

Market Discipline and Financial Stability

Glenn Hoggarth
Patricia Jackson
and
Erlend Nier

E-mail: glenn.hoggarth@bankofengland.co.uk; p.jackson@bankofengland.co.uk;
erlend.nier@bankofengland.co.uk

MARKET DISCIPLINE AND FINANCIAL STABILITY

This paper contributes to understanding the role that capital markets play in fostering financial stability by considering the channels through which the markets, including debt and equity markets, can exert discipline on banks. In particular, the paper explores whether market discipline is effective in influencing bank behaviour.

Effective market discipline depends on a number of important elements. (1) The market must have the information to be able to assess the riskiness of the banks relative to capital. (2) Market participants must be at risk of loss if the banks fail or they will not act upon the information¹. For the threat of market discipline to affect behaviour of the banks a third element is necessary as well. (3) The cost to the bank of an adverse market view must be significant. The paper tests whether there is a link between risk taking by banks and factors which would reduce the effectiveness of market discipline such as wide deposit protection schemes and limited disclosure. It finds that these factors are related to higher risk taking. The broad policy implications are considered. The paper also looks at whether supervisors can harness the capital markets in their assessment of the riskiness of regulated firms. It considers if various market indicators, drawn from the debt, equity and options markets reflect the riskiness of individual banks and therefore could provide a cross check on supervisory judgements.

1. Channels for market discipline

There are several channels through which the market can exert discipline on banks or other financial intermediaries. But the effectiveness of all can be affected by public policies in terms of bailout of banks or protection for some depositors.

The equity price is important to the bank's management because it will determine the cost and availability of new capital. Perhaps, in terms of management incentives, the risk of becoming a takeover target if the share price is weak may be of even greater importance. Growing use of share options as part of remuneration also gives senior management a direct interest in the share price, although this does not mean that their incentives and those of shareholders are aligned because the horizon may be different.

¹ These two conditions are widely recognised –see Morgan and Stiroh (1999).

One drawback with the share price as a channel for market discipline is that shareholders' incentives are not aligned with those of the authorities and creditors because of shareholder limited liability. If the bank fails the shareholders lose the value of the shares but do not have to meet the debts. When a bank is weak this could make gambling for resurrection, by increasing risks for the possibility of greater returns, potentially attractive. Shareholder assessment of risk will also be affected by the perception of the likelihood of a bailout and whether, if some action were taken, shareholder value would be kept intact. Some authorities have made clear that shareholders should expect to be penalised if a bank has to be supported, George (1994). A number of theoretical contributions have focused on the effect of the safety net on banks' and their shareholders' incentives to take excessive risk. In particular, starting with Merton (1977), a number of authors have analysed incentives created by flat-rate deposit insurance schemes. Such schemes create a subsidy to banks that is more valuable if a bank engages in riskier activities. Shareholder vigilance in monitoring a bank can also be affected by the regulatory framework if that is perceived as likely to prevent a failure. Shareholders might in effect "sub-contract" monitoring of extreme risks to the regulator. There is some anecdotal evidence that this is the case –with shareholders focussing on expected earnings rather than risks.

A more effective route for market discipline may well be a bank's counterparties. The cost and availability of funding is clearly important because it directly affects a bank's ongoing profitability and its ability to grow. All deposits can potentially run but the most sensitive are likely to be those from other banks because of access to better information and more regular monitoring. Retail depositors are only likely to react in a nuclear way when concerns have reached the press. In addition, the incentives of retail depositors are affected by the existence of deposit protection schemes. Nozaki (2002) and Blum (2002), have emphasised that deposit insurance *per se* removes the incentive of depositors to monitor banks and may, in the presence of limited liability, result in excessive risk taking. Bank counterparties will have a much more fine-tuned response to perceived risks.

Access to swap and other derivative contracts is of almost as much importance as funding. Sophisticated banking operations give rise to a myriad of exposures which need to be hedged, and access to these contracts is an essential part of risk management. It is possible for a bank to hedge interest rate risk in the banking book by match funding, ensuring there are no gaps between the refix dates on the funding and each loan but this is very cumbersome. A sophisticated bank which suddenly found it had no access to the swaps market would probably find it almost impossible to continue in business. In the case of swaps, as well as deposits, limits seem, from anecdotal evidence, to be rather more responsive than price. For community banks, which have access to large quantities

of retail deposits and for whom sophisticated hedging might be less assiduously carried out, this market discipline route will be less effective.

A number of developments in recent years have started to limit interbank exposures. The introduction of RTGS for most major payments systems in the late 1990s has eliminated gross intra-day exposures between members. CLS which started in 2002 enables the banks to avoid FX settlement risk and increasing use of repo has reduced interbank exposures between banks. Also the development of netting arrangements for swaps, using standard legally tested documentation, has meant that each firm is more protected in the case of the failure of a counterparty. Paradoxically these measures which make the system less vulnerable to a shock (which is clearly very important) may also, eventually, have the effect at this point of making market discipline less effective.

But even with the current strong incentives banks have to monitor the riskiness of their counterparties, as with any other market discipline channel, the effectiveness will be contaminated by any expectations of government support. Indeed the external ratings, at least in part used by the market to assess risk, explicitly reflect the rating agencies assessment of likelihood of support from a parent or in the case of a large bank more likely the government.

Subordinated debt may also help to provide market discipline. At present, banks can use subordinated debt meeting particular requirements for up to half the minimum capital required under the Basel Accord – the minimum ratio is 8% with 4% having to be Tier 1 capital (shareholders funds etc) and 4% can be subordinated debt and general provisions. Discussions with banks indicate that they target the Tier 1 ratio which is important for their solvency and their rating but use subordinated debt as a flexible buffer above this target level. This is borne out by the fact that banks hold proportionately more excess in Tier 1 capital. For the large UK banks the average Tier 1 ratio is currently around 8³/₄% (against a minimum of 4%) and the other Tiers (Tier 2 and 3) account for a much smaller proportion (the ratio of Tier 2 plus Tier 3 to risk-weighted assets is less than 4%). Given the relatively modest use of subordinated debt (for the UK banks it accounts for only around 3% of total liabilities) it is a limited channel for market discipline – although it does give the banks added flexibility with regard to their capital requirements.

At present the channels most likely to exert pressure on banks in a graduated way are the equity market and bank counterparties and of these the one with interests most closely aligned with the authorities is the interbank market.

2. The effectiveness of market discipline

In terms of public policy it is clearly important that there is a graduated response from the market to the onset of problems, picking up early warning signs in time for management's behaviour to be influenced, rather than participants reacting in a nuclear way to apparent severe difficulty. But this implies considerable transparency about the nature of risks faced by a bank. Large market reactions to relatively small events may reflect the current substantial asymmetries of information between the shareholders and the banks².

Even with adequate information disclosure, for market discipline to be effective in enhancing financial stability one of a further two conditions needs to be met. (1) Bank management must react to the potential threat that discipline will be applied if the market realises that risks are high relative to capital by adjusting behaviour, thereby reducing the likelihood of eventual banking problems. Or (2) management reacts to early market discipline in sufficient time again to reduce the likelihood of banking problems becoming severe.

There is a small literature that examines the extent to which banks respond to changes in the yield of their subordinated debt. Covitz, Hancock and Kwast (2000) provide evidence that banks' decision to issue additional subordinated debt is influenced by yield spreads. Increases in yield are associated with a reduction in new issues of debt. However, Bliss and Flannery (2002) fail to find any evidence that following a change in yield spreads managers respond by changing their banks' balance sheet allocations. From this evidence, it is not clear that the subordinated debt channel is an effective route for market discipline. Given the modest reliance on this type of debt such results may not be entirely surprising. In particular, changes in subordinated debt spreads may not be sufficiently costly to the bank and its management to result in effective market discipline. In addition, as pointed out by Evanoff and Wall (2000), these studies are attempting to capture one aspect of discipline imposed by the debt market – *ex post* discipline. It may well be difficult to identify the exact timing of any management reactions to the application of market discipline let alone the threat.

However, it is possible to be fairly sure that market discipline will be more effective if banks publish core statistics on their financial condition. The issue that might be tested is therefore whether transparency affects risk taking. There is a small, theoretical literature which looks at this question.

² For example, NatWest became a takeover target after making a relative small loss because of a problem with an option pricing model.

Cordella and Yeyati (1998) assume bank deposits are uninsured but that banks enjoy limited liability which induces them to prefer higher risk for given return. They show that if depositors can observe banks' behaviour the amount of risks that banks decide to take on will be efficient. Bank managers will know that the more risks they take the greater the compensation required by the depositors. However, if the amount of risk taking is unobservable, then limited liability will induce the bank to choose a higher risk profile at the expense of depositors.

In a similar vein, Boot and Schmeits (2000) present a theoretical analysis of the incentives of banks to take risks and relate these to the degree of bank transparency. The degree of transparency determines the sensitivity of the bank's funding cost to its risk-taking behaviour. In their model, bank managers have to exert effort in order to reduce risk. Since effort is costly, in the absence of transparency, the manager will choose lower levels of effort, thus resulting in higher risk. As transparency increases, effort and thus risk become more observable implying that banks will face a higher short-term funding cost for low levels of effort. Consequently, managers will choose higher effort levels and thus lower risk when transparency is high than when it is low.

Empirical studies of the effect of transparency on risk-taking have been limited. In this section of the paper we draw on some research carried out in the Bank of England by Baumann and Nier (2003). We use a large cross-country panel dataset consisting of observations on 729 individual listed banks from 32 different countries. While this panel dataset is unbalanced, it typically comprises observations from 1993 to 2000. This dataset allows us to test the impact of a number of market discipline factors on bank behaviour. Market discipline variables considered relate both to the strength of the safety net and to the transparency of banks' risks (disclosure).

Measures of the strength of Market discipline

(1) Deposit protection

Depositor protection is likely to weaken market discipline. Demirgüç-Kunt and Sobaci (2001) provide a dataset on the existence and extent of deposit insurance schemes across countries³. Using this dataset we have constructed an index of the extent of depositor protection (depins). It takes into account the features which will affect market discipline from depositors – coverage of interbank

³ Using this dataset, Demirgüç-Kunt and Detragiache (2003) provide evidence that explicit deposit insurance tends to increase the likelihood of banking crises in a sample of 61 countries over the years 1980-97.

deposits by insurance, co-insurance (ie, less than 100% payout on the portion of deposits covered) and unlimited coverage.

depins= sum of depins2, depins3, depins4, depins5

depins2=1 if there exists an explicit deposit insurance scheme, =0 otherwise

depins3=1 if there is no coinsurance, =0 otherwise

depins4 =1 if interbank deposits are covered, =0 otherwise

depins5=1 if coverage is unlimited, =0 otherwise

The higher the value of the index, the lower the discipline on banks from depositors.

(2) The safety net

The social cost of bank failure can be large. This may encourage governments to bail out, rather than close, a failed bank. But governments worry about the moral hazard this type of implicit insurance creates. They will therefore typically try to maintain a reputation for toughness by limiting bailouts to systemically important situations or indeed, as suggested by Freixas (1999), by playing mixed strategies to create a measure of “constructive ambiguity” with respect to their bail-out decision⁴. From the point of view of the market, therefore, a government bailout in the event of failure has a probability distribution, which may depend both on the bank in question and on the government concerned. The Fitch rating agency assigns a support rating that reflects the probability of support from a parent or the government. For most large banks only the latter is important. The support rating ranges from 1 (near certain bail-out) to 5 (bail-out very unlikely). Gropp, Vesala and Vulpes (2002) find that subordinated debt yields reflect bank risk for banks with a public support rating of 3 and above, but do not reflect bank risk for banks whose public support rating is 1 or 2. Their study suggests that market discipline is largely absent if markets believe that a bailout is very likely. We follow Gropp *et al* and construct an indicator variable (supp) which takes the value 1 if the public support rating indicates that a bail-out is very likely (support rating equal to 1 or 2) and 0 if the public support rating indicates a low probability of a bail-out (rating is 3, 4, or 5)⁵. We conjecture that market discipline is weaker if supp=1. Clearly state ownership would be another form of support but in fact all state-owned banks are excluded from our sample as are banks with state guarantees.

(3) Disclosure

⁴ In game theory, if a strategy assigns a probability strictly between zero and one to a particular action, the strategy is referred to as a mixed strategy.

⁵ While the study by Gropp *et al* (2002) suggests the use of an indicator variable, an alternative is to use the support rating as assigned on the scale from 1 to 5. The results are not materially affected by whether one uses one or the other.

As discussed earlier, the theoretical work of Cordella and Yeyati (1998) and Boot and Schmeits (2000) point to the commitment effect of bank disclosure. However, in practice, measuring the amount of information available to investors is difficult. We have constructed two different measures of disclosure, one of which is a simple binary measure and the second is an index of disclosure, which we have constructed by measuring the amount of information available from banks' published accounts as represented in the Fitch BankScope data base.

The disclosure index records whether or not the bank provides information on 18 categories of core disclosure in its published accounts (as represented in the BankScope database). All of the 18 categories are related to one or more dimensions of the bank's risk-profile (interest rate risk, credit risk, liquidity risk and market risk) or the capital/reserves it holds to back the risk. For each category, we have assigned a value of one if the bank provided information and zero, if the bank did not provide information. The variable (disc) is normalised to take values between zero and 1 and is available for each bank in each year of our sample.

The basic idea of the index is to measure the level of detail which banks provide in their published accounts. To arrive at the disclosure index we define a number of dimensions of accounting information which we think can be mapped into indicators of bank risk. A total of 18 sub indices are created which reflect whether the bank's accounts (as presented in BankScope) provide any detail on each dimension. The sub indices are then aggregated to form a composite disclosure index.

The composite index is defined as

$$DISC = \frac{1}{20} \sum_{i=1}^{18} s_i$$

where each subindex, s_i , can be related to one or more sources of risk or the buffers against risk. We have defined a total of 18 subindices. Rather than ordering the subindices with respect to the source of risk to which they relate, the definition and ordering of the subindices follows the presentation in the BankScope database.

The following table lists the subindices used to construct the composite disclosure score. For all subindices, we assign a 0 if there is no entry in any of the corresponding categories and a 1 otherwise, except for the capital subindex. For the latter, we assign a 0 if there is no entry in any of these categories, a 1 if there is one entry only, a 2 if there are two entries and a 3 if there are three or four entries. Note that whenever a bank provides information on three of these items, one can infer the

fourth. Providing three items is therefore viewed as informationally equivalent to providing four items. The maximum attainable score on the sum of the subindices is 20.

Table 1: Sub-indices used to Construct the Composite Disclosure Index

	Sub-index	Categories
Assets		
Loans	S ₁ : Loans by maturity	Below 3 months, 3-6 months, 6 months – 1 year, 1-5 years, 5 years +
	S ₂ : Loans by type ¹	Loans to Municipalities/Government, Mortgages, HP/Lease, Other Loans
	S ₃ : Loans by counterparty	Loans to Group Companies, Loans to other Corporate, Loans to Banks
	S ₄ : Problem loans	Total Problem loans
	S ₅ : Problem loans by type	Overdue /Restructured /Other non-performing
Other Earning Assets	S ₆ : Securities by type (detailed breakdown)	Treasury Bills, Other Bills, Bonds, CDs, Equity Investments, Other Investments
	S ₇ : Securities by type (coarse breakdown)	Government Securities, Other Listed Securities, Non-listed Securities
	S ₈ : Securities by holding purpose	Investment Securities, Trading Securities
Liabilities		
Deposits	S ₉ : Deposits by maturity	Demand, Savings, Below 3 months, 3-6 months, 6 months – 1 year, 1-5 years, 5 years +
	S ₁₀ : Deposit by type of customer	Banks Deposits, Municipal/Government
Other Funding	S ₁₁ : Money market funding	Total Money Market Funding
	S ₁₂ : Long-term funding	Convertible Bonds, Mortgage Bonds, Other Bonds, Subordinated Debt, Hybrid Capital
Memo Lines		
	S ₁₃ : Reserves	Loan Loss Reserves (Memo)
	S ₁₄ : Capital	Total Capital Ratio, Tier 1 Ratio, Total Capital, Tier 1 Capital
	S ₁₅ : Contingent Liabilities	Total Contingent Liabilities
	S ₁₆ : Off-Balance Sheet Items	Off-Balance Sheet Items
Income Statement		
	S ₁₇ : Non-interest Income	Net Commission Income, Net Fee Income, Net Trading Income
	S ₁₈ : Loan Loss Provisions	Loan Loss Provisions

The categories chosen reflect the presentation in the BankScope database. As a result, the split into the two dimensions “Loans by type” and “Loans by counterparty” is not exact.

(4) Listing

Both the quality and quantity of disclosure provided by a bank may depend on where it is listed. Firms registered outside the US and listed on a primary US exchange may provide their US shareholders with financial statements prepared under their domestic (non-US) generally accepted

accounting principles. But the Securities and Exchange Commission (SEC) requires such firms to reconcile their reported earnings and shareholder's equity to US GAAP as part of a Form-20 filing. It is widely believed that the quality of statements prepared in accordance with US GAAP is superior to alternative disclosure regimes⁶. Empirical research is largely supportive of this view. Amir, Harris and Venuti (1993) find that the reconciliation of earnings and shareholder's equity in Form-20 filings are value-relevant in the sense that they increase the association between accounting earnings and security returns. Leutz and Verrecchia (2000) find that German firms which have voluntarily adopted US GAAP for their reporting have lower measures of information asymmetry and higher stock liquidity compared to a control group of firms employing the German reporting regime. Apart from increasing the quality of disclosure, a US listing may also increase the quantity of disclosure as the Form 20 requires disclosure of information, which may not be required under the bank's national accounting regulations. We therefore have constructed a measure of disclosure based on whether the bank has a listing on a primary US exchange. The variable list takes the value one if the bank is listed on the NYSE, the NASDAQ or the AMEX⁷.

Country-level evidence – stylised facts

A key variable that determines a bank's risk of default is the amount of capital it holds as a buffer against adverse credit events. Our main hypothesis is that if factors are present which are likely to increase the effectiveness of market discipline then banks would have an incentive to hold more capital, all else equal. In this section we look at the correlation across banking systems of capital ratios and various factors related to the strength of market discipline.

Chart 1a illustrates the degree of correlation between the average capital ratios – defined as the inverse of the leverage ratio ($\text{equity}/(\text{assets}-\text{equity})$) – by country and depositor protection as measured by our index. Countries are ordered by the size of their average capital ratios in 1997 from countries with low average capital ratios, to countries with high capital ratios in ascending order. The same chart shows the level of the deposit insurance index for each country, where high values

⁶ There has been a wave of accounting frauds in the USA. Typically, in these cases the published accounts did not meet the US accounting standards. These cases may not necessarily change the belief that accounts that do comply with US GAAP may be more informative than accounts that comply with alternative standards.

⁷ We have also assigned the list variable to US banks, on the grounds that US banks listed on a primary US exchange would be subject to the same disclosure regime as foreign banks listed on a US exchange. Our regression results are not sensitive to this choice.

correspond to more generous schemes with presumably greater moral hazard incentives. A trend line through the observations for the deposit insurance scheme can be interpreted as revealing the degree of correlation between the deposit insurance index and the average capital ratio. Its negative slope implies that there is a negative correlation between depositor protection and average capital ratios. Table 3, confirms that the correlation coefficient is negative. However, the P-value indicates that the correlation is not quite statistically significant.

Chart 1b shows the degree of correlation between average capital ratios and the average of the public support rating for the sample of banks in the particular banking system. The markedly downward sloping trend line suggests a strong negative correlation between the average of the support rating and the average capital ratio. This is confirmed by Table 3, which shows that the correlation is negative, sizeable and statistically significant at the one per cent level.

Chart 1c illustrates the degree of correlation between the average disclosure index and the capital ratio by country. In line with expectations, the trend line shows a positive slope indicating a positive correlation between average disclosure levels and average capital ratios. Table 3 suggests that this correlation is less strong with a P-value in excess of 10 per cent.

Finally, Chart 1d shows the correlation between the average capital ratio and the fraction of firms in each country that are listed on a primary US stock exchange. The trend line suggests that the correlation is mildly positive, which again is confirmed by Table 3.

Bank level evidence – panel data analysis

By using aggregate banking system data, within-country differences between banks on the factors determining the size of capital buffers will average out. A disadvantage of country level analysis, however, is that cross-country differences in capital ratios may be due to factors other than market discipline effects. For example, in 1997 a number of countries in the sample faced a banking crisis. This would have resulted in a higher incidence of non-performing loans which, in turn, could have affected average capital ratios. Moreover, the average bank size is likely to vary across country. To the extent that a bank's size is a determinant of its desired capital buffer – for example, due to diversification effects – this could also affect the conclusions to be drawn from the evidence on country averages. We therefore augment the findings on country averages with panel regressions at a bank level. These regressions test whether market discipline variables affect the size of individual

banks' capital buffers, controlling for bank risk and other factors affecting a bank's capital, such as GDP growth and bank size. In using information on the entire time series from 1993 to 2000, these regressions also allow more precise estimates of the effects of market discipline on banks' capital buffers.

In particular, the basic relationship we have estimated is

$$CAP_{it} = f(RISK_{it}, MKD_{it}, Z_{it}) + v_{it}, \quad (1)$$

(+) (+)

where i denotes group (bank) and t denotes time (year).

This regression allows us to test whether market discipline factors affect bank capital controlling for asset risk and other factors explaining bank capital. The bank's asset risk (*RISK*) is expected to have a positive effect on (desired) capital. A prudent bank, which targets a particular level of default risk, would hold a bigger capital buffer if it were to take on more portfolio risk. As measures of *RISK* we include both components of the standard deviation of weekly bank equity returns, beta and idiosyncratic risk. In addition, we include the one-period-ahead ratio of loan loss provisions. This variable (provisions ($t+1$)) is taken to reflect current credit risk, as we can think of it as measuring expected loan loss provisions next period. For this variable we likewise expect a positive relationship with capital.

In addition to the *RISK* variables we include a number of other control variables (Z)⁸. More profitable banks will find it easier to accumulate equity through retained earnings. We therefore include the bank's return on equity (roe) as a variable capturing this effect. We also hypothesise that larger banks will hold less capital. The reason is that larger banks will tend to find it easier to raise new capital from the market, should they need it. We measure size by the log of total assets (logsize) and expect this variable to be negatively associated with capital. We expect past and present realised bad loan experience to have a negative effect on bank capital. We think of the ratio of non-performing loans (non-perf.loans) as reflecting such realised credit risk. Current and past bad loans

⁸ We do not include minimum capital requirements as a control variable for two reasons. First, regulatory minima are expressed in terms of risk-adjusted assets, whereas our measure of capital is the inverse of leverage and thus relates to total assets. Second, regulatory minima do not vary much across countries. Available empirical evidence (Barth, Caprio and Levine (2000)) suggests that by 1999 all but a handful of countries in our sample had adopted the Basel 8% benchmark. This creates a collinearity issue, since the minimum is a constant for most observations and varies only for 71 out of the 729 banks in our sample.

will have triggered provisions and write-offs and will therefore have had a negative effect on the size of the capital buffer. In addition, the level of capital banks hold may depend on the position of the economic cycle. We therefore include GDP growth as a further right-hand side variable⁹. Since non-performing loans are counter-cyclical, a major aspect of the effect of growth on capital is taken account of separately. But there could be further effects. For example, in upswings loan growth would tend to be higher, reducing the capital ratio unless banks issue more capital. Finally, we include the bank's market share which is defined as its total assets divided by the sum of total assets of all banks (both listed and unlisted) in each country. The reason for including market share is that, in the presence of switching costs, a higher market share results in a competitive advantage, which would have a positive effect on profitability, and hence capital¹⁰.

Estimating the effect of market discipline on bank capital buffers at a bank level faces one major difficulty, which is that some of the market discipline variables are likely to be endogenous (ie, themselves dependent on bank capital). In particular, the amount banks disclose may be determined jointly with the amount of capital they choose to hold. A bank that wishes to raise more equity in the capital market may need to increase its disclosure to ensure that it can find sufficient investor demand. This reverse-causality would also result in a positive relationship between disclosure and capital. To address the endogeneity problem we adopt an instrumental variables Two Stage Least Squares (TSLS) procedure. In the first stage, the endogenous variable is regressed on a set of exogenous regressors. We then predict the dependent variable of this regression taking account only of the information used by the first-stage regression and use the predicted value of the variable, rather than its actual value in the second stage regression.

Table 4 shows the regression results. Columns 1 and 2 concentrate on the effect of the safety net¹¹. We find that both deposit insurance (depins) and expected government support (supp) to have the expected negative effect on bank capital buffers, reflecting the moral hazard incentives arising from explicit or implicit government insurance. These results turn out to be very robust to different specifications. Column 3 and 4 focus on the effect of disclosure. Both the US listing variable and the disclosure index show a statistically significant positive coefficient, suggesting that more

⁹ Borio, Furfine and Lowe (2001) report simple correlations between capital ratios and GDP growth for a number of countries. They find that measured capital ratios are pro-cyclical in some countries and counter-cyclical in others. Ayuso, Perez and Saurina (2002) find evidence that capital buffers are weakly counter-cyclical in Spain over the period 1986-2000.

¹⁰ Kim, Kliger and Vale (2001) infer the size of switching costs from a dynamic market share equation. They estimate switching costs to be around 4% for a sample of Norwegian banks.

¹¹ We have included deposit insurance in all regressions since it turns out to be an important control variable.

disclosure leads banks to hold higher capital buffers¹². Importantly, the effect of the US listing variable is robust when the regression is run on a sub sample excluding all US banks (for which list takes the value 1) and all Japanese banks (for which list takes the value 0). The Japanese banks were excluded as a test because they comprised a single large group. The coefficient of the disclosure index likewise appears robust when the regression is run on a variety of sub samples.

There may also be reason to believe that investors have more information about a bank if the bank is rated by a major rating agency. The argument is that rating agencies act as intermediaries in the disclosure process. They gain access to information that is not publicly available to investors and feed this information into the rating, see Kliger and Sarig (2000). We have investigated the effect of a variable which captured whether or not the bank was rated by a major credit rating agency. We failed to find any strong evidence for a disciplining effect of this variable. This suggests that a rating does not substitute for disclosure to the public at large.

In sum, the regression results are consistent with the notion that market discipline affects the incentives of banks to limit their risk of insolvency. They show that explicit and implicit government guarantees – measured by a deposit insurance index and the Fitch public support rating, respectively – result in lower capital buffers, everything else equal. We also find evidence that banks that disclose more information – measured by whether a bank has a US listing or by the disclosure index – have a higher capital buffer and thus more protection against unexpected losses than banks that disclose less.

3. Implications for public policy

These results underline the importance of governments creating the right environment for market discipline to be effective. Safety nets/deposit protection schemes need to be kept to the minimum. In addition state ownership of banks should be avoided. An open market allowing takeover of weak banks by foreign banks will also enhance the threat of market discipline. Where it is difficult politically or for current financial stability reasons to move from current wide safety nets authorities need to realise that the onus of discipline will rest largely with the supervisors. This might well need to influence the way that supervision is carried out.

¹² For disclosure, most results are qualitatively unchanged in a regression on their actual, rather than their fitted value.

With wide safety nets it is even possible that a bank in difficulty rather than experiencing deposit outflows might have net inflows because it may be willing to pay more for its funds – a case like this has been seen in the London market where part of the group benefited from a wide safety net in one overseas country and another part did not. There were net inflows into the one part and substantial net outflows from the other.

The close link between information disclosure and risk also highlights the importance of the authorities encouraging greater disclosure by banks. Research carried out by the Bank of England into the timing of changes in disclosure by a very limited sample of large UK banks has indicated that it is driven by external requirements. US and UK accounting standards have developed in a similar way over the past twenty years with the US leading the way making a US listing important. This research indicated that banks react to new requirements promptly (sometimes a year ahead of the required date) but do not appear to have been proactive in providing more than was required. This is also supported by the evidence from the world-wide sample. There are a number of German banks in the sample and disclosure of the Tier 1 ratio (ie, shareholders' funds to risk weighted assets), which is the key measure in terms of a bank's solvency (see Jackson, Perraudin and Saporta 2002), was largely limited to banks with a US listing. There could be a co-ordination issue where banks would only disclose information if other banks had to as well (Shaffer 1995). Mandatory requirements could therefore be important.

Several arguments have been put forward which might discourage the authorities from requiring greater disclosure. One is that if banks are rated they disclose private information to the rating agencies making public information disclosure less important. In fact the Bank of England research on the effect of disclosure found that the existence or not of a rating was far less important in terms of a bank's risk profile than the amount of disclosure to the market as a whole. This may be because of the effect which implied support has on the ratings, limiting their usefulness in terms of an assessment of intrinsic credit worthiness.

Another argument against mandatory requirements relates to the possibility that more information disclosure might increase the volatility of markets. Morris and Shin (1999), looking at the game theoretic implications, argue that more disclosure might exacerbate sudden market movements but the general effect is ambiguous. Sometimes greater provision of information is beneficial but sometimes it can be detrimental. It must be the case that disclosure of severe problems might add to volatility, although in bad times banks/investment banks under market pressure or subject to rumour

are tending to disclose much more information. Generalised concerns about risks in particular areas of activity have also led to increased disclosure. Concerns about overheating in the UK mortgage market led to material new disclosures by major players.

Information asymmetries in periods when concerns are being raised about particular firms or market segments therefore seem to be adding to market volatility for some firms. Probably here the important issue is to ensure sufficient information at all times for there to be a graduated response to developing problems from the market.

For disclosure to reduce asymmetries the type of information disclosed is critical. It is not enough for banks to increase the amount of qualitative information about risk and risk management or the production of a range of disparate measures. They need to produce hard disclosure which is directly comparable across banks and encompasses the measures of importance to the market – eg, the Tier 1 ratio not Tier 1 plus Tier 2. The Basel Committee on Banking Supervision, as part of the introduction of the market risk amendment to the 1988 Accord allowed banks to use internal VaR models to assess market risk. Banks using this approach were required to use a model to estimate losses, over a ten-day holding period, with a 99% confidence level. As part of the allowance that a bank could use internal models the Committee recommended hard disclosure of the VaR estimates¹³ but did not prescribe the actual measure. Banks have chosen to disclose VaRs on many different bases making any comparison across banks impossible. The table below sets out the basis for the VaRs published by the large UK banks and shows a substantial variation in approach – the same is also true of the US banks. Banks might argue that they are showing the VaR which they use for internal purposes but under the market risk amendment if they are using VaR for setting capital requirements they should also use that model for their own internal purposes.

Lloyds	HSBC	Abbey	Standard Chartered	Barclays
95%, 1 day	99%, 10 days	95%, 1 day	97.5% , > 1 day	98%, 1 day

Hendricks (1995) shows that it is not possible accurately to convert a 95% VaR to 99% using the normal distribution – the errors could be very large. VaRs on different confidence levels therefore cannot be put on to a comparable basis. Duffie and Pan (1997) do, however, show that scaling up the

¹³ Firms should provide daily information on profits and losses on trading activities, combined with daily value at risk numbers. See Recommendations for Public Disclosure of Trading and Derivatives Activities of Banks and Securities Firms (Basel Committee/IOSCO, October 1999).

one-day VaR by $\sqrt{10}$ is a reasonable approximation for moving from a one-day to a ten-day holding period, making the differences in this aspect less important.

The problem regarding the confidence interval underlines the importance of the authorities requiring core disclosures on a comparable basis to enable differences across banks to be assessed.

One of the huge benefits of Basel 1 is that it has offered the markets a way of comparing the capital of the banks according to the risk assets ratio – the ratio of capital to risk-weighted assets. There is a standard set of weights that are applied to the portfolio and the capital that is recognised in the numerator is also laid down. But even with this standard metric not all banks disclose the Tier 1 ratio.

Over time even the Tier 1 ratio has become less useful as a common metric as banks, particularly in the USA, have securitised a large proportion of their higher quality loans. By March 1998 outstanding non-mortgage securitisations by the 10 largest bank holding companies amounted to around \$200 billion – more than 25% on average of these banks' risk weighted loans (Jackson *et al* 1999). This increased riskiness relative to a given risk asset ratio for these banks.

With pressure on the Accord the Committee has reacted by developing a revised approach, Basel II, with a much more fine-tuned approach to measuring the risks on the banks' portfolios. Under the more advanced internal ratings approaches the risk weights for loans will reflect a detailed assessment of risk which will in turn make the Basel ratio for banks on this approach a more comparable risk metric. Although this will depend upon the way that standards for internal processes are applied in different countries.

But much further than this, the Committee is also under Pillar 3 requiring banks to disclose much more about their risks and the capital which they have to back them. Banks will have to disclose the composition of capital including not just the Tier 1 element but also any innovative instruments included in Tier 1. On interest rate risk banks will have to show the increase or decrease in earnings or economic value which would result from an interest rate shock applied to the banking book. The interest rate shocks will vary across banks reducing comparability but the size of the shock would be disclosed. On credit risk all banks will show provisions and past due assets by geographic region and industry type. Banks using internal systems to assess the riskiness of their loans will have to publish information on the breakdown of loans by probability of default (PD) band and default outturns for the main portfolios – corporate/sovereign/interbank and the main retail portfolios. For each portfolio

they will also have to disclose a weighted average loss given default per PD band. Comparability will be enhanced by the standards which will underpin the basis of the PD and LGD estimates because these will be used to set the capital requirements under the more sophisticated approaches. Again the Committee has developed a common language for credit risk (PD, LGD) which can be then be used as a common metric. Banks will also have to show information on credit risk mitigation –collateral and credit derivatives.

The International Accounting Standards Board is also rightly focussing on the need for enhanced disclosure. In the EU adherence to international accounting standards will be mandatory for listed companies by 2005. The proposals for added disclosure are in terms of general principles but the current focus by the market on the Basel ratio for banks indicates that comparability should not be forgotten. This could perhaps be achieved with greater guidance/recommendations.

The industry is resisting requirements for comparable disclosure on the grounds that tailoring the disclosure to a bank's own circumstances/systems is important. But the huge focus given to the Basel ratio, because it is broadly comparable, highlights the importance of publishing other common measures.

The widespread resistance to comparable disclosure is rather hard to understand – banks with low risk profiles might be expected to be in favour. It is possibly the case that given the cyclical nature of banking all banks believe that they may experience difficult times on occasion. Clearly there are costs regarding disclosure and the private benefits may not been seen as outweighing them. There are, however, several papers which have shown a link between lower disclosure and higher costs on funding which should influence the banks – Botosan (1997) and Sengupta (1998). The authorities of course have to take into account the public benefits as well.

4. Evidence on risk sensitivity of prices

Another rather different question is the extent to which supervisors can and should be using market prices as an additional guide to the riskiness of the banks which they supervise. The market view of the riskiness of a bank may supplement the balance sheet and other information to which the supervisors have access¹⁴. As with all measures of market discipline market prices will be

¹⁴ Although a study on emerging-market economies, Bongini, Laeven and Majnoni (2002) finds that in the recent South East-Asian crisis that information on bank equity prices did not outperform backward-looking information contained in balance sheet data.

contaminated by expectations of a safety net and deposit protection arrangements. A prior question with regard to any market indicator therefore is whether the market believes that particular banks would be allowed to fail and whether equity holders and subordinated bond holders would be bailed out. Most of the detailed evidence we present is for the UK where the authorities have gone to some lengths to minimise any expectation of bailout, see George (1994), and the results could well be substantially different for markets with different expectations. But papers looking at other markets also indicate that market indicators can play a useful role.

In a comprehensive survey of market indicators of banks in the United States, Flannery (1998) concludes that markets have, in general, reflected actual or prospective bank risk. Both equity and bondholders react promptly to new information about bank risk and make rational inferences about the implications of that information for other banks. Also, (equity) market variables provide relatively good information on future bank performance. More recently, Evanoff and Wall (2002) found that subordinated debt spreads were better than reported capital ratios at predicting banking problems while Swidler and Wilcox (2002) found that implied volatilities from equity prices contain information over and above that from changes in share prices and subordinated debt yields.

There have also been two recent studies on European data. Sironi (2003) considered the *information content* of subordinated debt spreads for European banks. He examined new debt issues to assess whether investors were discriminating amongst banks according to credit quality, and used credit ratings and published accounting data as a measure of bank riskiness. His results supported the hypothesis that holders of subordinated debt rationally discriminate between the risk profiles of private sector banks. He also found evidence that the risk sensitivity of spreads increased during the 1990s, perhaps reflecting a reduction in the perceived public sector safety net. Gropp *et al* (2002) assessed the leading indicator properties of two market indicators – equity-based distance to default and bond spreads – for European banks. They found that distance to default was a good longer indicator (6 to 12 months) and bond spreads a shorter indicator (6 month or less) of bank default, proxied by Fitch financial strength ratings downgrades to C or below. Importantly, the bond spread results were strongest for banks that least expected to receive official support (ie, those with the lowest support ratings)¹⁵.

¹⁵ Gropp *et al* also find that bond spreads for large UK banks are significantly higher – around 100 basis points – than for other European banks. They interpret this as the perception that the support of a safety net is smaller in the UK than elsewhere in Europe.

Therefore, although there seem to be different views over which particular market data are most useful in assessing bank risk, the evidence from the United States and Europe suggest that market data of one type or another tend to reflect changes in bank risk and/or can predict future bank vulnerabilities.

It is difficult to make a judgement over whether market prices are an accurate indicator of bank failure in the UK given the relatively small number of cases. To the extent that failures have occurred – with the exception of Barings – they have generally been smaller banks which do not issue publicly traded bonds or equities (see Logan, 2001). A number of listed commercial companies have failed though in the UK and Tudela and Young (2003) find that Merton-based probability of defaults (PDs) provide a strong signal of their future failure. In particular, they find that over the 1990-2001 period for a large sample (7,500) of companies the mean-value of the 1-year PD for twelve months before the default date is 32.0 per cent for defaulters and 5.2 per cent for non-defaulters. Moreover, this market information adds predictive power on future company failure over and above the information from company balance sheet data.

Nonetheless it is possible to look at the extent to which market prices do appear to reflect the riskiness of a bank. The market prices which we assess are bond spreads and three equity-based indicators (real equity prices, implied volatilities and implied PDs) – for 7 major UK banks¹⁶. We have adopted two separate

¹⁶ Bond spreads are measured as the difference between a 5 year bond and a risk-free government bond of similar maturity, implied volatilities are a forward-looking measure of equity volatility derived from the price of an option contract, implied PDs are calculated over a fixed 5 year horizon from a Merton model. The seven banks are Abbey National, Barclays, Standard Chartered, NatRBoS, HSBC/Midland, Bank of Scotland and Lloyds TSB.

approaches to assessing the value of the prices as indicators. The first looks at whether there is an econometric relationship over time between each market indicator and banks' accounting ratios that may serve as a proxy for vulnerability. The second looks at how the indicators have reacted to discrete known events that would have been expected to increase bank fragility.

The econometric approach investigated whether changes in market indicators were statistically significantly associated with current or future changes in certain banks' balance sheet data – proxies for underlying bank fragility. The proxies used for actual bank risk were excess capital over the supervisory trigger ratio (a measure of the bank's ability to withstand shocks), provisions as a percentage of total assets (*ex post* credit risk) and the ratio of risk-weighted to unweighted assets (a broad brush measure of the riskiness of the bank using the existing Basel risk weights)¹⁷. The panel regressions were carried out for the seven original largest UK banking groups over the period 1995 H1 to 2002 H2.

Table 2: Bank Market Indicators and Balance Sheet Measures of Risk

Market Indicators	Balance sheet measures of risk
Bond spread (over risk-free rate)	Excess capital ratio above the regulator's minimum
Real equity price	Provisions/total assets
Implied volatilities	Risk-weighted assets/total assets
Implied probabilities of default	

The method attempts to reveal whether (i) there is a contemporaneous relationship between market indicators and accounting information of bank risk and/or (ii) whether market information provides leading information on actual bank risk over and above that obtained from past information on actual risk. Given that banks' accounts are published with a one to two months lag then evidence of a contemporaneous relationship may suggest market data is a short leading indicator of the published balance sheet data.

The results provide some evidence for contemporaneous relationships between changes in market indicators and proxies for actual risk. Changes in all four market indicators had a statistically significant association in the expected direction with current movements in one or more of the balance sheet risk measures – implied PDs and implied volatilities with excess capital; real equity prices with provisions, and bond spreads, real equity prices and implied volatilities with risk

¹⁷ The (twice yearly) data to construct these accounting ratios are based on confidential returns by the UK FSA.

weighted/total assets (see Table 5). That said, only a small part of the variation in the market indicators was due to changes in these balance sheet measures.

The *leading* indicator properties of the market data were tested by seeing whether lagged changes in the market indicators could explain current changes in the actual risk measures over and above what is explained by past changes in actual risk. None of the four market indicators were found to have predictive power (and be correctly signed) upto one year ahead for actual risk, at least looking at the whole sample period (Table 6). In sum, market information seems to be a reasonably useful reflector of current balance sheet measures of bank risk but not of future risk.

One problem with the above analysis is that the balance sheet measures may not really reflect the risk of the bank – risk weighted assets under Basel I are a limited assessment of true risk. (Although actual provisioning is closer to a true risk measure.) Another way to assess the extent to which market prices reflect risk is to look at the reaction to news. We adopted an event approach to see whether bank market indicators react to significant bank specific, banking system or macroeconomic events. There are certain caveats to this analysis. First, these events are qualitative measures therefore there is some subjectivity over whether an event should be regarded as significant or not. Second, there may be some ambiguity over the expected impact on market prices. For example, assuming that it is a significant event, is the announcement of the chief executive's resignation bad rather than good news? Third, some events might have been expected and thus factored into the market. Therefore the occurrence of the event may not have any impact on market prices.

Bearing these caveats in mind we looked at the behaviour of the market indicators in the week when twenty known significant adverse events occurred. The left-hand column of Table 7 lists the adverse 'shocks' that were known to have affected one or more banks. They include fifteen events affecting specific banks, one banking sector shock (the release of the Cruickshank Review saying that the banks were making 'excessive' profits) and four broader macro-type shocks (the bailout of LTCM, devaluation of the Russian rouble, 9/11, and the announcement of Enron's bankruptcy). The figures in the next four columns show the number of counter intuitively signed changes in the indicator in the week of the shock. They can be regarded as akin to a Type I error, in that the indicator fails to record an adverse event. So, for example, none (0%) of Barclays' market indicators reacted perversely to the resignations of chief executives in November 1998 and in April 1999. The mean for each event or group of events is shown in the right hand column. We also show how much –

measured in relation to the past standard errors of the series – the indicator moved, averaged across banks.

It is evident from the means that overall in the face of adverse events all the 4 market indicators usually move – around 73%-85% of the time – in the expected direction (ie they moved in the wrong direction 15%-27% of the time). They are also generally more sensitive to idiosyncratic shocks than broader ones. Amongst the indicators, on balance implied PDs and implied volatilities most frequently move in the expected direction. This is especially true in the case of implied volatilities if the release of the Cruickshank Report is excluded – an event where the expected directional impact on financial markets is not clear cut. Another stylised fact is that bond spreads are more sensitive to macroeconomic events than bank specific news whereas the opposite is true for equity-based measures¹⁸.

Within the macroeconomic events, all three equity based measures, unlike bond spreads, moved sharply in reaction to 9/11. In contrast, bond spreads rose dramatically in reaction to LTCM but the equity based measures moved only modestly. This may reflect equity prices reacting more to events which could affect earnings and bond prices reflecting changes in risk.

Table 8 shows another measure of the usefulness of market information – the number of false signals (Type II errors). It shows the number of times (weeks) in the year that the market indicator moved by more than during the week of the specified adverse event (or the other specified events in the table). On this criterion the market indicators seem usually to be quite noisy. The size of moves in the adverse news weeks was, on average, larger than in 70% of the other weeks but this left 30% (15) of non-adverse news weeks with larger movements. Not surprisingly 9/11 was an exception in that the financial market indicators generally moved by a larger amount than in all the other weeks of 2001. But even here, bond spreads moved by more in 8 other weeks of the year than during the week of the attack.

So although market indicators usually move in the expected direction in reaction to specific large events, there are often times when they move by a large amount that cannot be related to events. In other words, although Type I errors are quite small Type II errors seem quite large.

¹⁸ Correlations of movements in market indicators across the 7 largest UK banks also suggest that debt based measures have responded more to common shocks than equity-based measures in recent years (since 1997). The average bilateral correlations between banks for bond spreads and credit default swaps is around 0.8-0.9 but only 0.5-0.6 for the three equity-based measures.

In order to investigate the scale of Type II errors in more detail we looked to see for each of the four market indicators whether the largest 10 market movements for each bank can be explicitly related to news events. Again here there is a subjective judgement over what entails an actual event and we have erred on the side of including some smaller events and ones less pronounced than used in Table 7. The results are shown in Charts 2-5. The vertical axis shows the number of banks which experienced one of their 10 largest movements for a particular indicator at that time. What we have categorised as a macroeconomic event is shown as a pink spike in the chart, industry wide are yellow and bank specific events green. If we could not account for an event it is shown in white. Overall we could not explain around 20% of large market movements confirming that Type II errors are quite large. Of the remainder, macroeconomic events account for one half for all indicators, but for bond spreads alone they account for 90% of events.

In summary, the econometric analysis provides some evidence that movements in all market indicators reflect contemporaneous changes in balance sheet measures of bank risk. But the event studies suggest more strongly that implied volatilities are the best reflectors of risk. The results also suggest that although market indicators have more or often than not reacted in the expected directions to adverse events, the indicators appear to be noisy with large movements often seemingly not related to a large event – that is type I errors were quite small but Type II ones quite large. Also, in recent years at least, debt-based market indicators appear to be more sensitive to macroeconomic risks than bank specific ones whereas the reverse is the case for equity-based indicators.

Given the usefulness of debt indicators the introduction of mandatory subordinated debt issuance has been advocated as a way of giving access to improved information on the views of a class of investor whose interests are aligned with those of the authorities. Calomiris and Powell (2001) find that various measures taken in Argentina to increase market discipline – including mandatory subordinated debt requirements – have worked reasonably well. Banks in Argentina were required to issue SND for two percent of their deposits each year. That said, in periods of market stress – the east Asian crisis in 1997 and the Russian crisis in 1998 – debt issues were very difficult for banks. Therefore, the central bank put back the compliance date for SND requirements several times and increased the range of liabilities that banks could issue to satisfy the requirement.

This section has focussed on information from widely traded securities. Given the importance of bank counterparties in market discipline one area which could be pursued is whether a sharp reduction in CD issuance for example is a good leading indicator of problems. There is some anecdotal evidence that if the price is likely to rise banks stop issuing.

5. Conclusion

Across the globe supervision is used to reduce the likelihood of bank failures and to avoid widespread banking crises. Market discipline has an important role to play in this by encouraging more prudent behaviour reducing reliance on intervention by the authorities. There is evidence for example that those banks which disclose more, and therefore which are more subject to market discipline, tend to hold more capital. The converse of this is that supervisors need to be particularly vigilant regarding banks for whom market discipline will not be effective.

- Where the safety net or deposit protection is wide or banks are state-owned.
- Where banks are protected from takeover.
- Where the bank can rely on community deposits reducing market discipline from bank counterparties.

The authorities need to try to take action in good times to increase market discipline by reducing safety nets and improving disclosure, particularly key elements of comparable disclosure such as those tested in this paper. The authorities have an important role to play in developing common disclosure measures. Where increased disclosure standards are laid down, emphasis needs to be placed on the use of a common metric for core parts of the disclosure. In terms of co-ordination this probably is a role that only the authorities can play.

Market prices can also be used to supplement other supervisory information in assessing the riskiness of banks. Equity-based indicators seem to be more sensitive to bank specific information with bond indicators picking up macroeconomic information.

But thought perhaps needs to be given to how the authorities can take advantage of information on the views of bank counterparties, probably through volume indicators.

References

- Amir, Eli, Trevor S Harris and Elisabeth K Venuti (1993), 'A Comparison of the Value-Relevance of U.S. versus Non-U.S. GAAP Accounting Measures Using Form 20-F Reconciliations', *Journal of Accounting Research*, Vol. 31 Supplement, pp. 230-264
- Ayuso, J, Perez, D and Saurina, J (2002), 'Are Capital Buffers Pro-cyclical? Evidence from Spanish Panel Data', Bank of Spain, Working Paper No. 24
- Barth, JR, Caprio, G and Levine, R (2000), 'Regulation and Supervision: What Works Best?' *World Bank Policy Research Working Paper*, No. 2725
- Baumann, Ursel and Erlend Nier (2003), 'Market Discipline, Disclosure and Moral Hazard in Banking', *Bank of England Working Paper*, forthcoming
- Berger, Allen, N (1991), 'Market Discipline in Banking', *Proceedings of a Conference on Bank Structure and Competition*, Federal Reserve Bank of Chicago, May, pp. 419-437
- Bliss, R and M Flannery (2002), 'Market discipline in the governance of US bank holding companies: Monitoring vs. Influencing', *European Finance Review*, Vol 6, pp. 361-395
- Blum, Jürg (2002), 'Subordinated Debt, Market Discipline and Banks' Risk Taking', *Journal of Banking and Finance*, Vol 26(7), pp. 1427-41
- Bongini, Paulo, Laeven, Luc and Majnoni, Giovanni (2002), 'How good is the market at assessing bank fragility? A horse race between different indicators', *Journal of Banking and Finance*, Vol. 26, No. 5, pp. 1011–1028
- Boot, Arnoud W, A, and Schmeits, Anjolein (2000), 'Marked Discipline and Incentive Problems in Conglomerate Firms with Applications to Banking', *Journal of Financial Intermediation*, Vol. 9, pp. 240-273
- Borio, C, Furfine, F and Lowe, P (2001), 'Procyclicality of the Financial System and Financial Stability: Issues and Policy Options', BIS Papers, No. 1, Basel, March
- Botosan, Christine, A (1997), 'Disclosure Level and the Cost of Equity Capital', *The Accounting Review*, Vol 72, (3), pp. 323-349
- Calomiris, C, W and Powell, A (2001), 'Can emerging market bank regulators establish credible discipline? The case of Argentina, 1992-99', in Miskin, F S (ed), *Prudential Supervision*, NBER
- Cordella, Tito and Eduardo Levy Yeyati, (1998), 'Public Disclosure and Bank Failures', *CEPR Discussion Paper* No. 1886
- Covitz, Daniel, Hancock, Diana and Kwast, Myron (2000), 'Market Discipline, Banking Organizations and Subordinated Debt', Paper presented to the 2000 Global Finance Association Meetings, April 21, Chicago
- Demirgüç-Kunt, Asli and Detragiache, Enrica (2003), 'Does Deposit Insurance Increase Banking System Stability? – An Empirical Investigation', *Journal of Monetary Economics*, forthcoming

- Demirgüç-Kunt, Asli and Sobaci, Tolga (2001), 'Deposit Insurance Around the World: A Data Base', *World Bank Economic Review*, Vol. 1513
- De Nicolo', G, and M, L, Kwast (2001), 'Systemic risk and financial consolidation: are they related?', *Federal Reserve Board Working Paper* No. 2001-33
- Duffie, Darrell and Jun Pan (1997), 'An Overview of Value at Risk', *The Journal of Derivatives*, Spring, Vol. 4 No. 3
- Evanoff, Douglas, D, and Wall, Larry, D, (2000), 'The Role of Subordinated Debt in Bank Safety and Soundness Regulation' in Proceedings to the 36th Annual Conference on Bank Structure and Competition
- Evanoff, D, E, and L, D, Wall (2002), 'Measures of the riskiness of banking organisations: subordinated debt yield, risk-based capital and examination ratings', *Journal of Banking and Finance*, May
- Flannery, M, J (1998), 'Using market information in prudential bank supervision: a review of the US empirical evidence', *Journal of Money, Credit and Banking*, Vol. 30, No. 3, pp 273-305
- Freixas, Xavier (1999), 'Optimal Bail Out Policy, Conditionality and Creative Ambiguity', Financial Markets Group, London School of Economics, *Discussion Paper* No. 327
- George, E, A, J (1994), 'The Pursuit of Financial Stability', *Bank of England Quarterly Bulletin*, February
- Gropp, Reint, Jukka Vesala and Guisepe Vulpes (2002), 'Equity and Bond Market Signals as Leading Indicators of Bank Fragility', *European Central Bank Working Paper*, No. 150
- Hamalainen, Paul, Maximilian J, B, Hall and Barry Howcroft (2001), 'A Framework for Implementing Market Discipline in Financial Regulatory Design', *Loughborough University Banking Centre Research Paper* No. 147/01
- Hendricks, Darryl (1995), 'Evaluation of Value-at-Risk Models Using Historical Data', *Risk Measurement and Systemic Risk, Proceedings of a Joint Central Bank Research Conference, Board of Governors of the Federal Reserve System*, November
- Jackson, Patricia *et al* (1999), 'Capital requirements and bank behaviour, the impact of the Basle Accord', *Basle Committee on Banking Supervision Working Papers*, No. 1, April
- Jackson, Patricia, William Perraudin and Victoria Saporta (2002), 'Regulatory and 'economic' solvency standards for internationally active banks', *Journal of Banking and Finance*, special issue on Banks and Systemic Risk, Vol. 26. No.5, May
- Kim, M, Kliger, D, and Vale, B (2001), 'Estimating Switching Costs and Oligopolistic Behaviour', University of Haifa, *Discussion Paper* No. 01-02
- Kliger, Doron and Oded Sarig (2000), 'The Information Value of Bond Ratings', *Journal of Finance*, Vol 55(6), pp. 2879-2902
- Leutz, Christian and Verrecchia, Robert E (2000), 'The Economic Consequences of Increased Disclosure', *Journal of Accounting Research*, Vol. 38, pp. 91-135

- Logan, A (2001), 'The United Kingdom's small banks' crisis of the early 1990s, what were the leading indicators of failure?', *Bank of England Working Paper*, No. 139
- Martinez Peria, Maria Soledad and Schmuckler, Sergio L (2001), 'Do Depositors Punish Banks for Bad Behaviour? Market Discipline, Deposit Insurance and Banking Crises', *Journal of Finance*, Vol. 56, pp. 1029-1051
- Merton, Robert C, (1977), 'An Analytic Derivation of the Cost of Deposit Insurance Loan Guarantees', *Journal of Banking and Finance*, Vol. 1, pp. 3-11
- Morgan, D and Stiroh, K (1999), 'Bond Market Discipline of Banks: Is the Market Tough Enough?', *Federal Reserve Bank of New York Staff Report*, No. 95, December
- Morris, S and H, S, Shin (1999), 'Risk Management with Interdependent Choice', *Oxford Review of Economic Policy*, Autumn
- Nozaki, Masahiro (2002), 'Banking with Adverse Selection', *mimeo*, Brown University
- Sengupta, Partha (1998), 'Corporate Disclosure Quality and the Cost of Debt', *Accounting Review*, Vol. 73 (4), October, pp. 459-474
- Sironi, Andrea (2003), 'Testing for market discipline in the European banking industry: evidence from subordinated debt issues', *Journal of Money, Credit and Banking*, forthcoming
- Shaffer, S (1995), 'Rethinking Disclosure Requirements', *Federal Reserve Bank of Philadelphia Business Review*, May/June, 15-19
- Swidler, S and J, A, Wilcox (2002), 'Information about bank risk from option prices', *Journal of Banking and Finance*, 26(5), May
- Tudela, Merxe and Garry Young (2003), 'A Merton Model Approach to Assessing the Default Risk of UK Public Companies', *Bank of England Working Paper*, forthcoming

Chart 1a: Capital ratio and deposit insurance across countries

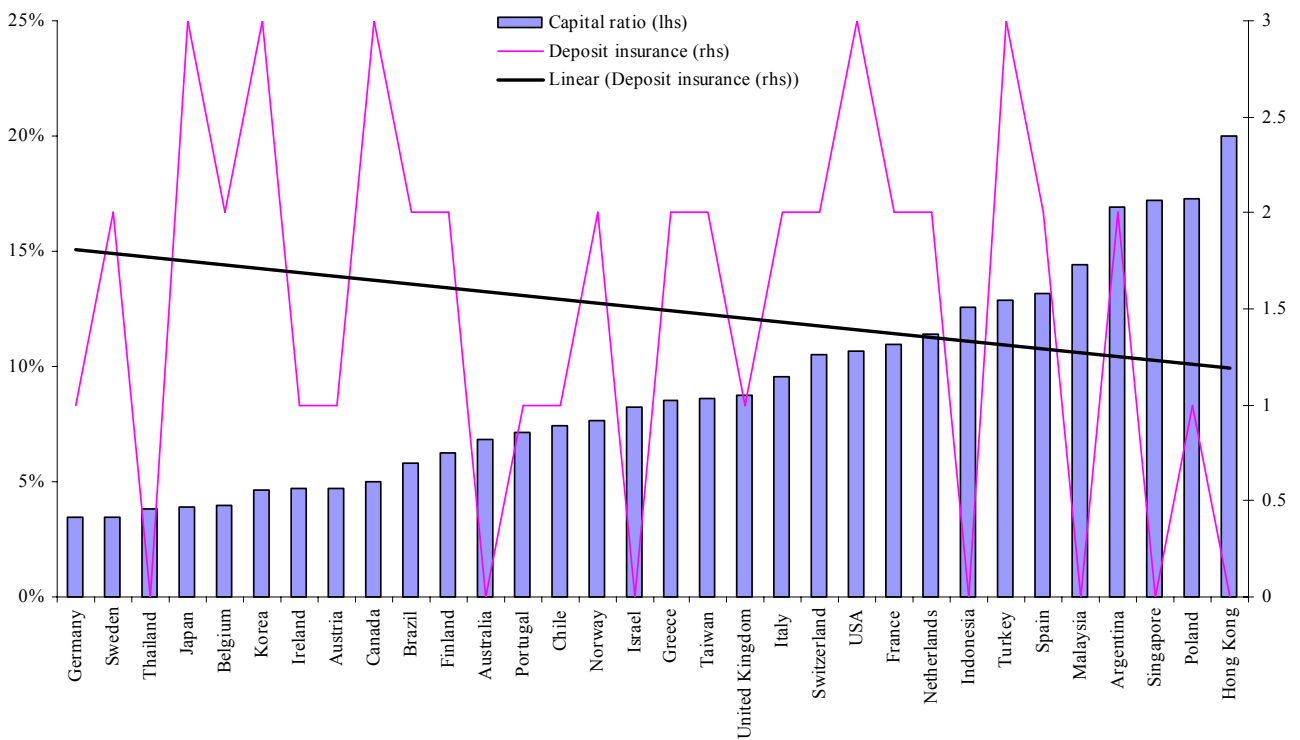


Chart 1b: Capital ratio and support rating across countries

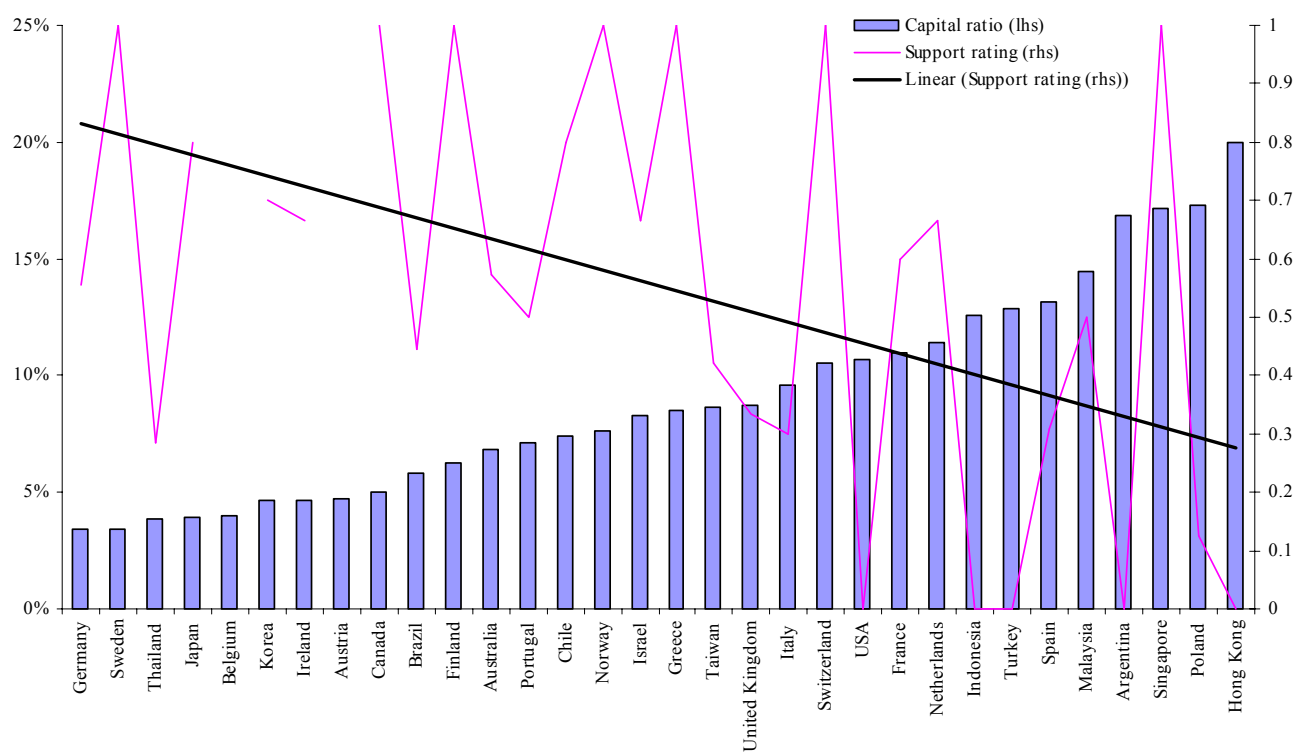


Chart 1c: Capital ratio and disclosure across countries

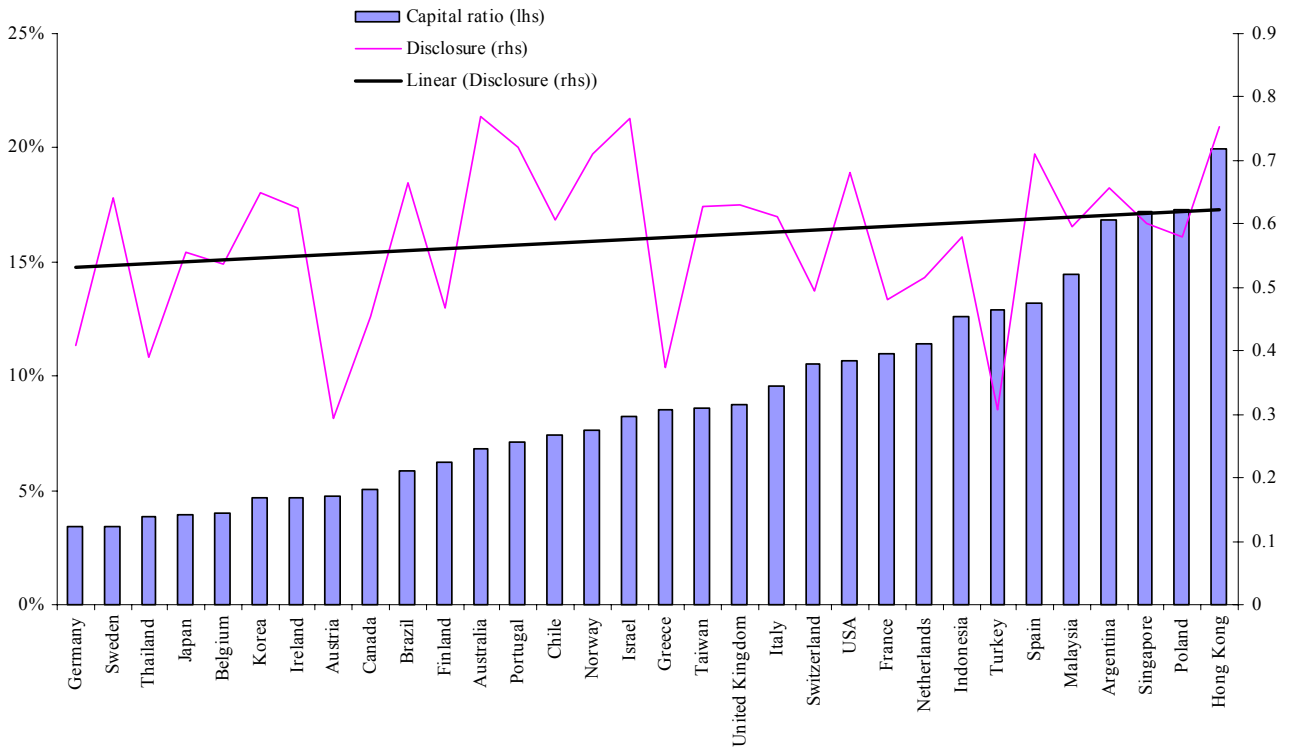


Chart 1d: Capital ratio and US listing across countries

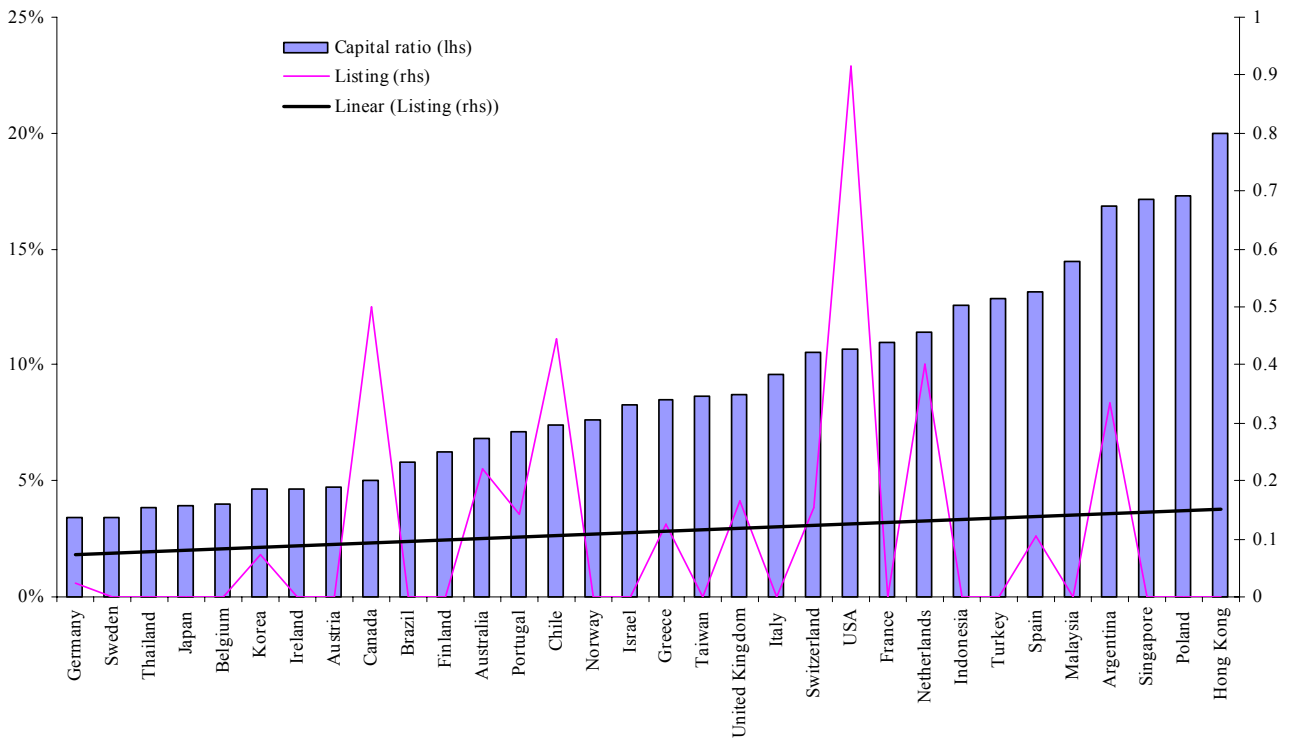


Table 3: Cross-country correlations

	Deposit Insurance	Support rating	Disclosure	US listing
Correlation coefficient	-0.26	-0.49***	0.23	0.05
P-value	0.1543	0.0054	0.202	0.773

Table 4: Instrumental variable fgls regression model with heteroskedastic panels and panel-specific ar(1). Dependent variable: cap

	(1) TS FGLS (Safety net)	(2) TS FGLS (Safety net)	(3) TS FGLS (Disclosure)	(4) TS FGLS (Disclosure)
Dep. Variable	Cap	Cap	Cap	Cap
Constant	-3.053121***	-3.197193***	-3.71296***	-2.387271***
Provisions (t+1)	.0531211***	.1059141**	.0631186***	.0453969**
Beta	.0057842***	.0037409***	.0043833***	.0063161***
Idios. Risk	.146355***	-.0211465	.1244541***	.1206784***
Logsize	-.0130054***	-.0055223***	-.0118416***	-.0140268***
Roe	.0385067***	.0420866***	.041514***	.0375441***
GDP growth	.0132699**	-.0578104***	-.094983***	.009019
Non-perf. loans	-.1036349***	-.0276951***	-.0853132***	-.1172002***
Market share	-.0156366	.0210283**	-.0655683***	-.0106407
Time trend	.0016722***	.0016958***	.0020121***	.0013506***
Depins	-.013674***	-.0060593***	-.0209578***	-.0148809***
Supp		-.027708***		
List			.0244858***	
Disclosure				.0335751***
No. of obs.	1814	772	1814	1814
No. of groups	405	168	405	405
Log likelihood	5859	2642	6051	5850

*** Statistical significance at the one percent level

** Statistical significance at the five percent level

* Statistical significance at the ten percent level

Table 5: Contemporaneous Relationships between balance sheet measures and market indicators

Coefficients and their associated standard errors (below in brackets) from a random effects regression of the change in each market indicator on the change in three proxies for bank risk between 1995H1 and 2002H2¹

Dependent variable:	(1) Bond spread (mean period)	(2) Bond spread (end period)	(3) Real equity price (mean period)	(4) Real equity price (end period)	(5) Implied volatility (mean period)	(6) Implied volatility (end period)	(7) Implied PDs (mean period)	(8) Implied PDs (end period)
Excess capital	-0.001 (0.46)	-0.005 (1.61)	0.010 (1.45)	0.003 (0.39)	-0.001* (1.71)	0.000 (0.27)	-0.000* (1.80)	-0.000 (0.62)
<i>Observations</i>	53	53	91	91	44	44	82	76
<i>Banks</i>	6	6	7	7	6	6	7	7
Provisions to total assets	-2.861 (0.12)	4.741 (0.15)	-105.723** (2.00)	-16.670 (0.26)	8.249 (0.95)	9.075 (1.03)	0.046 (1.47)	0.034 (0.92)
<i>Observations</i>	54	54	99	99	51	51	84	77
<i>Banks</i>	6	6	7	7	6	6	7	7
Risk weighted to total assets	2.796* (1.76)	3.352 (1.62)	-8.344** (2.19)	-1.122 (0.24)	0.925** (2.33)	0.716 (1.61)	0.003 (1.47)	0.003 (1.11)
<i>Observations</i>	48	48	84	84	47	47	75	68
<i>Banks</i>	6	6	7	7	6	6	7	7

All variables are in first differences

* significant at 10%; ** significant at 5%; *** significant at 1% level

¹ The regression being estimated is:

$$\Delta \text{Market Indicator}_{it} = \mu + \alpha_1 \Delta \text{Risk Indicator}_{it} + v_i + \varepsilon_{it}$$

Table 6: Leading Indicator Properties of Market Indicators

Results from a chi-squared test on whether the coefficients on the lags of the market indicator variable are equal to zero in a Granger causality test on the bank risk proxies (figures shown are probabilities)¹

Market Indicators	Dependent variable 1: Excess capital	Dependent variable 2: Provisions to total assets	Dependent variable 3: Risk-weighted to total assets
Bond spread (mean of period)	0.1502	0.7386	0.4025
Bond spread (end of period)	0.1295	0.6335	0.5773
Real equity price (mean of period)	0.6584	0.7344	0.6074
Real equity price (end of period)	0.2621	0.3380	0.8802
Implied volatility (mean of period)	0.007***(a)	0.5124	0.4616
Implied volatility (end of period)	0.0678*(a)	0.8678	0.6697
Implied PDs (mean of period)	0.9538	0.2177	0.3428
Implied PDs (end of period)	0.3363	0.3460	0.2304

(a) Coefficients are counter-intuitively signed.

* significant at 10%; ** significant at 5%; *** significant at 1% level

¹ The regression being estimated is:

$$\Delta Risk Indicator_{it} = \mu + \alpha_1 \Delta Risk Indicator_{it-1} + \alpha_2 \Delta Risk Indicator_{it-2} + \beta_1 \Delta Market Indicator_{it-1} + \beta_2 \Delta Market Indicator_{it-2} + v_i + \varepsilon_{it}$$

With the null hypothesis of $H_0: \beta_1 = \beta_2 = 0$

Table 7: Number of counter-intuitively signed movements in the indicators in the week of a shock (pseudo Type I errors) and size of that movement relative to the indicator's standard deviation^(a)

EVENT		Bond spread ^(b)	Real equity price ^(c)	Implied volatilities ^(b)	Implied PDs ^(b)	Mean (%)
Discovery of £50mn loss in Natwest's option trading book on 28/2/97	Proportion of counter-intuitively signed changes	NA	0/1	NA	0/1	0%
	Size	NA	0.38	NA	0.2	0.29
Devaluation of the Thai baht, affecting Standard Chartered on 2/7/97	Proportion of counter-intuitively signed changes	NA	1/1	NA	1/1	100%
	Size	NA	-0.26	NA	-0.13	-0.2
Devaluation of the Indonesian rupiah, affecting Standard Chartered on 14/8/97	Proportion of counter-intuitively signed changes	NA	1/1	NA	0/1	50%
	Size	NA	0	NA	0	0
Day of widest spread of Hong Kong interbank rates over US rates affecting HSBC on 23/10/97	Proportion of counter-intuitively signed changes	0/1	0/1	NA	0/1	0%
	Size	0.34	0.85	NA	0.52	0.57
Barclays' profit were 20% lower than market expectation on 17/2/98	Proportion of counter-intuitively signed changes	1/1	0/1	0/1	0/1	25%
	Size	-0.05	0.43	0.23	0.23	0.21
Standard Chartered issue a profit warning on 27/11/98	Proportion of counter-intuitively signed changes	NA	0/1	NA	0/1	0%
	Size	NA	0.48	NA	0.72	0.6
Resignation of Martin Taylor (Barclays' chief executive) on 27/11/98	Proportion of counter-intuitively signed changes	0/1	0/1	0/1	0/1	0%
	Size	0.11	0.44	0.81	0.53	0.47
Barclays issue a profit warning on 7/1/99	Proportion of counter-intuitively signed changes	1/1	0/1	0/1	0/1	25%
	Size	-0.04	0.66	0.24	0.43	0.32
Resignation of Michael O'Neill (Barclays' new chief executive) on 13/4/99	Proportion of counter-intuitively signed changes	0/1	0/1	0/1	0/1	0%
	Size	0.11	0.09	0.33	0.02	0.14
Bank of Scotland's bid for Nat West fails on 15/2/00	Proportion of counter-intuitively signed changes	0/1	0/1	0/1	0/1	0%
	Size	0	2.35	0.82	0.7	0.97
Lloyds-TSB's bid for Abbey National fails due to OFT's decision on 10/7/01	Proportion of counter-intuitively signed changes	0/1	0/1	0/1	0/1	0%
	Size	0	0.88	0.2	0.12	0.3
Abbey National increase their wholesale provisions on 25/7/01	Proportion of counter-intuitively signed changes	NA	0/1	1/1	0/1	33%
	Size	NA	0.99	-0.03	0.37	0.44
Argentina announces default and pesification, affecting HSBC (claims on Argentina as % of	Proportion of counter-intuitively signed changes	NA	1/1	0/1	1/1	67%

EVENT		Bond spread ^(b)	Real equity price ^(c)	Implied volatilities ^(b)	Implied PDs ^(b)	Mean (%)
shareholder's funds: 9.8%), 01/12/01						
	<i>Size</i>	<i>NA</i>	<i>-0.47</i>	<i>0.08</i>	<i>-0.11</i>	<i>-0.17</i>
Royal Bank of Scotland's provisions are up by 54%, 28/02/02	Proportion of counter-intuitively signed changes	NA	1/1	NA	NA	100%
	<i>Size</i>	<i>NA</i>	<i>-0.56</i>	<i>NA</i>	<i>NA</i>	<i>-0.56</i>
Abbey National announced it was likely to report a full year loss for the first time ever, 10/06/02	Proportion of counter-intuitively signed changes	NA	0/1	0/1	NA	0%
	<i>Size</i>	<i>NA</i>	<i>0.62</i>	<i>1.17</i>	<i>NA</i>	<i>0.9</i>
Mean	Proportion of counter-intuitively signed changes	29%	27%	11%	15%	21%
	<i>Size</i>	<i>0.07</i>	<i>0.46</i>	<i>0.42</i>	<i>0.28</i>	<i>0.31</i>
INDUSTRY WIDE EVENTS						
Release of Cruickshank Report claiming banking sector made 'excessive profits' on 20/3/00	Proportion of counter-intuitively signed changes	1/5 (20%)	1/7 (14%)	2/5 (40%)	1/7 (14%)	22%
	<i>Size</i>	<i>0.03</i>	<i>-0.69</i>	<i>0.45</i>	<i>-0.36</i>	<i>-0.14</i>
MACRO EVENTS						
Devaluation of the Russian rouble on 17/8/98	Proportion of counter-intuitively signed changes	1/4	6/7	1/3	6/7	58%
	<i>Size</i>	<i>0.08</i>	<i>-0.26</i>	<i>-0.09</i>	<i>-0.08</i>	<i>-0.09</i>
Announcement of LTCM's difficulties and bailout on 24/9/98	Proportion of counter-intuitively signed changes	1/4	1/7	0/3	1/7	14%
	<i>Size</i>	<i>0.35</i>	<i>0.52</i>	<i>0.2</i>	<i>0.32</i>	<i>0.35</i>
Terrorists attacks in the United States on 11/9/01	Proportion of counter-intuitively signed changes	0/4	0/7	0/6	0/7	0%
	<i>Size</i>	<i>0.1</i>	<i>1.53</i>	<i>2.28</i>	<i>0.5</i>	<i>1.10</i>
Announcement: Enron is on the brink of bankruptcy, S&P downgrade to junk, shares fall, 28/11/01	Proportion of counter-intuitively signed changes	NA	1/7	2/6	0/7	16%
	<i>Size</i>	<i>NA</i>	<i>0.14</i>	<i>0.18</i>	<i>0.16</i>	<i>0.16</i>
Mean	Proportion of counter-intuitively signed changes	17%	29%	17%	25%	22%
	<i>Size</i>	<i>0.18</i>	<i>0.48</i>	<i>0.64</i>	<i>0.23</i>	<i>0.38</i>
ALL EVENTS						
Mean	Proportion of counter-intuitively signed changes	25%	27%	15%	17%	21%
	<i>Size</i>	<i>0.10</i>	<i>0.41</i>	<i>0.49</i>	<i>0.23</i>	<i>0.31</i>

^(a) For the size comparison, a positive figure reflects an intuitively signed move. A negative one a counter-intuitively signed move.

^(b) Figures presented on bond spreads, implied PDs and implied volatilities are calculated from the absolute change in the week around the shock. Standard deviations (the denominator for the size comparison) are calculated from the level of the variable over the entire period for which the indicator is available.

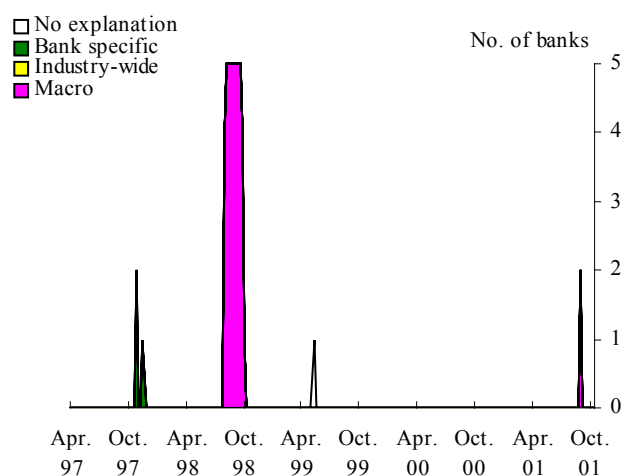
^(c) Figures presented for real equity prices are calculated from the absolute change in week around the shock For the size comparison, the numerator is the absolute movement in the week and the denominator is the standard deviation of the level of real equity prices in that year (because it is trended).

Table 8: Number of weeks in the year of the shock when the market indicator moved in an adverse direction by more than in the week of the shock (pseudo Type II errors)^(a)

EVENT	Bond spread	Real equity price	Implied volatilities	Implied PDs	Mean
EVENTS AFFECTING SPECIFIC BANKS					
Discovery of £50mn loss in Natwest's option trading book on 28/2/97	NA	21 wks	NA	6 wks	14 wks
Devaluation of the Thai baht, affecting Standard Chartered on 2/7/97	NA	42 wks	NA	41 wks	42 wks
Devaluation of the Indonesian rupiah, affecting Standard Chartered on 14/8/97	NA	33 wks	NA	32 wks	33 wks
Day of widest spread of Hong Kong interbank rates over US rates affecting HSBC on 23/10/97	0 wks	0 wks	NA	0 wks	0 wks
Barclays' profit were 20% lower than market expectation on 17/2/98	27 wks	5 wks	10 wks	7 wks	12 wks
Standard Chartered issue a profit warning on 27/11/98	NA	5 wks	NA	4 wks	5 wks
Resignation of Martin Taylor (Barclays' chief executive) on 27/11/98	21 wks	4 wks	3 wks	3 wks	8 wks
Barclays issue a profit warning on 7/1/99	29 wks	3 wks	7 wks	2 wks	10 wks
Resignation of Michael O'Neill (Barclays' new chief executive) on 13/4/99	14 wks	22 wks	2 wks	25 wks	16 wks
Bank of Scotland's bid for Natwest fails on 15/2/00	9 wks	0 wks	4 wks	0 wks	3 wks
Lloyds-TSB's bid for Abbey National fails due to OFT's decision on 10/7/01	18 wks	3 wks	5 wks	5 wks	6 wks
Abbey National increase their wholesale provisions on 25/7/01	NA	1 wk	24 wks	2 wks	8 wks
Argentina announces default and pesification, affecting mainly HSBC (claims on Argentina as % of shareholder's funds: 9.8) on 01/12/01	NA	46 wks	16 wks	47 wks	36 wks
Royal Bank of Scotland's provisions are up by 54% on 28/02/02	NA	35 wks	NA	NA	20 wks
Abbey National announced it was likely to report a full year loss for the first time ever on 10/06/02	NA	1 wk	0 wks	NA	4 wks
Mean	17 wks	15 wks	8 wks	13 wks	13 wks
INDUSTRY WIDE EVENTS					
Release of Cruickshank Report claiming banking sector made 'excessive profits' on 20/3/00	16 wks	46 wks	24 wks	46 wks	33 wks
MACRO EVENTS					
Devaluation of the Russian rouble on 17/8/98	16 wks	35 wks	22 wks	36 wks	27 wks
Announcement of LTCM's difficulties and bailout on 24/9/98	15 wks	9 wks	14 wks	8 wks	12 wks
Terrorists attacks in the United States on 11/9/01	8 wks	4 wk	0 wks	2 wks	4 wks
Announcement: Enron is on the brink of bankruptcy, S&P downgrade to junk, shares fall on 28/11/01	NA	12 wks	16 wks	9 wks	12 wks
Mean	13 wks	15 wks	13 wks	14 wks	14 wks
ALL EVENTS					
Mean	16 wks	16 wks	11 wks	15 wks	15 wks

^(a) Where two events affecting the same bank occur in the same year, the week of the other event is excluded from the comparison. Figures for bond spreads, implied PDs and implied volatilities compare absolute changes and equity prices the percentage change in the week of the shock with other weeks of the year.

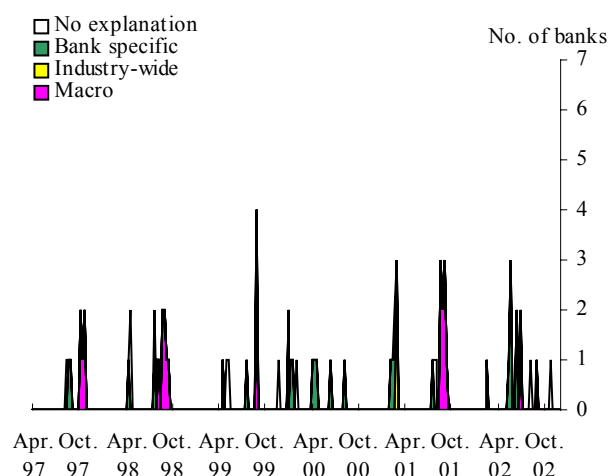
Chart 2: Explanation for the ten largest adverse four weekly movements in UK banks' bonds spreads^(a)



(a) - Bloomberg, Reuters News and Financial Times used as sources of news stories for the explanation.

Banks included in the sample: Abbey National, NatWest/Royal Bank of Scotland/HBOS, Barclays, Midland/HSBC and Lloyds TSB.

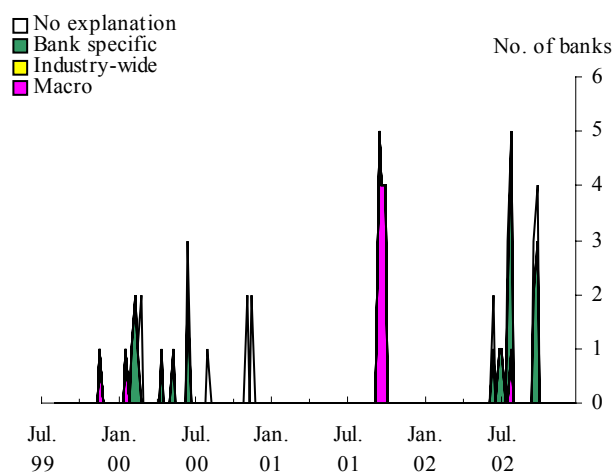
Chart 3: Explanation for the ten largest adverse four weekly movements in UK banks' real equity prices^(a)



(a) - Bloomberg, Reuters News and Financial Times used as sources of news stories for the explanation.

Banks included in the sample: NatWest/Royal Bank of Scotland, Standard Chartered, Abbey National, Bank of Scotland/HBOS, Barclays, Midland/HSBC and Lloyds TSB.

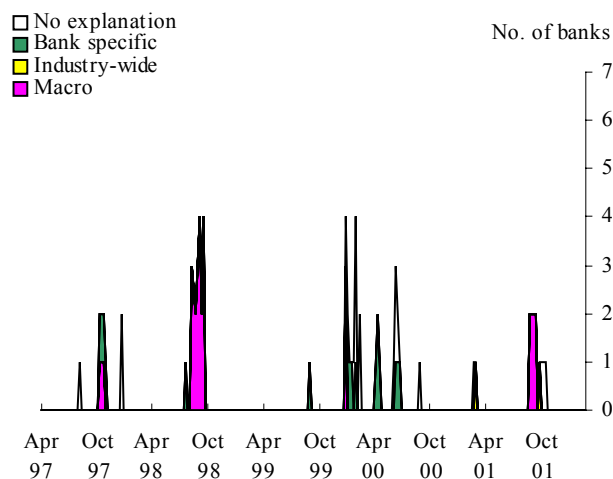
Chart 4: Explanation for the ten largest adverse four weekly movements in UK banks' implied volatilities^(a)



(a) - Bloomberg, Reuters News and Financial Times used as sources of news stories for the explanation.

Banks included in the sample: Abbey National, Barclays, Bank of Scotland/HBOS, NatWest/Royal Bank of Scotland, Midland/HSBC, Lloyds TSB.

Chart 5: Explanation for the ten largest adverse four weekly movements in UK banks' implied probabilities of default^(a)



(a) - Bloomberg, Reuters News and Financial Times used as sources of news stories for the explanation.

Banks included in the sample: Abbey National, Barclays, Bank of Scotland/HBOS, Standard Chartered, NatWest/RBOS, Midland/HSBC and Lloyds TSB.