MARKET DISCIPLINE, DISCLOSURE AND MORAL HAZARD IN BANKING

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Abstract:

This paper investigates the effectiveness of market discipline in limiting excessive risk-taking by banks. We have constructed a large cross-country panel data set consisting of observations on 729 individual banks from 32 different countries over the years 1993 to 2000. Theory implies that the strength of market discipline ought to be related to the extent of the government safety net, the observability of bank risk choices and to the proportion of uninsured liabilities in the bank's balance sheet. We test for hypotheses relating to all of these factors at the bank level. Panel data estimation techniques are applied to both capital regressions, which aim to explain banks' choice of capital buffers, and risk regressions, which aim to explain bank risk. Our results suggest that moral hazard exists and that market discipline plays a role in mitigating banks' risk of insolvency.

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Section 1: Introduction

In recent years considerable attention has been paid to the topic of market discipline in banking. Market discipline refers to a market-based incentive scheme in which investors in bank liabilities, such as subordinated debt or uninsured deposits, "punish" banks for greater risk-taking by demanding higher yields on those liabilities[2]. The reason market discipline is needed is that banks are prone to engage in moral hazard behaviour. Banks collect deposits and invest these funds in risky assets (loans). To safeguard against insolvency, banks hold capital buffers against adverse outcomes in their investments in risky assets (loan default). But the bank's private solvency target may not take into account the interests of depositors, nor of society as a whole. As a result, banks may engage in excessive risk-taking. Market discipline is a mechanism that can potentially curb the incentive to take excessive risk, by making risk-taking more costly for banks.

This paper sets out to investigate the effectiveness of market discipline in providing incentives for banks to limit their risk. As has been emphasised by Berger (1991), Bliss and Flannery (2000) and Hamalainen and Howcroft (2001), the "previous literature has concentrated primarily on whether the market prices [of bank liabilities] react adversely to information about risk" (Berger 1991)[3]. But this does not reveal the degree to which market discipline is effective as an incentive scheme, i.e. to what degree the existence of market discipline actually influences bank behaviour.

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[2] The increase in the required yield may manifest itself in a price effect (a rise in interest rates) or a quantity effect (investors withdraw their funds).

[3] A small literature examines the extent to which banks respond to changes in the yield of their subordinated debt. Bliss and Flannery (2002) fail to find any evidence that following a change in yield spreads managers respond with changes in balance sheet allocations. As pointed out by Evanoff and Wall (2000a), this "study is attempting to capture one aspect of discipline imposed by the debt market – *ex post* discipline. [That is,] do managers change their behaviour following a change in yield spreads? Another form of discipline, and that most typically associated with sub debt proposals, [refers to how banks may change their behaviour] in an attempt to *avoid* having the market impose costs through increased spreads. This *ex ante* discipline encourages firms to prudently manage risk" (emphasis added). Covitz, Hancock and Kwast (2000) provide evidence that banks' decision to issue additional sub debt is influenced by yield spreads. Increases in yield are associated with a reduction of new issues of debt. In contrast to both these studies, our study is an attempt to examine the effectiveness of ex ante discipline.

This is an important question given proposed changes in banking regulation. While Pillar 2 of the proposed New Basel Accord attempts to strengthen supervisory oversight, the Basel Committee has taken the view that enhancing market discipline is important in a world where supervisory resources are limited and banking activities are becoming more and more complex. This view is reflected in Pillar 3 of the proposed new Accord, which relies on enhancing bank disclosure to strengthen market discipline. To the extent that the New Basel Accord shifts some of the burden of bank oversight from supervisors to markets, it is important to ascertain whether market discipline can be effective, and under what conditions it might not be. Our paper seeks to fill this gap[4] and assembles evidence both on the existence of moral hazard in banking and on the power of market discipline to limit bank risk-taking.

We have chosen to analyse the existence of moral hazard and the effectiveness of market discipline in a unified empirical framework, because both concepts are intimately related. Blum (2002) and Cordella and Yeyati (1998) show that in the absence of bankruptcy costs and corporate governance problems between bank shareholders and manager, if bank deposits are uninsured and the bank's risk choice is observable by depositors, the bank's risk choice will be efficient. The reason is that banks internalise the impact of their risk choice on depositors since these in turn will demand higher compensation if the bank incurs higher risk. In such a world there is perfect market discipline and no moral hazard. Conversely, if deposits are insured or the bank's risk choice is not observable by depositors, then the bank will choose a higher risk profile at the expense of depositors. The reason is that depositors will not demand a higher return in response to higher risk choices by the bank. In such a world there is no market discipline and the bank's choice of its risk of default is subject to moral hazard.

This theoretical framework suggests that the effectiveness of market discipline in containing excessive risk-taking hinges on 1.) the extent of the government safety net 2.) the degree to which the bank is financed by uninsured liabilities and 3.) the extent of observability of bank risk choices. Market discipline is likely to be more effective, the lesser the degree of explicit or implicit government

[4] In a recent paper, Barth, Caprio and Levine (2002) analyse the implications of various features of the regulatory and supervisory regime. However, their analysis is essentially static, in that most of these features relate to 1999. In addition, the impact of these variables is analysed at country level, rather than at bank level.

guarantees relating to bank liabilities, the greater the amount of uninsured liabilities in the bank's balance sheet and the greater the degree of bank disclosure.

In order to test the empirical validity of these hypotheses we have constructed a large cross-country panel data set, which covers 729 individual listed banks from 32 different countries over the years 1993 to 2000. Apart from increasing the sample size, our motivation for assembling cross-country data is that the effectiveness of market discipline is likely to vary across countries. For example, the extent of depositor protection is likely to vary across countries, but not for banks within the same country. Likewise, the observability of banks' risk choices may vary according to the disclosure environment in which the banks operate and this environment is likely to vary across countries.

The rest of this paper is organised as follows. Section 2 describes our research design and outlines a number of hypotheses we can test using our dataset. Section 3 describes our sampling strategy and provides descriptive statistics for the main variables of interest. Section 4 presents bank level panel data analysis of the relationship between market discipline and the size of bank capital buffers. Section 5 presents the results pertaining to the relationship between market discipline variables and bank risk. Section 6 discusses the results of a number of robustness checks. Finally, section 7 summarises our findings and concludes.

Section 2: Hypotheses and Research Design

1. Capital and Risk Regressions

Our basic hypothesis is that market discipline, if effective, forces banks to maintain a lower probability of default, ceteris paribus. In order to investigate this hypothesis empirically we posit a relationship between bank capital and bank asset risk and determine whether this relationship is affected by market discipline variables. In **capital regressions**, the basic relationship we have estimated is

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

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

The capital ratio (*CAP*) is defined as the ratio of equity capital to total assets minus equity, in book values[5]. Equity includes common stock, preferred stock, capital surplus, retained earnings as well as capital reserves.

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. Shrieves and Dahl (1992) as well as Calomiris and Wilson (1998) provide evidence that changes in bank risk are positively associated with changes in bank capital for US banks. But one might also expect a positive relationship to hold cross-sectionally (across banks). Bank asset risk is difficult to measure. Our strategy has therefore been to include a number of measures of bank risk as right hand side variables.

In the capital regressions we treat risk in year t as exogenous for capital in year t. The idea is that risk in year t is largely determined by decisions in previous years, whereas capital is more easily adjusted during the course of the year, in response to changes in exogenous factors. In particular, since loans are non-tradable, the risk arising from a bank's loan portfolio is not easily changed over the course of one year, but determined by the bank's loan policy in previous years[6]. Capital on the other hand, can be adjusted in the course of the year, e.g. by changing dividends, by issuing more equity or by retaining earnings.

The desired level of capital may vary across banks. In particular, banks with relatively easy access to the capital market may want to hold less capital, since they will find it easy to raise new capital should they need it. On the other hand, banks with limited access to the capital market may want to hold larger

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[5] By the balance sheet identity, the denominator is equal to the sum of debt and deposits. By definition therefore, the capital ratio is the inverse of the leverage ratio.

[6] The past decade has seen a growing range of new techniques for transferring credit risk, see Rule (2001). Some of these techniques, eg credit default swaps, allow banks to transfer credit risk relatively rapidly. However, the size of these markets is still limited, and we would not expect banks to hedge all their credit exposure using these instruments. The reason is potential moral hazard. If a bank were to hedge all of its credit exposure, it would lose the incentive to monitor its creditors, which would increase the likelihood of creditor default.

capital buffers, since they cannot as easily raise new capital. In addition, the actual level of bank capital may differ from the desired level due to the influence of exogenous factors, such as the position of the economic cycle. These considerations justify the inclusion of a number of control variables (*Z*).

The main variables of interest in this regression are the market discipline variables. Controlling for both bank risk and exogenous factors, we expect market discipline (*MKD*), if effective, to cause banks to hold more capital.

In addition to capital regressions, we have estimated **risk regressions**. These regressions have a single risk variable as the dependent variable and both capital and market discipline variables on the right hand side. That is

$$RISK_{it} = g(CAP_{it}, MKD_{it-s}, Z_{it-s}) + w_{it} \qquad (2)$$

(+) (-)

In these regression we would expect capital to be positively associated with risk, but market discipline to be negatively associated with risk. Stronger market discipline would force banks to take less risk for a given capital buffer.

Since capital is thought of as endogenous to risk, we have used the predicted value of a first stage instrumental variables regression to control for endogeneity of capital in the risk regressions. Moreover, since we think of bank risk as being determined by the long term strategy of the bank, we use lags of the MKD variables as well as the control variables in the risk regressions.[7]

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[7] In view of the likely persistence in our dependent variables over time an alternative to a static model would have been a dynamic specification. For the capital variable, persistence could arise since raising capital is costly. A lagged capital term could account for adjustment costs of attaining the desired level of capital. Similarly, bank risk is related to the business cycle (economic expansions are associated with rapid loan growth and often with a reduction in borrower quality) and shocks to economic growth are generally persistent over a certain period of time. For two reasons, however, we do not pursue this route. First, the time-span of our sample is relatively short (T=6 for most estimations since for many banks/variables the initial year is missing and since we have a lag structure in our regression equation), limiting the effectiveness of dynamic estimation procedures. Second, a major disadvantage of dynamic estimation procedures is that in order to achieve consistent estimates, one needs to eliminate time-invariant bank-specific effects. Since some of our market discipline variable vary little or not at all over time, we would not be able to assess the effect of these variables in a dynamic framework. Thus, we

2. The Strength of Market Discipline

As set out above, three sets of factors are likely to determine the strength of market discipline. Accordingly, we have collected data on three sets of market discipline variables.

(i) MKD (insurance)

Depositor protection is likely to weaken market discipline. Demirgüc-Kunt and Sobaci (2000) provide a dataset on the existence and extent of deposit insurance schemes across countries[8]. Using this dataset we have constructed an index of the extent of depositor protection (depins) as follows:

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

We expect market discipline to be weaker and moral hazard incentives to be stronger the higher is the value on the index. First, we expect depositors to feel better protected and consequently depositor market discipline to be weaker if there is an explicit deposit insurance scheme. In the absence of an explicit scheme, there may be an expectation that the government will reimburse depositors in the event of a bank failure. But the uncertainty surrounding an ad hoc reimbursement by the government is likely to mean that depositors will be more wary where they put their funds[9]. Likewise, if there is co-

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largely use the time dimension of our dataset to impose some structure on expected relationships and to eliminate endogeneity while capturing potential correlation across time and banks in the error structure.

[8] Using this dataset, Demirgüc-Kunt and Detragiache (2000) 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.

[9] Martinez Peria and Schmuckler (2001) show that for the cases Argentina, Chile and Mexico depositors responded to banks' risk choices even though deposit insurance schemes exist in these countries. This suggests that even explicit depositor protection schemes may not always be fully credible.

insurance, depositors bear part of the risk of bank failure and will therefore be more wary about where they hold their bank deposits. But if there is no co-insurance scheme, depositors do not bear this risk and depositor market discipline is likely to be weaker. Moreover, if interbank deposits are covered by deposit insurance this may result in weaker market discipline arising from the interbank market[10]. Finally, if there is a ceiling on the size of deposits that are covered by the insurance scheme, this may lead to market discipline arising from large depositors. But if coverage is unlimited we expect depositor market discipline to be weak[11]. Due to the way we have constructed the index, high values on the index ought to be associated with weak market discipline and strong moral hazard incentives.

A second dimension of insurance arises from the fact that the social cost of bank failure can be large. This may prompt 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 banks or indeed, as suggested by Freixas (2000), by playing mixed strategies[12] to create a measure of "constructive ambiguity" with respect to their bail-out decision. 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 responsible. The Fitch IBCA rating agency assigns a rating that reflects this probability of government bailout. This rating is known as the Fitch IBCA Public Support rating. It ranges from 1 (near certain bail-out) to 5 (bail-out very unlikely). Gropp, Vesala and Vulpes (2001) show that subordinated debt yields reflect bank risk for banks with a public support rating of 3 and higher, 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,

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[10] Interbank deposits are protected in only two out of the 32 countries in our sample, in the USA and in Canada.

[11] De Nicolo (2000) analyses the impact of deposit insurance coverage relative to per capita GDP on insolvency risk as captured by a measure of the distance to default. He finds that this variable is negatively related to insolvency risk for the largest banks in his sample, but insignificant overall.

[12] 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.

Vesala and Vulpes (2001) and construct an indicator variable[13] (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). We conjecture that market discipline is weaker if supp=1.

(ii) MKD (funding)

Our theoretical framework suggests that the effect of market discipline ought to be stronger the larger the amount of uninsured funding. For a given increase in bank risk, the resulting market discipline is likely to have a stronger negative effect on profitability the larger is the amount of uninsured funding.

We measure the amount of uninsured funding of a bank by the ratio of deposits due to banks to total deposits (bankdepr).[14] The reason is that deposits held by banks are typically wholesale CDs, which are not covered by deposit insurance schemes. In addition, banks are likely to be informed investors in the interbank market. A lending bank is likely to be subject to the same kinds of shocks to risk and profitability as the borrowing bank. As a result, certificates of deposits are likely to be sensitive to the risk the borrowing bank is taking. Consistent with this conjecture, Ellis and Flannery (1992) find that CD rates paid by large money centre banks include significant default risk premia.

(iii) MKD (Disclosure)

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[13] While the study by Gropp Vesala and Vulpes (2001) 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.

[14] As an alternative variable measuring the extent of uninsured funding, we have collected data on the ratio of subordinated debt to total deposits (subdebtr). A number of proposals advocate the use of mandatory subordinated debt as a tool to subject banks to stronger market discipline (see Evanoff and Wall (2000) for a survey of such proposals). We have encountered a number of problems with this variable. First, only about 60 percent of the banks in our sample report their subordinated debt in their annual accounts (leading to a small sample size), and of these 31 percent reported zero subordinated debt, indicating that some banks may not have access to the market for subordinated debt. Second, the average size of the subordinated debt ratio relative to total assets amounts to only about 1%, which is very small compared to the bank deposit ratio (20%). For these reasons it proved difficult to eliminate the endogeneity of this variable, especially with respect to capital. Overall, data problems have been so severe that we decided to discard this variable from the analysis .

Cordella and Yeyati (1998) as well as Boot and Schmeits (2000) point to the commitment effect of bank disclosure. Banks that disclose more information choose lower default risk in equilibrium. The idea is that a bank that discloses its risk-profile exposes itself to market discipline and will therefore get penalised by investors for choosing higher risk. This effect is absent if investors do not know the risk-profile of the bank and weaker if the amount of information available to investors is limited.

Measuring the amount of information available to investors is difficult[15]. We have constructed three different measures of disclosure, two of which are simple binary measures and the third is an index of disclosure, which we have constructed by measuring the amount of information available in the bank's published accounts as represented in the Fitch IBCA BankScope data base.

There is reason to believe that investors have more information about a bank if the bank is rated by a major rating agency. 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. Kliger and Sarig (2000) suggest that this is the very reason why firms usually pay for the rating[16]. It allows firms to incorporate inside information into the assigned ratings without disclosing specific details to the public at large. A number of studies provide evidence that ratings do indeed contain information over and above information that is publicly known. Kliger and Sarig (2000) show that Moody's change to a finer grading system in April 1982 moved bond market prices for individual rated securities in a way consistent with the information (good or bad) associated with the finer rating. We conclude from this evidence that investors have more information on an individual bank if it is rated. We therefore construct an indicator variable (rat), which takes the value 1 if the bank is rated by any of the major

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[15] In particular, it is difficult to measure all dimensions (i.e. quality, quantity and timeliness) of disclosure. The use of disclosure indices has been popularised recently by La Porta et al (1998). Marston and Shrives (1991) provide a thoughtful survey of the older literature. Bushman and Smith (2003) survey more recent research.

[16] The alternative is an unsolicited rating. However, unsolicited ratings are rare. In 98% of cases, firms pay for their rating (Kliger and Sarig, 2000).

rating agencies (Standard and Poor's, Moody's or Fitch IBCA), and zero otherwise. We think that market discipline is likely to be stronger for rated banks.

Both the quality and the quantity of disclosure a bank provides 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 regimes[17]. 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) show that German firms which have voluntarily adopted US GAAP for their reporting show 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 entail an increase in 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 AMEX[18].

Finally, we have constructed a direct measure of the quantity of information pertaining to the risk profile of the bank, by creating an index of disclosure. This index records for 18 categories of possible disclosure whether or not the bank provides information in its published accounts as represented in the

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[17] 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.

[18] 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 than foreign banks listed on a US exchange. Our regression results are not sensitive to this choice.

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). 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, which is normalised to take values between zero and 1, is available for each bank in each year of our sample. A detailed description of this variable as well as of its distribution in our sample is provided in Box 1 (at the end of the paper).

3. Risk Variables

For both capital regressions and risk regressions we need a measure of banking risk. We focus on the following five measures of risk: the ratio of non-performing loans to total loans (rnperfloans), the ratio of loan loss provisions charges to total loans (rllprov), the standard deviation of weekly equity prices (stdev), beta and idiosyncratic risk (idios).

Both the ratio of non-performing loans and the ratio of loan loss provisions are measures of the bank's credit risk. While a measure of credit risk does not inform on all aspects of risk, credit risk is a major part of total risk for a typical banking institution. The ratio of non-performing loans is a measure of the stock of bad and doubtful loans and summarises the extent of credit risk the bank has taken on in the past. By contrast, the ratio of loan loss provisions is a measure of the flow of new bad loans, since banks would typically make provisions to cover against new non-performing loans.

The reliability of both of these accounting measures of credit risk will depend on accounting policies and accounting conventions, which might differ both across banks and across countries. Measures based on market prices avoid these difficulties and are therefore useful in particular in a cross-country set-up. A basic measure of risk that can be derived from market prices is the standard deviation of equity returns. Banks with large underlying asset risk should be more affected by new information than banks with a relatively safe underlying portfolio. The responsiveness of equity prices to news is therefore a measure of the riskiness of the bank[19]. We compute, for each bank and for each year, the standard

[19] A potential drawback of the standard deviation of equity prices as a measure of asset risk is that it could partly reflect investor uncertainty about the bank, rather than the true riskiness of the bank's assets. Indeed, the standard deviation of

deviation of weekly equity returns. We have chosen to use weekly returns, rather than daily returns to avoid biases arising from differences in trading volume and liquidity across banks and equity markets. The standard deviation of equity returns can be decomposed into two components, beta and idiosyncratic risk. Beta represents the systematic component of the standard deviation of returns and is estimated by market model regressions. Idiosyncratic risk is defined as the standard deviation of residuals of the market regression and is thus the component of risk that is orthogonal to beta. We estimate beta for each bank and each year from regressions of bank equity returns on the returns of the relevant market index. Idiosyncratic risk is estimated, again for each bank and for each year, as the standard deviation of the residuals of this regression[20].

Section 3: Sampling and Preliminary Data Analysis

1. Sampling and Outlier Analysis

Our sampling rule was to collect information on all banks which the BankScope database identifies as listed banks and which, again according to information available on BankScope, are incorporated in one of the 32 countries we selected for our analysis[21]. The BankScope database provides information for the years 1993-2000. We have collected accounting data from the BankScope database for each bank for which some observations were available. This procedure yielded an initial sample of 729 banks. As a result of keeping banks for which the time series is shorter than eight years the initial sample is unbalanced.

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equity prices is negatively correlated with the measures of disclosure list, rat and disc, see Table A5. But it is difficult to decide whether this reflects reduced investor uncertainty, or the incentive effects of disclosure on asset risk.

[20] Mathematically, the market model can be represented as. $E(R_{it}) = a_i + b_i E(R_{mt})$. This leads to the regression equation $R_{it} = a_i + b_i R_{mt} + e_{it}$, where $a_i = E(R_{it}) - b_i E(R_{mt})$ and $b_i = \frac{\text{cov}(R_{it}, R_{mt})}{\text{var}(R_{mt})}$. The residual of the market model regression is $e_{it} = R_{it} - [a_i + b_i R_{mt}]$. Idiosyncratic risk is defined as the standard deviation of e_{it}.

[21] These are Austria, Australia, Argentina, Belgium, Brazil, Canada, Chile, Finland, France, Germany, Greece, Hong Kong, Indonesia, Ireland, Israel, Italy, Japan, Korea, Malaysia, the Netherlands, Norway, Poland, Portugal, Singapore, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, the UK and the US.

Using the bank ticker symbols provided in the BankScope data base, we have identified weekly series of equity prices for each bank as available on Bloomberg and computed beta and idiosyncratic risk for each year and each bank using the main benchmark stock market index for each country. Table A1 (in the appendix) lists the stock market indices used. Equity price series were available for the majority of banks going back to the start of 1993. We have kept banks whose price series was shorter. Table A2 (in the appendix) summarises the datasource and variable definition for all variables used.

Outliers for the variables used were identified as follows. Charts were constructed for the variables over time, which allowed a first screening of the data. These revealed that one bank had a negative stock of non-performing loans. It was therefore excluded from the sample. Other observations for the risk variables that were dummied out in the investigation (a total of 11 observations were dummied out) coincided with the starting date of operation of the banks, and might therefore be related to faults in reporting. Outliers for the capital ratio were defined as all observations where equity was more than three times other liabilities. These 33 observations by a total of 9 banks were also dummied out. Although the chosen threshold is somewhat arbitrary, the aim was to exclude banks for which a different structural relationship might hold between bank risk and our market discipline and control variables than for retail banks. For instance, we aimed to exclude banks that had a very low share of deposit liabilities and which for that reason had very high capital ratios. Outliers for one of our control variables, Tobin's q, were defined as all observations with $q>10$. This led to the exclusion of 10 banks, all of which had ratios of market to book value of equity that seemed too high to be reasonable. We also found some outliers for the return on equity. We have excluded observations for the return on equity above 500% and below -1000%, which were three observations.

The number of observations available for the regression analysis changes according to which variables are included in the regressions. The last column in table 1 shows the number of observations available for each variable. Among the risk and capital variables, the least observations are available for the ratio of non-performing loans. Regressions that include this variable reduce the number of banks to about 580 banks and exclude Austrian and Greek banks entirely. The most restrictive variables in terms of sample size of the market discipline variables are the support rating and the bank deposit ratio. The support rating is only available for about 290 banks and no data exist for Austrian and Belgian banks. Including the bank deposit ratio reduces the sample to about 530 banks. This variable was not obtained for US banks (the US is otherwise the country most strongly represented in our sample).

2. Descriptive Statistics

Table 1 presents some aggregate summary statistics about the main variables of interest. It shows that overall, the largest variation can be found for the ratio of loan loss provisions and the ratio of non-performing loans to total loans, the lowest one for the disclosure index and the index of deposit insurance coverage. Furthermore, some variables vary little or not at all over time: The within variation is considerably lower than the between variation for the ratio of non-performing loans, the equity ratio and the bank deposit ratio. The within variation of the support rating, the deposit insurance, the US listing and the rating variables is zero.

Table 1: Overall summary statistics of the risk, capital and market discipline variables

	Mean	Overall Standard Deviation	Between Standard Deviation[1]	Within Standard Deviation[2]	Overall Coeffi-cient of Variation	5th Percentile	Median	95th Percentile	No. of Obs.
Risk and Capital Variables									
Ratio of Non-Performing	0.037234	0.093551	0.107546	0.046339	2.512515	0.001383	0.013309	0.111427	3180
Ratio of Loan Loss Provisions	0.012646	0.052496	0.032431	0.045051	4.151194	0.000149	0.004738	0.036858	4516
Std. Dev. of Equity Returns	0.047263	0.050195	0.036960	0.039872	1.062036	0.012667	0.037870	0.105065	4258
Beta	0.560347	0.546554	0.406968	0.373089	0.975385	-0.082934	0.499009	1.446418	4198
Idiosyncratic Risk	0.040590	0.035064	0.025815	0.026541	0.863855	0.012813	0.033498	0.085846	4198
Capital ratio	0.104599	0.191682	0.215984	0.081615	1.83254	0.029557	0.075792	0.20584	5043
Market Discipline Variables									
Support Rating	0.387543	0.487295	0.487721	0	1.257394	0	0	1	2312
Deposit Insurance	2.077957	1.030197	1.030803	0	0.495774	0	2	3	5952
Bank deposit ratio	0.201003	0.241827	0.237843	0.07596	1.203105	0.001245	0.111248	0.775571	3358
Disclosure Index	0.596123	0.272543	0.20862	0.175752	0.457192	0.05	0.7	0.85	5816
US listing	0.287634	0.452698	0.452601	0	1.573865	0	0	1	5952
Rating	.5403226	.4984133	.4987067	0	0.922437	0	1	1	5952

[1]: The between standard deviation is the standard deviation across banks of the average across time for each bank. It therefore ignores any variation over time.
[2]: The within standard deviation is the average across banks of the standard deviation across time for each bank. It therefore ignores any cross-sectional variation.

Section 4: Capital Regressions

1. A Basic Model of Bank Capital

In order to estimate the impact of market discipline variables on bank capital buffers we take a two step approach. We first estimate a basic model of bank capital and then examine the impact of market discipline in a second step. The basic model can be represented as

$$CAP_{it} = f(RISK_{it}, Z_{it}) + v_{it} \qquad (3)$$

As measures of *RISK* we include both components of the standard deviation of weekly equity returns, beta and idiosyncratic risk. For both variables we expect to find a positive relationship with capital. Banks that run higher risks should want to keep higher capital buffers as self-insurance against insolvency. In addition, we include the one-period-ahead ratio of loan loss provisions. This variable (frllprov) 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. A prudent bank would want to keep a larger capital buffer if it expects to make large loan loss provisions in the future.

We also include a number of control variables (Z)[22]. In the presence of asymmetric information, raising new capital may be costly for banks. Capital accumulation may therefore rely on internally generated funds (Pecking order theory of finance). More profitable banks will find it easier to accumulate equity

[22] We do not currently 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 et al, 2001) suggests that by 1999 all but a handful of countries in our sample had adopted the Basel 8% benchmark. This creates a potential collinearity issue, since the minimum is a constant for most observations and varies for only for 71 out of the 729 banks in our sample. That said, our results appear robust to the inclusion of this variable.

through retained earnings. We therefore include the bank's return on equity (roe) as a variable capturing this effect. We expect the bank's return on equity to be positively associated with capital[23].

We also hypothesise that larger banks will hold less capital ceteris paribus. The reason is that larger banks will tend to find it easier to raise new capital from the market, should they need it. Myers and Majluf (1984) show that in the presence of asymmetric information, raising new equity results in dilution costs to the issuer. For large banks, which are typically monitored by security analysts, asymmetric information should be less of an impediment to raising new equity. In addition, there are economies of scale in raising new capital. Because of high fixed costs arising from the underwriting and book-building process, equity issues are relatively more costly if they are small. For larger banks, raising new equity should therefore be relatively cheaper. Since for both reasons, larger banks will find it easier to raise new capital should they need it, they can afford to hold relatively less capital[24]. We measure size by the log of total assets (logsize) and expect this variable to be negatively associated with capital.

The level of capital banks hold may depend on the position of the economic cycle. Banks may use periods of expansion to accumulate capital through retained earnings. Recessions, on the other hand, are associated with loan defaults, which through higher provisions would eat into banks' earnings and (possibly) capital. At the same time, in recession periods banks may find it harder to raise new equity on the market, because of heightened investor risk aversion or greater asymmetric information between the bank and potential investors. For both reasons one might expect capital buffers to be procyclical. We

[23] Berger (1995) documents a positive relationship between ROE and capital ratios for a sample of US banks in the mid-to-late 1980s.

[24] In addition, larger banks may optimally want to hold less capital if they are better diversified. But this effect would at least partly be captured by the risk variables, in particular a lower idiosyncratic risk.

therefore expect a positive relationship between real GDP growth (gdp_g) and the size of capital buffers[25].

We expect past and present realised bad loan experience to have a negative effect on bank capital. We think of the stock of non-performing loans as reflecting such realised credit risk. Current and past bad loans will have triggered provisions and write-offs and will therefore have had a negative effect on the size of the capital buffer.

Finally, we include the bank's market share (ms) which is defined as its total assets divided by the sum of total assets of all banks (both listed and unlisted) in each country. 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 capital[26]. We therefore expect a positive relationship between market share and bank capital.

[25] Borio, Furfine and Low (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.

[26] 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 Norwegian sample of banks.

Table 2: A basic model of bank capital

	(1) OLS (robust)	(2) Fixed effects	(3) Between effects	(4) Random effects (AR1)	(5) Random effects FGLS
Dep. variable	**cap**	**cap**	**cap**	**cap**	**cap**
frllprov	.0725731	.1330946*	-.1163122	.0716094**	.1080752***
beta	.019737***	.0005908	.0354608***	.0029441**	.0077936***
idios	.2591609**	.0220571	.4648991***	.0997513***	.1709223***
logsize	-.0152102***	-.0118819***	-.0172999***	-.0181526***	-.0127402***
roe	.0594808***	.015232***	.0588244***	.0252595***	.0345852***
gdp_g	.0032455	-.0664496*	-.0798286	-.0556073*	.0368308***
rnperfloans	-.0511992	-.3430065***	-.0602338	-.1833428***	-.0790578***
ms	.032564	-.1692747*	.0622831	.0989482**	.0333506***
year	.0013793*	.0001375***		.0031136***	.0001356***
cons	-2.45335	.0106197	.3190203***	-5.847319***	(dropped)
No. of obs.	1853	1409	1853	1853	1814
No.of Groups	-	405	444	444	405
R-sq (within)	-	0.2412	0.0585	0.2436	-
R-sq(btwn)	-	0.0991	0.2896	0.1860	-
R-sq (overall)	0.2004	0.0970	0.1809	0.1536	-

*** Statistical significance at the one percent level
** Statistical significance at the five percent level
* Statistical significance at the ten percent level

Table 2 shows regression results for a number of different assumptions on the error structure of the basic model. Column 1 shows the results for a standard OLS regression of the model. Diagnostic tests on the residuals of this regression (not shown here) suggest non-normal residuals, which imply that GLS procedures may be preferred to OLS since they give less weight to large residuals when minimising the (weighted) sum of squared residuals to derive parameter estimates. Further tests point to the presence of both heteroscedasticity and autocorrelation in the residuals. The assessment of significance is therefore based on robust standard errors, which are valid in the presence of non-iid errors. Even though the OLS regression ignores the panel structure of the dataset and counterfactually assumes that all observations are on the same bank, all coefficients turn out to have the expected sign and some are highly significant.

The fixed effect estimator (column 2) focuses on the within unit (bank), i.e. across time, variation in the dependent and independent variables. In contrast to the OLS regression it is successful in distinguishing a significantly positive effect of expected future provisions and a negative effect of the current stock of

bad loans. The coefficient on beta is measured as very small and insignificant, which is due to the fact that there is little systematic movement over time in this variable. Interestingly, real GDP growth has a significantly negative effect in this regression. It therefore appears that capital is on average countercyclical, rather than procyclical. This result should be read with caution however, since the effects of the return on equity and of non-performing loans are partly cyclical effects and would absorb most of the explanatory power of GDP growth. Indeed, removing these cyclical variables from the regression results in capital to be procyclical.

The between estimator (column 3) focuses on across units (banks) variation in the dependent and independent variables. The regression shows a positive and highly significant coefficient on beta, indicating that cross-sectional variation in beta is important in explaining cross-sectional variation in capital. On the other hand, since the between estimator regresses time averages on time averages, it cannot take account of the time dimension of the data and cannot therefore distinguish between the effect of provisions and the effect of bad loans, which are both assigned a negative sign.

The random effects estimator (column 4) takes account of the panel structure of our data and uses both the across time and the across unit variation in the independent and dependent variables. In addition, it takes account of autocorrelation in the residual. (The estimated autocorrelation coefficient on the residual is 0.4). Since the random effects estimator is essentially a weighted average of the fixed and between estimators, the coefficient on beta is small, as a result of it being essentially zero in the fixed effect regression.

The random effects feasible GLS estimator (column 5) estimates the error variance-covariance matrix assuming that the error follows a panel-specific autoregressive process.[27] In addition, the variance of the error is allowed to be different across units (heteroskedastic).[28] Compared to the random effects

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[27] More formally, it is assumed that the error follows a process of the form $e_{it} = r_i e_{it-1} + u_{it}$.

[28] Formally, this means that $E(e_{it}^2) = s_i^2$. Our estimation procedure also assumes that errors are not contemporaneously correlated across banks, i.e. $E(e_{it} e_{jt}) = 0$. Models that assume contemporaneously correlated errors can only be applied to balanced samples. But as a result of limited data availability for some of our key variables all our regressions are estimated on unbalanced samples.

model with an autoregressive error shown in column 4, the FGLS estimator relaxes the restriction that the error is homoskedastic and that the autocorrelation coefficient be the same across banks. A Likelihood ratio test decides in favour of the less restrictive model. While the results on the coefficients are similar for the two specifications, the standard errors of the less restrictive version (column 5) are likely to be more reliable.

One advantage of a fixed effects approach is that the fixed effects estimator leads to consistent estimates even if the time-invariant component of the error term is correlated with the regressors. The random effects estimators may be subject to omitted variable bias in this case. Another drawback of the random effects specification is that it assumes that for each variable the coefficient of the between regression is the same as the coefficient of the fixed effect regression. A comparison between the fixed and between regressions suggests that this is unlikely to be the case for a number of variables, including provisions, non-performing loans and beta. Indeed, a Hausman specification test rejects the equality of the coefficients and suggests a fixed effects approach. Rather than mechanically following the outcome of such a test we continue adopting a random effects approach, for three main reasons. First, some of the market discipline variables of interest (including depins, supp, list and rat) do not vary over time and can therefore not be analysed using a fixed effects approach. Second, a fixed effects specification ignores cross-sectional variation in market discipline variables, which for the purpose of testing our hypotheses is an important dimension. Third, a random effects specification exploits both the time dimension as well as the cross-section variation. It is therefore more efficient, resulting in more precise estimates of the main variables of interest.

2. The Effect of Market Discipline

Estimating the effect of market discipline on bank capital buffers faces one major difficulty, which is that some of the market discipline variables are likely to be endogenous (i.e. themselves dependent on bank capital). While the insurance variables (depins and supp) are clearly strictly exogenous from the point of view of the bank[29], endogeneity is likely to be a problem both for the funding variable and the

[29] Government support variables could still be endogenous if government support responds to banking crises. This issue is further investigated in section 6, below.

disclosure variables. The bank's funding choice with respect to the amount of bank deposits it issues is likely to be determined jointly with its choice of capital. Banks that hold little capital may have to issue more bank deposits to ensure funding of their assets. This would result in a negative relationship between capital and the bank deposit ratio, which may obscure the positive relationship we expect to arise from the incentive effect of interbank market discipline. Similarly, bank disclosure may be determined jointly with the bank's choice of capital. 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 effect would result in a positive relationship between disclosure and capital. Eliminating this effect is therefore important if we want to interpret a positive coefficient on disclosure as a disciplining effect of disclosure on desired 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. We have adopted this approach for two endogenous variables: the ratio of bank deposits and the disclosure index. The other two disclosure variables - list and rat - are likely to suffer from an endogeneity bias to a lesser extent, since these are fixed across all years. In addition, again because these variables are fixed across time, it is much harder to satisfactorily predict their values from available exogenous variables.

We have used the same set of instruments for the funding variable and for the disclosure index. Table A3 in the appendix presents the results of the first stage regressions, and table A4 shows the correlation coefficients between the fitted values from the first stage and their actual values. The set of instruments includes a number of bank level variables (Loan ratio, return on equity, size, market share and the cost-income ratio). While all of these variables are endogenous over longer horizons, they are unlikely to be controlled by the bank over a one-year period and are therefore taken as exogenous. In addition to these bank-level variables, we exploit the cross-country dimension of our dataset and include country dummy variables, which would reflect the average level of the instrumented variable (disc and bankdepr) in each country. Since we know that both variables (in particular disc, see Box 1) vary through time, we also include a linear time trend (year) as an explanatory variable. Finally, to make sure that as a result of including year we do not create variables which have a simple time trend, we interact year with the set

of country dummy variables. As a result the predicted change in the instrumented variable through time will be specific to each country and therefore mimic the actual change in that variable at the country level. Again, this approach is motivated by our finding that the average change in disclosure is very different across countries (see Box 1).

Table 3 shows a first set of exploratory regressions. Column 1 concentrates on the effect of the insurance variables[30]. We find both depins and 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. Neither variable showed an insignificant or positive sign in any regression we ran. Column 2 shows that the fitted value of the bank deposit ratio (bankdeprfit) has the expected positive effect, indicating the incentive effect of interbank deposits. Again, the effect is highly significant[31]. Finally, column 3 shows that all of the disclosure variables have the predicted positive effect[32].

[30] We have included depins in all regressions since it turns out to be an important control variable.

[31] When using the fitted values bankdeprfit and discfit from the first stage regression, we should technically adjust the standard errors on these variables in the second stage to reflect that the predicted values are measured with error. But since we already impose a complicated structure on our errors, such an adjustment is not straightforward and we have therefore based inference on the ordinary second-stage GLS residuals. Some comfort may be taken from the fact that the unadjusted standard errors and p-values are very small in all of the regressions.

[32] For the bank deposit ratio as well as for disclosure, most results are qualitatively unchanged in a regression on their actual, rather than their fitted value.

Table 3: Exploratory regressions: Instrumental variable FGLS regression model with heteroskedastic panels and panel-specific AR(1). Dependent variable: cap.

	(1) TS FGLS (Insurance)	(2) TS FGLS (Funding)	(3) TS FGLS (Disclosure)
Dep. variable	**cap**	**cap**	**cap**
cons	-3.197193***	-3.454024***	-3.649336***
frllprov	.1059141**	.0594202***	.0711018***
beta	.0037409***	.0068974***	.0044572***
idios	-.0211465	.2067379***	.1292642***
logsize	-.0055223***	-.0168503***	-.014191***
roe	.0420866***	.0249058***	.0370462***
gdp_g	-.0578104***	-.1049978***	-.1026396***
rnperfloans	-.0276951***	.0105316**	-.0984541***
ms	.0210283**	.0535269***	
year	.0016958***	.0019019***	.0019853***
depins	-.0060593***	-.0097473***	-.0184712***
supp	-.027708***		
bankdeprfit		.0587845***	
rat			.0076448***
list			.022369***
discfit			.0230752**
No.of obs.	772	829	1814
No of groups	168	223	405
Log likelihood	2642	2894	6026

*** Statistical significance at the one percent level
** Statistical significance at the five percent level
* Statistical significance at the ten percent level

Table 4 shows some of our preferred final specifications for a multiple regression on all three market discipline factors. Note that we cannot include supp and rat at the same time since, by definition, any bank which has a Fitch IBCA public support rating has a value of 1 on rat. Including rat in addition to supp would therefore result in perfect collinearity of rat and the constant term. Some of the market discipline variables are highly correlated with each other. The highest significant correlation was found between the bankdepr and list (0.85). But it turns out that multicollinearity even for these two variables is mild. Table A4 in the appendix documents the degree of correlation and its level of significance for all variables.

Table 4: Preferred regressions: Instrumental variable FGLS regression model with heteroskedastic panels and panel-specific AR(1). Dependent variable: cap.

	(1) TS FGLS	(2) TS FGLS	(3) TS FGLS	(4) TS FGLS
Dep. variable	**cap**	**cap**	**cap**	**cap**
cons	-3.877475***	(dropped)	-4.064866***	-3.650589***
frllprov	.0690402***	.0515251**	.0827862***	.2375167***
beta	.0056411***	.0075076***	.0052489***	.0035739***
idios	.2173913***	.2639045***	.2114321***	-.0184409
logsize	-.0184908***	-.0161825***	-.0181269***	-.0073259***
roe	.0234317***	.0255846***	.0243298***	.0423658***
gdp_g	-.1234724***	-.0849401***	-.1211838***	-.1333192***
rnperfloans	.0045299	.0165498***	.0144832**	-.0452257***
year	.0339789***	.0436371***	.0275987***	.0131872**
ms	.0021254***	.0001547***	.0022114***	.0019132***
depins	-.0094181***	-.0083994***	-.0097421***	-.0073754***
supp				-.0210269***
bankdeprfit	.0561547***	.0616508***	.0560908***	
rat	.0057179***		.0050719***	
list	.0217115***		.0233972***	.010919***
discfit		.0247213***	.0139291*	.0635886***
No.of obs.	829	829	829	772
No of groups	223	223	223	168
Log likelihood	2935	2837	2934	2634

*** Statistical significance at the one percent level
** Statistical significance at the five percent level
* Statistical significance at the ten percent level

In addition to judging the statistical significance of the market discipline variables these results allow us to judge their economic significance. All bank-level variables (supp, bankdepr, rat, list and disc) range between zero and unity. The coefficient on each of these variables can therefore be interpreted as the absolute change in the capital ratio resulting from a unit increase in the market discipline variable. The mean capital ratio is about 10.5%. The coefficient on the variable bankdepr is about 5.6%. This says that a bank which has a bank deposit ratio of unity (and thus is financed fully by uninsured deposits) would have a capital ratio some 5.6% higher than a bank that had no bank deposits. When evaluated at the mean this amounts to a capital ratio of 16.1%. Similarly, a coefficient of –2.1% on the supp variable can be taken to mean that banks with likely government support have capital ratios about 2.1% lower than those without government support, i.e. around 8.4% when evaluated at the mean. For the rating variable rat we find that the coefficient is very small. Rated banks have capital ratios 0.5% higher than banks

without a rating. The coefficients on list and discfit are more sizeable implying 2.1% and 2.4% increases in the capital ratio respectively, as a result of an increase in disclosure from zero to unity.

3. Market Discipline with and without Government Support

Our main results point to the general effectiveness of market discipline. But an important question remains: Under what conditions is market discipline likely to be less effective?

One hypothesis we can test is that the disciplining effect of disclosure as well as that of uninsured liabilities may be weaker for those banks that enjoy a high degree of implicit government guarantees. Gropp, Vesala and Vulpes (2001) show that subordinated debt spreads have predictive power in explaining bank failure for banks which have a Fitch IBCA public support rating of 3 and higher (i.e. low probability of bail-out), but do not have any predictive power for those banks with a support rating of 1 and 2 (i.e. high probability of bail-out). We can test whether this has any incentive effect. In particular, we hypothesise that for banks for which yields do not respond to variations in risk, as a result of a high probability of a bail-out, the presence of uninsured liabilities will not result in a strong incentive to maintain high capital buffers. Similarly, for banks that enjoy a high probability of bail-out, disclosure may work less well as an incentive mechanism which induces banks to keep high capital buffers.

We test these hypotheses by concentrating on the subset of banks in our sample that are rated by Fitch IBCA and consequently have a public support rating. Our strategy is to split this sub-sample into two groups: banks which have a support rating of 1 and 2, i.e. supp =1, and banks which have a support rating of 3 and higher, i.e. supp=0[33] [34].

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[33] One could argue that this sample split merely tests for a size effect if it holds that supp is strongly correlated with size, so that only the large banks are likely to be bailed out by the government. Although there is a significant correlation between supp and logsize (coefficient of 0.53), we are testing for a differential effect since at least in some countries the probability of government support is unrelated to the size of a bank. For instance, in Argentina, Hong Kong, Indonesia, Turkey and the US supp=0, and in Canada, Finland, Greece, Norway, Singapore, Sweden and Switzerland supp=1 for all banks where data are available.

Table 5 shows the regressions results. The comparison is based on 66 banks for which supp=1 and 102 for which supp=0. For the bankdepr we find that the coefficient is negative in both subsamples[35]. Interestingly, however the coefficient is smaller in absolute value and not significantly different from zero in the subsample with low government support. For disclosure one finds that the coefficient is negative for banks that enjoy high government support but positive for banks with low government support.

Table 5: Split sample regressions: Instrumental variable FGLS regression model with heteroskedastic panels and panel-specific AR(1). Dependent variable: cap.

	(1) TS FGLS	**(1') TS FGLS**	**(2) TS FGLS**	**(2') TS FGLS**
	supp=1	**supp=0**	**supp=1**	**supp=0**
Dep. variable	**cap**	**cap**	**cap**	**cap**
cons	-2.087438***	-5.660534***	-1.76038***	-3.449024***
frllprov	-.0154527	-.1427295	-.0608725	.293924***
beta	.0007197	-.0002218	.000729	.0027724***
idios	-.0159832	.1510935***	-.0212808	.0416973
logsize	-.003938***	-.0215993***	-.0027331***	-.0081014***
roe	.0279642***	.0470165***	.0226763***	.0473083***
gdp_g	-.0091438	-.0989018***	-.0136239	-.0779791***
rnperfloans	.077851***	.0189508	.0700032***	-.1019149***
ms	.0063191	.3279481***	-.010803	.0318389
year	.0011172***	.0030499***	.0009538***	.0018158***
depins	-.0101975***	-.0009139	-.0104501***	-.0050073***
bankdeprfit	-.0177004***	-.0149274		
discfit			-.0270198**	.0688808*
No. of obs.	269	205	273	499
No. of groups	65	51	66	102
Log likelihood	1030	647	1039	1622

*** Statistical significance at the one percent level

[34] An alternative is to run a regression on both groups and to interact the market discipline variables with supp. Such a regression forces all coefficients, except for the interacted variable, to be the same for both groups. The results confirm our findings and lead to the same conclusions.

[35] Indeed the coefficient on the bankdepr turns out to be negative when the regression is run on the subsample of banks with a FitchIBCA rating.

** Statistical significance at the five percent level
* Statistical significance at the ten percent level

Overall the beneficial effect of market discipline appears weaker for banks which enjoy implicit government guarantees than for those banks which do not enjoy such guarantees. This result is consistent with the hypothesis that implicit government guarantees limit the effectiveness of market discipline and reduce the incentives of banks to maintain a low probability of default. To the extent that it may not be feasible or indeed desirable to remove implicit government guarantees, supervisory oversight may therefore need to continue to play a crucial role for those banks that are "too big to fail".

4. Non-linearity of Market Discipline Effects

The effect of market discipline on capital buffers might be non-linear. In particular, one might hypothesise that a bank that runs high risks, but is then forced to disclose more information about its risk profile, would have a stronger incentive to increase its capital buffer.

In order to investigate whether for banks that target lower solvency standards the effect of market discipline is weaker or stronger than for other banks we split the sample into two groups, banks with low capital and high risk and all other banks.

Since we have more than one risk variable, we need to reduce the number of variables to one composite measure. We have constructed such a summary measure of bank risk, using principal component analysis of the variables rnperfloans, rllprov and stdev.[36] The results shown in Table 6 compare those banks that have below median capital and above median risk to all other banks.[37] Those with below median capital and above median risk are labelled "high probability of default" banks. The other group, comprising all other banks, are labelled "medium and low probability of default".

[36] The objective of principal component analysis is to find the linear combinations of variables that contain most of the information (i.e. the greatest variance) with the aim to reduce the number of variables in the analysis.

[37] These are banks that either have a low probability of default (i.e. high capital ratios and low risk) or a medium default probability (with high capital and high risk or low capital and low risk).

Table 6: Comparison of "high default probability" and "low and medium default probability" samples. Dependent variable: cap.

	(1) TS FGLS	(1') TS FGLS	(2) TS FGLS	(2') TS FGLS
	high default probability	medium & low default probability	high default probability	medium & low default probability
Dep. variable	**cap**	**cap**	**cap**	**cap**
const	(dropped)	-1.354592***	(dropped)	-4.631775***
frllprov	-.1532039***	.1814764***	.1479851***	.7496448***
beta	.0053466***	.0055682***	.0060129***	.0063884***
idios	-.0262193***	.2120436***	-.0580544***	.1349354***
logsize	-.0024442***	-.0165434***	-.0036108***	-.0115811***
roe	.0166549***	.0078945*	.0348166***	.0681701***
gdp_g	-.0364906***	-.0655464***	.0463014***	.0892534***
rnperfloans	-.0660968***	.0119003	-.1546385***	.3049575***
ms	.009123*	.0138266**	-.0072604***	-.163539***
year	.0000539***	.0008514***	.0000355***	.0025058***
depins	-.0061846***	-.0118598***	-.0000394	-.0099964***
bankdeprfit	-.0080036***	.0578406***		
discfit			.0603677***	-.1345036***
No. of obs.	200	578	464	1279
No. of groups	73	160	154	279
Log likelihood	870	1952	1831	3935

*** Statistical significance at the one percent level
** Statistical significance at the five percent level
* Statistical significance at the ten percent level

We find that the coefficient on the bankdepr continues to have the effect as measured in the full sample (about 5.6%) for banks that have higher solvency targets. For banks that are closer to insolvency, by contrast, the effect is practically zero. This suggests that interbank market discipline only works for banks that are well capitalised and run conservative books, whereas bank deposits do not seem to have incentive effects for those banks that are closer to insolvency. One caveat is that the sample sizes for these regressions are relatively small, which would make the regression coefficients less reliable.

For the disclosure variable we find that for banks that are close to insolvency the effect of disclosure is stronger than in the full sample. The coefficient is about two to three times larger than for the full sample, suggesting that banks that are close to insolvency increase their capital more for a given increase in disclosure. That is, the incentive effects of disclosure are more pronounced for banks that run high risk strategies. The coefficient in the sample with medium and low default probability is negative.

This could be related to the fact that this sample is dominated heavily by a single country (USA) and that one needs cross-country differences in disclosure for the effect to come through.

Section 5: Risk Regressions

1. Empirical Specification

As an alternative approach to the capital regressions, we estimate the relationship between a single risk variable, capital, the market discipline variables, and some control variables controlling for exogenous drivers of bank asset risk. The risk regression equations thus take the form:

$$RISK_{it} = f(CAP_{it}, MKD_{it-s}, Z_{it-s}) + w_{it} \qquad (2)$$
$$(+) \quad (-)$$

For the most part, we concentrate on the ratio of non-performing loans as the risk variable, but we review other measures of risk as a way of checking the robustness of our findings. This seems appropriate, because non-performing loans are closely associated with other risk measures: correlation coefficients between non-performing loans and other risk measures, such as loan loss provisions and reserves, banks' beta, the standard deviation of equity returns and idiosyncratic risk are significant and positive.

We use lagged values of the explanatory variables for the risk regressions. The reason for this is that banks cannot easily change the composition of their assets in the short term: Risky assets (loans) cannot be liquidated and replaced by more liquid assets before maturity. Since the composition of banks' assets is relatively fixed in the short term, asset risk is likely to be predetermined. Furthermore, we are measuring *realised* asset risk when using the ratio of non-performing loans as opposed to *underlying* asset risk. The realisation of an increase in underlying asset risk can take time and is reflected in a larger ratio of non-performing loans, thus indicating *ex post* credit risk. Therefore, the effect of our explanatory variables on the ratio of non-performing loans should work with a lag.

The probability of default of a bank depends on how well capitalised that bank is and on the risk embedded in its assets. In order to capture the default risk from measures of asset risk, we thus need to

control for the amount of capital a bank holds. We therefore include the amount of equity capital the banks hold relative to other liabilities (cap) as independent variable. We expect the capital ratio to be positively related to bank risk if banks target a specific probability of default, which they can only achieve by increasing equity capital if asset risk increases. We think of capital as being endogenous and have instrumented this variable (as discussed below).

Bank risk may be driven by a number of factors outside the control of the bank, which we account for by including control variables. First, we include real GDP growth as well as its lagged value. This is, because bank risk is related to the economic cycle: the worst loans are typically made close to the peak of a cycle. Although risks are in general only assessed when credit losses materialise, i.e. in economic downturns, the actual problems that underlie those losses may be building up during the boom.[38] Consequently, GDP growth should be positively related to *ex ante* asset risk, but negatively to our accounting risk measure capturing ex post credit risk.

There could also be structural differences in bank risk for different types of banks, depending on their activities. For instance, the risk behaviour of savings banks and real estate and mortgage banks could be different from the behaviour of commercial banks. Savings banks have a large deposit base and generally invest these deposits in relatively safe assets. A large part of the loans made by real estate and mortgage banks are secured, also leading to lower asset risk. As a result, we expect negative signs on both dummy variables sav and real. As further control variables determining bank risk, we account for bank size using the first lag of the logarithm of total assets. Finally, banks whose charter value is low have less to lose from gambling, and therefore have stronger incentives to adopt such a strategy. Following Keeley (1990), we therefore also include Tobin's q[39] as measure of the charter value of a bank as control variable, and expect a negative sign on the lagged Tobins' q in the risk regressions.

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[38] Borio, Furfine and Lowe (2001) discuss in more detail the relationship between the business cycle and financial indicators of risk. Their view is that the financial risks develop with the cycle as credit extension grows, although their actual indicators suggest that perceived financial risk does not increase in business cycle expansions.

[39] Tobin's q is defined as the market value of equity divided by the book value of equity (average q).

2. Empirical Issues and Estimation Procedure

As for the capital regressions, diagnostic tests on the residuals of basic pooled OLS regressions on the ratio of non-performing loans (not shown here) suggest non-normal residuals, which imply that GLS procedures may be preferred to OLS. We also find evidence of heteroskedasticity and autocorrelation in the residuals. Both features are taken into account, using a heteroskedastic and AR(1)-consistent error structure.[40]

Although we are using the lagged values of the independent variables, we might still have an issue of some variables not being exogenous with respect to bank risk (i.e. they are correlated with the error terms). We therefore need to employ a two-stage least squares approach in our regression analysis. The variables for which we conduct the first stage regressions to alleviate the endogeneity (see Table A3 in the appendix for results) are:

(i) The disclosure index. When deciding how much information to disclose, banks may be influenced by the amount of underlying asset risk in their book in that period, which is reflected in the non-performing loans one period later. For instance, a bank with a large amount of asset risk may want to disclose less information about its balance sheet. As discussed above, we only instrument the disclosure index and not the variables list and rat.

(ii) The funding variable (bank deposit ratio). Banks with larger asset risk may - for a given capital cushion - try to refrain from issuing a large amount of uninsured liabilities since this could induce investors to monitor the banks' behaviour and punish them for higher risk.

(iii) The banks' capital ratio, which is also a choice variable for banks. Assuming that a bank targets its default probability, the equity ratio could be determined by the amount of risky assets in a bank's balance sheet, against which it holds capital in order to reach its target probability of default.

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[40] Likelihood-Ratio Tests for models with panel-specific autocorrelation coefficients versus models with a common AR(1) coefficient across panels support the former specification.

(iv) The charter value of a bank (Tobin's q). Theory (eg Merton, 1977) suggests that in the presence of limited liability, bank equity valuations may depend on the amount of risk banks take.

3. The Effect of Market Discipline on Risk

The main empirical results for testing the effect of market discipline on bank asset risk – captured by the ratio of non-performing loans – are shown in Table 7. Column (1) concentrates on the insurance variables, column (2) on the key funding variable, column (3) on disclosure variables and the last column tests the impact of different categories of market discipline variables in conjunction. Overall, we find a strongly significant effect of most market discipline variables on the ratio of non-performing loans.

Most of the control variables are significant and have the expected sign. The sign of the equity ratio, L1capfit, depends on the specification. This may be because two different effects are at work: on the one hand, banks that have high capital buffers on average also take on higher asset risk. On the other hand, a high ratio of non-performing loans is strongly associated with higher provisions, which may reduce capital due to an accounting relationship.[41] Both current and lagged real GDP growth have a negative sign in most regressions, indicating that part of the bad loans could take some time to be realised after an economic downturn. The dummy variable for savings banks also has a negative sign and its coefficient is significant in most regressions. This confirms that savings banks have lower asset risk, although this seems less convincing for real estate and mortgage banks.[42] The coefficient on lagged logsize is negative and highly significant so that it seems important as a control variable. The sign on lagged Tobins' q, L1qfit, also varies according to the specification. Hence, it does not clearly support the hypothesis that banks with a large charter value are reluctant to take high risks compared to banks that have little to lose**.**

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[41] More concretely, provisions may reduce current profits and thus retained earnings and capital. This effect should ideally have been eliminated in the first stage regression, but part of it may still be present.

[42] Arguably, loans made by real estate banks have lower loss given default, rather than a lower probability of default. This might explain why the real estate bank dummy is insignificant in the regression of the ratio of non-performing loans. The coefficient on real is significantly negative in regressions of loan loss provisions (not shown).

The deposit insurance index depins has - contrary to our prior - a negative sign (although a small coefficient).[43] The dummy supp, taking the value of 1 if government support is likely, is – as expected - positively related to risk. Although it is not significant in the regression shown in column (1), it is highly significant in other specifications where depins is excluded (e.g. column (4)).

The effect of the bank deposit ratio is positive, which is slightly puzzling. It does not confirm our prior that uninsured investors exert market discipline on banks' risk, at least overall.

Banks disclosing more information are found to have a lower ratio of non-performing loans in our model. This is confirmed by two of our three information variables. The strongest effects can be found for the disclosure index, whose coefficient is negative and statistically significant at the one-percent level. The variable list, which indicates whether a bank has a second listing in the US that subjects a bank to the SEC disclosure standards, also has a negative significant coefficient. Overall, rated banks in our sample are not associated with lower asset risk. A possible explanation could be that the variable rat is correlated with some omitted variable, causing a positive effect on the ratio of non-performing loans.

[43] A closer look at the deposit insurance variable provides two facts that may explain the negative sign. As it turns out, three (Indonesia, Malaysia and Thailand) out of seven countries that have no explicit deposit insurance scheme had a financial crisis during our sample period, which explains a relatively large ratio of non-performing loans for those countries during some years. Furthermore, the US is among the countries with the largest deposit insurance index and at the same time has banks with the on average lowest ratio of non-performing loans. Both findings lead to the negative sign on the variable depins.

Table 7: Instrumental variable FGLS regression model with heteroskedastic panels and panel-specific AR(1). Dependent variable: ratio of non-performing loans.

	(1) TS FGLS Insurance	(2) TS FGLS Funding	(3) TS FGLS Disclosure	(4) TS FGLS Multiple Categories
Dep. variable	**rnperfloans**	**rnperfloans**	**rnperfloans**	**rnperfloans**
cons	.2044214***	.1534507***	.1241212***	.3788262***
capfit	-.0386411***	.1006435***	-.1165542***	.1015197*
gdp_g	-.5881473***	-.428092***	-.4664636***	-.5610091***
L1gdp_g	-.6427979***	-1.043556***	-.6308903***	-1.120163***
sav	-.0135947***	-.0055504	-.0112828***	-.0257329***
real	-.0033733	-.0263987***	-.0051581	.0001936
L1logsize	-.0035955***	-.0084714***	-.0006757	-.0163801***
L1qfit	-.0226874***	.0409809***	.009589***	.0149546***
depins	-.0133184***			
supp	.0037902			.0261188***
L1bankdeprfit		.0379799***		.0073671
rat			.0057763***	
list			-.0290338***	-.0087642**
L1discfit			-.0637409***	-.0564494**
No. of obs.	995	1216	2364	655
No. of groups	207	290	497	148
Log likelihood	2651	3106	6982	1563

*** Statistical significance at the one percent level
** Statistical significance at the five percent level
* Statistical significance at the ten percent level

Again, the coefficients on the market discipline variables can give us some information on the economic significance of a change in market discipline. Banks that are sure to be bailed out by the government thus have a ratio of non-performing loans that is on average by about 2.6% higher than banks that are certain not to be bailed out. Similarly, banks listed in the US have on average ratios of non-performing loans between 1-3% lower than banks that do not have a second listing in the US. The coefficient on the disclosure index shows that banks providing information on all 18 subindices about their risk (see box 1) have a ratio of non-performing loans that is about 5-6% lower than for banks not disclosing any of this information.

4. Market Discipline with and without Government Support

How do the above results change if we split the sample into a "government support sample", which includes all observations where supp=1, and a "no government support sample", comprised of all observations where supp=0? We would expect market discipline to be weaker in the presence of likely government support, whereas the market discipline variables should have a stronger disciplining effect on bank risk if the government is not likely to support a failing bank.

Table 8 shows that we indeed find a stronger market discipline effect in the sub-sample of no government support. Column (1) presents the results for the ratio of non-performing loans if supp=1, whereas column (1') presents the corresponding results in the supp=0 sample. The amount of information banks disclose helps to reduce bank risk *in particular* if government support is unlikely. The disclosure index has a negative and highly significant coefficient in both sub-samples, but in the no government support sample, the effect is much stronger. This is similar for the bank deposit ratio: in contrast to the overall effect found for this variable (see table 7)[44], this variable now has a significant negative effect in both samples, indicating that uninsured funding sources do have the effect of exerting market discipline on banks. The effect is again stronger for the sample of banks that are not likely to be bailed out by the government. In sum, the above findings are consistent with the results found for the capital regressions although, as noted for the latter, the number of available observations in sub-sample regressions is considerably reduced which may have implications for the robustness of our results.

[44] The sample used for this result is different to the previous sample, since the support rating is only available for a smaller amount of banks. The current sample includes less US and Japanese banks, and more Latin American, European and Asian banks.

Table 8: Comparison of "government support" and "no government support" samples. Dependent variable: ratio of non-performing loans.

	(1) TS FGLS	(1') TS FGLS
	supp=1	supp=0
Dep. variable	**rnperfloans**	**rnperfloans**
cons	.1420789***	.6955267***
L1capfit	.6829797***	-.095057
gdp_g	-.5104284***	-.8076745***
L1gdp_g	-.9517311***	-1.635426***
sav	-.0058982	-.0165892***
real	-.0235409***	(dropped)
L1logsize	-.0051499***	-.0208811***
L1qfit	.0303052***	-.0094711
L1bankdeprfit	-.0288505***	-.0811522***
L1discfit	-.0467071***	-.2658484***
No. of obs.	350	305
No. of groups	78	70
Log likelihood	944	678

*** Statistical significance at the one percent level
** Statistical significance at the five percent level
* Statistical significance at the ten percent level

5. Non-linearity of Market Discipline Effects

Decamps, Rochet and Roger (2002) suggest that banks are prone to take higher risks in a "shirking region", where the value of a bank's assets are lower than a certain threshold which defines the necessary minimum capital requirement. Similarly, Chiesa (2001) shows in a theoretical model that banks do not monitor borrowers (which increases the banks' probability of default) if the capital they invest for a given level of loans is small, i.e. below a certain critical level. The question thus arises whether at comparatively low levels of capital banks are more likely to ignore market safeguards and pursue riskier strategies in the hope the gamble will pay off.[45] This leads to the hypothesis we want to

[45] Although minimum capital requirements are present in all of our sample countries, which are designed to induce banks to refrain from gambling, some banks actually breached those requirements and were allowed to continue operating.

examine in this extension: does market discipline work less well for banks that are closer to insolvency, because they have little to lose?

In order to test for this hypothesis we compare the differential effect of disclosure and bank deposits on bank risk for banks that have a high probability of default (i.e. that have at the same time low capital and high risk) compared to banks with medium or low probability of default. The first sub-sample thus includes banks whose capital is lower than the median and whose risk, measured by the principal component of the variables rnperfloans, rllprov and stdev, is higher than the median, and the second sub-sample is composed of the remaining banks. The results of the regressions for these sub-samples are presented in Table 9.

Table 9: Comparison of "high default probability" and "low and medium default probability" samples. Dependent variable: ratio of non-performing loans.

	(1) TS FGLS	**(1') TS FGLS**	**(2) TS FGLS**	**(2') TS FGLS**
	high default probability	**medium & low default probability**	**high default probability**	**medium & low default probability**
Dep. variable	**rnperfloans**	**rnperfloans**	**rnperfloans**	**rnperfloans**
cons	(dropped)	.0886234***	.3190186***	.1551695***
L1capfit	-.3414756***	.2963065***	.1745059***	-.0852698***
gdp_g	-.4798904***	-.4394391***	-.4713311***	-.4484234***
L1gdp_g	-.4288186***	-.9337741***	-1.377838***	-.656256***
sav	.0064502	.0091559***	-.0148741***	-.0095301***
real	.0188087*	-.0162151***	-.0026615	-.0232074**
L1logsize	.0020537***	-.0058487***	-.0060657***	.0003796***
L1qfit	.0207085***	.0463572***	.0251675***	-.0037699***
L1bankdeprfit	.1457034***	-.018549***		
L1discfit			-.2417594***	-.1214778***
No. of obs.	234	869	679	1604
No. of groups	85	226	205	351
Log likelihood	399	2444	1674	5156

*** Statistical significance at the one percent level
** Statistical significance at the five percent level
* Statistical significance at the ten percent level

The results in Table 9 provide some evidence that market discipline is subdued when borrowers are near insolvency, although the effect of disclosure in disciplining banks seems to be even stronger for banks with a high probability of default.[46] The bank deposit ratio has a negative sign in regressions for the medium and low default probability sample, whereas a positive coefficient in the sample of banks with a high default probability. Hence, its disciplining effect seems to work *only* when banks have a sufficient amount of capital at stake. The disclosure index has a negative highly significant coefficient in both sub-samples, but the coefficient is larger in the high probability of default sample. This implies that while other forms of market discipline may fail when a bank is close to insolvency, disclosure may be of particular importance in preventing banks' efforts to gamble for resurrection.

Section 6: Robustness Checks

To assess the robustness of our results, we undertake the following robustness checks: (i) we estimate both capital and risk regression models excluding those countries (US and Japan) which make up a disproportionately large part of our sample; (ii) we conduct fixed effects and between regressions to establish which dimension of the data – time series or cross-section - is mainly driving our results; (iii) we check whether our results hold in samples excluding all countries that experienced a crisis in our sample period; (iv) we re-estimate the basic risk regression model using the standard deviation of equity returns as dependent variable in order to check whether market discipline has a similar effect as above on a risk variable derived from market data.

1. Sample excluding USA and Japan

A large number of banks in our sample are registered in the USA and Japan. This sample composition calls for a robustness test. We have split the sample into three regions, Japan, USA and all other countries and performed separate regressions for these sub-samples. These regressions are based on 100 Japanese banks, 207 US banks and 439 banks from countries other than Japan and USA (although the

[46] We have tested the same hypothesis using the ratio of loan loss provisions as alternative dependent variable. The results for this variable confirm the above findings.

actual sample size varies depending on the variables included in the regression). The results for our second stage capital and risk regressions are summarised in Table 11, which shows whether the sign of each variable corresponds to our prior, and whether the coefficients are significant. The results are based on regressions of the basic model on capital and the ratio of non-performing loans including one market discipline variable.

Table 10: Robustness of sign and significance of MKD coefficients in sub-samples.

Variable	**Sample excluding US and Japan**	**US sample**	**Japan sample**
Dep. variable	***cap***	***cap***	***cap***
depins	✓✓	dropped	dropped
supp	✓✓	dropped	✓✓
bankdeprfit[1]	✓✓	n.a.	✓✓
rat	x	✓✓	x
list	✓✓	dropped	dropped
discfit	✓✓	x	✓✓
Dep. variable	***rnperfloans***	***rnperfloans***	***rnperfloans***
depins	✓✓	dropped	dropped
supp	✓✓	dropped	x
L1bankdeprfit[1]	✓✓	n/a	✓✓
rat	x	x	✓✓
list	✓✓	dropped	dropped
L1discfit	✓✓	✓	x

✓✓: correct sign and significant
✓: correct sign
x: incorrect sign
1: no data available for the US

Overall the results appear fairly robust. All market discipline variables except rat have the expected sign and are significant in the sample without the US and Japan. Both the US and the Japan sample, however, yield mixed results.

In particular, the coefficients on the insurance variables depins and supp retain their sign and significance in reduced-sample capital regressions. In the risk regressions, depins now has the expected positive significant coefficient in the sample excluding the US and Japan. In single country samples depins cannot be tested since it does not vary within countries. The variable supp also appears relatively

robust in the risk regressions, performing well in the sub-sample excluding Japan and the USA, but not in the Japan sample. It turns out that all of the banks in the US have a support rating of 3 or higher which is why the effect of supp cannot be tested for the USA, supp being zero for all banks.

The results pertaining to the funding variable bankdeprfit also appear to be highly robust. The bank deposit ratio has a positive significant coefficient in regressions on capital and a negative significant coefficient in regressions on risk for banks both in Japan and in the sample excluding Japan, while no data are available for the USA. But as seen earlier, the coefficient is wrongly signed for the risk regressions if those samples are combined, which is slightly puzzling. It could be related to fixed and between effects working in opposite direction, as will be explored in the next section.

Overall, the disclosure variables appear to be fairly robust. In particular, list has a consistently positive sign in regressions on capital when the US and Japan are excluded, while a negative sign in regressions on the ratio of non-performing loans. This is an important check for this variable since by definition list takes the value 1 for all US banks. In addition, it turns out that there are no Japanese banks with a US listing in our sample, so that, as a result, list takes the value 0 for all Japanese banks. While the results on the list variable are encouraging, the coefficient on the rat variable does appear somewhat sensitive to the sample employed.

Finally, the disclosure index shows a fairly robust behaviour in our sub-samples. In particular, discfit performs well in the sub-sample excluding the US and Japan in both the capital and risk regressions.[47] Furthermore, it is able to explain within-country variation in bank capital in Japan and to a lesser extent within country variations in the ratio of non-performing loans in the USA. However, it cannot explain differences in risk across Japanese banks and differences in capital in the US.

2. Fixed effects and between regressions – different samples

To analyse further which dimension of the data is driving our results we have conducted fixed effect regressions as well as between effects regressions for the different samples. It turns out that variation in

[47] It turns out that one needs to control for the support rating in the capital regressions to find a significantly positive effect for this variable in the sub-sample excluding the US and Japan.

disclosure over time is one of the main drivers of the overall effect of disclosure on capital, while this is less clear for the effect on risk, see Table 12. By contrast, for the bank deposit ratio, differences across banks are more important for the overall results for both capital and risk, see Table 13. The reason why L1bankdeprfit works less well in the main TSGLS overall sample risk regression compared to both the sample excluding US and Japan and the Japan sample is that it seems to be driven by cross-sectional differences in the sample excluding the US and Japan, whereas it is driven by a fixed effect in the Japan sample.

Table 11: Fixed effects regressions with AR(1) errors. Robustness of sign and significance of MKD coefficients in sub-samples.

Variable	**Sample excluding US and Japan**	**US sample**	**Japan sample**	**Full sample**
Dep. variable	***cap***	***cap***	***cap***	***cap***
bankdeprfit[12]	x	n/a	x	x
discfit	✓✓	x	x	✓✓
Dep. variable	***rnperfloans***	***rnperfloans***	***rnperfloans***	***rnperfloans***
L1bankdeprfit[1]	x	n/a	✓	x
L1discfit	✓	x	x	x

✓✓: correct sign and significant
✓: correct sign
x: incorrect sign
1: no data available for the US
2: Only these two MKD variables are included in the table since the other ones do not vary over time

Table 12: Between effects. Robustness of sign and significance of MKD coefficients in sub-samples.

Variable	**Sample excluding US and Japan**	**US sample**	**Japan sample**	**Full sample**
Dep. variable	***cap***	***cap***	***cap***	***cap***
depins	✓	dropped	dropped	✓✓
supp	✓✓	dropped	✓	✓✓
bankdeprfit[1]	✓	n/a	✓	✓✓
rat	x	✓	x	✓
list	✓	dropped	dropped	✓
discfit	x	✓	✓	x

Dep. variable	*rnperfloans*	*rnperfloans*	*rnperfloans*	*rnperfloans*
depins	x	dropped	dropped	x
supp	✓✓	dropped	x	✓✓
L1bankdeprfit[1]	✓✓	n/a	x	✓
rat	x	✓	✓✓	x
list	✓	x	dropped	✓✓
L1discfit	x	x	x	✓✓

✓✓: correct sign and significant
✓: correct sign
x: incorrect sign
1: no data available for the US

3. Sample excluding crisis countries

A number of countries experienced a financial crisis during our sample period (1993-2000). These are Japan, Thailand Indonesia, Malayisa and Korea. We re-estimate the effect of MKD variables in the sample excluding all of these countries, for two related reasons. First, the structural relationship between the MKD variables and our dependent variables could be different in countries that experienced a financial crisis. This could call into question the poolability of crisis and non-crisis countries. Second, with respect to the government support variables depins and supp in particular, we want to address a potential endogeneity issue. While both these variables are clearly exogenous from the bank's point of view, endogeneity could still pose a problem if government support is endogenous to the occurrence of a crisis. In particular, our deposit insurance index records legal arrangements relating to the deposit insurance scheme as of 1999. But we know that in Japan there has been a change to this legal framework in 1996 and that this change occurred in response to the developing banking crisis. In particular, prior to 1996 the Japanese deposit insurance fund operated under a pay-off cost limit, which effectively limited the pay-out ratio available to depositors in the case of a crisis. This pay-off cost limit was temporarily removed until March 2001, effectively granting unlimited deposit insurance coverage. In the cases of the other crisis countries - Thailand, Malaysia, Indonesia and Korea - there has been no change in the explicit deposit insurance regime in response to the crises. But in all four cases the government committed to extend blanket guarantees to all depositors. While this has had no effect on our deposit insurance index, which for Thailand Malaysia and Indonesia records no explicit scheme and for Korea a scheme with limited pay-outs, it might have had an impact on the implicit government support rating. This could create a reverse causality issue since low capital and high risk could have

triggered high government support as measured by supp. However, Table 14 shows that the exclusion of crisis countries does not materially alter the results.

Table 13: Robustness of sign and significance of MKD coefficients in sub-samples.

Variable	**Crisis countries[1]**	**Sample excluding crisis countries**	**Full sample**
Dep. variable	***cap***	***cap***	***cap***
depins	✓✓	✓✓	✓✓
supp	✓✓	✓✓	✓✓
bankdeprfit	✓	✓✓	✓✓
rat	x	✓✓	✓✓
list	dropped	✓✓	✓✓
discfit	✓✓	✓✓	✓✓
Dep. variable	***rnperfloans***	***rnperfloans***	***rnperfloans***
depins	x	x	x
supp	x	✓✓	✓✓
L1bankdeprfit	x	x	x
rat	x	x	x
list	dropped	✓✓	✓✓
L1discfit	✓✓	✓✓	✓✓

✓✓: correct sign and significant
✓: correct sign
x: incorrect sign
1: Japan, Thailand, Malaysia, Indonesia and Korea

4. The Standard Deviation of Weekly Equity Returns as Dependent Variable

In order to investigate whether the market discipline effect found for the balance sheet variable also holds for a risk variable derived from market data, we use the banks' standard deviation of weekly equity returns as alternative risk measure in the following specification. The advantage of this specification is that we exclude variations in the dependent variable arising solely due to definitional differences across countries, which are likely with the accounting variables. The results are presented in Table 15, where - as before - the first three columns show the effect of the different types of market discipline variables separately; column (4) shows a regression where the different types of market discipline variables are all included.

Most control variables exhibit a similar behaviour to before. The coefficient on the capital ratio is now more clearly positive. Risk as measured by the standard deviation of equity returns is negatively related to current GDP growth, indicating that the markets do not perceive risks to be increasing in business cycle expansions. Furthermore, the negative effect of the charter value on risk is more pronounced in this specification.

Overall, some evidence of market discipline is present, but it is weaker than in our main regressions.[48] Both insurance variables have a positive sign in column (1), but the coefficient on the level of government guarantee, supp, is not very robust – it is no longer positive and significant in the different regressions. Although the variable depins is – as before - negative when included separately, it has a positive sign when we exclude the countries with no explicit deposit insurance that had a crisis during our sample period. The amount of bank deposits relative to total deposits a bank holds does not have a significant effect on its risk measured by the standard deviation, as shown by the positive insignificant coefficient on this variable in column (2). The results for the disclosure variables L1discfit and list support our hypothesis that disclosure reduces bank risk: their coefficients are both negative and in most specifications significant. While this is in line with our findings for the ratio of non-performing loans, a caveat is that in regressions using the standard deviation as the dependent variable there is an alternative explanation for the negative effect of disclosure. Disclosure may reduce investor uncertainty about the bank rather than reduce asset risk as a result of incentive effects.

[48] As additional robustness checks, we have also used the ratio of loan loss provisions to total loans and a summary measure of risk, constructed as the principal component of the variables rnperfloans, rllprov and stdev, as alternative dependent variables. Both variables broadly confirm the evidence that market discipline reduces banks' risk of insolvency. L1discfit and list are the most robust variables across specification, followed by L1bankdeprfit and supp. Depins and rat do not have the expected sign in most cases.

Table 14: Instrumental variable FGLS regression model with heteroskedastic panels and panel-specific AR(1). Dependent variable: standard deviation of equity returns.

	(1) TS FGLS Insurance	(2) TS FGLS Funding	(3) TS FGLS Disclosure	(4) TS FGLS Multiple Categories
Dep. variable	**stdev**	**stdev**	**stdev**	**stdev**
cons	.0079678	-.0564203***	-.0120733**	.0426831***
capfit	.1797985***	.3320784***	.2528764***	.1411769***
gdp_g	-.1892763***	-.1263241***	-.1024832***	-.1786228***
L1gdp_g	-.0228595***	.0022781	.0647614***	.000539
sav	-.0226322***	-.0042318***	-.0114938***	-.0154052***
real	.0048026***	-.0103679***	-.0109344***	.0027891
L1logsize	.0027909***	.0047136***	.0026105***	.0037796***
L1qfit	-.010427***	.0017262	-.0023429**	-.0084016***
depins	.0029194***			
supp	.0014627			-.0037829*
L1bankdeprfit		.0019201		
rat			.0061442***	
list			-.0036686***	-.004999***
L1discfit			-.0030611	-.0616364***
No. of obs.	1050	1613	2650	1035
No. of groups	206	329	513	202
Log likelihood	3033	4723	7840	2917

*** Statistical significance at the one percent level
** Statistical significance at the five percent level
* Statistical significance at the ten percent level

Section 7: Conclusions

This paper examines empirically the hypothesis that market discipline provides incentives for banks to limit their risk of default. In particular, we analyse the effect of three sets of factors related to the strength of market discipline. These are 1.) the degree of explicit or implicit government guarantees (insurance), 2.) the amount of uninsured liabilities in the bank's balance sheet (funding) and 3.) the degree of observability of the bank's risk choices (disclosure).

In analysing these three sets of factors in a unified framework, this paper contributes to the existing literature in a number of ways. First, our study corroborates existing country level evidence of the effects of explicit deposit insurance schemes by analysing its effect at bank level. Second, we first provide evidence that implicit government support, as measured by the Fitch IBCA public support

rating, creates moral hazard. In addition, we analyse whether interbank discipline has incentive effects. Finally, to our knowledge, this paper is the first to study empirically whether bank disclosure has any impact on bank risk taking.

Our research strategy is to see whether any of these factors have an impact on the bank's probability of default using two different types of regressions. Capital regressions test whether market discipline factors affect the size of capital buffers, controlling for asset risk and other factors affecting bank capital. Risk regressions test whether market discipline affects the level of realised asset risk, for given capital buffers and controlling for other drivers of bank asset risk. Both sets of regressions yield results that are consistent with the notion that market discipline affects the incentives of banks to limit their risk of insolvency.

In capital regressions we find that explicit or implicit government guarantees lead banks to choose lower capital buffers, ceteris paribus. We also find that a higher share of uninsured funding has a disciplining effect leading banks to choose larger capital buffers for given risk. And we find evidence in favour of the idea that banks, which disclose more information and thus are subject to stronger market discipline limit their probability of defaults by choosing a higher capital buffer. However, we find that all of these effects are weaker when we look at the subsample of banks for which the market believes that government support will lead to a bail-out, effectively insuring investors. In addition we find that interbank discipline is not effective for banks that are close to insolvency, but disclosure is effective for these banks. This suggests that for banks close to insolvency discipline originates from investors other than banks.

The main findings of the capital regressions are generally confirmed by the risk regressions. In these regressions, we find that the effect of an extensive deposit insurance scheme on bank risk is somewhat mixed. We find stronger support for the notion that implicit government guarantees, resulting from banks being too big to fail, induce these banks to choose a higher probability of default, as measured by the ratio of non-performing loans for a given capital ratio. Overall, based on the risk regressions it is not clear that uninsured funding sources lead to lower default risks of banks. But we find strong support for the hypothesis that banks disclosing more information - either in their published accounts or by having a second listing in the US - have lower realised risk. Furthermore, the risk regressions confirm that market discipline is stronger when banks are not likely to be bailed out by the government. There

are also differential effects of market discipline on risk for banks that are close to insolvency compared to banks with a lower default probability. The bank deposit ratio only reduces realised risk for banks whose default probability is low. Disclosure, in contrast, is more effective in limiting realised risk for a given capital for banks with a high probability of default. This implies that disclosure is of particular importance when banks approach insolvency since other measures of market discipline may be less effective.

Our results are broadly supportive of recent policy initiatives. Enhancing market discipline through more disclosure and/or uninsured liabilities would appear to be beneficial in that both mechanisms seem to provide incentives for firms to maintain adequate solvency standards. But our results also indicate that the beneficial effect of these policy initiatives is likely to be stronger for banks that do not enjoy implicit government guarantees. This has important consequences on how to optimise the mix between Pillars 2 and Pillar 3 of the New Basel Accord. If implicit government guarantees cannot credibly be abolished or indeed are necessary to prevent systemic banking crises and the large economic costs that are associated with them, banks that are subject to such guarantees are likely to be less influenced by market discipline. Close supervisory oversight of these banks will therefore need to remain a crucial ingredient in the regulatory framework. In addition, our result that some forms of market discipline are less effective for banks which are close to insolvency reinforces the importance of minimum capital requirement as a prerequisite for the effectiveness of market discipline (Pillar 1 of the New Basel Accord).

Box 1: A Synthetic Disclosure Index Based on FITCH IBCA BANKSCOPE Information

As one of our market discipline variables, we have constructed a disclosure index using the BankScope database as our source of information. The purpose of this exercise is to arrive at bank-level information on disclosure. 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 subindices are created which reflect whether the bank's accounts (as presented in BankScope) provide any detail on each dimension. The subindices are then aggregated to form a composite disclosure index.

The composite index is defined as

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

where each subindex, s_i, can be related to one or more sources of risk (interest rate risk, credit risk, liquidity risk, market risk). We have defined a total of 18 subindices. Rather than ordering the subindices with respect to the source of risk on which they inform, 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 I: Subindices used to Construct the Composite Disclosure Index

	Subindex	Categories
Assets		
Loans	s_1: Loans by maturity	Sub 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, Sub 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

1 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.

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, Juan, Daniel Perez and Jesus Saurina (2000): "Are Capital Buffers Procyclical?", *mimeo*, Bank of Spain

Barth, James R., Gerard Caprio and Ross Levine (2001): "The Regulation and Supervision of Banks Around the World – A New Database" *mimeo*, World Bank

Barth, James R., Gerard Caprio and Ross Levine (2002): "Bank Regulation and Supervision: What works best?" *World Bank Working Paper*

Basel Committee on Banking Supervision Consultative Paper (January 2001): "A New Capital Adequacy Framework; Pillar 3 Market Discipline"

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

Berger, Allen, N. (1995): "The Relationship between Capital and Earnings in Banking", *Journal of Money, Credit and Banking*, Vol. 27, pp. 432-456

Bliss, Robert R. (2000): "Market Discipline and Subordinated Debt: A Review of Some Salient Issues", *mimeo*, Federal Reserve Bank of Chicago

Bliss, Robert R. and Flannery, Mark J. (2002): "Market Discipline in the Governance of U.S. Bank Holding Companies: Monitoring versus Influence", *European Finance Review*, Vol.6, pp. 419-437

Blum, Jürg (2002): "The Limits of Market Discipline in Reducing Bank's Risk Taking", forthcoming *Journal of Banking and Finance*

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, Claudio, Craig Furfine and Philip Lowe (2001): "Procyclicality of the financial system and financial stability: issues and policy options", *BIS Papers* No 1

Bushman, Robert, M and Abbie J. Smith (2003): "Transparency, Financial Accounting Information and Corporate Governance", *FRBNY Economic Policy Review*, forthcoming

Calomiris, Charles W. and Berry Wilson (1998): "Bank Capital and Portfolio Management: The 1930' 'Capital Crunch' and Scramble to Shed Risk", *NBER Working Paper* No. 6649

Chiesa, Gabriella (2001): "Incentive-Based Lending Capacity, Competition, and Regulation in Banking", *Journal of Financial Intermediation*, Vol. 10, pp. 28-53.

Cordella, Tito and Eduardo Levy Yeyati, (1998): " Public Disclosure and Bank Failures", *CEPR Discussion Paper* No. 1886

Covitz, Daniel, Hancock, Dianna and Kwast, Myron (2000): "Market Discipline, Banking Organizations and Subordinated Debt", Paper presented to the 2000 Global Finance Association Meetings, April 21, Chicago

Decamps, Jean-Paul, Jean-Charles Rochet and Benoit Roger (2002): The Three Pillars of Bael II: Optimizing the Mix in a Continuous-time Model", *mimeo*, University of Toulouse

Demirguc-Kunt, Asli and Detragiache, Enrica (2000): "Does Deposit Insurance Increase Banking System Stability? - An Empirical Investigation", *mimeo*, The World Bank

Demirguc-Kunt, Asli and Sobaci, Tolga (2000): "Deposit Insurance Around the World: A Data Base", *mimeo*, The World Bank

De Nicoló, Gianni (2000): "Size, Charter Value and Risk in Banking: An International Perspective" *IMF Working Paper*

Ellis, David M and Mark J. Flannery (1992): "Does the Debt Market Assess Large Banks' Risk?- Time series evidence from money center CDs", *Journal of Monetary Economics*, Vol. 30, pp. 481-504

Evanoff, Douglas D. and Larry D. Wall (2000): "Subordinated Debt as Bank Capital: A Proposal for Regulatory Reform", *Economic Perspectives*, Federal Reserve Bank of Chicago

Evanoff, Douglas D. and Wall, Larry D. (2000a): "The Role of Subordinated Debt in Bank Safety and Soundness Regulation" in Proceedings to the 36th Annual Conference on Bank Structure and Competition

Freixas, Xavier (1999): "Optimal Bail Out Policy, Conditionality and Creative Ambiguity", Financial Markets Group, London School of Economics , *Discussion Paper* No. 327

Gropp, Reint, Jukka Vesala and Guiseppe Vulpes (2001): "Equity and Bond Market Signals as Leading Indicators of Bank Fragility", *mimeo*, European Central Bank

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

Keeley, Michael C.(1990): "Deposit Insurance, Risk and Market Power in Banking", *American Economic Review*, Vol. 80, pp. 1183-2000

Kim, Moshe, Doron Kliger and Bent Vale (2001): "Estimating Switching Costs and Oligopolistic Behaviour", *Wharton School Working Paper* No. 01-13

Kliger, Doron and Oded Sarig (2000): "The Information Value of Bond Ratings", *Journal of Finance*, Vol. 55 (6), pp. 2879-2902

La Porta, Rafael, Lopez-de-Silanes, Florencio and Shleifer, Andrei and Vishny, Robert W. (1998): "Law and Finance", Journal of Political Economy, Vol. 106, pp. 1114-1155

Leutz, Christian and Verrecchia, Robert E. (2000): The Economic Consequences of Increased Disclosure", *Journal of Accounting Research*, Vol. 38, pp. 91-135

Marston, Claire L. and Philip J. Shrives (1991): "The Use of Disclosure Indices in Accounting Research: A Review Article", *British Accounting Review*, Vol. 23, pp. 195-210

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

Myers, Stewart and N. S. Majluf (1984): "Corporate Financing and Investment Decisions when Firms Have Information Investors do not Have", *Journal of Financial Economics*, Vol. 13, pp. 187-221

Rule, David (2001): "Risk Transfer between Banks, Insurance Companies and Capital Markets: and Overview", *Financial Stability Review*, Bank of England, December 2001, pp. 137-159

Shrieves, Ronald E. and Drew Dahl (1992): " The Relationship between Risk and Capital in Commercial Banks", *Journal of Banking and Finance*, Vol.: 16, pp. 439-457

APPENDIX

Table A1: Stock market indices used for beta regressions

Country	Bloomberg Code	No. of Constituents	Index
Argentina	MERVAL	12	Buenos Aires Stock Exchange Merval Index
Australia	AS51	200	St.&Poors / Australian Stock Exchange 200 Index
Austria	ATX	20	Vienna Stock Exchange Austrian traded Index
Belgium	BEL20	20	Brussels Stock Exchange Bel20 Index
Brazil	IBOV	57	Sao Paulo Stock Exchange BOVESPA
Canada	TS300	297	Toronto Stock Exchange 300 composite Index
Chile	IGPA		Santiago Stock Exchange IGPA Index
Finland	HEX	121	Helsinki Stock Exchange General Index
France	BCAC	40	CAC 40 Index
Germany	DAX	30	Deutsche Boerse AG German Stock Index
Hong Kong	HIS	33	Hong Kong Hang Seng Index
Ireland	ISEQ	64	Irish Stock Exchange overall Index
Israel	TA-25	25	Tel-Aviv 25 Index
Italy	MIB30	30	Milan Stock Exchange MIB 30 Index
Japan	NKY	225	Nikkei 225 Index Tokyo Stock Exchange
Netherlands	AEX	24	Amsterdam Stock Exchange OBX Index
Norway	OBX	25	Oslo Stock Exchange OBX Index
Poland	WIG	110	Warsaw Stock Exchange WIG total return Index
Portugal	BVLX	55	Bolsa de Valores de Lisboa BVL general Index
Singapore	STI	45	Straits Time Index
Spain	IBEX	35	IBEX 35 Index
Sweden	OMX	30	Stockholm Stock Exchange options market Index
Switzerland	SMI	27	Swiss market Index
Taiwan	TWSE	562	Taiwan Stock Exchange weighted Index
Turkey	TKSMCO		Turkey Stock market national Index
UK	UKX	100	FTSE-100 Index
US	SPX	500	Standard and Poor’s 500 Index

Table A2: Data sources

DATA SOURCE	DATE	VARIABLE	DESCRIPTION	DETAILS
BankScope	2001	rnperfloans	ratio of non-performing loans	ratio of non-performing loans to total loans
		rllprov	ratio of loan loss provisions	ratio of loan loss provisions to total loans
		supp	support rating	supp=1 if FITCH IBCA support rating equals 1 or 2, 0 otherwise
		subdebtr	sub debt ratio	ratio of subordinated debt to total deposits
		bankdepr	bank deposit ratio	ratio of deposits due to banks to total deposits
		disc	disclosure index	disclosure index, as described in main text
		list	second listing	list=1 if bank is listed on NYSE, NASDAQ or AMEX, otherwise 0
		rat	rating	rat=1 if rated by Moody's, Standard&Poor or FITCH IBCA, otherwise 0
		ms	market share	total assets of bank i relative to the sum of total assets of all banks in country j
		roe	return on equity	net income divided by the book value of equity from the previous period
		sav	savings bank	according to the definition in BankScope
		real	real estate bank	according to the definition in BankScope
		loanr	loan ratio	ratio of total loans to total assets
		cap	equity ratio	ratio of equity capital to debt and deposits
		logsize	log of total assets	logarithm of total assets
		q	Tobin's Q	market value over book value of equity
Bloomberg	2001	beta	beta	all underlying data from Bloomberg
		idios	standard deviation of residuals of the market regressions	all underlying data from Bloomberg
		q	Tobin's q	market value taken from Bloomberg
International Financial Statistics (IFS)	2002	gdp_g	real GDP growth	
Demirguc-Kunt and Sobaci (2000)	2000	depins	deposit insurance index	depins is the sum of 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

Table A3: Results of the first stage instrumental variable regression, using an FGLS regression model with heteroskedastic panels and panel-specific AR(1)

	disc	bankdepr	q	cap
_cons	-12.65387***	-15.54238***	.8375374***	.3587702***
gdp_g			3.563102***	-.0228468***
loanr	-.0121694*	-.0574148***	-.3283126***	-.0966199***
roe	-.0056848***	-.0029675*		.0309537***
logsize	.0158197***	.01255***	.0892278***	-.0136242***
ms	-.1131431***	-.0539308*	-1.726346***	-.016889
year	.0065946***	.0078697***		
ci	-.0000551***	-.0001062***	-.0015011***	-.0000131
dumarg	26.58592***	59.04265***	-.3182246**	.0383748***
dumaus	4.472535	-22.00019***	-.7458531***	-.0346183***
dumaustr	17.16109***	11.09516*	.0352465	-.0111422**
dumbel	-.0932381	-192.9669*	-.6486433***	-.0091126***
dumbra	17.21066***	55.43806***	-1.346772***	.0269591***
dumchi	-19.7038***	58.61713***	-.0909114	-.0108999**
dumfin	20.66664***	32.3018*	.0084949	-.0458034***
dumfra	14.72544***	30.59985***	-1.279202***	.0851945***
dumger	3.675175		-.5616022***	-.0403891***
dumgree	29.59142**	16.91996**	1.533395***	.0018069
dumire	43.21875***	-16.7894***	.1882477	-.0113683
dumit	-23.42388***	23.70009***	-.727633***5	.0011218
dumnet	-3.560938	29.78042**	-.1549273	-.0004281
dumnor	8.85864	-14.69407***	-1.080181***	-.0048854**
dumpol	-45.34905***	-4.490029	-.884528***	.0224022***
dumpor	-2.744827	-4.500517	-.5703384***	-.0095013**
dumspa	21.12482***	2.012002	-.3951759***	.0141936**
dumswe	-10.71672	-14.79453	-.3510967**	-.014866***
dumswi	-74.95439***	-8.636769	-.5567399**	.0260714
dumtur	-40.3291**	82.96783***	-.0989611	.0099189***
dumuk	-.6106999	28.22111***	.1257416	-.0106733***
dumcan	23.83527**	30.6896***	-.7376697***	-.0030994
dumisr	2.910969	28.07429***	-1.362265***	.0365078
dumjap	-26.49391***	18.73671***	-.8583088***	-.0171368***
dumhon	-40.93198**	21.46836***	-.4990249***	.0418075***
dumind	15.3435**	47.86358***	-.2464572	-.0240782**
dumkor	-50.31496***	146.4443***	-1.516598***	-.0149005***
dummal	18.84532***	24.89951***	.0568319	-.0033117
dumsin	-29.41763**	15.56693*	-.488746***	.0633722***
dumtai	-22.34153**	26.27745***		
dumtha	-9.584987	39.01017***	.4534216**	.0220269***
dumargy	-.0133289***	-.0296583***		
dumausy	-.0023969	.0110426***		
dumaustry	-.0085755***	-.0056791*		
dumbely	-.0000848	.0966524*		
dumbray	-.0086084***	-.0278927***		
dumchiy	.0098226***	-.0294229***		
dumfiny	-.0103198***	-.0163025*		
dumfray	-.0074192***	-.0151536***		
dumgery	-.001955			
dumgreey	-.0148167**	-.0085813**		
dumirey	-.0215926***	.0083108***		
dumity	.0117085***	-.0118774***		

Table A3 cont.: Results of the first stage instrumental variable regression, using an FGLS regression model with heteroskedastic panels and panel-specific AR(1)

	disc	bankdepr	q	cap
dumnety	.0017631	-.0149779**		
dumnory	-.0044225	.0072797***		
dumpoly	.0227073***	.0022026		
dumpory	.0013359	.0022401		
dumspay	-.0105926***	-.0010677		
dumswey	.0053145	.0076881		
dumswiy	.037489***	.0042905		
dumtury	.0200969**	-.041478***		
dumuky	.0002697	-.0142218***		
dumcany	-.012035**	-.0154641***		
dumisry	-.0014312	-.0141473***		
dumjapy	.0132505***	-.0095419***		
dumhony	.0204691**	-.0108996***		
dumindy	-.0077258**	-.0240939***		
dumkory	.0251521***	-.0733045***		
dummaly	-.0094611***	-.0125374***		
dumsiny	.014704**	-.0078705*		
dumtaiy	.0111386**	-.0132769***		
dumthay	.0047682	-.0196551***		
No. of obs	4681	3055	3140	4082
No. of groups	692	479	528	666

Table A4: Correlation coefficients between the fitted and the actual values of disc, bankdepr, q and cap

	discfit	**bankdeprfit**	**qfit**	**capfit**
disc	**0.3335**			
bankdepr		**0.6560**		
q			**0.4639**	
cap				**0.4301**

Table A5: Correlation matrix

	capfit	rnperfloans	rllprov	beta	idios	stdev	supp	depins	bankdeprfit	discfit	list	rat	qfit	logsize	ms	roe	gdp_g	sav	real
Capfit	1																		
Rnperfloans	-0.0784 (0.0000)	1																	
Rllprov	-0.0618 (0.0002)	0.2645 (0.0000)	1																
Beta	-0.1188 (0.0000)	0.1184 (0.0000)	0.0531 (0.0015)	1															
Idios	0.0465 (0.0089)	0.2002 (0.0000)	0.0436 (0.0098)	-0.0185 (0.2301)	1														
Stdev	0.0480 (0.0067)	0.2069 (0.0000)	0.0473 (0.0050)	-0.0103 (0.5025)	0.9987 (0.0000)	1													
Supp	-0.3713 (0.0000)	0.0048 (0.8569)	-0.0135 (0.5516)	0.1176 (0.0000)	-0.0907 (0.0002)	-0.0076 (0.7519)	1												
Depins	-0.0781 (0.0000)	-0.2994 (0.0000)	-0.0444 (0.0028)	-0.1604 (0.0000)	-0.0131 (0.3961)	-0.0186 (0.2253)	-0.0523 (0.0118)	1											
Bankdeprfit	0.1453 (0.0000)	-0.3190 (0.0000)	-0.0538 (0.0004)	-0.0048 (0.7724)	-0.0110 (0.5091	-0.0185 (0.2644)	-0.4280 (0.0000)	0.5746 (0.0000)	1										
Discfit	-0.0751 (0.0000)	-0.0954 (0.0000)	-0.0112 (0.4628)	0.1077 (0.0000)	-0.0132 (0.4282)	-0.0149 (0.3697)	0.0553 (0.0160	0.2931 (0.0000)	0.3197 (0.0000)	1									
List	0.0509 (0.0011)	-0.2785 (0.0000)	-0.0527 (0.0002)	0.0645 (0.0000)	-0.0159 (0.3025)	-0.0213 (0.1649)	-0.1506 (0.0000)	0.4723 (0.0000)	0.8534 (0.0000)	0.3051 (0.0000)	1								
Rat	-0.2936 (0.0000)	0.0749 (0.0000)	-0.0000 (0.9977)	0.2845 (0.0000)	-0.0274 (0.0750)	-0.0157 (0.3063)	. (1.0000)	-0.1040 (0.0000)	-0.1452 (0.0000)	0.1655 (0.0000)	-0.0333 (0.0100)	1							
Qfit	0.0783 (0.0000)	-0.1444 (0.0000)	-0.0978 (0.0000)	0.2489 (0.0000)	-0.0248 (0.1608)	-0.0225 (0.2028)	-0.2249 (0.0000)	0.0754 (0.0000)	0.5660 (0.0000)	0.1540 (0.0000)	0.5525 (0.0000)	0.1735 (0.0000)	1						
Logsize	-0.6618 (0.0000)	0.0114 (0.5205)	-0.0562 (0.0002)	0.2990 (0.0000)	-0.0662 (0.0000)	-0.0540 (0.0009)	0.5298 (0.0000)	0.0206 (0.1426)	-0.2417 (0.0000)	0.2389 (0.0000)	-0.0442 (0.0016)	0.5603 (0.0000)	0.0746 (0.0000)	1					
Ms	-0.1781 (0.0000)	0.0889 (0.0000)	0.0159 (0.2904)	0.2795 (0.0000)	-0.0094 (0.5646)	0.0046 (0.7787)	0.5989 (0.0000)	-0.3081 (0.0000)	-0.2764 (0.0000)	0.0844 (0.0000)	-0.0478 (0.0008)	0.3392 (0.0000)	0.0147 (0.3401)	0.4562 (0.0000)	1				
Roe	0.3216 (0.0000)	-0.4417 (0.0000)	-0.4098 (0.0000)	0.0254 (0.1184)	-0.0244 (0.1379)	-0.0243 (13.75)	-0.0195 (0.3913)	0.0389 (0.0064)	0.1216 (0.0000)	-0.0279 (0.0549)	-0.1240 (0.0000)	0.0091 (0.5528)	0.1896 (0.0000)	-0.0213 (0.1358)	-0.0116 (0.4234)	1			
gdp_g	0.2248 (0.0000)	-0.3161 (0.0000)	-0.1315 (0.0000)	0.1210 (0.0000)	-0.0090 (0.5872)	-0.0085 (0.6055)	-0.0252 (0.2735)	-0.1270 (0.0000)	0.2299 (0.0000)	0.0604 (0.0001)	0.1864 (0.0000)	0.0237 (0.0944)	0.3081 (0.0000)	-0.1022 (0.0000)	0.1431 (0.0000)	0.2835 (0.0000)	1		
Sav	-0.0352 (0.0240)	-0.0255 (0.1522)	-0.0156 (0.2969)	-0.0594 (0.0001)	-0.0066 (0.6697)	-0.0118 (0.4436)	0.1384 (0.0000)	-0.0022 (0.8687)	-0.0290 (0.0465)	0.0314 (0.0309)	-0.1039 (0.0000)	-0.0236 (0.0712)	-0.1236 (0.0000)	-0.0639 (0.0000)	0.0108 (0.4487)	0.0236 (0.1018)	0.0074 (0.6071)	1	
Real	-0.1647 (0.0000)	-0.0188 (0.2913)	-0.0127 (0.3964)	-0.0718 (0.0000)	-0.0118 (0.4438)	-0.0146 (0.3437)	0.0036 (0.8644)	-0.1812 (0.0000)	-0.1344 (0.0000)	-0.1882 (0.0000)	-0.1020 (0.0000)	0.0038 (0.7719)	0.0336 (0.0298)	0.0365 (0.0101)	-0.0500 (0.0004)	0.0070 (0.6279)	-0.0143 (0.3179)	-0.0390 (0.0029)	1