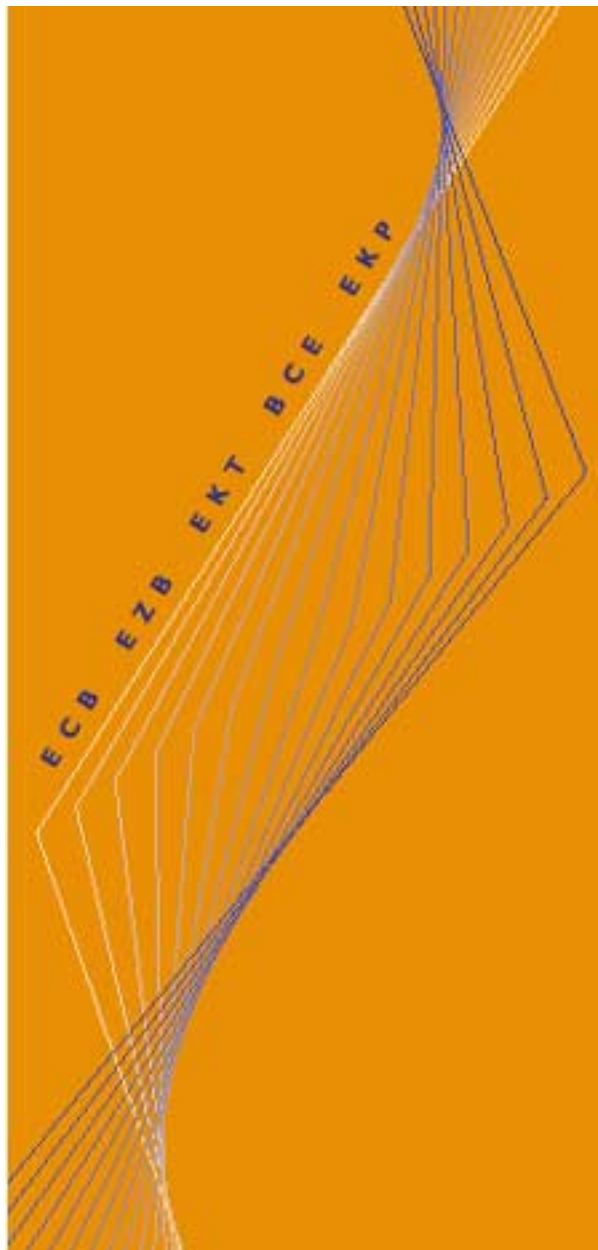


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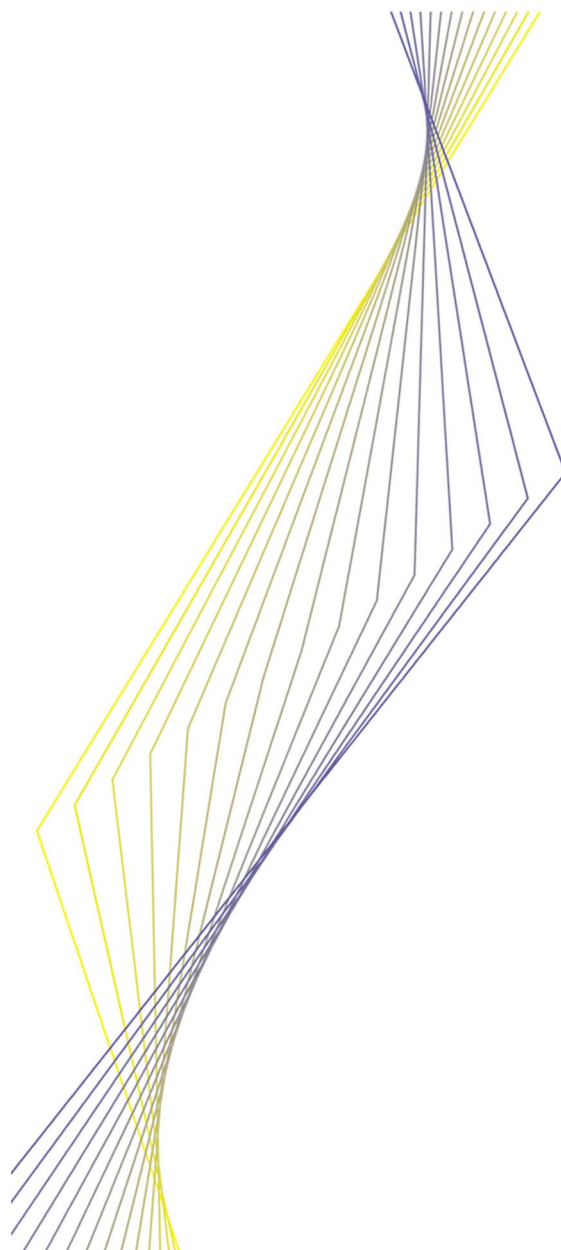
**DEPOSIT INSURANCE AND  
MORAL HAZARD: DOES  
THE COUNTERFACTUAL  
MATTER?**

**BY REINT GROPP  
AND JUKKA VESALA**

**March 2001**



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# Contents

Abstract	5
I Introduction	7
II Theoretical background	8
III Institutional background	11
IV Data sources and description	12
V Definitions of dependent and independent variables	13
VI Econometric model	15
VII Results	15
Deregulation and charter values	15
Deposit insurance and risk taking	16
VIII Refinements	18
IX Robustness	19
X Conclusion	20
Literature	22
Appendix I Deposit insurance system features in EU countries (end 1998)	29
Appendix II Definition of variables	30
Appendix III Country-specific effects for the stage I regressions	31
Appendix IV Computation of idiosyncratic risk	32
European Central Bank Working Paper Series	33



## Abstract

The paper analyses the relationship between deposit insurance, debt-holder monitoring, bank charter values, and risk taking for European banks. Utilising cross-sectional and time series variation in the existence of deposit insurance schemes in the EU, we find that the establishment of explicit deposit insurance significantly reduces the risk taking of banks. This finding stands in contrast to most of the previous empirical literature. It supports the hypothesis that in the absence of deposit insurance, European banking systems have been characterised by strong implicit insurance operating through the expectation of public intervention at times of distress. Hence the introduction of an *explicit* system may imply a *de facto* reduction in the scope of the safety net. This finding provides a new perspective on the effects of deposit insurance on risk taking. Unless the absence of any safety net is credible, the introduction of deposit insurance serves to explicitly limit the safety net and, hence, moral hazard. We also test further hypotheses regarding the interaction between deposit insurance and monitoring, charter values and “too-big-to-fail”. We find that banks with lower charter values and more subordinated debt reduce risk taking more after the introduction of explicit deposit insurance, in support of the notion that charter values and subordinated debt may mitigate moral hazard. Finally, large banks (as measured in relation to the banking system as a whole) do not change their risk taking in response to the introduction of deposit insurance, which suggests that the introduction of explicit deposit insurance does not mitigate “too-big-to-fail” problems.





## I Introduction

Deposit insurance is often argued to generate moral hazard and incentives for excessive risk taking by banks. This paper focuses on the counterfactual to deposit insurance. Does the absence of deposit insurance imply the absence of any safety net? Or does the absence of explicit deposit insurance suggest a system in which all creditors of banks are insured (or perceived to be insured) through a set of implicit government guarantees? If prior to the introduction of deposit insurance implicit guarantees were broad, the effect of introducing explicit deposit insurance on risk taking of banks may be ambiguous *ex ante*.<sup>1</sup> Based on the empirical evidence for Europe presented in this paper, it appears that explicit deposit insurance may in fact be a useful way to limit the safety net and, hence, moral hazard.

Previous empirical evidence concerning the impact of deposit insurance on bank risk taking and the potential for banking sector fragility is mixed. For example, Wheelock and Wilson [1994] and Alston et al. [1994] fail to establish a relationship between historical US bank failure rates and deposit insurance. In addition, Karels and McClatchey [1999] fail to find evidence that the adoption of deposit insurance increased the risk taking of US credit unions. Conversely, Wheelock [1992] and Thies and Gerlowski [1989] find a positive and significant relationship. Similarly, Demirguç-Kunt and Detragiache [2000] find in a sample of 61 countries that over a period from 1980-97 deposit insurance significantly increased the probability of a banking crisis.

The impact of deposit insurance on risk taking interacts with at least three other important factors: banks' charter values, the effectiveness of market monitoring by debt-holders and "too-big-to-fail." The failure to accurately account for any one of these factors may account for the mixed findings of the empirical literature. If banks are able to earn rents, either through regulatory limits on competition (e.g. Keeley [1990]) or bank-specific factors such as valuable lending relations (Berger and Udell [1995]) or the acquisition of reputation (e.g. Boot and Greenbaum [1993]), the effects of deposit insurance on risk taking may be mitigated. Similarly, the degree of risk taking of banks may be influenced by the amount of uninsured (e.g. subordinated) debt banks carry on their balance sheets, fostering effective monitoring by debt-holders (Dewatripont and Tirole [1993a]) and Calomiris [1999]). And third, if banks are perceived as "too-big-to-fail," their risk taking might not be affected by the deposit insurance arrangement, as they enjoy a comprehensive safety net in any case.

This paper aims to extend the empirical literature in two main ways. First, the existing empirical evidence regarding banks' risk taking tends to use U.S. data or use rather heterogeneous samples containing developing and developed countries, whose banking systems may be at widely different stages of liberalisation and sophistication. There is limited evidence for developed countries, concerning the impact of deposit insurance arrangements on risk taking in an environment of competitive banking outside the US. This paper attempts to fill part of this void. Second, our data set allows us to test a rich set of hypotheses regarding the interaction between deposit insurance, charter values, monitoring, "too-big-to-fail" and moral hazard, closing some of the gap between the theoretical and empirical literatures.

Our main findings can be summarised as follows: (i) We find strong evidence that the introduction of explicit deposit insurance may have significantly reduced banks' risk taking. (ii) We confirm Keeley's [1990] finding for the US that the value of a bank charter and the bank's risk taking are significantly negatively related. We also find that the effect of a reduction in risk taking due to explicit deposit insurance is less prevalent for banks with high charter values, which suggests that those banks did not

<sup>1</sup> *The ample intervention by the government during the Swedish and Finnish banking crises in the early 1990, where explicit and limited deposit insurance systems were not in place beforehand, can be taken as supporting evidence in favour of this contention.*

suffer from moral hazard even before the institutional change. This corroborates the view that moral hazard is mostly relevant when bank performance is weak (gambling for resurrection). (iii) We find that banks with high shares of subordinated debt reduce their risk taking more in response to the restriction of the safety net. This supports the notion that as the safety net is limited to depositors, subordinated debt holders have incentives and are able to monitor the bank. (iv) We find evidence of the “too big to fail” phenomenon in our data and that explicit deposit insurance does not significantly mitigate the moral hazard associated with “too big to fail.”

The remainder of the paper is organised as follows. In Section II we motivate and present our empirical hypotheses and provide a brief summary of the main results in the theoretical literature. In Section III, we provide some institutional background of deposit insurance and deregulation in the EU. In Section IV we describe the data set we employ, along with some summary statistics. Variable definitions, the empirical specification, and results are reported in Sections V, VI and VII, respectively. Section VIII presents some refinements of our empirical specification and Section IX discusses the robustness of our results. Section X concludes the paper.

## II Theoretical background

The theoretical literature (e.g. Freixas and Rochet [1997], Boot and Greenbaum [1993], Dewatripont and Tirole [1993a, 1993b] and Matutes and Vives [1995]) is unambiguous in that the public safety net, providing assistance to banks in distress and protecting banks’ claim-holders from losses, increases the propensity by bank managers to take on excessive risk (moral hazard).<sup>2</sup> This is since banks’ claim-holders do not have appropriate incentives to monitor the actions by the bank management. In what follows, we attempt to summarise the main results of these models insofar as they directly relate to the questions studied in this paper and propose one modification, which may significantly affect their empirical predictions.

In the following, rather than present a formal model we chose to graphically illustrate our arguments with simple, highly stylised bank balance sheets presented in Chart 1. The Chart illustrates the incentives to monitor of creditors under different safety net arrangements and considers the role of non-deposit creditors and charter values. Following Matutes and Vives [1995] we distinguish between three types of risk. Asset risk refers to risk taken on the asset side of the balance sheet, i.e. the riskiness of the bank’s loan portfolio. Leverage risk refers to the willingness and ability of the bank to compete for depositors and other creditors without incurring additional costs due to higher leverage. Overall risk is a combination of both asset and leverage risk. We use an ordinal scale of risk measurement, in which we distinguish between four levels of risk taking: low, medium, high and maximum.

Matutes and Vives [1995] and Dewatripont and Tirole [1993a] show that the degree of moral hazard depends on whether the performance of the bank is observable. In the case in which bank performance and asset risk are unobservable, asset risk is maximised even without deposit insurance.<sup>3</sup> In the following we will assume that asset risk, leverage risk and bank performance are observable. If this is the case, without deposit insurance, moral hazard will be limited to the standard corporate finance/limited liability case (Section IA of Chart 1). Depositors will adjust

2 *The safety net, defined as the protection of banks’ creditors against losses resulting from bank failures, is motivated in the first place by the short maturity structure of bank liabilities and the private information characteristic of their longer-maturity assets, reflecting banks’ unique liquidity creation and intermediation functions (Diamond and Dybvig [1983], Gorton and Pennacchi [1990] and Calomiris and Kahn [1991])*

3 *If the performance of the banks is not observable, Matutes and Vives [1995] argue that since depositors cannot differentiate between banks, they will charge interest rates which compensates for maximum risk. The bank, in turn, will have no incentive but to fulfil depositor’s expectations and assume that maximum risk.*

their compensation in line with the observable additional risk of the bank (Matutes and Vives [1995]) or will take control of the bank and act in a strongly interventionist manner (Dewatripont and Tirole [1993a]). Hence, asset, leverage and overall risk will be limited, at least as long as banks have positive net-worth.

Non-deposit (subordinated) creditors of the bank play a central role in the analysis of excessive risk taking by banks and the safety net. Dewatripont and Tirole [1993a, 1993b] point out that the structure of debt can be central for the effectiveness of the control of bank managers. They argue that personal depositors are not likely to exert much influence on banks even in the absence of deposit insurance, since they do not have the incentives (because they are too fragmented and tend to free-ride), nor the information or competence to monitor banks. Hence, the control exercised by these depositors would not be much affected by the safety net arrangements. In contrast, large depositors or subordinated debt-holders might include large financial and non-financial firms and institutional investors, who can be expected to have monitoring capability and to represent a significant threat of exercising the residual rights of control. A credible threat of loss for the holders of subordinated bonds is often emphasised as a key to effective market discipline (Calomiris [1999]). Based on these arguments, the riskiness of the bank is reduced in the presence of other creditors (Section 1B).

Next consider the role of charter values. Charter values may reflect a verifiable signal of good performance, as in Dewatripont and Tirole [1993a], or market power as in Keeley [1990], or the reputation of a bank as in Boot and Greenbaum [1993]. The effect of charter values on the degree of moral hazard and risk taking is shown in Section 1C. In the presence of charter values moral hazard is also limited as a high charter value acts to limit the conflict of interest between equity-holders and debt-holders.<sup>4</sup>

What happens if we introduce flat-premium deposit insurance into this scenario? To see this, consider Chart 1, Section 2A.<sup>5</sup> Without deposit insurance moral hazard is limited due to the role of depositors who offset higher risk taking by demanding higher interest rates. With the introduction of deposit insurance depositors have no longer the incentive to ask for compensation for risk taking. The bank, without facing any additional cost will maximise the risk of its loan portfolio and excessively compete for depositors, assuming high leverage risk. This is the standard result in the literature: Deposit insurance has increased moral hazard and risk taking of banks.<sup>6</sup> We can formulate the following general proposition:

**Proposition 1:** *The introduction of (flat-premium) deposit insurance increases leverage, asset and overall risk taking of banks.*

This result can be refined by the introduction of uninsured debt-holders or charter values into the balance sheet of the bank (Section 2B and 2C). The introduction of other, uninsured debt-holders has the effect that now, even in the presence of deposit insurance, there is one group of creditors of the bank that continues to have incentives to monitor bank risk and can adjust their behaviour accordingly. Hence the increase in moral hazard due to deposit insurance is less pronounced as for a banks without such creditors. The presence of a charter value will mitigate moral hazard by

<sup>4</sup> In Section 1C the bank's balance sheet also contains other debt, which will be useful in the subsequent analysis, but the argument here of course also goes through for a bank that has no other debt besides deposits.

<sup>5</sup> Without loss of generality we assume that the insurance premium is zero. We do not consider risk-based deposit insurance premia here, as none of the countries in the sample had such a system. Risk-based pricing of deposit insurance may at least in part resolve the moral hazard problems (e.g. Freixas and Rochet [1997], Matutes and Vives [1995]). Dewatripont and Tirole [1993b] argue, however, that it might generate perverse effects on banks' risk taking, if the higher cost of deposit insurance further reduces their solvency.

<sup>6</sup> We focus on the moral hazard issue leaving out the possible adverse selection that more risk-prone banks seek to be members of deposit insurance schemes, since in the more recent past deposit insurance schemes have been or have become compulsory (see discussion on the EU schemes in Section III). We also abstract from any agency problems, which might result from delegating the monitoring of banks' risks to a banking supervisory authority by the deposit insurance agency (e.g. Cordella and Yeyati [1998]).

aligning the incentives of equity holders and depositors (Dewatripont and Tirole [1993a]).<sup>7</sup> While the presence of other creditors and charter values mitigates the increase in risk taking, the overall effect of the introduction of deposit insurance is still higher risk. This can be seen in Chart 1 by moving from Panel 1 to Panel 2. We formulate two Corollaries to summarise these ideas and which serve to refine Proposition 1:

**Corollary 1:** *The introduction of deposit insurance increases the asset, leverage and overall risk of banks with low uninsured (subordinated) debt shares more than the risk of banks with high uninsured (subordinated) debt shares. (Panels 1A to 2A relative to panels 1B to 2B).*

**Corollary 2:** *The introduction of deposit insurance increases the asset, leverage and overall risk of banks with low charter values more than the risk of banks with high charter value. (Panels 1A to 2A relative to panels 1C to 2C).*

Next, again consider the case without deposit insurance. However, instead of assuming the complete absence of any safety net, suppose there exists some positive probability  $p$  that all creditors (and shareholders, although this is not necessary for the following to hold) are compensated if the bank fails (Chart 1, Section 3). This guarantee may take the form of a public announcement to that effect (essentially becoming an *explicit* guarantee, e.g. in Finland) or simply through the prevalent public perception that creditors of banks would be bailed out if things turned out badly. If deposit insurance were introduced in such a world and the restriction to only compensate depositors and only up to a pre-specified amount were credible, moral hazard would be reduced (Chart 1, Sections 2 and 3). That is, because in the case of an implicitly unlimited safety net, none of the creditors had any incentive to monitor. With deposit insurance, depositors with deposits above the pre-specified amount, uninsured depositors (e.g. interbank deposits) and other (subordinated) debt-holders would require compensation for additional risk taken on by the bank. Note the central role of non-insured debt holders in the reduction of moral hazard. Based on this, we obtain the converse to Proposition 1 above, namely

**Proposition 1a:** *The introduction of deposit insurance will reduce leverage, asset and overall risk taking of banks, if the limitation of the safety net is credible and the banks have at least some non-insured creditors who are able to monitor the bank.*

As is evident from Chart 1, Panels 3A and 2A, it is clear that non-insured creditors play a central role for the moral hazard reducing effect of deposit insurance and Corollary 1a follows immediately:

**Corollary 1a:** *The introduction of deposit insurance will reduce the leverage, asset and overall risk of banks with high uninsured (subordinated) debt shares more than that of banks with low uninsured (subordinated) debt shares. (Panels 3B to 2B relative to 3A to 2A).*

Banks with high shares of uninsured debt (Panel B), while not exposed to market discipline before introduction, are exposed to market discipline through these other uninsured claim holders after the introduction of explicit deposit insurance. As Calomiris [1999] argues, subordinated debt holders, as they tend to be large and co-ordinated, can perform this monitoring especially well. Hence, banks with high subordinated debt shares would reduce their risk taking more than other banks. In the limit, banks without other (subordinated) debt holders will not adjust their risk taking at all.

Given some level of uninsured debt, banks with high charter values can also be expected to behave differently in response to the introduction of deposit insurance compared to firms with low charter values. Moving from the broad implicit safety net to explicit deposit insurance should affect the risk

<sup>7</sup> Also many other authors reach this conclusion of more substantial incentives to gamble for resurrection when the level of bank capitalisation is low: e.g. Merton [1977], Kane [1989] and Keeley [1990].

taking of banks with low charter values more than banks with high charter values. Based on Keeley [1990] and others, in a world with a broad implicit safety net, charter values would mitigate the overall risk taking of banks: These banks would reduce their risk taking less in response to the introduction of explicit deposit insurance (Panel C). It is important to stress that this true only if one assumes that both banks are financed at least in part with some other, uninsured debt.<sup>8</sup>

**Corollary 2a:** *Under the assumption that both banks have some other, uninsured creditors, the introduction of deposit insurance will reduce the leverage, asset and overall risk of a bank with a low charter value more than that of a bank with a high charter value. (Panels 3C to 2C relative to 3B to 2B).*

Finally, the theoretical literature (e.g. Dewatripont and Tirole [1993b]) examines a potential problem related to the credibility of the restricted safety net and control exercised by large uninsured debt-holders in the context of very large banks. Losses from the failure of such a large bank might affect the banking system as a whole and, hence, imply systemic risk. In this case it might be expected that these “systemic” banks would never be liquidated or that the exposures of the systemically relevant debt-holders would always be covered, regardless of the features of the safety net arrangement (“too big to fail”). Hence, we have the following second proposition:

**Proposition 2:** *If the “too-big-to-fail” phenomenon is relevant, the establishment of the explicit deposit insurance system would have a smaller impact on large than small banks’ risk taking.*

In summary, in this Section we have attempted to show that changing the assumptions about the counterfactual to deposit insurance (no safety net vs. an implicit safety net) will have a strong impact on the predictions of existing models on moral hazard and risk taking of banks. In Sections VII and VIII, we will use a data set of European banks to test Proposition 1 against Proposition 1a, as well as Corollaries 1 and 2 against 1a and 2a, and also provide some evidence concerning Proposition 2.

### III Institutional background

Banking deregulation in Europe began in the late 1970s and continued through the early 1990s, although there were differences in the timing and speed of the process across countries (Canals [1993]). With few exceptions, regulations on banks’ competitive conduct have now largely been eliminated. These regulations included controls on banks’ deposit and lending rates, fees and commissions, as well as direct credit quotas and branching limitations. Functional separation of financial institutions, if it existed, has generally ceased. There was a shift in regulatory thinking from conduct regulations towards the use of prudential regulations (capital adequacy, exposure concentration limitations), freeing competition and abolishing regulatory protection of national markets. However, some country specific distortions remain, mainly related to taxation and subsidies, but they distort banking markets to a much more limited extent than in the past. While conclusive empirical evidence is still outstanding, the result of deregulation is generally believed to be a sharp increase in banking competition.

European Community legislation, primarily since the White Paper of 1985 “Completing the Internal Market”, has significantly contributed to this process and has provided incentives for national legislators to deregulate and streamline banking legislation. The most important piece of Community legislation was the 2<sup>nd</sup> Banking Co-ordination Directive (89/646/EEC) leading to unification of the regulatory framework for “entry control” and cancelling the major elements of

<sup>8</sup> Another channel through which explicit deposit insurance could reduce the risk appetite of bank managers could be the monitoring among banks themselves in a system where banks have to cover the costs of deposit insurance.

national separation of markets in legal/regulatory terms. The Directives on banks' own funds (89/299/EEC) and required solvency ratio (89/647/EEC) were adopted within the same time frame. However, these regulations in effect extended the scope of the 1988 Capital Accord of the Basel Committee on Banking Supervision issued for internationally active banks to all banks in the EU. The Basel Accord meant on one hand an important change in banking regulation away from intrusive conduct regulations towards greater reliance on prudential standards. On the other hand, it introduced more stringent capital requirements, which may have influenced banks' risk taking. We will use in the empirical analysis the implementation of the 2<sup>nd</sup> Banking Directive as a summary proxy for the "ultimate" deregulation process, while recognising that significant aspects of deregulation affecting banking competition and banks' risk taking incentives took place also before the implementation of this Directive.<sup>9</sup>

In order to support the orderly functioning of banking markets under the liberalised environment, a Directive on Deposit Guarantee Schemes (94/19/EC) was issued. It set the minimum formal deposit guarantee at 20 000 ecu.<sup>10</sup> In response to the Directive, three countries (Greece, Portugal and Sweden), which did not have any system before, introduced deposit insurance. Finland continued to be characterised by an implicit scheme until 1999.<sup>11</sup> None of the EU schemes guarantees interbank deposits and, effectively corporate deposits, as there is a limit to the coverage per depositor (Appendix I). Other debt instruments are all outside the scope of the coverage.

#### IV Data sources and description

The data used in this study were obtained from a number of different sources. The balance sheets and the income statements of EU banks are from the Fitch-IBCA Bankscope data set, which contains balance sheet data for a wide variety of European banks. We used consolidated balance sheets, supplemented by unconsolidated balance sheets for banks, which did not have consolidated data in Bankscope and did not have significant subsidiaries. We retained the banks for which we could ascertain a market value using Datastream, as market values are necessary to calculate our measure of charter value,  $q$ . This process yields a sample of 128 banks for 1991-1998. A few of the banks recorded by IBCA only report partial information on important data items. We used lagged variable regression or bank-specific means to impute these missing values. We also excluded 1991, as in Bankscope no information was available for all French banks and a large number of Italian banks, and we wanted to keep these important banking markets in the sample. The end result is a balanced panel containing 128 banks with data from 1992 to 1998 and a sample size of 896 observations. We supplemented this bank specific information with the stock market index for the country of origin of the bank, which we also obtained from Datastream. Datastream further provided us with the inter-day volatility of share prices, which we use in the risk equations. Other financial variables collected are the 10-year Government bond yields as a measure of the long-term nominal interest rate and the money market rate as a nominal short-term interest rate. The rates were obtained from the IMF's International Financial Statistics.

The resulting sample contains data for banks in all 15 EU countries (Table 1). The composition by country broadly corresponds to market size with the exception of the UK and Sweden, for which market values for banks were difficult to obtain in Datastream. Table 2 gives some descriptive summary statistics for the banks in the sample. The banks are relatively large, the average total assets is \$47 billion. The banks, hence, are approximately seven times the average size of all EU

9 The 2<sup>nd</sup> Banking Co-ordination Directive was originally envisaged to be implemented by 1 January 1993 (EU countries) and 1 January 1994 (EFTA countries Austria, Finland and Sweden according to the EEEA agreement). The actual implementation date of the directive varied from 1992 to 1995 in the individual countries.

10 This was required to exist in all EU Member Countries by 1 July 1995. A limitation to 15 000 ecu was possible until 31 December 1999.

11 Belgium, Ireland, Luxembourg and the Netherlands had a coverage lower than 20 0000 ecu before the Directive.

banks in the Bankscope, which we find unsurprising, because of our requirement that the banks be traded at a stock exchange. The sample banks represent approximately one sixth of the total assets of the EU banking sector. We note that the market appears to be broadly in equilibrium, as the sample mean of Tobin's  $q$  ratio (used as a measure of charter value) is almost exactly one, with a range from 0.86 to 1.10. Looking at country specific means, we find that the countries we would expect *prima facie* to still be most regulated or to have the most uncompetitive banking sectors, to have the highest  $q$  values. Indeed, Greece, Portugal and Spain all have  $q$ 's above 1.

The banks in our sample quite accurately reflect some of the stylised facts in European banking. For example, while the overall mean of the share of non-interest earnings in total earnings is 32.5 percent, this share has continuously increased from 27 percent in 1992 to 38 percent in 1998. Interestingly this is not reflected in the share of loans in total assets, which has remained approximately constant around the overall sample mean of 55 percent.

## V Definitions of dependent and independent variables

We are particularly interested in the effect of deposit insurance on bank behaviour. Given the cross-sectional and time series variation in deposit insurance in EU countries we are able to explicitly control for the effect of the existence of deposit insurance in the model. We create an indicator variable, which is equal to one when no system is in place, which was the case in Greece, Portugal and Sweden until 1995 and for Finland for the entire sample period. We also created an indicator capturing differences in deposit insurance coverage. The indicator equals one when coverage is extraordinarily high (Italy and France, which had coverage levels of 6 to 12 times the sample average, respectively and Germany, where the coverage is limited only by the book value of capital of the bank). Finally, in order to measure the impact of deregulation, we created an indicator, which reflects the implementation date of the Community legislation through the 2<sup>nd</sup> Banking Co-ordination Directive. The indicator equals one after the actual implementation date and implies that we model the liberalisation based on the Directive as a structural shift.

A bank's charter value can be defined as the present value of the stream of profits that it expects to earn when staying in business. Hence, the charter value would equal to the market value (present value of the future expected earnings/dividend) of its assets minus the replacement cost of the bank, i.e. the expense of rebuilding the existing bank from scratch (Demsetz et. al. [1996]). The market value is set to equal the market value of equity ( $E$ ) (stock price times the amount of equities outstanding) plus the book value of banks' liabilities ( $L$ ). This is reasonable, since the value of going concern would be reflected in the market value of the equity, as the equity holders would be the beneficiaries, not the debt holders. The replacement cost of a bank is simply the book value of its assets ( $A$ ). Hence, the charter value ( $CV$ ), which is divided by the book value of assets in order to obtain a scale-free measure, can be expressed as:

$$\frac{CV}{A} = \frac{E + L - A}{A}.$$

Adding 1 and simplifying gives Tobin's  $q$ , which in the following will be used as a proxy for a bank's charter value:

$$q = \frac{E + L}{A}.$$

This measure is also used by Keeley [1990] and Demsetz et. al. [1996]. For a bank with pricing power in either loan, deposit or other markets, the market value of assets ( $E+L$ ) would exceed their book value ( $A$ ), and  $q$  would exceed one. In equilibrium  $q$  would exactly equal one for an uninsured bank with no pricing power.

The measure  $q$  as a proxy for charter value has the advantage of permitting comparability across different bank sizes. Furthermore, it directly reflects the extent of monopoly rents earned by banks due to pricing power. Smirlock [1984] argues that because  $q$  relates the market value of banks' assets to their current cost, it is an ideal "all-in" measure of the rents. Any pricing power, irrespective of its source, would be reflected in the market value of banks' equity, and thus assets, but not in the cost of acquired assets. This circumvents also the significant measurement problems in trying to proxy the extent of pricing power through interest rates charged by banks for loans and deposits, and even more so through accounting-based measures of margins which can be driven by many auxiliary factors and accounting peculiarities.<sup>12</sup>

Two major difficulties arise in using  $q$  as a measure of banks' rents (or charter value). First, the book value of assets reflects historical costs, rather than current costs of the assets. Therefore, *ex post*  $q$  may diverge from  $l$  simply because asset return realisations may have been different from expectations, rather than as a reflection of market power. Hence, the theoretically correct *ex ante*  $q$  is measured with error when using the *ex post*  $q$ . Second,  $q$  and risk taking are likely to be simultaneously determined. Both of these reasons call for the use of instrumental variable methods in the empirical work. Hence, in the first stage, we estimate the charter value as a function of deregulation and bank specific balance sheet variables. The second stage of the model uses the predicted value from stage one as an explanatory variable in the regressions on bank risk taking.

In the regression analysis we also utilise balance sheet ratios to control for bank specific differences, including the share of deposits in total liabilities, the share of non-interest earnings in total earnings, and the share of loans in total assets. To control for different asset histories we include the growth rate of total assets since 1991. The share of non-interest income in total income was included to measure the bank's willingness and ability to diversify into non-lending, non-traditional activities, such as underwriting and to some extent will also proxy for the bank's "innovation ability." In the relationship between moral hazard and deposit insurance the monitoring of uninsured debt-holders may be quite important, as discussed in Section II. Therefore, we included the share of subordinated debt in total liabilities as an independent variable. In the European context, with significant differences in the size of countries' economies, we use the share of the bank's total assets in the total assets of the country's banking system to control for the "too-big-to-fail" effects on charter value and risk taking.

Further, we include a normalised country specific stock market index<sup>13</sup>, money market rates and a measure of the steepness of the yield curve, which we defined as the difference between money market rates and 10 year government bond yields. Finally, not all banks in the sample were commercial banks. We also had a limited number of co-operative banks and mortgage banks, which might experience valuations that are quite different from those of commercial banks. Specialised banks or banks with a somewhat different organisational form might face different constraints, as well as pursue different objectives relative to commercial banks.<sup>14</sup>

<sup>12</sup> These problems are evident, for example, in the empirical literature trying to establish the structure conduct-performance (SCP) paradigm for banking (as reviewed in Vesala [1996]).

<sup>13</sup> The respective stock market indices were normalised, such that for all countries 1991=100. This will ensure comparability across countries.

<sup>14</sup> With few exceptions, our choice of control variables corresponds closely to those of Keeley [1990]. For definitions of all variables see Appendix II.



## VI Econometric model

We estimate the following two-stage model:

$$(1) \quad q_{jt} = \alpha_0 + \alpha_1 D_{it} + B_1 X_{1jt} + B_2 C_{1it} + u_{1i} + \varepsilon_q$$

and

$$(2) \quad risk_{jt} = \delta_0 + \delta_1 D_{it} + \Pi_1 X_{2jt} + \Pi_2 C_{2it} + \delta_3 \hat{q}_{jt} + u_{2t} + \varepsilon_{risk}$$

where  $q_{jt}$  represents the market to book value of asset ratio for bank  $j$  at time  $t$ ,  $D_{it}$  represents a set of indicator variables describing the deposit insurance system and the degree of deregulation in country  $i$  at time  $t$ ,  $X_{1jt}$  and  $X_{2jt}$  represent a set of control variables unique to bank  $j$  at time  $t$ , and  $C_{1it}$  and  $C_{2it}$  are country specific control variables.  $\hat{q}_{jt}$  represents the predicted value from (1).

Equations (1) and (2) were subjected to extensive specification testing. Equation (1) is estimated using country-specific random effects, as specifications with bank-specific or time-specific effects were rejected. The country specific effects also serve to identify the model, as they are expected to reflect country specific differences in regulation and competition, which are modelled to affect charter values but not risk.<sup>15</sup> The risk equations (equation (2)) were estimated using time-specific fixed effects; country and bank-specific effects were rejected. The different measures of bank risk are discussed below.

## VII Results

### Deregulation and charter values

Table 3 gives the results of estimating the first stage of our model, equation (1), which relates deregulation variables, variables describing deposit insurance, market indicators and balance sheet variables of banks to our proxy for charter values,  $q$ . While this estimation primarily serves to generate predicted values for  $q$  in order to mitigate the simultaneity problem between  $q$  and measures of risk, the results may be of independent interest.

Our first finding is somewhat disappointing: None of the de-regulation and deposit insurance variables are significant. We can draw a number of tentative conclusions from this result. One, our measure of Europe-wide de-regulation may be too crude to pick up its impact on charter values. Alternatively, the effects of the 2<sup>nd</sup> Banking Directive (and the other parallel regulatory changes) may only gradually be felt over time, as it primarily deals with cross-border de-regulation. This idea is supported by the fact that cross-border mergers have so far been rare. Second, the deposit insurance dummies may be insignificant, because deposit insurance has no effect on charter values. Or, instead, the insignificance is due to two offsetting effects. The increase in the charter value due to the subsidy to attracting deposits may be counteracted by the increase in risk taking associated with the higher level of insurance, which is taken into account by the market. Unfortunately, given data limitations, we cannot distinguish between the two effects.

The estimated coefficients of the balance sheet variables generally conform to our priors in sign and magnitude. Banks with lower loan shares have higher charter values, as do more rapidly growing banks, as well as banks with a higher share of non-interest earnings. This may reflect that the market values more highly diversified banks or more innovative banks at a premium.

<sup>15</sup> This identification strategy can of course be criticised on a number of grounds. Alternatives are discussed in Section IX.

Finally, we find that market conditions and the specialisation of banks matter for charter values. Not surprisingly, when the stock market is performing well, market values tend to be higher relative to book values. The same is true for a steeper yield curve and the opposite for short-term interest rates. This is an expected result, since banks gain from lending long-term and borrowing short-term especially when the short-term rates are relatively low. We also find support for the notion that specialised banks are valued differently (generally less favourably) from commercial banks. The constant is estimated to be very close to one, as the dependent variable fluctuates around its equilibrium value. The country specific effects are significant for most countries and are reported in Appendix III. We interpret this finding, and also the finding that other specifications were strongly rejected in the specification tests, as evidence that differences in the national regulatory environment matter. One can conclude that European banking markets still need to be viewed as separate markets. This line of argument is corroborated by the insignificance of the Europe-wide deregulation variable.

### Deposit insurance and risk taking

The second stage estimates for the relationship between risk and deposit insurance, (equation (2)), are presented in Table 4. In the first instance, we test propositions 1 against 1a and later in the paper we will present refinements, which permit a test of the two corollaries and proposition 2. In line with the theoretical literature (e.g. Matutes and Vives [1995]) and the discussion in Section II, we distinguish between the three different types of risk: Leverage risk, asset risk and overall bank risk.

Leverage risk is defined as the book value of liabilities divided by the market value of assets (the market value of equity plus the book value of liabilities). It measures the degree of gearing of the bank; the more highly geared a bank is, the riskier it, as its cushion against an unexpected deterioration in the quality of its assets is smaller than in a less leveraged bank. Higher gearing may also reflect excessive competition for deposits as outlined in Section II. We proxy for asset risk by using the share of problem loans in total assets. We use the inter-day volatility of share prices as a measure of the overall risk of the bank. We defined the volatility as

$$Sd_j [\text{Ln} [p_d/p_{d-1}]]^* \sqrt{n}$$

for any year  $t$  and bank  $j$ , where  $p_d$  represents the stock price on day  $d$  and  $n$  represents the number of trading days and  $Sd$  is the standard deviation. As an alternative and robustness check, we also used a measure of overall risk, in which we extracted the non-diversifiable component. This was done, as we were concerned that our measure of overall risk may be driven by the volatility of the market portfolio rather than by non-diversified risk. To control for this, we estimated a standard market model and calculated the standard deviation of the residuals, which gives us a measure of idiosyncratic volatility. For the details of the calculation see Appendix IV.

All measures suffer from shortcomings. In particular, our measure of leverage would benefit from a market based measure of liabilities, which we did not have access to. The measure of asset risk is backward looking, as default or payment difficulties of the clients of a bank will only appear in our measure with a lag. For example, the bank may extend further loans, which enable its troubled customer to remain current on the initial credit. And third, differences in inter-day volatility may not only reflect the riskiness of a bank, but also the liquidity depth of the market for its shares. Despite our attempt at controlling for the liquidity of the market by scaling with the number of trading days per year, both of our stock market return based measures may suffer from this shortcoming. Nevertheless, as we would argue that these shortcomings are uncorrelated with each other, we would interpret consistent results across all three measures as quite strong evidence.

Table 4 shows that the coefficients are in fact strikingly consistent. Consider first the deposit insurance variables. While a high level of deposit insurance coverage does not appear to significantly affect risk taking, the absence of explicit deposit insurance is associated with significantly higher risk taking for all four measures of risk. Hence, we strongly reject proposition I in favour of proposition Ia. The finding deserves some further discussion. It is only plausible, when the regime prior to the introduction of deposit insurance was not characterised by the absence of any safety net, but the presence of a broad and implicit one. In this case, the establishment of *explicit* deposit insurance would limit the scope of the safety net and reduce moral hazard, since, first, explicit deposit insurance typically leaves out large depositors, as the coverage per depositor is limited. Second, the coverage is limited to depositors only, leaving out other debtors altogether. Finally, in the connection with the establishment of an explicit deposit insurance scheme, measures are usually taken to assure that the shareholders of the bank would lose their investment to an appropriate extent, regardless of the bank size, in case of insolvency and intervention by the government. All these aspects generally hold for the deposit insurance systems in the EU (see Appendix I). The extent of the implicit guarantees before an explicit deposit insurance system was in place is demonstrated by the Finnish and Swedish banking crises in the early 1990, where, for example, all creditors, not just depositors in the end were protected through a parliamentary resolution. Hence, our results would suggest that the counterfactual that has been assumed in the empirical literature, namely that, in the absence of explicit deposit insurance, banks operate in a completely uninsured environment, may be seriously flawed, at least in the context of developed economies.<sup>16</sup>

In contrast to our finding above that the 2<sup>nd</sup> Banking Directive did not affect charter values, it appears that it has significantly increased risk taking in terms of leverage and asset risk. However, the volatility of bank stock prices is lower after the implementation of the directive. We suspected that this may in part be due to overall market volatility during the different periods. However, the results remained unchanged when we controlled for market volatility in our idiosyncratic risk measure.

Now turn to the effect of changes in the charter value (predicted values of  $q$ ) on risk taking. As argued in the literature, banks with lower charter values exhibit significantly higher levels of risk. The coefficient on the proxy for charter value is negative in all four and highly significant in three out of the four specifications.<sup>17</sup>

The estimates for the control variables are also quite interesting. Consider the effect of the share of non-interest earnings first. While we found in the previous section that the market viewed diversification and innovation of banks positively, the trend away from the “standard” bank business of extending loans may also be associated with more risk taking. This trend is also visible when considering the effect of the share of loans in banks’ balance sheets. Banks with a higher proportion of loans in their portfolios have also a higher proportion of problem loans and, hence, more asset risk, but exhibit less risk based on the other three measures. Taken together, it appears there are two types of banks with two different strategies in the sample. One group of banks retains their focus on traditional loans, but expand their lending aggressively to maintain market

16 If a reform establishing an explicit deposit insurance scheme coincides with improvements in supervision or more stringent disclosure requirements (heightened market discipline), the reduction in risk taking could be attributed to these factors rather than the limitation of the safety net. However, developments in supervision and market disclosure have not been in Europe directly related to the changes in the deposit insurance arrangements.

17 Empirical studies for the US banking industry also support the existence of an inverse relationship between charter value and risk taking. Keeley [1990] and Demsetz et.al. [1996] present evidence for a sample of large US bank holding companies. Grossman [1992] finds that, in the 1930s, US thrifts operating in more competitive regulatory regimes (with lower charter values) were more prone to undertake risky lending activities than those operating in more restrictive regimes. More indirectly, empirical research has shown that moral hazard became more severe in US thrift institutions during the 1980s as the capital that was at stake diminished (e.g. McKenzie et. al. [1992] and Brewer and Mondschean [1994]). High level of capital has also been shown to provide incentives for prudent banking (Furlong and Keeley [1989]), irrespective of the charter value considerations.

share, with consequences for the quality of the portfolio. The second group is moving away from lending and into non-traditional activities, such as underwriting. The quality of the loan portfolio of these banks is not deteriorating, but they are exposed to more risk through venturing into new areas. Both types of banks, although they may be pursuing completely different strategies, have become exposed to more risk. Interestingly, banks with a higher share in the total assets of the banking system in their country do not exhibit more risk in either leverage or assets than other banks. We may be observing the net-effect of two offsetting effects here: Increases in risk due to moral hazard and reductions in risk due to better diversification. We find inconclusive evidence regarding the idea that subordinated debt holders are able to exert a strong influence on the risk taking of banks (Corollary 1). The coefficient has the expected significantly negative sign only for idiosyncratic risk. We suspect that the power of the test proposed here may not be very high and provide further evidence on this point and on “too big to fail” issue in the following section.

Some of the control variables for market conditions have a somewhat surprising effect on risk taking. For example, a higher stock market is associated with higher risk taking. A possible interpretation of this finding may be that the coefficient is picking up the increase in risk associated with a rapid economic expansion, in which banks tend to herd towards sectors, which are already suffering from over-investment and may gear up to expand into these areas particularly aggressively. Higher short-term interest rates are associated with less risk taking and a steeper yield curve tends to be positively correlated with higher leverage, asset, overall and idiosyncratic risk of banks.

At this point a number of caveats may be in order. The sample sizes for our measure of asset risk, overall and idiosyncratic risk are reduced, from 896 to 343 and 672, respectively, due to data availability. In the case of the asset risk equation, the Hausman specification test rejected the model with the stock market index. We speculate that this is due to the fact that the dependent variable is a balance sheet measure of risk, in contrast to the other three, which are based on market valuations. We also find that with regard to overall risk, our independent variables are only able to explain very little of the total variation in the dependent variable. In part, this is why we also report the results for idiosyncratic risk and, in fact, the results improve considerably.

## VIII Refinements

While we have taken care to use a number of different measures of bank risk and found largely consistent results across all measures, we were concerned that the results may tell us little about the effect of deposit insurance, but rather highlight differences in countries unrelated to deposit insurance. Recall that the group of countries without deposit insurance includes Finland (throughout the sample period), Greece, Portugal and Sweden (all until 1995). We considered the possibility that coefficient on the dummy on the absence of explicit deposit insurance simply measures that these countries are different from the remainder of the sample for reasons completely unrelated to deposit insurance. For example, both Finland and Sweden experienced banking crises at the beginning of our sample period; it is possible that this may be driving our results and simply reflect that banks are “riskier” at the time of a banking crisis.<sup>18</sup> Regarding Greece and Portugal, we were concerned that our results could reflect the fact that the banking sector in these countries may have simply been less developed or otherwise dissimilar from the “core” EU countries.

In order to address these concerns, we propose a number of refinements to our specifications, which not only represent a stronger test of our hypotheses regarding deposit insurance and moral hazard, but also allow us to test Corollaries 1 and 2, as well as Proposition 2 (see Section II). To this effect, we created the following sets of indicator variables and interacted them with the “no deposit insurance” indicator:

<sup>18</sup> Note, however, that we could argue that it may not be a coincidence that banking crises occurred in two countries without deposit insurance. This is the opposite point of the one in Demirgüç-Kunt and Detragiache [2000].

- A set of indicators, which distinguish between banks with subordinated debt shares above and below the median of the distribution, which permits us to test Corollary 1 against 1a. The share of subordinated debt is used as a proxy for uninsured debt more generally, as we were able to measure it more accurately than the other debt categories.
- A set indicators, which distinguish between banks with high charter values (charter values greater than 1) and other banks. This would allow a test of Corollary 2 against 2a.
- A set of indicators, which distinguish banks, based on their relative size in the banking system. We set the cut-off point at banks with more than 12 percent of the total assets of a banking system in their country of incorporation, which represents the 90<sup>th</sup> percentile of the distribution. The failure of banks with such a high share in the total assets of the banking system would clearly represent a systemic risk to the banking system as a whole. Hence, this distinction allows us to test the validity of Proposition 2.

Table 5 displays the results for the three hypotheses. We have limited the table to the interaction terms, as they are of particular interest.<sup>19</sup> Consider first the interaction terms with subordinated debt. We find evidence in favour of the notion that subordinated debt may act as market based limit to moral hazard and excessive risk taking of banks (Corollary 1a.). For all four measures of risk, banks with higher subordinated debt shares reduce their risk taking more than those with lower subordinated debt shares and the difference is significant at the 5 percent level for two out of the four measures. This finding further corroborates the notion that explicit deposit insurance was credible at limiting insurance to depositors. Second, for the charter value/no deposit insurance interaction terms, we find strong support for Corollary 2a. Banks with high charter values do not adjust their risk taking downwards in response to the introduction of deposit insurance and banks with low charter values do. For leverage and idiosyncratic risk, we can reject that the two coefficients are equal at the 1 and 10 percent confidence levels, respectively. Higher charter values act as deterrence against additional risk taking, regardless of the safety net arrangements in place. Finally, we also find support for Proposition 2, namely, that banks, which constitute a particularly large share of the banking system in a given country, do not adjust their risk taking. The coefficients are statistically significantly different at least at the five- percent level for three or the four risk measures.<sup>20</sup> We interpret this finding as evidence that “too big to fail” has remained a relevant issue before and after the introduction of explicit deposit insurance and further that the limit of the safety net to depositors is only credible for smaller banks.

These results also enhance our confidence in the main argument of the paper, namely that deposit insurance may in fact reduce moral hazard. This is, because the evidence just presented is not only a function of country-specific variation, but reflects bank-specific variation. Hence, we would suggest that the introduction of deposit insurance in Europe has resulted in a reduction and limitation of the safety net, reducing moral hazard especially for smaller banks and banks with low charter values. We also conclude that subordinated debt holders may be playing an important monitoring role and may exert market discipline to reduce the risk taking of banks when they are outside the deposit insurance guarantee.

## IX Robustness

We performed a number of additional robustness checks. One, we experimented with different instruments for the charter value. In the primary specifications, the identification of the model is based on the country specific effects. We re-estimated the models with lagged  $q$  as an instrument

<sup>19</sup> The coefficients on all other variables are robust to the introduction of these interaction terms. The complete results are available from the authors upon request.

<sup>20</sup> The coefficients using overall risk are not statistically different.

for charter value. Alternatively, we used all balance sheet variables except the subordinated debt share as instruments, i.e. we assumed that risk taking was unrelated to the share of deposits and loans in the balance sheet. Our results were unaffected by both of these changes.

Second, while the explanatory power of the independent variables is quite high for leverage and asset risk ( $R^2$  of 0.25 and 0.24, respectively), the model for overall and idiosyncratic risk only explains a small fraction in the variation of the dependent variable ( $R^2$  of 0.08 and 0.11, respectively). While our specifications are not rejected based on the Hausman and Lagrange Multiplier test statistics, we considered the possibility that a more sophisticated error structure may be more appropriate, for example to allow for persistence in stock price volatilities. We experimented with an autocorrelated error structure of up to 6 lags and also estimated generalised linear models with stationary, unstructured and non-stationary correlation matrices. All specifications yielded quite consistent results and are available from the authors upon request.

Third, we report results from a “between estimator” and from a sample limited to those countries that did not have deposit insurance for at least part of the sample period (Finland, Greece, Portugal, and Sweden) in Table 6. A “between estimator” is an estimator that uses group averaged data, i.e. we calculated variable averages for each bank and fitted an OLS model to this data. The objective is to isolate the “cross-sectional” effects from the “time series” effects within the panel, as the approach minimises not the overall squared differences, but the cross-sectional squared differences. We find that the coefficients for the dummy on deposit insurance are primarily driven by cross-sectoral variation, as the coefficients for the “between estimator” are larger than those found in the earlier models in the previous section. This provides support for our suspicion expressed earlier that we are at least in part measuring the difference in risk taking between groups of countries, which may not necessarily relate to the introduction of explicit deposit insurance. Nevertheless, even using the sample limited to the countries that for at least part of the sample period did not have deposit insurance, we find that the no-deposit insurance dummy has a positive sign for all three measures of risk and is statistically significant for two out of the four risk measures.

## X Conclusion

This paper analysed the relationship between deposit insurance, bank charter values, debt-holder monitoring, and risk taking for European banks. Utilising cross-sectional and time series variation in the existence of deposit insurance schemes in the EU, we find that the establishment of explicit deposit insurance, significantly reduces the risk taking of banks. This finding stands in contrast to most of the previous empirical literature. It supports the hypothesis that in the absence of deposit insurance, European banking systems have been characterised by strong implicit insurance operating through the expectation of public intervention at times of distress. Hence the introduction of an *explicit* system may imply a *de facto* reduction in the scope of the safety net. This finding provides a new perspective on the effects of deposit insurance on risk taking. Unless the absence of any safety net is credible, the introduction of deposit insurance, restricted to depositors only, serves to explicitly limit the safety net and, hence, moral hazard. Our findings generally support the idea that explicit safety net arrangements are more “incentive-compatible” than the implicit ones, representing a vague but *ex ante* unlimited commitments by the government to intervene and protect banks’ claim-holders. The government may not be able to eliminate the safety net altogether and credibly commit not to intervene under times of distress.

We have stressed in our analysis that the limit to the safety net has to be credible for deposit insurance to have a “beneficial” effect. The credibility of the system may hold the key to reconciling the evidence presented in this paper with some of the evidence in the previous literature, which

tended to find that deposit insurance increases moral hazard. The previous literature largely used data from developing or emerging markets, e.g. Demirgüç-Kunt and Detragiache [2000], or historical data sets from the 1920s as in Grossman [1992] or Wheelock [1992]. It is plausible that weaker institutional structures, as for example in emerging markets, make a limitation to the safety net less credible.<sup>21</sup> Alternatively, in countries with underdeveloped subordinated debt markets, subordinated debt holders or other uninsured bank creditors may not be able to perform the monitoring role that would have the risk reducing effect on banks in the presence of deposit insurance. Clearly, in those countries deposit insurance may have quite different effects from those shown in this paper.

We also tested further hypotheses regarding the interaction between deposit insurance and monitoring, charter values and “too-big-to-fail”. We find that banks with lower charter values reduce risk taking more after the introduction of explicit deposit insurance, supporting greater moral hazard when banks perform weakly. We further find evidence that subordinated debt holders are able to effectively monitor banks. Hence, our findings would support subordinated debt as a market based device for disciplining bank management, as proposed for example by Calomiris [1999]. Finally, large systemically important banks do not change their risk taking in response to the introduction of deposit insurance, which suggests that the introduction of explicit deposit insurance does not mitigate “too-big-to-fail” problems.

<sup>21</sup> We would like to thank Patrick Honohan for pointing this out to us.

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**Table 1****Number of banks per country**

Austria	3	Italy	24
Belgium	1	Luxembourg	4
Denmark	10	Netherlands	3
Finland	2	Portugal	6
France	20	Spain	14
Germany	22	Sweden	2
Greece	7	United Kingdom	7
Ireland	3	<b>Total</b>	<b>128</b>

**Table 2****Descriptive statistics**

	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>Std. dev</b>
Total assets (\$ millions)	47148.9	261.7	704686.8	91281.4
Market-to-book asset ratio, $q$	0.99	0.86	1.10	0.04
Demand deposits/Total assets (%)	69.4	2.7	94.7	21.1
Loans/Total assets (%)	54.8	0.05	98.8	21.1
Non-interest earnings/Total earnings (%)	32.5	-7.6	87.8	16.6
Market value capital-to-asset ratio (%)	5.3	0.00	25.8	3.98

**Table 3****Deregulation and Charter Values**

Estimated using feasible GLS with random effects across countries. Standard errors in parenthesis. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5% and 1% levels, respectively. The dependent variable is the market value of assets divided by the book value of assets. For all variable definitions see Appendix II.

Liberalisation	EC Directive implemented	0.0022 (0.003)
Deposit insurance	Absence of explicit deposit insurance	0.001 (0.006)
	Deposit insurance coverage high	-0.005 (0.012)
Balance sheet	Demand deposit share	-0.0007 (0.007)
	Loan share	-0.022*** (0.008)
	Share of non-interest earnings	0.023*** (0.008)
	Growth rate of assets since 1991	0.006 (0.017)
Market indicators	Share of total assets of bank in banking system	-0.012 (0.015)
	Stock market index	0.010*** (0.002)
	Money market rate-government bond yield	0.003*** (0.001)
	Money market rate	-0.0014** (0.0007)
Bank specialisation (omitted category: commercial banks)	Co-operative banks	-0.019*** (0.003)
	Mortgage banks	0.005 (0.003)
Constant		0.997*** (0.013)
R <sup>2</sup>		0.22
Hausman test <sup>1)</sup>		7.20
Lagrange multiplier test <sup>2)</sup>		390.3***
N		896

1) Significance indicates a fixed effects model may be more appropriate.

2) Significance indicates a random effects model may be more appropriate.

**Table 4****Charter Values, Deposit Insurance and Risk**

All models were estimated using fixed effects across time periods. Standard errors in parenthesis. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5% and 1% levels, respectively. The dependent variables are the total liabilities divided by the market value of assets, the share of problem loans in total loans and the inter-day volatility, respectively.

Dependent variable		Leverage Risk	Asset Risk	Overall Risk	Idiosync. Risk
Deposit insurance	Absence of explicit deposit insurance	0.032*** (0.007)	0.022*** (0.006)	0.152*** (0.061)	0.124*** (0.036)
	Deposit insurance coverage high	-0.033** (0.017)	-0.0014 (0.007)	0.050 (0.043)	-0.029 (0.021)
Liberalisation	EC Directive implemented	0.020** (0.008)	0.015** (0.006)	-0.122*** (0.037)	-0.056*** (0.016)
Charter values	Predicted $q$ (charter value)	-1.25*** (0.323)	-1.92*** (0.369)	-0.719 (4.32)	-0.685*** (0.196)
Balance sheet	Demand deposit share	-0.007 (0.008)	0.016 (0.016)	-0.017 (0.081)	-0.146*** (0.038)
	Loan share	-0.280*** (0.007)	0.044*** (0.016)	-0.002 (0.100)	-0.237*** (0.046)
	Share of non-interest Earnings	0.262*** (0.076)	0.106*** (0.015)	0.117 (0.156)	0.243*** (0.074)
	Share of subordinated debt	0.621*** (0.111)	-0.131 (0.117)	0.448 (1.03)	-1.48** (0.619)
	Share of total assets of bank in banking system	-0.070 (0.044)	-0.054** (0.024)	-0.012 (0.181)	0.044 (0.078)
Market indicators	Stock market index	0.117*** (0.032)		0.088* (0.056)	0.175*** (0.025)
	Money market rate	-0.018*** (0.005)	-0.010*** (0.001)	-0.046** (0.018)	-0.038** (0.019)
	Money market rate -government bond yield	0.036*** (0.010)	0.012*** (0.002)	0.0203** (0.0105)	0.023*** (0.005)
Bank specialisation	Co-operative banks	-0.234*** (0.062)	-0.033*** (0.008)	0.0029 (0.095)	-0.119*** (0.043)
	Mortgage banks	0.055*** (0.016)	0.010** (0.005)	-0.003 (0.036)	0.034** (0.015)
Constant		1.24*** (0.322)	1.94*** (0.380)	0.937 (4.218)	0.703*** (0.191)
R <sup>2</sup>		0.25	0.24	0.08	0.11
Hausman test <sup>1)</sup>		2.77	27.20**	28.90**	130.4***
Lagrange multiplier test <sup>2)</sup>		1.27	0.14	2.33	6.58*
N		896	343	672	672

1) Significance indicates a fixed effects model may be more appropriate.

2) Significance indicates a random effects model may be more appropriate.

**Table 5****Refinements: Charter Values, “Too Big to Fail”, and Monitoring**

All models were estimated using fixed effects across time periods. Standard errors in parenthesis. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5% and 1% levels, respectively. The dependent variables are the total liabilities divided by the market value of assets, the share of problem loans in total loans and the inter-day volatility, respectively. All other control variables are as in Table 4.

	Monitoring by debt-holders				Charter values				“Too big to fail”			
	Leverage risk	Asset risk	Overall risk	Idiosync. risk	Leverage risk	Asset risk	Overall risk	Idiosync. risk	Leverage risk	Asset risk	Overall risk	Idiosync. risk
Interaction terms: Absence of explicit deposit insurance interacted with:												
Dummy=1 if subordinated debt share ≤ 0.013 (median)	0.143 (0.091)	0.023** (0.009)	0.009 (0.010)	0.116** (0.051)								
Dummy=1 if subordinated debt share > 0.013 (median)	0.145** (0.072)	0.037*** (0.007)	0.026*** (0.007)	0.130*** (0.044)								
Dummy=1 if q > 1					0.005 (0.008)	0.018** (0.008)	0.084 (0.095)	0.066 (0.056)				
Dummy=1 if q ≤ 1					0.052*** (0.007)	0.026*** (0.008)	0.188*** (0.072)	0.155*** (0.042)				
Dummy=1 if share in assets of banking system > 0.12 (95 <sup>th</sup> perc.)									0.014 (0.012)	0.011 (0.010)	0.242* (0.137)	-0.006 (0.140)
Dummy=1 if share in assets of banking system ≤ 0.12 (95 <sup>th</sup> perc.)									0.036*** (0.007)	0.029*** (0.007)	0.133** (0.066)	0.136*** (0.037)
Equality of coefficients <sup>1)</sup>		**	**		***			*	***	**		***

1) \*, \*\*, \*\*\* represents that equality of the two coefficients can be rejected at the 10%, 5% or 1% level, respectively.

**Table 6****Robustness: Cross-sectional versus time series effects**

	Between estimator				Sample limited to FI, GR, PT and SE			
	Leverage risk	Asset risk	Overall risk	Idiosync. risk	Leverage risk	Asset risk	Overall risk	Idiosyncratic risk
Absence of explicit deposit insurance	0.049** (0.022)	0.043* (0.022)	0.225** (0.105)	0.294*** (0.113)	0.004 (0.016)	0.009** (0.004)	0.015 (0.056)	0.161*** (0.056)
R <sup>2</sup>	0.27	0.47	0.24	0.15	0.37	0.41	0.24	0.12
N	128	58	96	96	119	62	98	98

## Chart I

### Stylised Bank Balance Sheets, Deposit Insurance and Moral Hazard

#### 1. No deposit insurance

A.

Assets	Liabilities
Loans	Deposits
	Equity

Asset risk:      Leverage risk:  
 Medium      Low  
 Overall risk:  
 Medium

B.

Assets	Liabilities
Loans	Deposits
	Other debt
	Equity

Asset risk:      Leverage risk:  
 Low      Low  
 Overall risk:  
 Low

C.

Assets	Liabilities
Loans	Deposits
	Other debt
Charter value	Equity

Asset risk:      Leverage risk:  
 Low      Low  
 Overall risk:  
 Low

#### 2. Deposit insurance

A.

Assets	Liabilities
Loans	Deposits Ins.
	Equity

Asset risk:      Leverage risk:  
 Maximum      Maximum  
 Overall risk:  
 Maximum

B.

Assets	Liabilities
Loans	Deposits Ins.
	Other debt Unins.
	Equity

Asset risk:      Leverage risk:  
 Medium      Medium  
 Overall risk:  
 Medium

C.

Assets	Liabilities
Loans	Deposits Ins.
	Other debt Unins.
Charter value	Equity

Asset risk:      Leverage risk:  
 Medium      Medium  
 Overall risk:  
 Medium

#### 3. No deposit insurance, but "implicit safety net"

A.

Assets	Liabilities
Loans	Deposits Ins. with p
	Equity Ins. with p

Asset risk:      Leverage risk:  
 Maximum      Maximum  
 Overall risk:  
 Maximum

B.

Assets	Liabilities
Loans	Deposits Ins. with p
	Other debt Ins. with p
	Equity Ins. with p

Asset risk:      Leverage risk:  
 Maximum      Maximum  
 Overall risk:  
 Maximum

C.

Assets	Liabilities
Loans	Deposits Ins. with p
	Other debt Ins. with p
Charter value	Equity Ins. with p

Asset risk:      Leverage risk:  
 Medium      High  
 Overall risk:  
 Medium

## Appendix I Deposit insurance system features in EU countries (end 1998)

Country	Date established	Coverage limit (per bank per depositor)	Foreign currency deposits covered	Interbank deposits covered	Administration <sup>1)</sup>	Funding
Austria	1979	20,000 euro	No	No	private	unfunded
Belgium	1974	15,000 euro (20,000 in 2000)	No	No	joint	funded
Denmark	1988	40,045 euro	Yes	No	joint	funded
Finland	1999	25,000 euro	Yes	No	private	funded
France	1980	60,000 euro	No	No	private	unfunded
Greece	1995	20,000 euro	No	No	joint	funded
Germany	1966	20,000 euro <sup>2)</sup>	Yes	No	private (private) joint (official)	funded
Ireland	1989	15,000 euro	No	No	government	funded
Italy	1987	103,291 euro	Yes	No	private (CB approves decisions)	unfunded
Luxembourg	1989	12,500 euro			private	
Netherlands	1979	20,000 euro	Yes	No	government	unfunded
Portugal	1995	25,000 euro	Yes	No	government	funded
Spain	1977	20,000 (from 1.1.2000)	Na	Na	joint	funded
Sweden	1996	29,000 euro	Yes	No	government	funded
United Kingdom	1982	22,200 euro	No	No	private	mixed <sup>3)</sup>

1) The government includes the central bank.

2) The public scheme provides a coverage up to 20,000 euro, but the private scheme provides a coverage up to 0.3% of the liable capital of the bank for each depositor.

3) There is an initial contribution and ex post funding when needed.

## Appendix II Definition of variables

Symbols:  $j$  = banks,  $t$  = periods,  $i$  = countries.

EC Directive Implemented

= 1 if  $i$  = DE, GR, FR, IE, IT, NL, PT, SE, UK and  $t \geq 1993$

$i$  = BE, LU, AT, FI and  $t \geq 1994$

$i$  = ES and  $t \geq 1995$

$i$  = DK and  $t \geq 1996$

= 0 otherwise.

Absence of explicit deposit insurance = 1 if  $i$  = GR, PT, SE and  $t \geq 1996$

$i$  = FI

= 0 otherwise.

Deposit insurance coverage high = 1 if  $i$  = DE, FR, IT

= 0 otherwise.

Demand deposit share = Demand deposits <sub>$jt$</sub>  / Total assets <sub>$jt$</sub> .

Loan share = Customer loans <sub>$jt$</sub>  / Total assets <sub>$jt$</sub> .

Share of non-interest earnings =  $1 - [\text{Interest earnings}_{jt} / \text{Total operational earnings}_{jt}]$

Growth rate of assets since 1991 =  $\{[\text{Assets}_{jt} - \text{assets}_{jt-1}] / \text{Assets}_{jt-1}\}$

Total assets of bank divided by total assets of banking system = Total assets <sub>$jt$</sub>  / Total assets of banking system <sub>$it$</sub>

Stock market index =  $[\text{Stock market index}_{jt} / \text{Stock market index}_{i1991}] * 100$

Money market rate-Government bond yield = Money market rate <sub>$it$</sub>  - Government bond yield <sub>$it$</sub>

Money market rate = Money market rate <sub>$it$</sub>



### Appendix III Country-specific effects for the stage I regressions

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#### Country<sup>1)</sup>

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Austria	-0.0004	
Belgium	0.0046	
Germany	0.0191	***
Denmark	-0.0132	***
Spain	0.0110	***
Finland	-0.0074	*
France	-0.0085	***
United Kingdom	0.0166	***
Greece	-0.0286	***
Ireland	0.0244	***
Italy	-0.0106	***
Luxembourg	-0.0162	***
Netherlands	0.0141	***
Portugal	0.0009	
Sweden	-0.0056	

---

1) \*, \*\*\* indicate statistical significance at 10% and 1% levels, respectively.

## Appendix IV Computation of idiosyncratic risk

We computed our measure of idiosyncratic risk by first estimating a standard market model of the form <sup>22</sup>

$$R_{jt} = \alpha_{jt} + \beta_{jt} R_{it} + \varepsilon_{jt} \quad (\text{A1})$$

where  $R_{jt}$  denotes the log daily stock return of bank  $j$  during year  $t$  and  $R_{it}$  represents the log daily return of the market portfolio in country  $i$  during year  $t$ . Hence, we estimate the model with about 250 daily observations for each bank in each year.<sup>23</sup> The residuals of this regression are commonly referred to as “abnormal” returns in the event study literature (e.g. MacKinlay [1997]) and would be represented by

$$\hat{\varepsilon}_{jt} \equiv AR_{jt} = R_{jt} - \hat{\alpha}_{jt} - \hat{\beta}_{jt} R_{it} \quad (\text{A2})$$

where  $\hat{\alpha}_{jt}$  and  $\hat{\beta}_{jt}$  are the estimated coefficients from equation (A1). If we take the standard deviation of both sides of (A2) we obtain

$$\sigma_{AR_{jt}} = \sqrt{\sigma_{R_{jt}}^2 - \hat{\beta}_{jt}^2 \sigma_{R_{it}}^2} \quad (\text{A3})$$

Equation (A3) can be interpreted as the idiosyncratic volatility of the stock price of bank  $j$  during period  $t$ .

22 See MacKinlay [1997] for further discussion on estimating such models, as well as their relative advantages and disadvantages relative to other methods.

23 As the model was estimated with daily data, it is likely that the normality assumption is violated at least in some cases and OLS estimation (which is what we use) may not be entirely appropriate. However, as Cable and Holland [2000] show, robust estimation will not necessarily solve the problem. At present, to our knowledge, there does not exist a solution to this issue.

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