share price index versus all-share index *(semiannual change)*	
Average yield spread between bank bonds and government bonds	
Average yield spread between interbank CDs and treasury bills	
Range or spreads between bank bonds and government bonds (highest to lowest, percentage points)	
Number of bank rating downgrades within the observation period	
II. External factors	
4. Financial fragility	
Financial debt of the non-financial corporate sector	
Financial debt of the household sector	
Interest servicing costs of the corporate sector	
Interest servicing costs of the household sector	
5. Asset price developments (percentage changes in the respective indices)	
General stock index	
Dow Jones Euro STOXX index	
US stock index	
Commercial real estate prices	
Residential real estate prices	
6. Cyclical and monetary conditions	
Rate of real GDP growth	
Rate of nominal GDP growth	
Rate of growth in real aggregate investment	
Rate of growth in real private consumption	
Rate of unemployment	
Rate of change in M2/M0	
Rate of change in the three-month money market interest rate	
Rate of change in long-term real interest rate (10-year government bond)	
Rate of change in the nominal long-term interest rate (10-year government bond)	
Rate of change in the exchange rate of EUR, DKK, GBP, GRD and SEK versus USD	
Rate of change in the consumer price index (CPI)	
U = unconsolidated “host country” data, C = consolidated “home country” data.	

In addition, it is important to analyse overall *flows of financial resources* and the *development of financial fragility in other economic sectors* (households, corporations and non-bank financial institutions). This allows, for example, a better understanding of the debt servicing capability of the borrower sectors. Data are generally much less developed for these two areas than for banks. Both areas currently suffer from a lack of consistent and timely data (particularly financial accounts statistics) for EU member states (and other countries) for the purposes of euro area-wide analysis. The achievement of adequately harmonised and timely international statistics would represent a major contribution to improving financial stability analysis.

Box 4

Data sources for macroprudential indicators

A large number of MPIs have been assembled from the ECB Monetary and Banking Statistics (MBS) and other statistics. Moreover, the development of the MBS as regards non-bank financial intermediation (other than pension funds and insurance companies), MFI (retail) interest rates, and possibly also financial derivatives will provide valuable material for macroprudential analysis.

The reporting population covered by the MBS (excluding central banks), monetary financial institutions (MFIs), comprises resident credit institutions as defined in Community legislation, and all other resident financial institutions whose business is to receive deposits and/or close substitutes for deposits from entities other than MFIs and, for their account (at least in economic terms), to grant credits and/or to make investments in securities. These other resident monetary financial institutions notably include money market funds. MFIs consolidate the business of all their offices (head office, subsidiaries and/or branches) located within the same national territory. Separate information on balance sheet data on credit institutions is available. MBS data is compiled on a "host country" basis: the business of foreign branches of domestic credit institutions is reported by the country abroad, whereas the business of resident branches of foreign credit institutions is considered as domestic.

Exposures towards emerging and developing countries and other consolidated cross-border credit exposures are available from the BIS consolidated international banking statistics, which are currently being enhanced to include relevant off-balance sheet items.[12]

OECD, ECB and commercial sources (such as Datastream) are used for stock market data and macroeconomic and financial developments. Real estate prices are obtained from the BIS or European Mortgage Federation sources.

Bank profitability and solvency data are collected in cooperation with the Groupe de Contact from supervisory sources. Currently, efforts are being made to improve the database for non-performing assets and provisioning needed to assess asset quality issues. The data are collected on a consolidated "home country" basis (except for Luxembourg and Austria), that is, including the global operations of the domestically incorporated banks and covering domestically operating subsidiaries of foreign banks. The analysis of the data is subject to some complications as there are inconsistencies between balance sheet and profitability data. However, it is also useful to consider both "residency-based" and "consolidated" data. For the purposes of linking macroeconomic and financial developments in a particular market to the banking activity in this market, unconsolidated "host country" information is appropriate, while consolidated data are needed to appreciate credit exposures, profitability and solvency.

3.1 Data to capture flows of funds

Credit flows from financial institutions to households and corporations may play a fundamental role in the build-up of asset price bubbles.[13] Banks may extend more credit on the basis of the increasing value of collateral, and this trend may be exacerbated if lending policies are focused on a "point in time" evaluation of the borrower rather than on a "through the cycle" assessment of the probability of default. Furthermore, the process may be reinforced if banks engage in tough competition for market share in the credit market. Empirical findings in connection with recent Scandinavian crises are in line with this reasoning with regard to the development of an unsustainable real estate market bubble.[14] There is also evidence that bank loans to the real estate sector triggered asset price inflation in Japan, the United Kingdom and the United States in the 1980s. For example, Hargraves et al[15] take the view

[12] See Committee on the Global Financial System (2000).

[13] See Fisher (1993); Minsky (1977 and 1991) and Eichengreen and Portes (1987).

[14] See Berg (1998) and Bäckström (1998).

[15] See Hargraves et al (1993).

that asset price inflation in Japan and the United Kingdom in the 1980s was largely attributable to a mismatch between the assets and liabilities of banks. The decline in traditional lending activities, such as loans to corporations and, in the case of Japan, to the general government sector, coincided with abundant deposit funding and capital inflows. The resulting excess liquidity induced banks to expand lending in other areas, such as real estate projects which might otherwise have been rejected. Asset price inflation was less pronounced in the United States, because the changes in borrowing and saving patterns were accompanied by a decline in sources of funding for banks.

Flow-of-funds matrix

The determinants and effects of bank credit growth can be usefully studied within *a coherent framework of financial flows*, ie *a flow-of-funds matrix* (see Box 5). An ideal data set for the purposes of macroprudential analysis would comprise a rather detailed matrix which could be used, for example, to relate banking flows to other financial flows. The matrix would show the acquisition of financial assets and the composition of financial liabilities for each sector of the economy (households, non-financial corporations, banks, institutional investors, general government sector and the rest of the world). Each sector would appear both as (i) a holder of financial assets (rows) and (ii) a debtor or issuer of securities (columns). The matrix should also show the financial instruments traded in the financial markets. For the macroprudential analysis of the EU banking sector, it would ideally be constructed both at EU or euro area level and at national level, since national systems still have many peculiarities as regards financial structures and instruments and the underlying determinants of financial flows. The construction of the complete matrix at EU or euro area level would be possible only after the harmonisation of disparate national methodologies for financial account statistics.

A stock version of the matrix, constructed on the basis of the outstanding amounts, would also be highly relevant for analysing the composition of financial assets and liabilities and hence, for example, their vulnerability to a stock market decline.

Data needed to construct the flow-of-funds matrix

For the time being, it is not possible to construct a stocks or flows matrix for the euro area or the European Union as a whole. Some countries produce the data on a regular basis (eg France, Spain, Germany and Italy), but the geographical coverage and timeliness of data at international level are not adequate. However, for analytical purposes, certain data can be obtained from existing statistics on monetary financial institutions (MFIs; see Box 5) and balance of payment statistics.[16] Statistics on general government deficits and aggregated accounts of corporations represent complementary sources. Another major shortcoming is the very limited availability of data related to institutional investors and non-financial corporations. For the euro area, the ongoing work of developing financial account statistics is filling important gaps in the information base (many relevant cells in the matrix; see Box 5).

3.2 Data required to construct financial fragility indicators

Given the importance of financial fragility indicators, it is important that they are available on a timely and frequent basis (eg quarterly). Data items which are particularly relevant for calculating indicators for *household and corporate sector gross and net leverage,* and for *evaluating the composition of their financial assets and liabilities* are listed in Box 6.[17]

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[16] The euro area aggregated balance of payments provides reasonably good proxies for the accumulation of financial assets and the structure of financial liabilities of the rest of the world in its transactions with the euro area. The part on portfolio investments is useful, as flows are available by instrument (debt and equity, money market instruments and others) and by sector (general government, MFIs and other sectors) for both assets and liabilities. The main shortcoming is the fact that no further sectoral breakdown is provided for the non-financial private sector.

[17] In order to calculate leverage, additional data are needed. For example, in order to calculate the degree of leverage of an indebted household owning real estate, data on the value of the real estate assets would need to be combined with data on the debt liabilities.

Box 5

Flow-of-funds matrix

Composition of financial liabilities by sector	Households	Non-financial corporations	Banks	Institutional investors (non-bank financial institutions)	General government	Rest of the world	Total
1. Acquisition of financial assets			**A**		**A**	Capital outflows	**A**
Households							
Deposits (1)			**A**				
Equities							
Interest bearing securities (1)							
Non-financial corporations (NFCs)						Capital outflows by NFC	Total acquisition of assets by NFC
Deposits (1)			**A**				
Equities							
Interest bearing securities (1)							
Banks (2)	**A**	**A**	**A**	**A**	**A**	**A**	**A**
Loans (1)	**A**	**A**	**A**	**A**	**A**	**A**	**A**
Equities						**A**	**A**
Interest bearing securities (1)	**A**	**A**	**A**		**A**	**A**	**A**
Institutional investors							.
General government			**A**				
Rest of the world			**A**				
Total	**Total liabilities**	**Total liabilities**	**Total liabilities**	**Total liabilities**	**Total liabilities**	**Total liabilities**	**Sum of financial assets = sum of financial liabilities**
2. Structure of financial liabilities by instrument (3)						**Capital inflows**	**Total debt accumulation**
3. Net acquisition of financial assets (3)	**Net surplus**	**Net surplus**	**Net surplus**	**Net surplus**	**Net surplus of general government**	**Current account surplus**	**Zero**

A = available for euro area countries from the MFI and balance of payments statistics (the two sources can exhibit methodological discrepancies). The availability refers to the respective stock items. Shaded cells represent data items which are not relevant.

(1) The distinction between short-term and long-term instruments is important.

(2) Monthly stocks and flows of MFIs' holdings of loans, securities and shares are available with a basic sectoral breakdown. On a quarterly basis, data on MFI issues of such instruments are broken down by sector (households, corporations, central and other general government, other financial intermediaries, insurance companies and pension funds and non-residents Monetary Union Member States and others). The exercise is more difficult on the liabilities side, because data on securities issued by MFIs are not broken down by sector. The calculation of flows requires additional methodological steps, as stocks have to be corrected for exchange rate changes, market price variations and the effect of changes in the composition.

(3) These items have a similar structure to that for financial assets. They are therefore not reproduced in the table.

Box 6

Relevant data items from financial accounts for calculating financial fragility indicators

1. Total financial assets of non-financial enterprises
2. Total financial assets of households
3. Bonds and short-term securities held by non-financial enterprises
4. Bonds and short-term securities held by households
5. Shares and other equities issued by residents and held by non-financial enterprises
6. Shares and other equities issued by the rest of the world and held by non-financial enterprises
7. Shares and other equities issued by residents and held by households
8. Shares and other equities issued by the rest of the world and held by households
9. Shares in mutual funds held by households
10. Shares and other equities issued by non-financial enterprises
11. Short-term debts of non-financial enterprises
12. Long-term (and medium-term) debts of non-financial enterprises
13. Short-term debts of households
14. Long-term (and medium-term) debts of households
15. Gross saving of non-financial enterprises (non-financial accounts item)
16. Non-financial assets of households (non-financial accounts items)

At the moment, the main sources available for these items are the OECD Annual National Accounts and heterogeneous national sources. These sources do not, however, provide a satisfactory solution, since they are not available on a timely basis (for the OECD data, the delay is almost two years) and their frequency is generally not adequate. For macroprudential analysis, it is necessary to have access to country-level data, since the financial accounts data, for example, need to be linked to country-specific credit developments.

As noted, the situation is improving for the euro area because financial accounts statistics are being compiled (providing data for the items listed in Box 6). At present, proxies for household and corporate sector leverage and debt servicing burdens can be constructed by using money, banking, securities and interest rate statistics, but the scope of this exercise is obviously limited because credits from non-bank sources are excluded.

It would also be useful to have data for calculating measures of the debt servicing burdens of households and firms. A breakdown of debts into fixed and variable rate contracts would be valuable too.

4. Developing the analytical tools

Enhancing analytical capabilities is a never-ending task, as is the development of the information base. It is important in order to improve understanding of the links between macro developments (external factors) and the exposures and soundness of financial institutions (internal factors). The tools developed in this field could be used, for example, to evaluate asset price developments and their impact on financial stability, which is a key issue in financial stability analysis. While it is true that sharp falls in asset prices may not always trigger financial crises and that crises can occur without significant asset price cycles, a correlation between the two developments has often been found.[18]

The two aspects, (i) evaluating the current level of asset prices and correlations across markets and asset classes and (ii) analysing the potential impact of a fall in asset prices on the banking system (as part of a more general exercise to establish the links between the macro developments and banking sector soundness), are discussed in the next two subsections.

[18] A recent study found that in 16 out of 38 equity market crises from 1970 to 1999, stock market turbulence was associated with the spread of banking difficulties (Vila (2000)). The key role of the real estate market has been stressed by Herring and Wachter (1999).

4.1 Analysis of asset price levels and correlations

Analysis of stock price developments

For stock markets, the set of indicators which needs to be followed is rather large. This includes four types of indicators described in Section 2.1: measures of market volatility, market depth and liquidity, credit standing and "triggering factors", such as possible deviations of stock prices from the value suggested by fundamental determinants.

The fundamental value of stocks equals the expected value of the cash flows associated with the holding of stocks (ie dividends), discounted by an appropriate discount rate which comprises a risk free nominal interest rate and a component to compensate investors for the risk of holding equity (*equity risk premium*). As shown by Allen and Gale (1998), the inability of investors to observe how risky issuers' investments are decided upon can lead to risk-shifting behaviour and cause assets in fixed supply to be bid up further by the issuers. While an obvious example of an asset that is in fixed supply in the short term is real estate, stocks can also be considered to be in fixed supply in the short run, since it takes time to identify profitable opportunities and expand the supply of stocks. It has been claimed that, in addition to the impact of stickiness in supply, "irrational exuberance" on the part of investors can drive stock prices above the fundamental value.

Traditional measures of stock price valuation, such as the price-earnings ratio, are used to give a possible indication of overvaluation using historical pricing behaviour as the benchmark. However, this kind of assessment is subject to considerable uncertainty, since there is a large amount of uncertainty involved in identifying the factors that determine the fundamental value.

The *prices of options on stock indices* can be used to give some indications for assessing the likelihood of a sharp decline in stock prices. These prices reflect the expectations of market participants concerning possible changes in stock price levels over the lifetime of the options. A widely used indicator is the implied volatility of stock prices, which summarises the expectations of market participants about the standard deviation of stock prices from current levels. However, implied volatility cannot give any indication as to whether market participants consider stock price increases or declines to be more likely. When a wide array of option prices is available for different exercise prices, it is possible to extract information relating to the expected direction of future changes in stock prices. In particular, on the basis of assumptions regarding the shape of the probability distribution of future outcomes, it is possible to estimate risk neutral probability density functions. These functions indicate the expected probability of various magnitudes of change in stock prices assuming risk neutrality on the part of market participants (see Box 7.A).

Finally, an investigation of developments in *sector-specific stock indices* can help in the analysis of the sources of changes in overall stock prices as well as the associated risks (see Box 7.B).

Analysis of correlation

A particular source of concern is the possibility that stock price shocks could spill over across markets, or into other asset markets, such as the real estate market. Such spillover effects could reflect commercial relations between firms, sensitivity to common factors, and links between stock portfolio adjustments as a number of stock investors make portfolio allocation decisions at the global level. Box 8 shows measures of correlation across European and US stock markets, showing important links with the US market and quite significant correlations across European markets.[19] There are, nevertheless, quite significant variations across countries.

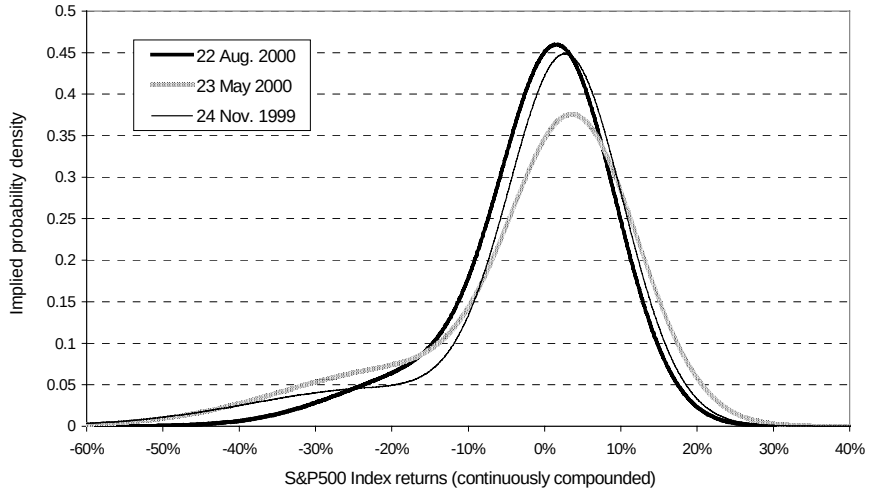
[19] Despite this high degree of interdependence between financial markets, stock prices in the euro area do not appear to respond consistently negatively, or markedly, to sharp declines in US stock prices. In the period from January 1992 to May 2000, on the 10 occasions when US stock prices declined over two consecutive months (from month-end to month-end), euro area stock prices declined over the two-month horizon on seven occasions.

Box 7.A

Extracting information on stock market developments from option prices

Looking at options on the Standard and Poor's 500 index for the United States, between May and August 2000 market participants seemed to have revised downwards the risk neutral probability of declines expected over a horizon of about four months. This is shown by the fact that, in the chart, the left-hand side of the curve shifts downwards between May and August 2000. However, the probability of sizeable declines remained larger than the probability of sizeable increases, as shown by the fact that the area under the left-hand side of the curve is generally larger than that under the right-hand side of the curve. As at 22 August, the probability of a decline of 30% or more over the next three and a half months was perceived to be just below 2%, whereas it stood at more than 6% on 23 May and at slightly less than 6% on 24 November 1999 (see table).

Implied risk-neutral probability densities for S&P500 index returns
(Based on option contracts with 114 days to expiration)



Measures of uncertainty for the S&P 500 index implied in option prices[1]

Implied probability of an **increase** of x% or more in the S&P 500 index 114 days after the respective estimation dates				Implied probability of a **decrease** of x% or more in the S&P 500 index 114 days after the respective estimation dates			
x	**24 Nov 99**	**23 May 00**	**22 Aug 00**	***x***	**24 Nov 99**	**23 May 00**	**22 Aug 00**
10%	14.1%	17.9%	11.4%	**-10%**	18.0%	22.6%	17.0%
20%	1.0%	2.1%	0.6%	**-20%**	10.4%	12.8%	6.5%
25%	0.2%	0.5%	0.1%	**-25%**	8.1%	9.4%	3.7%
30%	0.0%	0.1%	0.0%	**-30%**	5.9%	6.4%	1.9%

Descriptive statistics of implied distributions[2]	**24 Nov 99**	**23 May 00**	**22 Aug 00**
Standard deviation of implied RND	13.8%	14.8%	10.7%
Skewness of implied RND	-1.5	-1.1	-0.9
Excess kurtosis of implied RND	2.8	1.2	1.3

[1] Sources: Reuters; CME; CBOE; and ECB calculations. [2] 114-day horizon.

Box 7.B

Extracting information on stock market developments from sector indices

In April 1986, following an increase of 187% over the preceding 12 months, the price-earnings ratio in the euro area financial sector had reached a value of about 86 - well in excess of the average value of 45 observed over the period from 1973 to 1984. In the course of May 1986, stock prices in this sector declined by 12%. During that month, stock prices declined not only in the financial sector but also in most other business sectors, despite an average price-earnings ratio in the other business sectors of 16, which was well within the "standard" range of fluctuation. In the light of the above example, the prevailing high price-earnings ratios recently seen in the telecommunications, media and technology (TMT) sector may be seen as a particular source of concern both in the United States and in the euro area (see table). These high stock price valuations in the TMT sector arose principally from the sub-component constituted by firms active in information technology. High sectoral price-earnings ratios may prove to be adequate if corporate earnings increase rapidly in the sector concerned. However, until such an increase in corporate earnings starts to materialise, there is a possibility that stock prices in the sector concerned will be subject to large swings on account of changes in the perception of corporate earnings prospects.

Sectoral price-earnings ratios

(Stock index level divided by total earnings per share; figures in brackets are standard deviations)

	Euro area		**United States**	
	1973-99	August 2000	1973-99	August 2000
Resources	10.5 (6.2)	18.0	14.2 (8.1)	21.9
Basic industries	11.0 (2.8)	14.2	15.2 (6.7)	15.4
General industrials	13.1 (3.2)	20.0	14.7 (5.2)	31
Cyclical consumer goods	13.6 (13.2)	12.8	12.8 (8.6)	8.8
Non-cyclical consumer goods	13.7 (4.4)	25.1	18.3 (7.4)	31.3
Cyclical services	15.4 (4.5)	30.9	18.6 (7.3)	29.9
Non-cyclical services	14.5 (6.9)	33.1	14.7 (7.2)	24.7
Utilities	13.4 (3.8)	21.7	10.7 (3.8)	19.4
Information technology	16.5 (8.0)	58.5	20.5 (9.7)	67.8
Financials	34.0 (18.2)	18.9	11.5 (4.0)	19.7
Telecoms, media and technology (TMT)	14.0 (7.2)	43.3	17.7 (8.3)	50.8
Other than TMT	13.2 (3.5)	18.9	13.9 (5.0)	24.0
Total market	13.4 (3.8)	22.2	14.6 (5.6)	29.5

Source: Datastream.

Box 8

Correlation of stock exchange returns[1]

	BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	US
BE	1.00															
DK	0.42	1.00														
DE	0.62	0.52	1.00													
GR	0.25	0.23	0.31	1.00												
ES	0.56	0.44	0.64	0.29	1.00											
FR	0.59	0.45	0.74	0.26	0.66	1.00										
IE	0.47	0.34	0.48	0.30	0.46	0.45	1.00									
IT	0.46	0.41	0.57	0.20	0.55	0.58	0.37	1.00								
LU	na	na	na	na	na	na	na	na	1.00							
NL	0.64	0.47	0.73	0.23	0.63	0.70	0.53	0.56	na	1.00						
AT	0.58	0.31	0.56	0.27	0.44	0.45	0.36	0.36	na	0.43	1.00					
PT	na	na	na	na	na	na	na	na	na	na	na	1.00				
FI	0.33	0.34	0.48	0.17	0.43	0.46	0.36	0.40	na	0.49	0.19	na	1.00			
SE	0.48	0.36	0.60	0.25	0.57	0.59	0.46	0.44	na	0.58	0.35	na	0.58	1.00		
UK	0.54	0.44	0.59	0.18	0.57	0.63	0.57	0.48	na	0.68	0.39	na	0.43	0.52	1.00	
US	0.50	0.34	0.56	0.19	0.50	0.55	0.48	0.38	na	0.58	0.36	na	0.41	0.52	0.58	1.00

[1] Over the period May 1988 to September 2000. Correlation of weekly returns. In order to ensure the greatest possible data homogeneity across countries, all returns have been calculated on the basis of the "total market" indices computed by Datastream.

Source: Datastream.

The correlations tend to change over time. For example, from 1992 to 1998 the correlation coefficient of stock price developments between the euro area and the United States increased from around 0.2 to around 0.5, but has since declined to around 0.35. Such changes can partly be explained by changes in stock market volatility. However, the marked increase since 1992 would seem to suggest that the degree of interdependence between stock markets has increased in recent years.

Empirical studies have shown that what is especially relevant for financial stability is the fact that the correlations tend to be significantly higher during periods of financial market stress.[20] Hence, the use of correlations obtained under normal circumstances, or over a longer time span, is not appropriate when constructing crisis scenarios. Box 9.A indicates that cross-market correlations almost always increase when moving from a period of lower stock market volatility (low uncertainty) to a period of higher volatility (high uncertainty), and almost always decrease when moving from a period of higher volatility to a period of lower volatility. Box 9.B shows variations in correlations between European and US stock indices when divided into high and low volatility periods and displays the same phenomenon of higher correlations during high volatility periods.[21]

Real estate markets tend to exhibit lower cross-market correlations than the stock markets, particularly the residential market. However, data availability somewhat restricts the scope of analysis of price developments in real estate markets. Real estate prices can be correlated with stock prices, but a positive coefficient is not obtained in all cases, as shown in Box 10. Real estate prices may be stickier over the short run than stock prices. As a result, there may be positive and higher coefficients of correlation between real estate prices and *lagged* stock prices.

[20] See BIS (2000).

[21] See Forbes and Rigobon (1999).

Box 9.A

Changes in stock market correlations between high- and low-volatility periods

Changes in correlations between stock markets when moving from low- to high-volatility periods

Period	Number of increases	Number of decreases
Correlations between EU countries		
From May 1988 - July 1990 to July 1990 - Oct 1992	78	0
From Oct 1992 - Sept 1997 to Sept 1997 - Sept 2000	98	7
Correlations between EU countries and the United States		
From May 1988 - July 1990 to July 1990 - Oct 1992	11	2
From Oct 1992 - Sept 1997 to Sept 1997 - Sept 2000	15	0

Changes in correlations between stock markets when moving from high- to low-volatility periods

Period	Number of increases	Number of decreases
Correlations between EU countries		
From Sept 1987 - Dec 1987 to Jan 1988 – July 1990	0	55
From July 1990 - Oct 1992 to Oct 1992 - Sept 1997	9	82
Correlations between EU countries and the United States		
From Sept 1987 - Dec 1987 to Jan 1988 – July 1990	0	11
From July 1990 - Oct 1992 to Oct 1992 - Sept 1997	3	11

The volatility indicator used to split the 1988-2000 period is the standard deviation, which is calculated over moving and centred windows of 11 weeks.

Source: Datastream.

Box 9.B

Correlation between European and US stock exchange indices[1]

	May 1988 to September 2000 (whole period)	September 1987 to December 1987 (87 crisis)[2]	May 1988 to July 1990 (low volatility)	July 1990 to October 1992 (high volatility)	October 1992 to September 1997 (low volatility)	Sept 1997 to September 2000 (high volatility)
BE	0.50	0.62	0.39	0.49	0.46	0.57
DK	0.34	0.77	0.28	0.46	0.26	0.36
DE	0.56	0.68	0.41	0.55	0.46	0.66
GR	0.19	na	-0.01	0.25	0.04	0.35
ES	0.50	0.83	0.41	0.52	0.40	0.58
FR	0.55	0.70	0.43	0.56	0.47	0.63
IE	0.48	0.69	0.35	0.39	0.42	0.60
IT	0.38	0.54	0.21	0.36	0.24	0.57
LU	na	na	na	na	0.16	0.22
NL	0.48	0.82	0.59	0.53	0.56	0.62
AT	0.36	0.68	0.20	0.48	0.34	0.47
PT	na	na	na	0.37	0.16	0.43
FI	0.41	na	0.12	0.25	0.39	0.56
SE	0.52	0.56	0.41	0.57	0.43	0.61
UK	0.58	0.83	0.55	0.51	0.51	0.69

[1] Correlation of weekly returns. To ensure the greatest possible data homogeneity across countries, all returns have been calculated on the basis of the "total market" indices computed by Datastream. [2] This period does not form part of the "whole period" displayed in the first column.

Source: Datastream.

Box 10

Cross-correlation of asset prices

	Correlation between house prices and stock exchange prices			Correlation between commercial real estate prices and stock exchange prices	Correlation between house prices and commercial real estate prices
Frequency	**Quarterly[1]**	**Semiannual[2]**	**Yearly[3]**	**Yearly[3]**	**Yearly[3]**
BE	-0.30	-0.36	-0.22	na	na
DK	0.21	0.30	0.38	na	na
DE	na	na	0.32	0.16	0.03
ES	-0.11	-0.08	-0.17	-0.05	0.5
FR	0.45	0.54	0.05	0.05	0.71
IE	0.22	0.23	0.44	na	na
IT	na	-0.18	-0.48	-0.20	0.54
NL	na	na	0.64	na	na
AT	na	0.30	0.31	na	na
PT[4]	-0.17	-0.27	na	na	na
FI	0.25	0.39	0.53	0.20	0.67
SE	0.05	0.32	-0.13	0.03	0.29
UK	na	na	0.26	-0.11	0.58
US	na	na	0.68	0.47	0.32

[1] Quarterly coefficients are estimated on the basis of quarterly price series over the period from the fourth quarter of 1988 to the fourth quarter of 1999. [2] Semiannual coefficients are estimated on the basis of semiannual series over the period from the second half of 1988 to the second half of 1999. [3] Annual data are estimated on the basis of annual series for the years 1988 to 1998. As they rely on only 11 years of data, they should be interpreted with caution. [4] For PT, all series start in 1990.

Sources: BIS for BE, DK, ES, IE, LU, AT, PT, FI, SE, UK, JP, US; European Mortgage Federation for DE, NL; Ministère de l'Equipement for FR; Consulente Immobiliare for IT. Available data are not sufficient to carry out the correlation analysis for GR and LU.

4.2 Analysis of the impact on the banking sector

The previous sections show how the observation and interpretation of the established set of MPIs, together with the systematic monitoring of asset price developments, can provide a useful tool for identifying areas of potential vulnerability within the macroeconomic environment that could have a negative impact on the banking sector. In addition, important information can be obtained from the supervisory authorities as regards, for example, the direct credit, market and earnings risks of banks vis-à-vis asset price declines.[22]

"Stress testing" using aggregated data

By itself, the monitoring of MPIs, although inserted into a specific analytical framework, does not provide a means of estimating the impact on the banking sector of a *destabilising event*, such as a sharp decline in asset prices, since it does not explicitly consider the causal relationships between the different variables being monitored. Therefore, once the areas of vulnerability have been identified, the natural next step is to develop a set of analytical tools that permit such a result to be achieved. The outcome of the analysis could be used to evaluate the impact of a given macroeconomic scenario on the banking system (a kind of *stress testing*). In general, these stress tests would be aimed at analysing the impact of changes in key macro variables on the balance sheets of financial institutions. A stress test may follow a well defined and consistent historical or hypothetical scenario or involve simulations obtained from macroeconomic forecasting models. The IMF and the World Bank have adopted these kinds of stress testing techniques within the Financial Stability Assessment Program.[23] Such analyses can be useful, but they would have to rely on quantitative empirical results to analyse

[22] According to a recent report from the Banking Supervision Committee, *Asset prices and banking stability* (April 2000), the perception of the supervisory authorities has been that the direct credit and other commercial risks of EU banks vis-à-vis a stock market decline are quite manageable, while a real estate market slump would represent a more significant concern.

[23] See the description of the stress tests carried out in the context of the FSAPs by the IMF in Ingves et al (2000).

the impact on the banking sector. Such analyses should be distinguished from those which make use of bank-level information (as discussed at the end of this subsection).

One example is the evaluation of the effects of an asset price decline through its impact on macroeconomic performance, as simulated by a macroeconomic model. An analysis of the impact on the banking sector of a change in macroeconomic conditions triggered by an asset price decline can be divided into two parts:

(i) the effect on macroeconomic conditions of a negative shock on asset prices;

(ii) the impact on the banking sector of a change in macroeconomic conditions, for example GDP.

Box 11 contains a flow chart showing the causal links between the variables. The first part looks at the effect that a large decline in asset values may have on aggregate demand through "wealth effects" (a slowdown in consumption and business investment and a reduction in GDP). In this case, a macroeconomic model simulation would have to be used to obtain the values of the macroeconomic variables (GDP and other relevant variables). The second part of the analysis looks at the impact on the banking sector of the changes simulated in the first part of the exercise. The purpose of this is to focus on variables that can give an indication of increased vulnerabilities within the banking sector. The analysis could concentrate on assessing the impact on the level of non-performing loans as well as on other indicators of bank soundness. Box 11 illustrates the complexity of the exercise, which produces many uncertainties and makes it difficult to assess the risks involved.

Developing a model to assess the links between macro developments and bank soundness

Broadly speaking, a set of tools which would allow the kinds of "stress tests" mentioned above would comprise several instruments, the common feature of which would be that they provide a causal link between a collection of variables of particular interest for the purposes of the analysis. In other words, a distinctive feature of such a set of analytical tools would be the fact that they rely explicitly on a model.[24]

The value of models as a means of better understanding the impact of a shock on the banking sector is quite clear, but their limits should also be recognised. A model is no more than a simplified representation and for this reason its results should always be interpreted with caution. In this respect, a model can be more or less refined depending on the goals of the analysis and the kinds of constraints faced. Ideally, a full model should be capable of estimating the determinants of the main elements of the balance sheets and profit and loss accounts of banks. One particularly important set of constraints is the availability (or lack of availability) of the long back series of reliable data necessary to evaluate the relationships between the variables.

In any case, given the acknowledged need for and usefulness of a set of analytical tools, there have been several attempts to develop models aimed at analysing the condition of the banking sector. These models can be classified according to different factors, including:

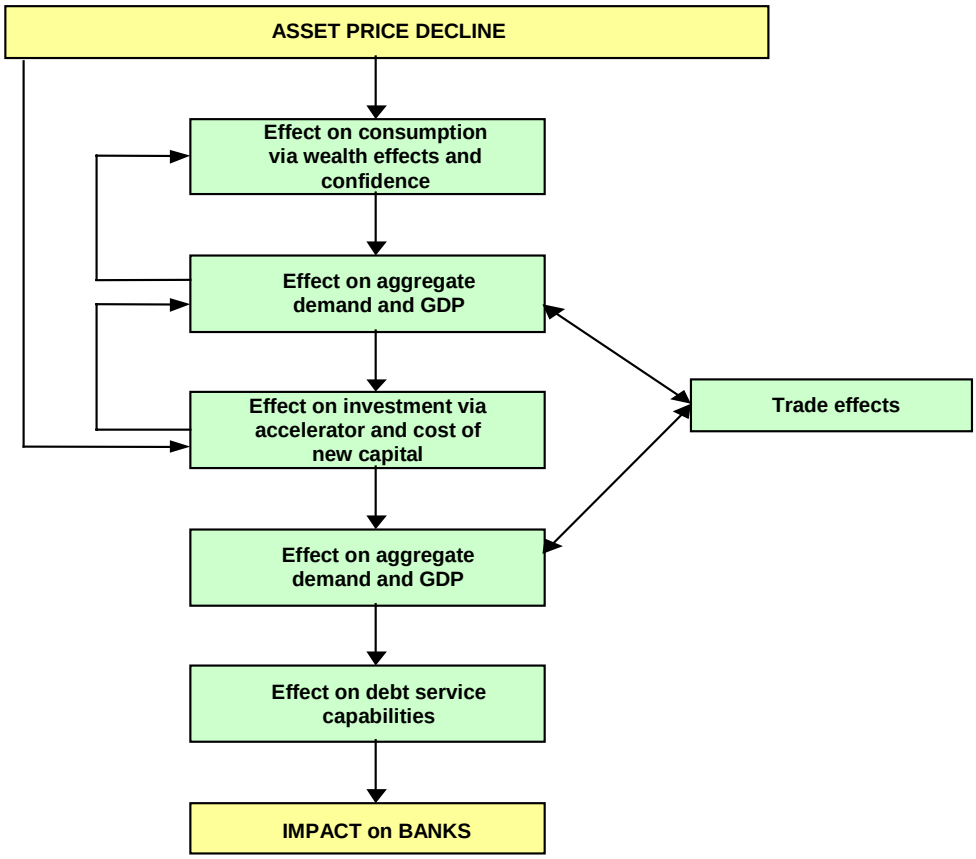
(i) the scope of the model, namely whether it is at aggregated (macro) or disaggregated (micro) level;

(ii) the type of data employed in the model (supervisory information, public information);

(iii) the variables to be explained or predicted (probability of failure, levels of bank risk, loan losses, profitability and solvency).

[24] A model is in fact usually defined as a set of causal relationships (qualitative or quantitative) between a collection of variables employed for the (simplified) description of a certain group of phenomena.

Box 11: **Impact on the banking sector of a change in macroeconomic conditions triggered by an asset price decline**



As noted in Section 2.2, there are several papers which attempt to estimate the impact of macroeconomic variables on the condition of banks. The IMF and the World Bank in particular have produced a large number of research papers on this topic. By looking at past episodes of banking crises, Demirguc-Kunt and Detragiache (1999) and Hardy and Pazarbasioglu (1998) attempt to identify macroeconomic variables able to predict the probability of a systemic crisis. Gonzales and Hermosillo (1999) make use of a combination of micro and macro variables in an attempt to predict the probability of banking crises.

At the European level, the WGMA is exploring the issue and some central banks are engaged in projects aimed at estimating the effect of changes in macroeconomic variables on their respective banking sectors. Sveriges Riksbank has developed an econometric model which reveals relationships between business failures (as an indicator of the degree of credit risk in a bank portfolio) and a number of macroeconomic variables.[25] The Bank of Finland has also developed a model relating the level of loan losses of banks as a dependent variable to a set of macroeconomic variables (rate of change in GDP, real interest rate, level of indebtedness of the banks' borrowers).[26]

[25] See Lindhe (2000).

[26] See Pesola (2000).

"Stress testing" using bank-level information

These kinds of stress tests need to be distinguished from the macro-level analyses described above.

First, macro variables can sometimes be entered into the *early warning systems* used by the supervisory authorities to assess the risk of failure of a single institution. There is quite extensive literature on models aimed at estimating the likelihood of individual bank failures.[27] More recently, increasing use has been made of publicly available market information (stock prices and spreads on banks' bonds) to gauge the probability of default at individual bank level.[28]

Second, stress testing is an increasingly widely used and sophisticated *tool for internal risk management in banks.* An analysis of stress tests conducted by major financial institutions may help in understanding the sensitivity of the financial system as a whole to various shocks, as well as in understanding the risks for individual institutions.[29] Some EU supervisory authorities have already required banks to conduct sensitivity analyses for certain adverse events, such as a fall in real estate prices or a substantial increase in interest rates.[30]

5. Conclusion

This paper demonstrates that there is a specific role for macroprudential analysis using aggregated data. Aggregated figures for the banking sector can yield important signals of system problems which cannot be extracted from individual data alone (accumulation of exposures at the system level and exposure to common factors). They also provide a benchmark against which individual institutions can be compared. It is important to monitor relevant developments in the non-financial parts of the economy because the health of financial institutions reflects the health of their counterparties. The monitoring of financial market stress signals is becoming an increasingly important component of financial stability analysis as markets gain in importance for financial intermediaries and for the economy as a whole. However, there is a limit beyond which one cannot go without having information on individual institutions. Most importantly, aggregate figures can mask substantial idiosyncratic exposures or problems at some systemically relevant institutions. These kinds of risks cannot be addressed by aggregated analysis, so it is necessary to have stress tests at the individual institution level, for example, in order to be able to spot idiosyncratic vulnerabilities. Aggregated data could also be misleading when addressing some specific issues, such as the extent of cross-border interbank market links and cross-border business in general, since it tends to be concentrated among large institutions rather than evenly distributed. Hence, the view of international contagion risks derived from aggregated data may be distorted. Supervisory insight is the main tool for alleviating this problem in macroprudential analysis.

Given the problems associated with the use of aggregated information alone, most financial stability reports published by central banks (eg the Bank of England and Sveriges Riksbank) include statistics referring to major domestic banking institutions. Large banks have a more diversified portfolio of activities, especially when the whole banking group is taken into consideration. But although the likelihood that large banks will incur major problems might be lower, the impact of such problems occurring at a large bank would be more widespread. Absolute size is not the only relevant factor, however. The interbank market is a major channel for contagion. Contagion may also spread through capital market activities or through difficulties experienced at non-bank subsidiaries. This being the case, structural features - such as the ownership structure or composition of the group or conglomerate to which the bank belongs - might also provide an indication of the systemic importance

[27] For example, see Vulpes (1999).

[28] Nickell and Perraudin (1999) provide an example of such models. They use a model based on equity prices to derive the implied probability of default and the capital requirement for a set of UK banks.

[29] See Committee on the Global Financial System (March 2000).

[30] See publication of the Banking Supervision Committee of the European System of Central Banks, ECB (2000).

of the bank. A particular bank might be a core intermediary in a particular market, even if it does not rank among the largest institutions.

Regular contacts with major, market-leading intermediaries are useful for producing timely and meaningful information on major trends in the financial system, such as developments in market liquidity. Monitoring only quantitative indicators could lead to a delayed and incomplete view of developments of importance for financial stability. An adequate exchange of information among responsible supervisory authorities, and where necessary with central banks, is a crucial factor in the process of safeguarding financial stability.

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