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SURNAME	Suntheim
FIRST NAME	Felix
PhD Registration Number	1194570

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January 31, 2012

Felix Suntheim

Essays in Banking

Felix Suntheim
Universitá Commerciale Luigi Bocconi, Milan

Thesis Committee:
Andrea Sironi, Department of Finance, Bocconi University Milan
Francesco Corielli, Department of Finance, Bocconi University Milan
Fausto Panunzi, Department of Economics, Bocconi University Milan

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Contents

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Preface

This dissertation consists of three essays in the field of banking. The banking sector has received a considerable amount of attention, both by the general public and by academics, during the last few years. The financial crisis of 2007 and 2008 has shown how excessive risk-taking in the financial service industry can lead to the failure of individual financial institutions and ultimately trigger a severe global economic crisis. While the causes of such excessive and imprudent risk-taking are complex, misaligned incentives, governance mechanisms and regulation have been a contributory factor. This thesis addresses various issues in the broad field of corporate governance in banking to answer some pressing issues regarding the way governance influences the stability of the financial system. The first chapter deals empirically with CEO incentives and their impact on bank risk. The second chapter takes a more behavioral stance and relates CEO overconfidence to risk taking behavior in banking. In the third chapter the social connections of board members and their influence on the banking system are investigated.

The first chapter titled *Managerial Compensation in the Financial Service Industry* deals with the incentives inherent in the CEOs' compensation contract and how these incentive influence bank risks and bank policies. Moreover, by using an international dataset with detailed information on the equity based pay of CEOs of large financial institutions I can draw conclusions about the interaction of CEO incentives with corporate governance mechanisms and supervisory power.
The portfolio of a CEO consists typically of options, stocks and restricted stocks and I construct two measures to capture the incentives of the CEO. Delta is the sensitivity of the CEO's portfolio value to a 1% change in stock prices. It measures how well the incentives between the CEO and shareholders are aligned. Vega on the other hand is the sensitivity of the CEO portfolio value to a 1% change in equity volatility. It is a direct measure of the risk taking incentives of the CEO. These two measures are then related to proxies of bank risk and bank policies. Bank risk measures are: The standard deviation of equity returns, the idiosyncratic and the systematic part of risk, calculated by using an industry CAPM, and the distance-to-default. The first three measures are all market based while the distance-to-default also incorporates total asset risk. From

a bank policy perspective I look at banks' capital ratio and at the ratio of non-interest income to total income. The latter proxies for investment banking activities and high levels of securitization, which both have been found to be related to high bank risk.
Bank risk characteristics and the two incentive variables are most likely all determined endogenously. I therefore employ a simultaneous equation model to test for the effect of incentives on risk. I find that in the pre-crisis period banks whose CEOs have high risk taking incentives are riskier and engage in riskier bank policies. However this relationship is blurred by the financial crisis. While banks with high vega low delta CEOs performed worse during the crisis in terms of accounting performance such a relationship does not exist for equity based performance and risk measures. When looking at the impact of regulation and corporate governance I find that stronger regulation makes banks more active in adjusting incentives to their risk. The impact on the board however is rather weak.
This article makes various policy relevant contributions, especially in the light of new regulations that have a focus on executive compensation and corporate governance. First of all I show that monitoring the incentives inherent in the CEO compensation contracts is important for supervisory authorities, no matter in which regulatory framework the bank operates in. Second, strong supervision and what has been called 'prompt remedial action' can be potent means to prevent excessive risk taking. Third, new regulations on corporate governance seem unnecessary given the relatively uncertain impact on CEO incentives and on how they translate into bank risk.

The second chapter titled *CEO Overconfidence in Banking* tries to explain bank risks from a more behavioral point of view. Data on the exact exercise year for all options held by the CEOs of large international banks allows us classify CEO as overconfident. Overconfident CEO will underestimate risks and therefore increase the riskiness of their institution.
The optimal exercise time is estimated for each option in the CEO's portfolio using a subjective option pricing methodology. Assuming that CEOs are risk averse and just partially able to hedge their portfolio of stocks in their own company, it is typically optimal for them to exercise their options early. We classify a CEO as overconfident if she exercises a large proportion of her options later than optimal.
Overconfident CEOs are found to take on more risk, where risk is measured by the

standard deviation of equity returns and by the distance-to-default. This effect is reduced if the board is more active, i.e. meets more often.
From a policy perspective this study shows that CEO personality can be an important determinant of bank risk that a regulator may be able to respond to. Moreover the study shows that active bank boards may be useful to counterbalance such a CEO.

The third chapter titled *Social Networks in the Banking Sector* looks at the network of bank board members and its effect on individual bank policy and on the stability of the financial system as a whole. Social networks have been shown to be an important factor of managerial decision making and therefore to influence corporate policies. Information submitted through the network can either lead to destabilizing group-think or create valuable benefits for the connected banks. Especially the potential influence of the social network on the systemic risk of a bank is important. The recent financial crisis has shown that in a connected banking system the default of some individual banks may impact the whole financial system through investments in similar assets or through the interbank market. Identifying social connections as a driver of asset commonality would give us a better understanding of how banking networks function. We use data on the past and current board memberships of executive and supervisory directors of large international banks to create a network of social or professional relationships. We find that the number of connections between two banks positively affects their equity return correlations, an effect that is reduced beginning with the onset of the financial crisis. Presumably word-to-mouth made bank managers first invest in similar assets and by the same mechanism reduce their holdings as soon as the financial crisis hit. When looking at the complete network structure we see that socially central banks are more systemic, have higher systematic risk before the crisis and reduced levels of systematic risk during and after the crisis. The effect of the network on the interbank market is asymmetric, socially central banks lend more to their peers than banks that are located on the perimeter of the network.

Chapter 1: Managerial Compensation in the Financial Service Industry[†]

Felix Suntheim

Abstract

This study uses a unique dataset with detailed information on CEO remuneration of major international banks from 2000 to 2008 to give a comprehensive overview of compensation practices in banking throughout the world, the impact on risk and bank policy choices and the determinants. I show that remuneration had an impact on bank performance during the financial crisis. Banks which endowed their CEO with high risk taking incentives performed worse in the period after the Lehman collapse in terms of accounting performance. Using simultaneous equation models I show that before the crisis various measures of bank risk have been positively correlated with CEOs' risk taking incentives. From a bank policy perspective high vega low delta CEOs rely on riskier, fee based activities and higher leverage. Moreover I investigate the interaction between corporate governance, regulation and CEO compensation. Stronger regulation induces banks to react more to bank risk when

[*]Bocconi University, E-mail: felix.suntheim@unibocconi.it

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setting their compensation contracts. Corporate governance mechanisms have a limited impact on the way banks set their compensation and on the way incentives impact bank risk.

1 Introduction

Triggered by the U.S. subprime crisis, financial institutions around the world have suffered from tremendous write downs on their assets. According to estimates of the Boston Consulting Group, the global banking industry's market capitalization dropped from $ 9.3 trillion in October 2007 to $ 3.1 trillion in February 2009 and since then has regained about 50% of the lost market value. A wide range of fiscal, monetary and financial polices has been implemented to cut the feedback loops between the financial sector and the real economy. Additional to central banks' effort to support liquidity in the financial industry, governments intervened heavily in the financial system. Total upfront government financing sums up to 5.8 % of GDP on average for advanced economies reaching more than 50 % of GDP when taking into account total support of the financial sector (including guarantees and central bank liquidity provisions).[1]

To justify the expenditures on bailouts of those firms which are widely perceived to be responsible for the crisis, policy makers have been introducing and are planning to introduce various new financial regulations, out of which restrictions on executive compensation play a prominent role. For example the U.S. implemented the troubled assets relief program (TARP), which provides capital injections to the financial sector contingent on the compliance to limits on executive compensation. In Germany banks seeking help from the comparable SoFFin program need to limit their CEOs' remuneration to a maximum of half a million Euro per year, including bonus payments. Similar restrictions hold for banks participating in the British bank

[1] According to IMF staff position note SPN/09/13.

rescue package. Further regulation on bank CEOs' remuneration are discussed and range from increasing shareholder rights over stronger supervisory power to plain restrictions on the levels of CEO pay.
Ex-post we can say that banks took on too much risk during the period which led to the recent financial turmoil. Many institutions shifted their business model from traditional banking to more volatile investment banking, relied heavily on loan securitization or overloaded their portfolios with mortgage backed securities whose risk was not correctly understood. High leverage ratios, both on-balance sheet and off-balance sheet, aggravated the situation even further. Kashyap et al. (2008) argue that the contamination of bank balance sheets with a great range of problematic assets was caused by the failure of incentive and risk control systems within banks. Bank CEOs are in fact key decision makers who are exposed to various forms of performance based compensation and additionally aligned to shareholders' interests via bank equity. To form an opinion about an adequate regulation of their compensation contracts several questions have to be answered:

First, are the incentives provided by CEOs' compensation packages designed to increase bank risk through risky bank policy choices? Coles et al. (2006) for U.S. firms and recently DeYoung et al. (2009) for U.S. banks study the impact executive compensation packages have on risk and policy choices. Both studies find that CEO incentives do have an impact on risk taking. My work complements this strand of literature by providing for the first time international evidence over a comparatively long sample period. The dataset comprises detailed information on base salary, bonus payments, stock ownership and option holdings of top officers of 112 banks from 23 countries for the period 2000-2008. I investigate the effect managerial compensation has on bank risk by explaining market and accounting based risk measures (equity risk, idiosyncratic risk, systematic risk, distance-to-default), and measures of bank policies (non-interest income, leverage) with CEO incentives. The sensitivity of CEOs' portfolio[2] to changes in equity volatility (vega) is used as a

[2]Options, stocks and restricted stocks.

measure of risk taking incentives. The sensitivity of CEOs' portfolio to stock price changes (delta) is used as a proxy for the incentive alignment between shareholders and management. Though depending on option characteristics and on the leverage of the bank, typically stock options provide higher incentives to increase volatility than stocks. Therefore CEOs with a greater exposure to options would be expected to choose riskier policies leading to an increase in bank risk, while CEOs with large stock holdings would act in a more conservative fashion.
My results show that there is a strong link between CEO incentives and bank risk taking. I find that equity volatility and idiosyncratic risk increase in vega and decrease in delta. When looking at bank policies I find that the non-interest income to total income ratio is higher for CEOs with high vega and low delta. A high level of non-interest income is an indicator of banks' focus on fee based activities and of the securitization of loans, two activities which have been associated with high risk. Similarly the capital ratios of banks with strong risk taking incentives and lower levels of exposure to stock price movements are lower, indicating that leverage is used as mean to take on more risk. Although these effects are smaller than documented by DeYoung et al. (2009) for a larger set of US banks over a different time period I do not find that US banks drive the results.

Second, how does remuneration policy interact with bank characteristics, different regulatory regimes and corporate governance? Are compensation systems comparable throughout the world and is it necessary to introduce new, potentially distortive regulations or are there already supervisory regimes and corporate governance mechanisms in place that address the problem of excessive risk taking incentives accurately? On the one hand tough regulation may encourage shareholders to increase CEO risk taking incentives as a countermeasure. On the other hand strong supervisory authorities may be able to prevent excessive risk taking of banks which would reduce the need to launch expensive risk inducing remuneration schemes. Similarly, bank supervision may be a substitute for monitoring and could therefore decrease the necessity of tying managerial wealth to bank performance. John and Qian (2003) interpret lower pay-performance sensitivities in banks than in manu-

facturing firms as evidence for this hypothesis. Different to previous studies the international character of my dataset allows to assess the impact of the regulatory environment on the structure and the level of CEO remuneration. I measure regulatory power via the indices provided by Barth et al. (2001) (supervisory rights, capital requirements, private monitoring). Good corporate governance should be able to set incentives levels optimally from a shareholders perspective but possibly not from the regulators perspective. I investigate the effect of corporate governance on compensation by using detailed data on the board and its remuneration committee.

I find that the structure and level of managerial compensation in the banking sector has been converging over time. Cash compensation and bonuses have reached similar levels in most countries, long term incentive plans have been widely adapted and equity based compensation plays an increasingly important role. Nevertheless CEOs from the US rely far more on equity based compensation and long-term incentive plans than banks from any other country throughout the whole sample period. This is especially interesting in the light of new regulatory proposals that encourage exactly these types of remuneration.[3] When looking at the impact of regulation on CEO compensation the findings of John and Qian (2003) cannot be supported. In my sample banks from countries with strong regulators rely more on equity based compensation than those from countries with weaker supervisory authorities. I also find evidence that banks from countries with stronger regulation are more active when adjusting their CEOs incentives to bank risk. High bank risk and risky bank policies let the board set CEO compensation in a manner that incentvizes the CEO to take on less risk. I find relatively little impact of banks' boards on the compensation structure. Although one would imagine the CEOs of large international banks to be very mobile a large portion of the variation in CEO pay can be explained by country fixed effects. Nevertheless, similar to Fahlenbrach (2008) banks with weak corporate governance structures tend to grant contracts with larger pay-for-performance components, like high delta options and large bonus payments. The

[3]See for example the FSB's "'Principles for Sound Compensation Practices"' or the "'Revised Capital Requirements Directiv"' issued by the European Commission.

compensation committee does not have any impact on the level of incentive pay, bonus payments or total compensation, a finding which is especially interesting in light of good governance guidelines which propagate the implementation of such a committee. Not surprisingly most of the sample banks have implemented a compensation committee during the sample period. Looking closer at the characteristics of the option granted we see that a weaker committee, i.e. with more committee members, tends to give the CEO options with a shorter vesting period and a lower exercise price. A more active committee grants less options with lower risk taking incentives and less exposure to changes in the banks' stock price. Women on the board lead to lower levels of option based pay and to option grants that are less favorable to the CEO.

Third, did managerial compensation actually play a role in the recent financial crisis? Fahlenbrach and Stulz (2009) and Beltratti and Stulz (2009) try to explain the returns of banks during the financial crisis using bank and country specific governance measures. Fahlenbrach and Stulz (2009) find no evidence that banks with a more risk inducing remuneration policy performed worse during the financial downturn, using a sample of U.S. banks. Beltratti and Stulz (2009) report that on an international level banks with shareholder friendly boards performed worse and those exposed to stricter capital regulation better. I contribute to this literature by extending the Fahlenbrach and Stulz (2009) approach to an international sample, taking into account regulation and legal environments. Furthermore my dataset allows to investigate the impact of the timeseries of CEO compensation on the banks' performance during the financial crisis.
Although I do not find any impact of managerial compensation on equity returns during the crisis, I can show that accounting based performance measures are strongly correlated with my incentive measures. Banks relying on option based compensation and on short term bonuses performed worse than banks whose CEOs held a large share in stocks.

The remainder of the paper is organized as follows. The next section summarizes the existing literature on managerial compensation. Section 3 presents and summarizes the data, gives a qualitative overview on remuneration practices and describes the variables used in the empirical analysis. Section 4 shows the result of several simultaneous equation models explaining bank risk, bank policy choices and banks' board reaction to it. Section 5 deals with the impact of CEO compensation on bank performance during the financial crisis. Section 6 shows how the regulatory environment and corporate governance impact executive compensation and section 7 concludes.

2 Literature

Early studies in the area of managerial compensation focus on the link between remuneration and performance for firms in the U.S.[4] They find that pay for performance sensitivities are predominantly driven by stock options and stock ownership but - though increasing over time - remain relatively low. Murphy (1998) summarizes the literature on executive compensation in the U.S. and presents some stylized facts. Pay levels are industry dependent with lower than average remuneration in utilities and higher remuneration in financial service companies,[5] CEO compensation is increasing in firm size and the option component accounts for the largest block of total compensation.

Due to limited data availability relatively few international comparisons have been carried out. Almost all of them using survey data from consulting companies.[6] They confirm the conventional wisdom that CEO pay in the US exceeds pay in other countries and that the holding of stock options and stock ownership are much more developed in the US.

[4]See for example Murphy (1985), Jensen and Murphy (1990b) or Jensen and Murphy (1990a).

[5]See Carroll and Ciscel (1982) on the effect of regulation on managerial compensation, Houston and James (1995), Hubbard and Palia (1995) or Ang et al. (2002) for an analysis of compensation in the banking industry.

[6]E.g. Abowd and Bognanno (1995).

Managerial compensation in the financial sector has been investigated by several authors, mainly from an U.S. point of view. The literature starts with Barro and Barro (1990) who verify that CEO pay depends on stock performance. Hubbard and Palia (1995) examine the effect of deregulation in the U.S. banking system on the pay-performance relationship. They find a higher pay-performance sensitivity when competition increases. Burghof and Hofmann (2000) analyze 52 banks from 12 European countries for the years 1995-1997. They find weak evidence of an influence of pay-performance-sensitivities on banks' performances. John and Qian (2003) hypothesize that pay-performance sensitivities should be declining in debt ratios in order to restrain managers from risk shifting. Regulation and firm size could be substitutes for monitoring of banks' management and could therefore decrease the necessity to align managerial incentives via high pay-performance sensitivities. Consistently the authors document lower pay-performance sensitivities in the banking sector than in the manufacturing sector in a sample of U.S. banks between 1992 and 2000. Chen et al. (2006) use a sample of 68 American banks from 1992 to 2000 to test whether option based compensation induces risk taking in the banking industry. Using some rough proxies for CEO's exposure to stock options and solely market based risk measures the authors find evidence supporting their conjecture. Using a similar sample Mehran and Rosenberg (2007) find that an increase in bank CEOs' stock option holdings are associated with higher equity risk and a capital build up. Recently various authors have been looking at governance features of banks to explain the credit crisis. Fahlenbrach and Stulz (2009) and DeYoung et al. (2009) try to explain the bank performance during the financial crisis using compensation policies as an explanatory variable. Fahlenbrach and Stulz (2009) do not find any evidence that banks with high risk taking incentives performed worse during the financial downturn. DeYoung et al. (2009) on the other hand report riskier policies for banks with a more risk inducing compensation structure.Cheng et al. (2010) find residual pay to be correlated various risk measures, for example with a firms sensitivities to a change in the ABX subprime index in a sample of US banks. They argue that compensation and risk taking is not related to governance variables but

to ownership of institutional investors which is taken as evidence that investors with short-term preferences incentivize firms to take on more risk.
Erkens et al. (2009) and Beltratti and Stulz (2009) use an international dataset with corporate governance variables of financial firms in 2006 to explain risk taking and stock market performance in 2008 to 2009. Erkens et al. (2009) find that banks with more independent boards were more likely to raise fresh capital and disclosed greater writedowns during the crisis. Beltratti and Stulz (2009) find lower stock returns for financial institution with shareholder friendly boards. Chesney et al. (2010) show that governance features of financial firms in the US were related to writedowns in the credit crisis.

3 Data & descriptive statistics

3.1 Data

In order to conduct a panel data analysis of bank remuneration policies I follow two alternative approaches: First I select the world's 250 largest (by total assets) banks in 2000. This procedure guarantees a sample free of survivorship biases, which is necessary to evaluate the influence of managerial incentives on bank risk appropriately. It is however clear that many of those banks are enjoying implicit too-big-to-fail guarantees which may increase risk taking incentives. From the selected institutions I exclude banks which are not publicly held and banks which do not disclose any information on managerial compensation for at least two consecutive years. Selecting publicly traded banks allows me to calculate stock market based measures of incentives, besides that disclosure requirements are typically higher for traded companies. Second I select the top five banks by total assets in each country of the original sample in each year. This sample differs from the first mainly through a lower fraction of U.S. banks and is therefore smaller then the first sample. This sample is mainly used for the analysis of compensation in relation to the regulatory regime a bank is operating in.

The total number of remaining banks is 112. The data items (collected from

annual reports, proxy statements and the Compustat Execucomp database) are:

- Personal (CEO name, tenure)
- Cash remuneration (salary, bonus payments, long term incentive plans)
- Interest in the banks shares (direct or through restricted shares[7])
- Stock options (grant date, vesting date, exercise price, exercise date, performance criteria)

Appendix A shows all the selected banks and their disclosure policies regarding total compensation, cash bonuses, stock holdings and option holdings. In countries with mandatory disclosure rules, information on compensation policies is standardized and mostly complete. In all other countries the amount and detail of information disclosed varies considerably among the banks and over time. In general, disclosure improves over time, most frequently when a new CEO enters the bank. Information on the exact exercise date is rarely reported.[8]

For the smaller sample I complement this data on CEO compensation with the following information on corporate governance practices for each bank:

- Is the CEO member of the board of directors, and if yes is she the chairman of the board?
- General information on the board of directors (number of directors, number of independent directors, fraction of female directors, number of board meetings.)
- Information on the remuneration committee (Has a remuneration committee been implemented? Is the CEO member of the committee or does she attend its meetings? Is the CEO chairman of the committee? Number of committee meetings, number of independent directors on the committee.

[7]Restricted shares are share grants tied to performance or vesting criteria.

[8]In few cases it is possible to infer the exercise dates from the stock price at the date of exercise, otherwise the middle of the fiscal year is assumed to be the exercise date.

Stock market data comes from CRSP for US banks and Compustat for all other banks. Bank balance sheet data is taken from Bureau van Dijk's Bankscope database. The indices describing the regulatory environment are constructed using the procedure developed by Barth et al. (2001). The data is available through the Worldbank for 2001, 2003 and 2007. Information on the minimum capital requirements for each country comes from the same source. The existence of an explicit deposit insurance scheme has been documented by Demirg-Kunt et al. (2006). Macro variables come from the Worldbank database. Information on geographic segmentations for each bank from Datastream. Shareholder rights are measured via the revised anti director rights index of Djankov et al. (2008).

3.2 Structure of CEO remuneration

CEO pay in the banking industry typically consists of four different components. The base salary is usually determined according to industry and firm size benchmarks and acts as a basis for the calculation of bonuses and stock option grants.

Short term bonuses are functions of pre-specified performance criteria. They are not paid below a certain level of performance and are capped above a certain threshold. The typical performance measures are accounting based but can also be discretionary measures like an outstanding performance related to M&A activities. Accounting measures have the advantage of being easily verifiable, which in turn makes it easier for managers to relate their own actions to the bonus payments. On the other hand they can be manipulated more easily and are backward looking and short-run which might lead to myopic decision making.

Stock options give the CEO the right to buy shares of the bank at the pre-specified exercise price. Although option design varies across banks, the typical option contract has a maturity of 10 years (less frequently 5-7 years) and vests after 3 years (less frequently options become exercisable gradually over time). The exercise price is usually set at the market price around the grant date or slightly

above. Frequently the exercise of an option is conditional on the achievement of a pre-specified performance criteria which is either an accounting measure, a stock price hurdle or the stock performance relative to a peer group.[9]

Other forms of compensation include long-term incentive plans which have replaced stock option plans in some banks. Under these plans restricted shares are granted or a bonus is paid when pre-specified performance criteria are met over a horizon longer than one year (typically 3-5 years).

On top of these compensation packages CEOs typically hold shares in the bank. This stock ownership results either from the exercise of stock options and share plans, from mandatory minimum requirements on CEO shareholdings set by banks or from voluntary purchases of stocks by CEOs.

3.3 Managerial incentives

Similar to most of the literature on managerial compensation, I construct several measures of CEO incentives based on the sensitivities of CEO wealth with respect to the bank's stock price and standard deviation. As in Jensen and Murphy (1990a) or Murphy (1998) Delta is the dollar change of CEO wealth for a one percent change in banks' market capitalization. It measures how aligned managerial incentives are with the interests of shareholders.

Vega on the other hand, as introduced by Guay (1999), is defined as the change in CEO wealth for a 0.01 change in annualized standard deviation of stock returns. Vega rewards managers for increasing equity risk and is therefore a counterweight to CEO risk aversion.
I compute delta and vega for all the components of managerial compensation as

[9]Performance criteria vary from easy to reach and flexible to fixed and dependent on peer group performances.

follows:

- Sensitivities for option holdings can be computed directly using the Black-Scholes option pricing model modified to account for dividend payments.

- Executive wealth varies with the value of holdings of stocks and restricted stocks. Delta is defined as the change in portfolio value for a 1% change in the banks market capitalization. As shown by Black and Scholes (1973) common stock can be seen as a call option with the total value of the firm as an underlying assets and face value of debt as the exercise price. Using the KMV model the value of the banks' assets and asset volatility can be computed by solving numerically a nonlinear system of two equations. I follow Guay (1999) and compute common stocks sensitivity to a one percent change in annualized standard deviation by using the Black & Scholes model.[10]

- Estimating a time-series of company specific pay-performance sensitivities for cash compensation is not feasible given that there is just one observation for each CEO per year. Proxies for risk taking incentives through cash compensation are constructed using ratio of bonus payments to total salary.

Most of the studies using panel data on executive compensation from the US, e.g. Coles et al. (2006) and DeYoung et al. (2009), compute sensitivities using the 'one-year approximation' methodology proposed by Core and Guay (2002). Since before fiscal year 2006 no details on previous option grants had to be disclosed in the annual proxy statements, Core and Guay (2002) estimate the exercise price from the realizable values of exercisable and unexercisable options. This procedure leads to an understatement of the true exercise price because the number of out-of-the-money stock options is not disclosed. Moreover time to maturity of the options are not disclosed and are set between six and nine years. Core and Guay (2002) report that

[10]The equation for equity comes from Merton's model as $E_0 = V_0 N(d_1) - Fe^{-rT} N(d_2)$. Asset volatility is characterized by $\sigma_E = \frac{V_0}{E_0} N(d_1)\sigma_V$. The relation of a change in asset volatility for a given change in equity volatility is given in the model by $\sigma_E = \frac{V_0}{E_0} N(d_1)\sigma_V$, where σ_E is the standard deviation of stock returns, V_0 is the asset value, E_0 is the value of equity and σ_V the asset volatility. $d1$ is specified in the usual way.

biases resulting from their methodology are severe when the price-to-strike ratios are low. My hand-collected sample allows me to circumvent these imprecisions and to calculate sigma and vega precisely.

Long term incentive plans (LTIP) became increasingly popular during the last five years. These LTIPs are typically composed of restricted stocks or performance stocks which vest after a pre-specified period or when achieving certain performance goals. Due to the big differences in performance criteria and vesting schedules it is not feasible to compute sensitivities of these performance stocks accurately. Like most of the literature I treat restricted stocks like normal stocks, which will most probably understate the risk taking incentives provided by them.

3.4 Descriptive statistics

Table 1 summarizes the main sample characteristics by country and by legal origin as defined in La Porta et al. (1998). The average compensation amount and structure vary considerably among the different countries with lower levels in the Scandinavian countries,[11] high values of stock options and managerial stock ownership in the countries with English legal origin and above average bonus payments in German legal origin countries.

Mean total compensation is about $3.6 million out of which roughly 60% is paid as bonuses. The average CEO holds 0.32% of her employers equity through stocks. The average CEO portfolio increases by $1.14 million for a one percent increase in shareholder value and by $204,000 for a 0.01 increase in stock return volatility. The sensitivity of CEO option portfolios to a stock price change is highest in the English origin banks, sensitivities from stock and restricted stocks is highest in German legal origin countries and the Scandinavian countries exhibit low sensitivities through all means of compensation.

Table 2 and Figure 1 show the evolution of the different variables over time. Total compensation increased steadily from an average of $3.24 million in 2000 to

[11] High levels of stock ownership are mainly driven through Finnish Sampo Bank

Figure 1: The development of CEO sensitivities with respect to changes in equity volatility over time. Options, stocks and restricted stocks denote the change in CEO portfolio value with respect to a 0.01 increase in volatility. In thousand US$.

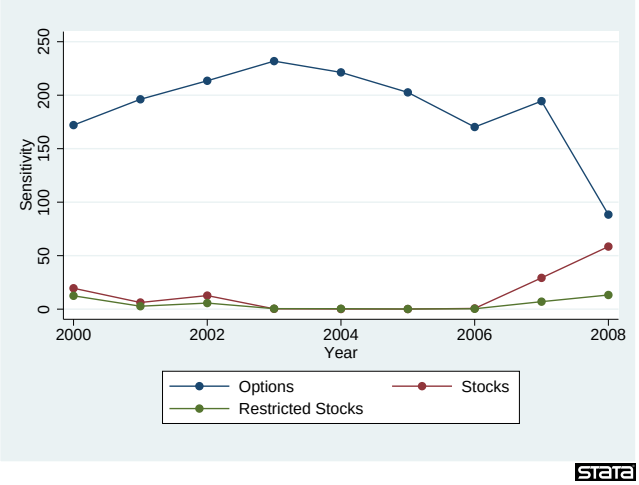


Table 1: Summary Statistics
The data covers CEO characteristics and ranges from 2000 to 2008. All variables are expressed in 2008 thousand US dollars. Salary is the non-performance related part of CEO wage, bonus payments is typically related to achievements of short-term accounting-based performance measures. Option is the value of CEOs' option package computed with the Black&Scholes formula adjusted for dividends. Stockholdings includes CEO stockholdings and restricted shares. Total Compensation consists of base salary, bonus payments, long-term incentive plans and share-based payments. N is the number of bank-year observations and banks is the number of banks in each country.

Country / Legal Origin	Salary	Bonus payments	Ownership	Options	Stockholdings	Total Compensation	# Banks	N
Australia	1.23	2.70	0.07%	5.41	13.16	4.94	6	51
Austria	2.21	2.34	0.04%	0.24	5.64	2.86	1	9
Belgium	1.03	1.23	0.00%	1.51	0.75	2.66	2	18
Canada	1.12	1.71	0.06%	23.53	15.73	5.17	6	54
Denmark	1.11	0.12	0.00%	2.31	0.40	1.13	1	8
Finland			2.09%	0.00	201.17	2.31	1	8
France	1.08	1.03	0.00%	9.39	2.56	1.97	6	44
Germany	1.16	3.56	0.03%	0.29	7.21	4.66	7	32
Hong Kong	0.87	0.74	2.02%	1.88	48.33	1.38	4	31
Ireland	1.08	1.05	0.23%	2.43	10.48	2.55	3	27
Israel	0.76	0.77	0.00%	0.03	0.00	1.58	3	22
Italy	1.74	1.24	0.04%	5.26	10.39	2.82	5	29
Malaysia	0.59		0.01%	0.12	0.74	0.16	1	9
Netherlands	1.17	0.93	0.01%	1.38	3.47	3.10	3	23
Norway	0.60	0.21	0.01%	0.03	0.30	0.75	2	17
Singapore	0.88	2.37	0.34%	1.71	47.15	2.62	3	25
South Africa	0.56	1.00	0.44%	4.54	39.34	1.63	4	35
Spain	2.82	4.01	0.02%	0.69	8.42	6.09	4	28
Sweden	0.87	0.38	0.06%	1.12	1.17	1.21	5	44
Switzerland	1.28	0.64	0.07%	5.14	30.79	8.06	2	3
Thailand			0.01%	0.00	0.59	0.24	1	1
UK	1.56	1.71	0.04%	3.04	7.33	4.04	12	82
USA	1.00	3.33	0.59%	39.51	113.26	4.98	30	239
English	1.08	2.43	0.42%	20.08	58.22	4.03	16	576
French	1.52	1.60	0.02%	4.53	5.23	3.23	4	142
German	1.31	3.18	0.03%	0.61	8.49	4.52	5	44
Scandinavian	0.82	0.32	0.26%	0.88	21.68	1.21	4	77
Total	1.14	2.17	0.32%	14.67	43.29	3.66	12	839

$4.55 million in 2007 until the financial crisis melted it down below the level of 2003. Similarly sensitivities towards price changes rose until the beginning of the financial crisis when many CEOs where replaced at the same time leading to lower stock and option holdings. Moreover government interventions decreased the overall level of performance pay. For most of the years the sensitivity of stock and restricted stock portfolios to changes in volatility are low. The increase in Vega in 2007 is due to the decline in price-to-strike ratios for many banks. While a dramatic drop in prices leaves stock options out of the money with low vega and low delta, the equity options get closer to their exercise prices and risk taking incentives from stocks and restricted stocks increase.

Table 3 shows the evolution of different components of executive compensation over time and by country. CEOs from the US and Canada rely far more on equity based compensation than banks from any other country throughout the whole sample period. Nevertheless there seems to be some convergence in terms of the structure and the level of compensation. Base salaries reach similar levels in most countries during the last three-year period. Longterm incentive plans became a standard component over time in most countries as can be seen from the payouts of longterm bonuses and by looking at the occurence of restricted stcoks. Vesting criteria are used predominantly by banks from Australia and the UK. Table 3 also shows how disclosure improved over time, while information on various components of compensation is not available for the early sample years most of the banks fully disclose their CEO's remuneration package by the end of the sample period.

Table 4 and Table 5 show the board characteristics for each country and over time. There is little time variation in the sample period. The percentage of women

Table 2: Managerial compensation over time
Total Compensation is expressed in million 2008 US dollars and consists of base salary, bonus payments, long-term incentive plans and share-based payments. Bonus denotes the fraction of bonus payments to total compensation. Ownership is the percentage of shares of the company held by the CEO through stocks or restricted shares. Delta is the sensitivity of CEOs' option portfolio to a $ 1000 change in shareholder value. Vega is the total change in CEO wealth with respect to a 0.01 change in Volatility. Delta and Vega are expressed in thousand 2008 US dollars.

	total comp	bycomp bonus	ownership	delta option	delta stock	delta re-stricted	vega option	vega stock	vega re-stricted	N
2000	3.28	45.02%	0.62%	350.35	708.89	79.30	172.06	19.54	12.48	77
2001	2.56	43.44%	0.61%	285.16	908.93	82.68	196.17	6.24	2.75	85
2002	2.63	43.05%	0.34%	235.51	546.88	74.46	213.49	12.70	5.69	92
2003	3.51	46.26%	0.32%	321.96	662.41	80.39	231.86	0.30	0.48	96
2004	4.23	49.85%	0.30%	350.10	735.09	100.14	221.34	0.13	0.41	100
2005	4.47	50.45%	0.28%	343.78	825.71	118.98	202.64	0.09	0.15	101
2006	4.59	42.57%	0.16%	427.59	672.09	114.49	170.27	0.67	0.37	100
2007	4.59	36.70%	0.21%	265.53	821.77	108.80	194.44	29.25	7.00	100
2008	2.62	18.42%	0.14%	128.24	327.58	44.92	88.38	58.51	13.25	88
Total	3.66	41.81%	0.32%	302.32	692.88	91.12	189.19	13.70	4.36	839

Table 3: Managerial compensation over time and by country
Bonus and Salary denote the average cash payments. Option value is the average Black&Scholes value of a CEO's option portfolio. Longterm is the amount of long term incentive payments made. All values are expressed in 2008 million US dollars. Options are the number of underlying shares divided by the number of shares outstanding. Vesting criteria is the percentage of options whose exercise depends on special vesting criteria. Stocks and Restricted are the percentage ownership through stocks and restricted stocks.

Country	Bonus	Salary	Option Value	Longterm	Options	Vesting criteria	Stocks	Restricted	# Banks	N
2000 - 2002										
Australia	1.14	0.82	5.01	0	0.1616%	56.93%	0.0571%	0.0002%	6	16
Austria			0.18	0	0.0797%	50.00%			1	3
Belgium	0.54	0.85	1.46	367,896	0.0376%	0.00%	0.0020%	0.0000%	2	6
Canada	1.65	0.82	18.13	68,738	0.4342%	13.00%	0.0258%	0.0232%	6	18
Denmark			0.47		0.0124%	0.00%		0.0007%	1	2
Finland			0.00		0.0000%		2.1162%	0.0000%	1	2
France	0.99	0.78	9.27	16,362	0.1102%	21.93%	0.0074%	0.0002%	6	13
Germany			2.34		0.0175%	0.00%			7	1
Hong Kong			0.23		0.0487%	0.00%	7.6263%	0.0000%	4	8
Ireland	0.50	0.66	1.47	221,898	0.1882%	0.00%	0.4531%	0.0011%	3	9
Israel		0.95	0.00		0.0000%				3	4
Italy	0.62	1.05	2.63	0	0.1568%	32.37%	0.0011%	0.0000%	5	8
Malaysia			0.14		0.0062%	0.00%	0.0017%		1	3
Netherlands	0.44	0.87	2.18		0.0142%	0.00%	0.0005%	0.0093%	3	6
Norway	0.02	0.44	0.07	0	0.0419%	25.00%	0.0030%	0.0000%	2	5
Singapore	1.27	0.38	1.83		0.0702%	0.00%	0.5235%		3	8
South Africa	0.49	0.38	2.77		0.1563%	3.31%	0.5877%	0.0147%	4	11
Spain	4.09	3.10	0.03		0.0005%	0.00%	0.0560%	0.0071%	4	5
Sweden	0.11	0.71	0.61	0	0.0296%	0.00%	0.0756%	0.0000%	5	14
UK	0.88	1.15	3.03	247,814	0.0412%	33.02%	0.0064%	0.0213%	12	29
USA	3.57	1.03	44.59	877,008	0.4614%	2.20%	0.6180%	0.1617%	30	83
2003 - 2005										
Australia	3.01	1.23	5.71	109,844	0.1611%	61.45%	0.0588%	0.0094%	6	18
Austria	1.61	2.15	0.44	1,001,385	0.0301%	0.00%	0.0758%	0.0000%	1	3
Belgium	1.32	1.10	2.00	416,784	0.0398%	0.00%	0.0035%	0.0019%	2	6
Canada	1.88	1.17	22.57	442,003	0.2949%	7.60%	0.0207%	0.0414%	6	18
Denmark	0.14	0.87	2.09		0.0443%	0.00%		0.0019%	1	3
Finland			0.00		0.0000%		2.0917%	0.0000%	1	3
France	1.19	0.94	7.61	108,985	0.2659%	23.79%	0.0083%	0.0000%	6	16
Germany	4.89	1.18	0.63	0	0.0083%	0.00%	0.0204%	0.0134%	7	11
Hong Kong	0.73	0.84	1.27		0.0829%	0.00%	0.8376%	0.0151%	4	12
Ireland	1.12	1.09	2.16	231,676	0.0744%	23.25%	0.2407%	0.0081%	3	9
Israel	1.05	0.63	0.00		0.0000%				3	9
Italy	1.13	1.82	9.52	0	0.1983%	24.51%	0.0165%	0.0000%	5	11
Malaysia			0.03		0.0069%	0.00%	0.0083%		1	3
Netherlands	0.82	1.20	0.82	568,612	0.0182%	0.00%	0.0010%	0.0112%	3	9
Norway	0.24	0.65	0.03	0	0.0339%	11.11%	0.0055%	0.0000%	2	6
Singapore	2.50	0.99	1.17		0.0528%	0.00%	0.3591%		3	9
South Africa	1.09	0.61	4.69		0.1274%	8.05%	0.7461%	0.0122%	4	12
Spain	4.27	3.16	0.36		0.0051%	0.00%	0.0020%	0.0111%	4	11
Sweden	0.44	0.89	1.37	0	0.0412%	0.46%	0.0982%	0.0000%	5	15
UK	2.03	1.66	3.26	1,178,869	0.0837%	58.50%	0.0114%	0.0407%	12	29
USA	4.23	1.00	35.36	742,314	0.4589%	1.56%	0.5805%	0.0962%	30	84
2006 - 2008										
Australia	3.76	1.58	5.47	0	0.0999%	65.23%	0.0704%	0.0157%	6	17
Austria	2.82	2.25	0.11	0	0.0019%	0.00%	0.0501%	0.0000%	1	3
Belgium	1.71	1.11	1.07	849,000	0.0211%	0.00%	0.0000%	0.0033%	2	6
Canada	1.59	1.37	29.90	1,196,656	0.2370%	5.32%	0.0216%	0.0482%	6	18
Denmark	0.12	1.19	3.74		0.0691%	0.00%		0.0031%	1	3
Finland			0.00		0.0000%		2.0673%	0.0000%	1	3
France	0.91	1.42	11.39	142,985	0.0506%	24.51%	0.0102%	0.0000%	6	15
Germany	2.84	1.15	0.00	151,179	0.0004%		0.0378%	0.0366%	7	20
Hong Kong	0.75	0.90	3.74		0.1063%	0.00%	0.8623%	0.0552%	4	11
Ireland	1.53	1.43	3.67	448,249	0.0626%	38.28%	0.0521%	0.0245%	3	9
Israel	0.60	0.81	0.07		0.0596%	40.00%	0.0013%		3	9
Italy	1.81	2.19	2.67	0	0.0250%	0.00%	0.1595%	0.0000%	5	10
Malaysia		0.59	0.19		0.0182%	0.00%	0.0138%		1	3
Netherlands	1.41	1.37	1.41	355,752	0.0108%	0.00%	0.0018%	0.0100%	3	8
Norway	0.30	0.70	0.00	0	0.0000%		0.0084%	0.0000%	2	6
Singapore	2.66	0.96	2.21		0.0529%	0.00%	0.1952%		3	8
South Africa	1.33	0.66	6.02	2,589,621	0.0978%	14.59%	0.2081%	0.0117%	4	12
Spain	3.82	2.57	1.26	4,397,848	0.0060%	0.00%	0.0028%	0.0127%	4	12
Sweden	0.57	1.00	1.34	0	0.0203%	18.14%	0.0377%	0.0001%	5	15
Switzerland	0.64	1.28	5.14	0	0.0358%	0.00%	0.0200%	0.0686%	2	3
Thailand			0.00		0.0000%		0.0076%		1	1
UK	2.34	1.94	2.78	1,494,540	0.0248%	86.32%	0.0109%	0.0310%	12	24
USA	1.99	0.96	38.51	2,898,271	0.3782%	2.35%	0.2883%	0.0395%	30	72

on the board of directors increases from 10% in 2000 to 18% in 2008 and the CEO is more likely to attend compensation committee meetings in the earlier sample years. The number of board meetings stays stable until 2008 when boards met more frequently, supposedly to manage challenges posed by the financial crisis. The percentage of CEOs that are also board members decreases over time More interesting are the crossectional differences in the sample. The average number of board members varies from 8 in Finland to 19 in Germany and Spain. The frequency of board meetings varies from 7 to 47, implying possibly large differences in monitoring activities of boards. Boards are dominated by men all over the world, with higher numbers especialy in the Scandinavian and German speaking countries. Most banks have established a committee that deals specifically with managerial compensation. These committees meet between one and ten times per year, have mainly independent members and mostly meet without the presence of the CEO.

Table 6 gives a detailed overview on option characteristics. Over time the number of options granted with vesting criteria increases. Most options are garnted with ten years to maturity, but maturities smaller than that are not uncommon neither. Options vest on average three years after the grantdate although staggered options where a part of the package vests earlier are not uncommon neither.

Table 7 gives summary statistics on the variables used in the multivariate analysis.

Looking at the development of remuneration policies and board characteristics in the financial sector during the last ten years is especially relevant in the light of recent proposals by international supervisory bodies on how to regulate corporate governance practices in banks. The financial Stability Board (FSB) issued in 2009 the 'Principles for Sound Compensation Practices' and the 'Principles for Sound Compensation Practices: Implementation Standards' (the Principals and Standards), which address reforms of remuneration structure, corporate governance, supervision

Table 4: Board characteristics for the top five banks of each country if available from 2000 to 2008. CEO on board is the percentage of banks in which the CEO is part of the board. Independence is the percentage of independent board members as reported by the bank. Women on board gives the percentage of female board members. Compensation committee is the percentage of banks which have a compensation committee. CEO on committee is the percentage of banks in which the CEO attends compensation committee meetings or is member of the compensation committee. Committee independence is the percentage of independent board members in the compensation committee as reported by the bank.

Country	# Board members	# Board meetings	CEO on board	Indep.	Women on board	Comp. committee	Committee meetings	CEO on committee	Committee indep.	N
Australia	10	11	98%	83%	17%	100%	6	20%	98%	41
Austria	17	7	0%		23%	44%	1	0%		9
Belgium	17	8	100%	43%	8%	100%	3	19%	63%	16
Canada	17	13	100%	88%	20%	100%	6	29%	100%	42
Denmark	18	14	0%	100%		50%	2	0%		8
Finland	8	13	100%	59%	9%	75%	5	0%	94%	8
France	18	8	46%	37%	6%	100%	4	0%	62%	35
Germany	19	7	0%		20%	23%	4	0%		13
Hong Kong	15	7	100%	42%	5%	92%	3	0%	76%	25
Ireland	14	10	100%	68%	9%	100%	5	0%	100%	26
Israel	15	31	0%		15%	32%	6	0%		22
Italy	18	16	71%	57%	4%	59%	2	0%	47%	17
Malaysia	11	17	100%	49%	6%	100%	10	11%	56%	9
Netherlands	11	9	0%	93%	8%	95%	4	5%	100%	22
Norway	10	19	0%	81%	36%	56%	5	0%	100%	16
Singapore	12	8	100%	68%	5%	100%	3	54%	68%	24
South Africa	18	7	94%	59%	10%	100%	4	55%	69%	33
Spain	19	11	75%	48%	11%	71%	7	0%	87%	28
Sweden	12	15	85%	58%	29%	93%	5	12%	75%	41
Switzerland	10	47	0%	90%	20%	100%	7	0%	100%	3
Thailand	19	12	100%	37%	5%	100%	6	0%	33%	1
UK	17	11	100%	52%	11%	100%	6	0%	92%	42
USA	14	12	95%	85%	17%	100%	7	0%	100%	40
Total	15	12	74%	64%	14%	88%	5	12%	84%	521

Table 5: Board characteristics for the top five banks of each country if available from 2000 to 2008 by year. CEO on board is the percentage of banks in which the CEO is part of the board. Independence is the percentage of independent board members as reported by the bank. Women on board gives the percentage of female board members. Compensation committee is the percentage of banks which have a compensation committee. CEO on committee is the percentage of banks in which the CEO attends compensation committee meetings or is member of the compensation committee. Committee independence is the percentage of independent board members in the compensation committee as reported by the bank.

Year	# Board members	# Board meetings	CEO on board	Indep.	Women on board	Comp. committee	Committee meetings	CEO on committee	Committee indep.	N
2000	15	12	81%	54%	10%	90%	5	10%	91%	31
2001	15	11	82%	60%	11%	78%	5	16%	78%	50
2002	15	12	81%	62%	11%	83%	5	17%	81%	54
2003	15	11	77%	64%	12%	84%	5	18%	83%	61
2004	15	11	77%	64%	14%	86%	5	12%	86%	65
2005	14	11	72%	64%	16%	89%	5	11%	84%	65
2006	15	12	71%	67%	16%	89%	6	11%	85%	66
2007	15	12	69%	65%	15%	93%	5	7%	84%	67
2008	15	15	63%	67%	18%	95%	6	5%	85%	62
Total	15	12	74%	64%	14%	88%	5	12%	84%	521

Table 6: Summary Statistics on Option characteristics. Criteria granted shows the ratio of total option grants with performance criteria attached to the total number of option grants. Maturity granted shows the years to maturity of an option grant. Vesting granted is the vesting period. Moneyness granted is the ratio of strike price to stock price.

Year	Mean				
	Granted criteria	Granted maturity	Granted vesting	Granted moneyness	N
1992	0.00	10	2	0.95	9
1993	0.07	9	2	0.94	19
1994	0.00	10	3	1.02	28
1995	0.05	9	2	1.01	31
1996	0.03	9	2	1.03	37
1997	0.14	9	3	1.03	45
1998	0.14	9	2	1.05	57
1999	0.14	9	2	1.01	71
2000	0.12	8	3	1.00	77
2001	0.16	8	2	1.01	85
2002	0.11	9	2	1.01	92
2003	0.20	9	3	1.04	96
2004	0.15	8	2	1.00	100
2005	0.21	8	2	0.97	101
2006	0.18	8	3	0.97	100
2007	0.13	8	3	1.00	100
2008	0.16	9	3	0.98	88
2009	0.00	3	3	1.53	71
Total	0.14	9	2	1.00	1,213

Table 7: Summary statistics
This table provides summary statistics for the risk measures and control variables used in the analysis. The sample spans 112 banks over the years 2000-2008.

Variable	Mean	Std. Dev.	N
Total risk	0.343	0.277	899
Idiosyncratic risk	0.018	0.012	895
Distance to default	2.551	10.365	714
Non-interest income / net income	1.704	10.958	862
Total capital ratio	0.048	0.445	892
T1 ratio	0.09	0.03	782
Total assets ($000s)	375,194,245	519,604,602	892
Market-to-book	1.949	1.691	886
Tenure	5.73	5.044	910

and disclosure. In line with these proposals the European Commission issued the revised Capital Requirements Directive (CRD III) and the European Banking Authority (EBA) its guidelines on sound remuneration policies in the financial sector. All these regulatory reforms, which are now successively implemented into local legislation, are similar in essence and I will briefly describe them and then compare them to the compensation and governance structures already in place. First, financial institutions are required to implement a corporate governance system that is able to monitor compensation policies in line with prudent risk taking. For large financial institutions such corporate governance systems include a remuneration committee that consists of independent and qualified members, able to link compensation practices with overall bank risk, capital and liquidity. Second, the regulatory reforms emphasize the importance of long-term compensation packages that are linked to performance and risk. Malus and clawback clauses are tools to adjust variable compensation to long run risks. While required to be consistent with prudent risk taking incentives, a substantial proportion of compensation packages has to be paid in equity-based instruments. However, no recommendations on the explicit characteristics of option packages are made. Third, more extensive disclosure rules will be

implemented and regulators will have more possibilities to intervene when compensation practices are not in line with regulatory standards.

As pointed out in the previous paragraph table 3 shows that especially in the US equity based compensation and long-term compensation have been in place during the whole sample period, while banks in other countries have just been slowly implementing these components and have not reached the levels of American banks. Tables 3 and 5 draw a similar picture for corporate governance mechanisms. US banks did comply with most measures of good corporate governance required by the new regulations. Boards are of moderate size with mainly independent members, all banks had a compensation committee implemented which consisted of independent members only and met frequently. Given the performance of the US banking system during the financial crisis all this casts some doubt whether the abovementioned regulatory reforms will be sufficient to guarantee a sound and stable banking system. Especially the lack of precise requirements on the characteristics of stock options could be potentially harmful as I will explore in the next two sections.

4 The effect of managerial incentives on bank risk and bank policy variables

Agency conflicts between managers and shareholders are typically mitigated by tying managers' wealth to firm performance using bonus programs and stock option schemes. On the one hand high sensitivities of compensation packages with respect to equity returns guarantee a better alignment of shareholders' interests with managerial incentives. On the other hand high pay-performance sensitivities increase managers' exposure to equity risk. Managerial wealth in the form of stocks, options, bonus payments and human capital is linked to firm performance and is in general not diversifiable such that managers are exposed to more risk than diversified shareholders. The resulting agency conflict can induce managers to forgo profitable

investment projects as has been shown for example by Smith and Stulz (1985).

As a consequence securities whose value is increasing in equity volatility like options or bonus programs are used to induce managerial risk taking. Guay (1999) uses the vega of managers' stock option portfolios as a measure of convexity and finds that it is positively correlated with stock return volatility. Coles et al. (2006) argue that shareholders set their CEO's delta and vega such that shareholder value is maximized. They find that higher vega leads to riskier policy choices[12] while an increase in delta leads to the implementation of more conservative corporate policies. Therefore I expect that banks implement riskier strategies when CEO incentives are aligned through high vega.
The effect of delta on risk shifting behavior is not clear. On the one hand managers are exposed to more risk the higher delta, on the other hand alignment to shareholders' incentives could lead to the acceptance of high risk but positive net present value projects which would increase firm risk.

Endogeneity is clearly an issue when analyzing the relationship between incentives and risk measures. The principal agent model predicts that managerial compensation structure is dependent on firm risk. Managers of risky firms would want higher fixed salaries and less performance related pay. Shareholders of high risk firms may prefer to reduce firm risk by implementing low vega contracts. I use the following system of equations to address this point. In the model executive compensation and equity risk are jointly determined depending on bank characteristics.

$$\begin{aligned}
\text{bank risk}_t &= f(vega_t, Delta_t, \text{bank characteristics}_{t-1}, \text{economic condition}_t, \text{fixed effects}) \\
\text{vega}_t &= f(bankrisk_t, delta_t, \text{bank characteristics}_{t-1}, \text{salary}_t, \text{fixed effects}) \\
\text{delta}_t &= f(bankrisk_t, vega_t, \text{bank characteristics}_{t-1}, \text{tenure}_t, \text{fixed effects})
\end{aligned}$$

[12]Measured through R&D expenditures, leverage and capital expenditures

To test the hypotheses several market and accounting based measures of bank risk and bank policy are employed. The first variable is the annualized standard deviation of equity returns measured over a 120 trading day window. To control for market wide effects I use an industry CAPM model with the *STOXX Global 1800 Banks* index as market index. The resulting Beta is used as a proxy for systematic risk and the standard errors of the regression are used as proxies for the idiosyncratic component of risk. The fourth measure of bank risk employed is the distance-to-default, defined as the number of standard deviations the value of assets is away from default. As default point I use the face value of debt and I assume a one year maturity. An advantage of the distance-to-default over the before mentioned risk measures is, that it includes information on asset volatility, the market value of assets and on leverage. Gropp et al. (2002) argue that a distance-to-default measure is in fact a leading indicator of bank fragility.
The same model is employed when looking at bank policy variables. Three variables are used: The ratio of equity to total assets represents the leverage decision of bank managers. Although tied by regulation banks do have some discretion when setting their capital structure. A similar measure is the Tier 1 ratio, which also takes into account the riskiness of assets. DeYoung and Roland (2001) and Stiroh (2006) find that fee based activities are associated with higher risk than traditional lending activities. Stiroh (2006) links various components of non-interest income (revenues from investment banking, loan sales, other non-interest income, sale of assets and net securitization) with risk. The last proxy for risky policy choices is therefore total net fee-based income scaled by net income.

The control variables and their hypothesized effect on bank risk are: (1) The market-to-book ratio proxies for investment opportunities. It may also account for a bank's franchise. (2) The capital ratio is defined as total equity divided by total assets. High capital ratios are expected to lead to lower risk. (3) The log of total assets. Large banks are more diversified than small banks but may take on higher risks because of implicit "too big to fail" guarantees.

The system of equations is exactly identified through one variable unique to each equation. The three instruments used are: Economic condition, which is the exposure of each bank to country risk. I use information on geographical segmentation from Datastream to construct a bank specific measure of exposure to GDP-growth. The effect of country risk on bank risk and bank policies is not clear. On the one hand strong economic conditions might reduce overall, on the other hand they might allow for the implementation of riskier policies. Since decisions on the CEOs compensation structure are typically long term decision I think it is reasonable to believe that the economic condition does not affect the way CEO's incentives are set. High cash compensation allows the CEO to diversify her portfolio and therefore reduces risk aversion Guay (1999). High fixed salaries can also indicate CEO entrenchment which could lead to low risk taking incentives of CEOs (Berger et al. (1997)). Tenure is used as an instrument for Delta. Prior studies have shown that CEO reaching retirement tend to have high-delta contracts in order to overcome horizon problems (Core and Guay (1999)).

In addition to the above mentioned variables each equation contains country fixed effects, year fixed effects and dummies for different bank types. the risk and incentive variables are winsorized at the 1% level.

4.1 Empirical results

4.1.1 Compensation and bank risk

I first report results of 2SLS regressions of bank risk measures on CEO incentives and control variables for the full sample period 2000 till 2008. On the one hand I expect CEO incentives to drive bank risk in the expected fashion, on the other hand it might be that during the financial crisis government interventions, high levels of CEO turnover and markets updating their beliefs about systemic risks blur this

relationship.

The first findings are shown in Table 8 and Table 9 and indeed there is little evidence of a significant impact of CEO incentives on the standard deviation of equity and through idiosyncratic risk. However higher levels of delta reduce systematic risk and increase the distance-to-default. The only evidence for an increase in bank risk through CEO incenitves comes from panel A in Table 9 which shows higher levels of vega increasing systematic bank risk. Figure 1 showed the steep drop in risk taking incentives during the financial crisis, coming from option grants that were deep out of the money after huge drops in equity prices of my sample banks and from CEO turnover with new CEOs having less options in their portfolios. This abrupt decline in vega may then not have been reflected in bank risk during the crisis, which would explain the insignificant coefficients for vega. These findings are somehow in line with Fahlenbrach and Stulz (2009) who argue that CEO incentives did not play a major role during the financial crisis. At least it seems that the risk increasing effect of CEO incentives was not significantly associated with higher bank risk for most specifications. To take into account the possibility that the relationship between incentives and risk has been different before and after the crisis I will look at two sup-samples separately. In section 5 I will explore the effects of incentives on bank performance during the crisis in more detail, whereas the following sub-sections deal with the way incentives impact bank risk and bank policies during normal times.

4.1.2 Compensation and bank risk in normal times

Table 10 and Table 11 show the results of the estimations of the simultaneous equation models for the sub-period 2000 till 2006. In each specification the jointly determined variables are the measure of risk, vega and delta. Vega and Delta are expressed in logarithms of the mean value during one year.[13] Both variables are computed using options stocks and restricted stocks, excluding restricted stocks leads to a less significant coefficient for delta which could imply that treating re-

[13]Using end of year values does not change any of the results

Table 8: Simultaneous equation model of bank risk and CEO incentives for the period 2000 to 2008. Bank risk is represented by the standard deviation of daily stock returns (Panel A) and idiosyncratic risk (Panel B) derived from an industry CAPM model. CEO incentives are the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent change in stock price (delta) and to a 0.01 increase in volatility (vega). Economic condition is the GDP growth in each country waited by the banks' share of assets or income coming from that country. ln(mtb) is the natural logarithm of the market-to-book ratio. Lnta is the natural logarithm of banks' total assets. Capital ratio is the banks' total capital ratio. ln(tenure) is the natural logarithm of CEO's tenure, ln(salary) the natural logarithm of CEOs' fixed salary. Estimation is done using two-stage-least-squares. Kleibergen-Paap denotes the Kleibergen-Paap rk LM statistic. All equations contain year dummies, country dummies and bank specialization dummies.

	Panel A: Total risk			Panel B: Idiosyncratic risk		
	sigma	vega	delta	idiosyn.	vega	delta
sigma		0.708	5.317			
		(11.42)	(5.27)			
idiosyn.					120.562	216.155
					(383.97)	(246.03)
ln(vega)	-0.001		0.186***	0.000		0.154
	(0.01)		(0.06)	(0.00)		(0.13)
ln(delta)	-0.008	0.537		-0.001	0.647	
	(0.02)	(0.44)		(0.00)	(0.47)	
$\ln(\text{mtb})_{t-1}$	-0.021***	-0.272	0.292***	-0.001*	-0.149	0.330*
	(0.01)	(0.35)	(0.11)	(0.00)	(0.38)	(0.17)
lnta_{t-1}	-0.008	0.083	0.473***	-0.001**	0.094	0.609*
	(0.01)	(0.38)	(0.10)	(0.00)	(0.53)	(0.36)
$\text{capital ratio}_{t-1}$	-0.812*	-4.852	-0.912	0.001	-3.370	0.422
	(0.46)	(14.74)	(5.51)	(0.02)	(11.07)	(5.64)
economic condition	0.228*			0.007		
	(0.12)			(0.01)		
ln(salary)		2.652***			2.335**	
		(0.91)			(0.94)	
ln(tenure)			0.344***			0.408***
			(0.07)			(0.13)
N	502	502	502	501	501	501
Kleibergen-Paap	10.15***	3.01*	2.72*	9.32***	1.74	0.95

Table 9: Simultaneous equation model of bank risk and CEO incentives for the period 2000 to 2008. Bank risk is represented by systematic risk (Panel A) and the distance-to-default (Panel B). CEO incentives are the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent change in stock price (delta) and to a 0.01 increase in volatility (vega). Economic condition is the GDP growth in each country waited by the banks share of assets or income coming from that country. ln(mtb) is the natural logarithm of the market-to-book ratio. Lnta is the natural logarithm of banks' total assets. Capital ratio is the banks' total capital ratio. ln(tenure) is the natural logarithm of CEO's tenure, ln(salary) the natural logarithm of CEOs' fixed salary. Estimation is done using two-stage-least-squares. Kleibergen-Paap denotes the Kleibergen-Paap rk LM statistic. All equations contain year dummies, country dummies and bank specialization dummies.

	Panel A: Systematic risk			Panel B: Distance-to-default		
	beta	vega	delta	DTD	vega	delta
beta		0.619	1.312			
		(2.97)	(1.51)			
DTD					-1.380	0.883**
					(1.40)	(0.43)
ln(vega)	0.105***		0.091	-0.107		0.249***
	(0.04)		(0.15)	(0.07)		(0.07)
ln(delta)	-0.122*	0.588		0.294*	0.921	
	(0.07)	(0.44)		(0.16)	(0.60)	
$\ln(\text{mtb})_{t-1}$	0.011	-0.213	0.194***	0.132***	0.029	0.009
	(0.03)	(0.25)	(0.04)	(0.04)	(0.32)	(0.10)
lnta_{t-1}	0.024	-0.038	0.346***	0.134**	0.089	0.132
	(0.03)	(0.25)	(0.06)	(0.06)	(0.26)	(0.12)
$\text{capital ratio}_{t-1}$	-0.994	-2.716	1.768	25.386***	30.510	-21.819*
	(1.33)	(12.84)	(3.23)	(3.37)	(34.19)	(11.33)
economic condition	0.790**			5.834**		
	(0.36)			(2.51)		
ln(salary)		2.298**			2.023**	
		(1.17)			(0.79)	
ln(tenure)			0.387***			0.243***
			(0.09)			(0.08)
N	501	501	501	502	502	502
Kleibergen-Paap	9.59***	9.21***	3.22*	9.15***	6.91**	13.90***

stricted stocks like normal stocks correctly reflects the incentive structure of CEO compensation contracts. Bank risk and CEO incentives are thought to be chosen simultaneously, depending on bank characteristics. Panel A in Table 10 shows the results for the model with the standard deviation of equity as proxy for bank risk, the specification in Panel B uses idiosyncratic risk as a proxy for risk. Table 11 contains two systems' specifications. Panel A shows the specification with systematic risk, in Panel B the distance-to-default is the measure of bank risk.

I find that high vega contracts lead to higher volatilities, higher idiosyncratic and systematic risk and lower values for the distance-to-default. The effect of delta on bank risk goes in the opposite direction. These findings are in line with the hypotheses formulated above and with the findings in the literature on US firms (Coles et al. (2006)) and on US banks (DeYoung et al. (2009)). It partially contradicts the findings of Fahlenbrach and Stulz (2009) who do not find any impact of compensation on risk taking during the financial crisis. Option based compensation leading to high vega contracts induces managers to increase bank risk whereas stock holdings make CEOs more vulnerable to stock price decreases and therefore reduce their incentive to increase risk. One has however to remember that in times of crisis when the equity option goes from deep in the money to at the money risk taking incentives from stocks increase while option vega most likely declines.

The effects of incentive measures on bank risk are smaller than those documented in the literature on US banks (DeYoung et al. (2009)), which could be due to differences in the sample or because the effect is significant but smaller for non-US banks. A 10% increase in vega leads to a 0.4% increase in risk while a 10% increase in delta reduces risk by 0.85%. Similary Idiosyncratic risk increases by 0.32% for a 10% change in vega and decreases by 0.51% for a 10% increase in delta. Coefficients for systematic risk are higher and therefore indicate that managers alter bank risk to a larger extend by increasing the banks' beta, in line with the theoretical predictions of Landier et al. (2010). A 10% increase in vega leads to 1% higher systematic risk

and a 10% increase in delta to a 1.7% decrease in systematic risk. It is not just equity risk that is influenced by managerial incentives but also the overall risk of default. A 10% increase in vega reduces the bank's distance to default by 1.9% and a 10% increase in delta to an increase by 4.8% .

Equations two and three of each panel show how compensation is set. Coefficients on the risk measure in the delta and vega equations have the expected sign, with high risk inducing higher delta and lower vega contracts, but are not or just marginally significant. The Kleibergen-Paap rk LM statistic is in all but two equations significantly different from zero and the null-hypothesis of under-identification can be rejected.

4.1.3 CEO incentives and bank policy

In this sub-section I will focus on the channels through which banks increase risk. 12 shows the results of three simultaneous equation models with fee-based income, tier 1 ratio and total capital ratio as bank policy variables. Bank policies, vega and delta are thought to be chosen simultaneously taking into account lagged bank characteristics. The results show that banks with high vega and low delta CEOs obtain a higher proportion of total income from fee-based activities, which are presumably riskier than the traditional lending business. Similarly high delta contracts are associated with higher capital ratios whereas the effect of vega goes in the opposite direction. There is no effect of CEO incentives on Tier 1 capital, most likely because compliance to capital regulation prevents banks from lowering Tier 1 ratios to increase risk.

At the means of the data a 10% increase in vega leads to a 0.2% lower capital ratio while a 10% increase in delta yields a 0.76% higher ratio. Similary a 10% in vega increases fee based income by 0.85% and an increase in delta by the same amount reduces it by 7%.

Table 10: Simultaneous equation model of bank risk and CEO incentives for the period 2000 to 2006. Bank risk is represented by the standard deviation of daily stock returns (Panel A) and idiosyncratic risk (Panel B) derived from an industry CAPM model. CEO incentives are the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent change in stock price (delta) and to a 0.01 increase in volatility (vega). Economic condition is the GDP growth in each country waited by the banks share of assets or income coming from that country. ln(mtb) is the natural logarithm of the market-to-book ratio. Lnta is the natural logarithm of banks' total assets. Capital ratio is the banks' total capital ratio. ln(tenure) is the natural logarithm of CEO's tenure, ln(salary) the natural logarithm of CEOs' fixed salary. Estimation is carried out using two-stage-least-squares. Kleibergen-Paap denotes the Kleibergen-Paap rk LM statistic. All equations contain year dummies, country dummies and bank specialization dummies.

	Panel A: Total risk			Panel B: Idiosyncratic risk		
	sigma	vega	delta	idiosyn.	vega	delta
sigma		-6.632	4.334			
		(15.66)	(5.95)			
idiosyn.					-119.288	168.086
					(388.42)	(163.58)
ln(vega)	0.014***		0.049	0.001**		0.008
	(0.01)		(0.09)	(0.00)		(0.12)
ln(delta)	-0.029**	0.707		-0.001*	0.684	
	(0.01)	(0.47)		(0.00)	(0.43)	
$\ln(\text{mtb})_{t-1}$	0.014***	0.030	0.211***	0.001***	-0.059	0.165*
	(0.00)	(0.25)	(0.07)	(0.00)	(0.24)	(0.09)
lnta_{t-1}	0.001	-0.087	0.420***	-0.001*	-0.093	0.531***
	(0.01)	(0.33)	(0.09)	(0.00)	(0.46)	(0.17)
capital ratio_{t-1}	-0.291	-20.556	1.089	-0.015	-18.695	2.544
	(0.27)	(16.25)	(3.50)	(0.01)	(17.53)	(4.09)
economic condition	0.184***			0.008***		
	(0.06)			(0.00)		
ln(salary)		3.128**			3.215**	
		(1.30)			(1.38)	
ln(tenure)			0.449***			0.463***
			(0.10)			(0.10)
N	385	385	385	384	384	384
Kleibergen-Paap	8.08**	8.00**	6.08**	8.71**	10.20***	5.80**

Table 11: Simultaneous equation model of bank risk and CEO incentives for the period 2000 to 2006. Bank risk is represented by systematic risk (Panel A) and the distance-to-default (Panel B). CEO incentives are the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent change in stock price (delta) and to a 0.01 increase in volatility (vega). Economic condition is the GDP growth in each country waited by the banks share of assets or income coming from that country. ln(mtb) is the natural logarithm of the market-to-book ratio. Lnta is the natural logarithm of banks' total assets. Capital ratio is the banks' total capital ratio. ln(tenure) is the natural logarithm of CEO's tenure, ln(salary) the natural logarithm of CEOs' fixed salary. Estimation is carried out using two-stage-least-squares. Kleibergen-Paap denotes the Kleibergen-Paap rk LM statistic. All equations contain year dummies, country dummies and bank specialization dummies.

	Panel A: Systematic risk			Panel B: Distance-to-default		
	beta	vega	delta	DTD	vega	delta
beta		-0.996	0.906			
		(3.18)	(1.26)			
DTD					3.201	0.310
					(6.13)	(0.38)
ln(vega)	0.091***		0.032	-0.162***		0.146***
	(0.03)		(0.12)	(0.06)		(0.05)
ln(delta)	-0.144**	0.668		0.418**	-0.037	
	(0.06)	(0.46)		(0.17)	(1.81)	
$\ln(\text{mtb})_{t-1}$	0.043**	-0.096	0.228***	0.092	-0.411	0.178**
	(0.02)	(0.18)	(0.04)	(0.07)	(0.67)	(0.08)
$\ln\text{ta}_{t-1}$	0.042	0.011	0.386***	0.126	-0.485	0.282***
	(0.03)	(0.31)	(0.06)	(0.08)	(0.89)	(0.10)
capital ratio_{t-1}	0.099	-17.081	-0.119	28.924***	-117.089	-9.127
	(1.34)	(13.40)	(2.67)	(3.71)	(192.33)	(11.51)
economic condition	0.905***			4.692		
	(0.35)			(2.87)		
ln(salary)		3.261**			4.351	
		(1.44)			(2.99)	
ln(tenure)			0.447***			0.343***
			(0.10)			(0.08)
N	384	384	384	385	385	385
Kleibergen-Paap	8.76***	7.62***	4.80**	8.65***	1.05	3.71*

As in the bank risk equations in the previous subsection none of the bank policy variables has a significant impact on the compensation contracts of the CEO.

4.1.4 Regulation

DeYoung et al. (2009) argue that after deregulation in the United States bank business policies became more sensitive to CEO risk taking incentives, that boards of high risk banks decreased the risk taking incentives of their CEOs and that incentives were used to encourage CEOs to exploit new growth opportunities. My international dataset allows me to check more directly the impact of regulation on compensation and on the way it influences risk and policy variables. A strong regulator may be able to force banks to set incentives more in line with the banks risk bearing abilities or to limit the CEOs possibilities to act on her incentives. I therefore expect in countries with strong regulation the effect of vega on risk to be lower and on the other side risk taking incentives to be lower when bank risk is high.

To test these hypotheses I construct a measure of regulator power from the Worldbank indexes on official supervisory power, supervisory independence and Capital. The variable Regulation is calculated as the sum of the three indexes standardized for each year. The model estimated is an extended version of the one used in the previous subsection, where the regulatory variable is interacted with each of the endogenous variables sigma, delta and vega. The identifying variables are cash salary, tenure, the economic environment and the interaction of each of these variables with the regulatory measure. Estimation is carried out using two-stage-least-squares with the same control variables as in the previous subsection.

The results in Table 13 show that when regulation increases bank boards seem to react more to bank risk when setting the compensation of the CEO. A result that can be directly related to the recent regulatory proposals on by the European Commission "prompt remedial actions", as described in the previous section. It seems that strong regulators do have the ability to change the way banks set their

Table 12: Simultaneous equation model of bank policies and CEO incentives for the period 2000 to 2006. Bank policies are represented by the ratio of fee-based income to total income (Panel A), the Tier 1 ratio (Panel B) and the total capital ratio (Panel C). CEO incentives are the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent change in stock price (delta) and to a 0.01 increase in volatility (sigma). Economic condition is the GDP growth in each country waited by the banks share of assets or income coming from that country. ln(mtb) is the natural logarithm of the market-to-book ratio. Lnta is the natural logarithm of banks' total assets. Capital ratio is the banks' total capital ratio. ln(tenure) is the natural logarithm of CEO's tenure, ln(salary) the natural logarithm of CEOs' fixed salary. Estimation is carried out using two-stage-least-squares. Kleibergen-Paap denotes the Kleibergen-Paap rk LM statistic. All equations contain year dummies, country dummies and bank specialization dummies.

	Panel A: Fee-based income			Panel B: Total Capital			Panel C: Tier 1		
	Non-interest	vega	delta	Total Capital	vega	delta	Tier 1 Capital	vega	delta
non-interest		-0.026	0.034						
		(0.21)	(0.09)						
capital ratio					-71.178	-1.179			
					(64.84)	(11.69)			
T1 ratio								2.473	0.312
								(3.98)	(0.71)
ln(vega)	0.144**		0.114**	-0.001*		0.132***	0.157		0.105
	(0.07)		(0.05)	(0.00)		(0.04)	(0.19)		(0.11)
ln(delta)	-1.199***	0.583		0.004*	0.764		-0.142	0.657	
	(0.46)	(0.54)		(0.00)	(0.48)		(0.31)	(1.01)	
$\ln(\text{mtb})_{t-1}$	0.418***	-0.006	0.269***	0.002	0.073	0.263***	0.753***	-1.993	0.056
	(0.11)	(0.18)	(0.04)	(0.00)	(0.24)	(0.04)	(0.25)	(3.23)	(0.54)
lnta_{t-1}	0.429**	-0.125	0.401***	-0.004***	-0.299	0.378***	-0.449	0.930	0.565
	(0.19)	(0.27)	(0.06)	(0.00)	(0.30)	(0.05)	(0.44)	(1.68)	(0.36)
$\text{capital ratio}_{t-1}$	-27.119	-17.566	-1.099						
	(22.73)	(14.02)	(2.81)						
economic condition	12.41			-0.060			3.298		
	(9.35)			(0.04)			(5.27)		
salary		0.000***			0.000***			0.000*	
		(0.00)			(0.00)			(0.00)	
tenure			0.093***			0.088***			0.095***
			(0.01)			(0.01)			(0.02)
Constant	-0.608	3.931	0.386	0.101***	8.216	-1.858	18.489**	-41.072	-5.312
	(3.27)	(5.70)	(1.35)	(0.03)	(7.33)	(1.19)	(8.18)	(67.80)	(12.90)
N	369	369	369	385	383	383	334	334	334
Kleibergen-Paap	9.08***	1.75	2.76*	8.84***	6.02**	5.13**	7.56***	2.53	0.38

Table 13: Simultaneous equation model of bank policies and CEO incentives for the period 2000 to 2006 with Regulation interaction terms. Bank policies are represented by total risk (Panel A), idiosyncratic risk (Panel B) and the ratio of non-interest income to total income (Panel C). CEO incentives are the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent change in stock price (delta) and to a 0.01 increase in volatility (sigma). Economic condition is the GDP growth in each country waited by the banks share of assets or income coming from that country. ln(mtb) is the natural logarithm of the market-to-book ratio. Lnta is the natural logarithm of banks' total assets. Capital ratio is the banks' total capital ratio. ln(tenure) is the natural logarithm of CEO's tenure, ln(salary) the natural logarithm of CEOs' fixed salary. Estimation is carried out using two-stage-least-squares. Kleibergen-Paap denotes the Kleibergen-Paap rk LM statistic. All equations contain year dummies, country dummies and bank specialization dummies.

	Panel A: Total risk			Panel B: Idiosyncratic risk			Panel C: Non-interest income		
	total risk	vega	delta	Idiosyncratic risk	vega	delta	Non-interest	vega	delta
sigma		-4.812	2.203						
		(17.63)	(5.23)						
idiosyn					120.059	17.479			
					(366.40)	(120.14)			
feebased								0.866	0.225
								(1.29)	(1.15)
ln(vega)	0.017**		0.006	0.001*		0.115	0.059		-0.088
	(0.01)		(0.14)	(0.00)		(0.10)	(0.51)		(0.93)
ln(delta)	-0.032**	1.172		-0.001*	0.325		-0.895*	3.825*	
	(0.02)	(0.83)		(0.00)	(0.46)		(0.51)	(2.01)	
regXsigma		-1.645**	0.205						
		(0.83)	(0.22)						
regXidiosyn					-145.240*	23.432			
					(78.56)	(19.89)			
regXfee								1.025	-0.342
								(1.20)	(1.29)
regXvega	-0.001		0.016	-0.000		-0.044	0.106		0.015
	(0.00)		(0.03)	(0.00)		(0.03)	(0.31)		(0.10)
regXdelta	-0.000	-0.634		0.000	0.119*		-0.049	-0.122	
	(0.01)	(0.58)		(0.00)	(0.07)		(0.21)	(0.11)	
N	385	385	385	384	384	384	369	369	369
Kleibergen-Paap	6.94***	6.53***	4.66**	1.95	8.76***	6.77**	1.51	4.12**	0.10

compensation structure. Bank boards may either adjust the incentive structure ex-ante in order to avoid regulatory interventions or regulators might directly impact the compensation structure if deemed inappropriately high. Although these findings show the potential effect regulation can have on CEO incentives it is noteworthy that among the countries with high values on the compound regulatory strength index are the United States. In line with the descriptive findings of the previous section, this casts some doubt on the sufficiency of the proposed changes in regulation.

4.1.5 Governance

Regulation supposedly impacts the risk incentive relationship by putting external pressure on decision makers within the banks, the executive board members, the supervisory board and the remuneration committee. In the light of regulatory efforts to implement governance systems that align compensation policies with prudent risk taking, a better understanding of the interaction between governance and compensation is desirable. While regulators seem to believe that good corporate governance practices - such as an independent and active remuneration committee, or a supervisory board that consists mainly of independent board members - are desirable, it is not clear from a theoretical point of view if such governance systems are effective in curbing excessive CEO pay structures. To test this relationship I modify the previous model by using measures of governance quality instead of measures of regulatory strength as interaction terms. For the sake of brevity results are not reported here, but none of the governance mechanisms did show any impact on the way incentives impact bank risk or on the way bank risk influences incentives. The measures used were the standard good corporate governance measures, the size of the board, the number of independent board members or the frequency of board meetings. Results for the remuneration committee were the same.

4.1.6 Differences between the US and the rest of the world

One policy relevant objective of this study is to see how CEO compensation influences bank policies and bank risk throughout the world and whether the results found for US banks and US firms can be generalized. So far I have documented that in a pooled sample of US and non-US banks high risk taking incentives lead to higher bank risk and riskier bank policies, coefficients are however smaller than documented in the US literature. To further investigate the differences between the US and the rest of the world I estimate the same seven simultaneous equation models for the non-US banks only. Sample size is reduced substantially such that some of the results have to be seen with caution.

The results in Tables 14, 15 and 16 exhibit a couple of findings that differ from the full sample results. First of all the risk reducing effect of delta mostly disappears in the non-US dataset, while the risk inducing effect of vega mostly remains. When looking at Table 1 that US banks are granting much larger packages of plain stocks to their CEO and therefore it is not surprising that the delta component plays a much more important part in the United States than outside the United States. This finding should also be reassuring for regulators' efforts to encourage banks to increase the stock based part of variable compensation. Second, the delta and vega equations show some more evidence for banks' efforts to adjust the different components of their compensation schemes. Delta in the vega-equation and vega in the delta-equation are more frequently significantly positive than in the full sample, indicating that bank boards or their compensation committees may be more active outside the US when adjusting the different components of compensation. However there is no evidence that banks would react to their own risk when setting up the remuneration contracts.

To conclude, it seems that the strength of the regulator matters for the way banks set their CEO's compensation while corporate governance mechanisms do not play a major role or their effectiveness is not captured by the standard measures of good corporate governance. I will investigate both issues in more detail in section 6

Table 14: Simultaneous equation model of bank risk and CEO incentives for the period 2000 to 2006 and for banks headquartered outside the United States. Bank risk is represented by the standard deviation of daily stock returns (Panel A) and idiosyncratic risk (Panel B) derived from an industry CAPM model. CEO incentives are the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent change in stock price (delta) and to a 0.01 increase in volatility (vega). Economic condition is the GDP growth in each country waited by the banks share of assets or income coming from that country. ln(mtb) is the natural logarithm of the market-to-book ratio. Lnta is the natural logarithm of banks' total assets. Capital ratio is the banks' total capital ratio. ln(tenure) is the natural logarithm of CEO's tenure, ln(salary) the natural logarithm of CEOs' fixed salary. Estimation is carried out using two-stage-least-squares. Kleibergen-Paap denotes the Kleibergen-Paap rk LM statistic. All equations contain year dummies, country dummies and bank specialization dummies.

	Panel A: Total risk			Panel B: Idiosyncratic risk		
	sigma	vega	delta	idiosyn	vega	delta
sigma		-2.095	-1.672			
		(10.51)	(5.45)			
idiosyn.					-421.458	100.549
					(841.33)	(265.17)
ln(vega)	0.010*		0.196***	0.000		0.164***
	(0.01)		(0.04)	(0.00)		(0.04)
ln(delta)	-0.030	0.656		0.000	0.980	
	(0.02)	(0.84)		(0.00)	(0.83)	
$\ln(\text{mtb})_{t-1}$	0.027**	0.260	0.188	0.000	-0.461	0.078
	(0.01)	(0.64)	(0.15)	(0.00)	(0.66)	(0.20)
lnta_{t-1}	0.000	-0.493	0.332***	-0.001***	-0.707	0.429*
	(0.01)	(0.54)	(0.09)	(0.00)	(1.09)	(0.23)
$\text{capital ratio}_{t-1}$	0.609	-82.967***	5.490	-0.007	-101.661***	1.186
	(0.57)	(24.79)	(7.00)	(0.02)	(29.21)	(6.46)
economic condition	0.345***			0.006*		
	(0.08)			(0.00)		
ln(salary)		5.503**			5.440**	
		(2.46)			(2.54)	
ln(tenure)			0.320***			0.373***
			(0.11)			(0.09)
N	206	206	206	205	205	205
Kleibergen-Paap	9.28***	14.45***	3.41*	10.54***	2.87*	3.91*

Table 15: Simultaneous equation model of bank risk and CEO incentives for the period 2000 to 2006 and for banks headquartered outside the United States. Bank risk is represented by systematic risk (Panel A) and the distance-to-default (Panel B). CEO incentives are the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent change in stock price (delta) and to a 0.01 increase in volatility (vega). Economic condition is the GDP growth in each country waited by the banks share of assets or income coming from that country. ln(mtb) is the natural logarithm of the market-to-book ratio. Lnta is the natural logarithm of banks' total assets. Capital ratio is the banks' total capital ratio. ln(tenure) is the natural logarithm of CEO's tenure, ln(salary) the natural logarithm of CEOs' fixed salary. Estimation is carried out using two-stage-least-squares. Kleibergen-Paap denotes the Kleibergen-Paap rk LM statistic. All equations contain year dummies, country dummies and bank specialization dummies.

	Panel A: Systematic risk			Panel B: Distance-to-default		
	beta	vega	delta	distance	vega	delta
beta		-4.177	0.229			
		(7.06)	(1.84)			
DTD					-2.413	0.593
					(1.99)	(0.46)
ln(vega)	0.045**		0.171***	-0.131**		0.220***
	(0.02)		(0.07)	(0.06)		(0.04)
ln(delta)	-0.052	0.817		0.337	1.378*	
	(0.07)	(0.78)		(0.23)	(0.79)	
$\ln(\text{mtb})_{t-1}$	-0.016	-0.834	0.130	0.752***	1.911	-0.362
	(0.04)	(0.76)	(0.12)	(0.21)	(1.75)	(0.42)
lnta_{t-1}	0.040	-0.245	0.344***	0.054	-0.292	0.270**
	(0.03)	(0.61)	(0.08)	(0.11)	(0.51)	(0.11)
$\text{capital ratio}_{t-1}$	4.605**	-93.951***	-0.461	40.580***	37.251	-23.790
	(1.87)	(25.80)	(9.93)	(7.13)	(101.88)	(20.46)
economic condition	0.754**			5.815		
	(0.37)			(3.79)		
ln(salary)		6.154**			3.558**	
		(3.04)			(1.70)	
ln(tenure)			0.385***			0.313***
			(0.09)			(0.11)
N	205	205	205	206	206	206
Kleibergen-Paap	10.34***	3.00*	4.90*	9.37***	3.65*	3.34*

Table 16: Simultaneous equation model of bank policies and CEO incentives for the period 2000 to 2006 and for banks headquartered outside the United States. Bank policies are represented by the ratio of fee-based income to total income (Panel A), the Tier 1 ratio (Panel B) and the total capital ratio (Panel C). CEO incentives are the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent change in stock price (delta) and to a 0.01 increase in volatility (sigma). Economic condition is the GDP growth in each country waited by the banks share of assets or income coming from that country. ln(mtb) is the natural logarithm of the market-to-book ratio. Lnta is the natural logarithm of banks' total assets. Capital ratio is the banks' total capital ratio. ln(tenure) is the natural logarithm of CEO's tenure, ln(salary) the natural logarithm of CEOs' fixed salary. Estimation is carried out using two-stage-least-squares. Kleibergen-Paap denotes the Kleibergen-Paap rk LM statistic. All equations contain year dummies, country dummies and bank specialization dummies.

	Panel A: Fee-based income			Panel B: Total Capital			Panel C: Tier 1		
	Fee-based	vega	delta	Total Capital	vega	delta	Tier 1 Capital	vega	delta
non-interest		0.209	-0.003						
		(0.41)	(0.14)						
capital ratio					-102.562	10.827			
					(108.89)	(24.72)			
T1 ratio								3.497	-2.011
								(6.62)	(3.43)
ln(total vega)	0.110		0.184***	-0.002***		0.194***	0.021		0.218**
	(0.13)		(0.04)	(0.00)		(0.03)	(0.06)		(0.10)
ln(total delta)	-0.970	1.060		0.008***	1.066		0.008	0.367	
	(0.84)	(0.85)		(0.00)	(1.06)		(0.23)	(1.43)	
$\ln(\text{mtb})_{t-1}$	-0.791	0.205	0.209	0.001	0.448	0.150	0.608**	-1.859	1.440
	(0.79)	(0.74)	(0.21)	(0.00)	(0.61)	(0.15)	(0.26)	(3.87)	(1.98)
lnta_{t-1}	0.770	-0.755	0.369***	0.001	-0.485	0.306***	-0.077	-0.677	0.276
	(0.57)	(0.48)	(0.07)	(0.00)	(0.43)	(0.10)	(0.14)	(0.71)	(0.28)
$\text{capital ratio}_{t-1}$	-86.221	-62.078	-3.213						
	(75.87)	(47.25)	(9.75)						
salary		0.000***			0.000**			0.000**	
		(0.00)			(0.00)			(0.00)	
tenure			0.104***			0.087***			0.150*
			(0.02)			(0.03)			(0.09)
economic condition	11.696			-0.066			-3.670		
	(10.32)			(0.05)			(5.28)		
N	190	190	190	206	204	204	202	202	202
Kleibergen-Paap	12.12***	1.35	1.44	16.87***	4.76*	5.91**	7.76**	0.63	0.39

5 Managerial compensation and the financial crisis

Beltratti and Stulz (2009) try to explain bank returns after the Lehman collapse by looking at bank-level governance, country level regulation and bank balance sheets. On the bank-governance side they find that banks with shareholder friendly boards performed worse during the crisis, but they cannot identify an effect of compensation policy proxies on bank returns. Fahlenbrach and Stulz (2009) use US-data on CEO compensation to identify the effect of stock and option based CEO compensation on banks' performance during the recent financial crisis. They find not only that high risk taking incentives and strong alignment with shareholders' interests had no impact on a bank's performance during the crisis, but also that CEOs' portfolio values declined considerably. There seems to be no evidence of CEOs foreseeing the financial downturn and reducing their exposure to stocks.
In general we would expect banks to perform better in a stricter regulatory environment, with CEOs well aligned to bank performance and with little risk taking incentives. A compensation structure rewarding long-term performance rather than short term profits would be considered favorable.

I follow the approach of Fahlenbrach and Stulz (2009) and try to explain stock market returns and accounting measures of performance (ROA and ROE) during the financial crisis in my international sample. Different to Fahlenbrach and Stulz (2009) I use four different measures of risk taking incentives. The option vega, vega from stocks and options and vega from stocks, options and restricted stocks. To take into account that most likely risky bank policies have not been implemented just before the crisis but that exposure to risk has been implemented over several years I take not only the level of vega in 2006 but also the average vega over the years 2001 to 2006 into account. Additionally the ratio of cash bonus to salary is taken as

a proxy for short term risk taking incentives. Bonus payments are typically based on accounting measures and related to the previous fiscal year, which makes this a backward looking measure. However it is interesting to include because different to options, short term bonus programs may give incentives to increase short-term profits while reducing long-term returns.
Control variables are chosen to represent the regulatory environment (Rights, Official, Capital, Independence, Private Monitoring) and bank characteristics (Size, Market-to-book ratio, Capital ratio). Banks with high levels of capital are thought to be less dependent on outside financing when markets freeze up. Lagged returns are included to control for the possibility that banks engaged in risky strategies with large tail risks that paid high returns just before the crisis but performed much worse during the crisis.

In line with the findings of Fahlenbrach and Stulz (2009) the results in Table 17 show that CEO risk taking incentives had little effect on the equity returns of banks during July 2007 and December 2008 in an international sample. The regressions in Table 17 use delta and vega from options, column one and four, from options and stocks, columns two and five and from stocks, options and restricted stocks, columns three and six. The first three regressions models use incentive variables from the year 2006 while in columns four to six the average incentives over the years 2001 to 2006 are used. For most of the specifications neither high vega contracts, nor low delta contracts, nor high bonuses had a negative influence on returns. The signs of the coefficients point however in the predicted direction. One concern is that market participants overreacted during the hight of the financial crisis and did not value all banks correctly. I try to address this concern in Table 18 by showing that the results also hold for a longer sample period, July 2007 till April 2009, in which markets arguably calmed down and mispricing should have been less severe. Banks with higher capital ratios and higher market-to-book ratios performed better. when looking at the regulatory variables it seems that banks from countries with strong regulation performed worse while stricter capital requirements and better private monitoring had a positive effect.

Table 17: Regression of the stock market returns between July 2007 and December 2008 on bank characteristics, indexes representing the legal and regulatory environment and on variables describing CEO incentives. The only bank-year considered is 2006. Means are the averages over the period 2001-2006. Rights the anti-director rights index, official is an index of supervisory power, restrict is an index of regulatory restrictions on bank activities, independence measures to which degree supervisory authorities are independent from the government and legally protected from the banking system, capital is an index of regulatory capital restrictions, private monitoring is an index of the extent to which supervisory agencies encourage private monitoring.

Variable	Return July 2007 - December 2008					
delta option	0.013					
	(0.09)					
vega option	-0.132					
	(0.20)					
delta option & stock		-0.004				
		(0.03)				
vega option & stock		-0.075				
		(0.11)				
delta option & stock & rights			0.001			
			(0.02)			
vega option & stock & rights			-0.050			
			(0.09)			
mean(delta option)				0.347**		
				(0.14)		
mean(vega option)				-0.351		
				(0.23)		
mean(delta option & stock)					0.038	
					(0.03)	
mean(vega option & stock)					0.132	
					(0.17)	
mean(delta option & stock & right)						0.035
						(0.02)
mean(vega option & stock & right)						0.259**
						(0.10)
bonus ratio	-0.001	-0.007	-0.007			
	(0.00)	(0.00)	(0.00)			
mean(bonus ratio)				-0.005	-0.006	-0.004
				(0.00)	(0.00)	(0.00)
return 2005	-0.030	0.014	0.069	0.064	0.170	0.420*
	(0.28)	(0.31)	(0.27)	(0.24)	(0.33)	(0.20)
roaa	11.946	9.555	-9.953	2.529	-0.674	-15.935***
	(9.84)	(10.79)	(17.52)	(13.65)	(16.52)	(4.44)
capital ratio	4.557**	5.182**	8.264**	4.488**	5.300*	8.013***
	(1.70)	(2.06)	(3.43)	(1.97)	(2.64)	(1.88)
mtb	0.016**	0.017**	0.085	0.011***	0.011***	0.015**
	(0.01)	(0.01)	(0.06)	(0.00)	(0.00)	(0.01)
ln(ta)	0.010	0.000	0.003	0.001	-0.002	-0.010
	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
Rights	0.004	-0.022	-0.028	0.073**	0.083*	0.078*
	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)
Official	-0.036**	-0.044*	-0.055**	-0.024*	-0.032	-0.033
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Restrict	-0.007	-0.022*	-0.032	0.009	0.005	-0.004
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)
Capital	0.021	0.034*	0.069**	0.019	0.023	0.053**
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
Independence	0.094	0.126*	0.264*	0.046	0.070	0.166*
	(0.06)	(0.07)	(0.13)	(0.05)	(0.07)	(0.09)
private monitoring	0.157**	0.179**	0.138**	0.089*	0.082	0.050
	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)
Constant	-2.192***	-1.922**	-2.110*	-1.859**	-1.752	-1.658
	(0.74)	(0.88)	(1.13)	(0.74)	(1.03)	(1.00)
R^2	0.370	0.335	0.355	0.485	0.448	0.587
N	86	74	64	74	66	57

Table 18: Regression of the stock market returns between July 2007 and March 2009 on bank characteristics, indexes representing the legal and regulatory environment and on variables describing CEO incentives. The only bank-year considered is 2006. Means are the averages over the period 2001-2006. Deposit is ratio the ratio of deposits to total assets. Rights the anti-director rights index, official is an index of supervisory power, restrict is an index of regulatory restrictions on bank activities, independence measures to which degree supervisory authorities are independent from the government and legally protected from the banking system, capital is an index of regulatory capital restrictions, private monitoring is an index of the extent to which supervisory agencies encourage private monitoring.

Variable	Return July 2007 - April 2009					
delta option	0.014					
	(0.10)					
vega option	-0.220					
	(0.20)					
delta option & stock		-0.016				
		(0.03)				
vega option & stock		-0.129				
		(0.10)				
delta option & stock & rights			-0.018			
			(0.02)			
vega option & stock & rights			-0.151			
			(0.10)			
mean(delta option)				0.368**		
				(0.13)		
mean(vega option)				-0.394		
				(0.24)		
mean(delta option & stock)					0.046	
					(0.04)	
mean(vega option & stock)					0.142	
					(0.16)	
mean(delta option & stock & right)						0.057
						(0.03)
mean(vega option & stock & right)						0.238**
						(0.11)
bonus ratio	-0.001	-0.007	-0.007			
	(0.00)	(0.01)	(0.00)			
mean(bonus ratio)				-0.001	-0.003	-0.001
				(0.01)	(0.01)	(0.01)
return 2005	-0.021	0.071	0.313	0.120	0.287	0.468*
	(0.32)	(0.36)	(0.29)	(0.25)	(0.34)	(0.23)
capital ratio	2.455	2.054	7.322*	2.395	2.639	5.014
	(1.84)	(2.26)	(3.69)	(1.65)	(2.60)	(3.12)
roaa	9.187	6.152	-21.342	-4.535	-9.247	-22.273***
	(9.81)	(9.80)	(18.71)	(10.64)	(12.56)	(4.44)
mtb	0.014	0.015	0.116**	0.014***	0.013***	0.019**
	(0.01)	(0.01)	(0.05)	(0.00)	(0.00)	(0.01)
ln(ta)	0.002	-0.013	0.015	-0.012	-0.023	-0.034
	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Rights	0.018	-0.001	0.032	0.100***	0.124**	0.114**
	(0.04)	(0.05)	(0.06)	(0.03)	(0.05)	(0.05)
Official	-0.034*	-0.034	-0.036	-0.017	-0.020	-0.022
	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
Restrict	0.019	0.014	0.039	0.017	0.018	0.001
	(0.02)	(0.02)	(0.03)	(0.01)	(0.01)	(0.02)
Capital	-0.008	-0.001	-0.013	0.013	0.011	0.042
	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
Independence	0.028	0.015	-0.022	0.047	0.040	0.154
	(0.06)	(0.08)	(0.11)	(0.05)	(0.08)	(0.11)
private monitoring	0.179**	0.196**	0.180**	0.078	0.068	0.037
	(0.07)	(0.07)	(0.07)	(0.06)	(0.07)	(0.08)
Constant	-2.043**	-1.597*	-2.703**	-1.543	-1.234	-1.008
	(0.74)	(0.86)	(1.14)	(0.93)	(1.13)	(1.17)
R^2	0.280	0.260	0.307	0.380	0.355	0.470
N	87	75	65	74	66	57

Table 19: Regression of the return on assets between the 3rd quarter 2007 and the 4th quarter 2008 on bank characteristics, indices representing the legal and regulatory environment and on variables describing CEO incentives. The only bank-year considered is 2006. Means are the averages over the period 2001-2006. Rights the anti-director rights index, official is an index of supervisory power, restrict is an index of regulatory restrictions on bank activities, independence measures to which degree supervisory authorities are independent from the government and legally protected from the banking system, capital is an index of regulatory capital restrictions, private monitoring is an index of the extent to which supervisory agencies encourage private monitoring.

Variable	Return on Assets 3rd quarter 2007 - 4th quarter 2008					
delta option	0.057***					
	(0.00)					
vega option	-0.100***					
	(0.01)					
delta option & stock		0.018***				
		(0.00)				
vega option & stock		-0.040***				
		(0.01)				
delta option & stock & rights			0.017***			
			(0.00)			
vega option & stock & rights			-0.034***			
			(0.01)			
mean(delta option)				0.049**		
				(0.02)		
mean(vega option)				-0.058**		
				(0.03)		
mean(delta option & stock)					0.003	
					(0.00)	
mean(vega option & stock)					0.004	
					(0.01)	
mean(delta option & stock & right)						0.003
						(0.00)
mean(vega option & stock & right)						0.008
						(0.01)
bonus ratio	-0.000***	-0.001	-0.001			
	(0.00)	(0.00)	(0.00)			
mean(bonus ratio)				-0.000	-0.000	-0.000
				(0.00)	(0.00)	(0.00)
return 2005	0.021	0.066*	0.052*	0.038*	0.061*	0.065**
	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)
capital ratio	0.014	-0.056	0.020	0.284***	0.282***	0.290**
	(0.09)	(0.08)	(0.08)	(0.08)	(0.10)	(0.10)
mtb	0.002**	0.001*	0.003	0.002	0.001	0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ln(ta)	-0.001	-0.000	-0.002	0.002	0.002	0.002
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Rights	0.004**	0.007	0.004	0.007***	0.008**	0.007**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Official	0.002	0.002*	0.001	0.001	0.002	0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Restrict	-0.000	-0.000	-0.004*	-0.000	-0.000	-0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Capital	0.001	0.000	0.005**	0.002	0.001	0.004**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Independence	0.001	0.003	0.025***	0.004*	0.004	0.014***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
private monitoring	0.004	-0.002	-0.006*	-0.002	-0.007**	-0.010***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.029	-0.036	0.002	-0.106	-0.096	-0.091
	(0.07)	(0.15)	(0.15)	(0.08)	(0.12)	(0.13)
R^2	0.625	0.575	0.679	0.489	0.414	0.490
N	78	67	57	68	61	52

Table 20: Regression of the return on equity between the 3rd quarter 2007 and the 4th quarter 2008 on bank characteristics, indices representing the legal and regulatory environment and on variables describing CEO incentives. The only bank-year considered is 2006. Means are the averages over the period 2001-2006. Rights the anti-director rights index, official is an index of supervisory power, restrict is an index of regulatory restrictions on bank activities, independence measures to which degree supervisory authorities are independent from the government and legally protected from the banking system, capital is an index of regulatory capital restrictions, private monitoring is an index of the extent to which supervisory agencies encourage private monitoring.

Variable	Return on Equity 3rd quarter 2007 - 4th quarter 2008					
delta option	1.696***					
	(0.35)					
vega option	-3.053***					
	(0.69)					
delta option & stock		0.522***				
		(0.19)				
vega option & stock		-1.181**				
		(0.46)				
delta option & stock & rights			0.489***			
			(0.10)			
vega option & stock & rights			-0.968***			
			(0.33)			
mean(delta option)				1.042**		
				(0.50)		
mean(vega option)				-1.360*		
				(0.74)		
mean(delta option & stock)					0.084	
					(0.06)	
mean(vega option & stock)					-0.136	
					(0.25)	
mean(delta option & stock & right)						0.084
						(0.07)
mean(vega option & stock & right)						-0.075
						(0.26)
bonus ratio	-0.013***	-0.036*	-0.032*			
	(0.00)	(0.02)	(0.02)			
mean(bonus ratio)				-0.007	-0.006	-0.004
				(0.01)	(0.01)	(0.01)
return 2005	-0.452	1.067**	0.775	0.405	0.841	0.943
	(0.60)	(0.49)	(0.50)	(0.42)	(0.56)	(0.61)
capital ratio	-3.852	-3.373	-1.449	5.078	6.114	6.532
	(3.88)	(5.52)	(4.96)	(3.39)	(4.99)	(5.55)
mtb	0.027*	0.011	-0.031	0.026**	0.022	0.029*
	(0.01)	(0.01)	(0.07)	(0.01)	(0.01)	(0.01)
ln(ta)	-0.058	0.017	-0.048	0.065	0.092	0.085
	(0.07)	(0.07)	(0.07)	(0.06)	(0.08)	(0.07)
Rights	0.010	0.195	0.161	0.197*	0.211	0.216
	(0.13)	(0.15)	(0.16)	(0.11)	(0.13)	(0.16)
Official	0.010	0.041	0.016	0.008	0.020	0.032
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)
Restrict	0.004	0.009	-0.076	0.022	0.011	-0.020
	(0.03)	(0.05)	(0.06)	(0.03)	(0.04)	(0.06)
Capital	0.010	-0.017	0.081	0.021	0.014	0.053
	(0.04)	(0.05)	(0.07)	(0.03)	(0.04)	(0.05)
Independence	-0.005	0.153	0.589**	0.090	0.158	0.322
	(0.08)	(0.16)	(0.26)	(0.06)	(0.12)	(0.21)
private monitoring	0.214	-0.040	-0.086	-0.042	-0.162	-0.221*
	(0.15)	(0.12)	(0.10)	(0.13)	(0.11)	(0.12)
Constant	0.116	-1.605	0.122	-3.096	-3.251	-3.180
	(2.03)	(2.43)	(2.36)	(2.01)	(2.55)	(2.38)
R^2	0.591	0.580	0.713	0.385	0.323	0.395
N	78	67	57	68	61	52

Table 19 and Table 20 show a different picture. Accounting performance seems to depend strongly on the incentives provided to the CEO. In Table 19 the dependent variable is the return on assets calculated from quarter three of 2007 till the fourth quarter of 2008 as net income over total assets.[14] In Table 20 the same exercise is done for return on equity. The incentive variables are specified as before, differentiating between option, stock and restricted stock based compensation and between the incentives in 2006 and in the five years before the crisis. For almost all the specifications return on equity and return on assets have been higher for banks with CEOs with high delta contracts in 2006. Moreover high vega banks performed worse, albeit coefficients are less significant.
An explanation for these results might be that stock markets overreacted and undervalued banks which were in fact healthier than their competitors. If that was the case the mispricing did however not vanish till April 2009, as we have seen in Table 18. Alternatively a contagion story could explain the results. Banks with different accounting performance where discounted equally by the market which incorporated the possibility of a spillover from weak banks to otherwise healthy banks. Such a discount would not necessarily be unwound over time which would be consistent with the results in Table Table 18. In many specifications banks performed worse if the CEOs received large bonuses just before the financial crisis. Bonus payments in the five year periods before the financial crisis however did not influence performance. This could be evidence in favor of myopic behavior before the onset of the crisis. Strategies that payed off in the very short run could have increased accounting performance, and therefore bonuses, just before the crisis. At the same time those strategies could have been profitable only in the short run, but value destroying in the long run.

Table 21 depicts the development of CEO wealth during the years 2006-2008.

[14]Not all the banks disclose quarterly financial statements and not all of the banks end their fiscal year in December which is why the sample size decreases compared to the regressions including equity returns.

Table 21: CEO wealth and CEO options characteristics after 2006. Stockholding is the dollar value of CEO stockholdings, Restricted is the dollar value of all restricted stocks, Option is the Black-Scholes value of option holdings. In the-money denotes the percentage of options in-the-money, vested the percentage of options vested and vested & in-the-money the percentage of options both in-the-money and vested.

Date	Stockholding	Restricted	Option	In-the-money	Vested	Vested & in-the-money	Options held	N
2006	38,247,656	10,769,000	16,752,301	94%	58%	53%	1,285,955	101
2007	47,460,514	10,519,361	13,080,124	72%	61%	47%	1,144,970	101
2008	17,436,215	3,954,155	9,261,759	51%	66%	44%	1,144,119	88
CEOs that stayed throughout the whole period								
2006	33,392,676	9,103,909	11,776,307	96%	55%	51%	1,092,480	61
2007	32,545,937	10,229,773	11,978,643	72%	59%	46%	1,114,761	61
2008	18,258,510	4,266,423	8,197,279	55%	69%	45%	1,221,738	61

While portfolio values were still increasing until 2007 they fell dramatically in 2008. To disentangle wealth loss from a drop in portfolio value because of a change in the position of the CEO I report also the portfolio values of CEO who stayed with their bank until 2009. Out of 101 CEOs in 2006 39 left their company during the period 2006-2009. The portfolio values of those staying dropped on average by around $ 23 million between 2006 and 2008 while the number of options outstanding even increased through new grants. Clearly CEOs did either not foresee the events or if they did they did not react to this insider information by selling their assets. One potential reason might be overconfidence as described in Malmendier and Tate (2005). A more detailed analysis of CEOs' exercise behavior is however left for future research.

6 Determinants of managerial compensation and bank regulation

In the previous section we have seen that banks from countries with powerful regulators are more sensitive to risk when setting compensation. It is of great importance - not only from an academic but also from a policymakers' point of view - to assess the impact of regulation and corporate governance mechanisms on how the banks set their compensation and therefore ultimately on how much risk a bank is taking.

6.1 Regulation and compensation

Strong regulatory authorities may reduce banks' incentive to implement high vega contracts, since expensive risk inducing contracts are less valuable for shareholders if supervisors do not allow banks to increase the riskiness of their business model. At the same time a powerful regulatory system is likely to reduce the demand for incentive alignment of CEOs because monitoring through the regulator would reduce the need to align incentives. Less stock based compensation would be the consequence. John and Qian (2003) interpret lower pay-performance sensitivities in banks than in manufacturing firms as evidence for this hypothesis. On the opposite one might argue that tough regulation incentivises shareholders to give higher risk taking incentives to the CEO as a countermeasure. Similarly strong regulation may be perceived as a guarantee against a systemic instability leading to less caution when incentivising CEOs. Strong shareholder rights should make it easier to align CEOs to the incentives and to the risk appetite of shareholders.

To understand the effect of regulation on managerial incentives I regress several characteristics of CEO compensation contracts on indices representing the supervisory environment. The indices are taken from Djankov et al. (2008) and Barth et al. (2001). Barth et al. (2001) conduct three cross-country surveys of how banks are regulated and supervised. The surveys have been completed in 2001, 2003 and 2007 respectively and I construct the following indices of regulatory power as described in Barth et al. (2004): *official* is an index of supervisory power, it measures the degree to which supervisory authorities may intervene in the banking system. *restrict* is an index of regulatory restrictions on bank activities, *independence* measures to which degree supervisory authorities are independent from the government and legally protected from the banking system. *capital* is an index capturing the stringency of the regulatory capital restrictions. It does not reflect the actual level of minimum capital requirements but the approach of the regulatory or supervisory

authorities towards assessing and verifying the funds used as regulatory capital. *Capital Requirement* is the regulatory minimum requirement. In most countries for most of the years it is set at 8% but about 10% of the countries in the sample have requirements between 8% and 12%. Additionally the existence of an explicit deposit insurance scheme has been documented by Demirg-Kunt et al. (2006) and is included as a dummy variable. *private monitoring* is an index which measures the extent of private monitoring, i.e. not by the regulatory authority, for each country. It measures for example the quality of disclosure requirements, director liability and audit requirements. The existence of an explicit deposit insurance scheme reduces the private monitoring index. *rights* measures shareholder protection with the revised anti-director rights index for each country as described in Djankov et al. (2008).

6.2 Corporate governance and compensation

Several studies have examined the impact of corporate governance on executive compensation, Core et al. (1999) for example find that less effective governance leads to higher executive compensation. Fahlenbrach (2008) argues that poor corporate governance is counterbalanced by compensation contracts that help better align CEOs' incentives. I use detailed information on the board of directors in general and on the compensation committee in specific to examine the impact of corporate governance on CEO compensation in the financial service industry.

The way corporate governance influences managerial compensation is not clear from a theoretical point of view. The so called substitution hypothesis predicts that firms with weaker governance structures would implement compensation contracts with high pay-for-performance sensitivities as substitutes for poor monitoring by the board of directors. At the same time the level of compensation might be higher to compensate the risk averse CEO for large bank-specific risk.
The entrechment hypothesis propagated by Bebchuk and Fried (2004) argue that weaker governance allows the CEO to extract rents through higher total compensation and lower pay-for-performance sensitivities.

Finally the complementarity hypothesis predicts that better governance leads to higher incentive pay, a board that understands the value of incentive pay to the firm's shareholders is more likely to implement such contracts. Hartzell and Starks (2003) for example find that institutional investors push for more equity based compensation.

To measure the quality of corporate governance on the board level I include the following variables: (1) Board size and the size of the compensation committee. Core and Guay (1999) for example argue that it is easier for the CEO to capture the board and that individual board members are less likely to be held accountable, implying less effective monitoring. (2) The fraction of independent directors both on the board and on the compensation committee. The empirical evidence is mixed. Yermack (1996) finds no evidence that a high fraction of outside directors is associated with CEO compensation, Mehran (1995) on the other hand can show that equity based compensation is higher for firms with more independent directors. (3) The number of board meetings and the number of compensation committee meetings. More frequent meetings may point towards a more active board that is better able to monitor the management. (4) Female is the ratio of female board members. Among others Barber and Odean (2001) document that women exhibit a smaller tendency to overconfidence and are more risk averse than men. A strong female presence on the board might therefore have an impact on the way executive compensation is structured.

The entrenchment hypothesis is tested by looking at variables that specifically rel;ate to the CEOs' ability to capture the board. (5) The CEO being also chairman of the board. Among others Core and Guay (1999) argue that CEO chair duality can cause agency problems. (6) The same argument is applicable to the CEO being part of the compensation committee. (7) CEO tenure is another proxy for entrenchment. After many years in the bank it is more likely that the CEO was able to form a board that is more loyal to him. Evidence for this hypothesis has been provided

by for example by Baker and Gompers (2002).

The control variables are drawn from the large body of literature that addresses the determinants of managerial compensation.[15] Bank size for opaqueness and firm complexity. Opaque banks may have a higher need for aligning CEOs' incentives because of high monitoring costs. The market-to-book ratio is connected to banks' investment opportunity set. Bank with more investment opportunities are more likely to provide managers with risk taking incentives to reduce costs from forgone high risk investment projects.[16] *Tenure* and *salary* represent both CEOs' possibility to diversify their wealth and managerial entrenchment. Diversified CEOs are less exposed to firm specific risk and therefore less averse to an increase of risk. Moreover banks will most likely adjust gradually to their CEOs target incentive levels. *cooperative & savings*, *investment*, *mortgage* are dummy variables for banks with a specialization different from a commercial bank or bank holding company, as reported by Bankscope.

6.3 Empirical results

The following two subsections show the impact of regulation and of corporate governance on compensation variables. Corporate governance variables are available for a subset of the original sample, specifically for a sample that includes only the five largest banks from each country. Regulatory variables on the other hand are available for the whole sample. All the regressions explaining the compensation structure contain year dummies and bank type dummies. Since most of the regulatory indices vary very little over time I show results with and without country dummies. As suggested by Petersen (2009) standard errors are clustered at the bank level to account

[15] In particular Guay (1999).

[16] E.g. Coles et al. (2006) find that firms with high R&D expenses implement high vega contracts. Hubbard and Palia (1995) report high delta contracts in deregulated banking markets.

for correlation across firms.[17]

6.3.1 Regulation

Table 22 shows how CEO incentives, measured as the logarithm of the sensitivity of CEOS' portfolio to an increase in volatility (vega) and to a change in stock price (delta), are related to the regulatory environment. The first two columns show regressions with year fixed effects only. Coefficients for Official supervisory power, independence of the regulator and the minimum capital ratio are all positive and significant, which points in the direction that stronger regulation leads banks to grant more incentive based pay. One concern is that unobservable country and firm specific factors are not properly captured by the control variables. Estimating country fixed effect models and firm fixed effect models could possibly solve this problem. The coefficient of these regressions however have to be looked at with caution since the time variation of the regulatory indices, although updated three times during the sample period is rather small. Columns three and four show a significantly positive coefficient for official supervisory power and a marginally significant coefficient for independence of the regulatory authority on the CEOs' vega. Including country fixed effects also increases the r-squared of the regression implying that compensation is largely set relative to country peers. Columns five and six show the same regressions using bank fixed effects. The coefficients for Official supervisory power and independence on vega stay significant and positive. All in all I interpret this as evidence for the hypothesis that banks reaction to strong regulation is to increase the risk taking incentives of there CEOs to counteract the stricter regulatory environment. It contradicts the findings of John and Qian (2003), who state that regulation and CEO incentives are substitutes.

[17] I follow mainly the approach of Fahlenbrach (2008) and estimate CEO compensation components as a function of firm characteristics, regulation, governance and fixed effects. An alternative would be to use a simultaneous equation approach as in the previous section. I refrain from this because GDP growth seems to be a weak instrument when including the financial crisis period.

Table 22: Regression of CEO incentives on variables capturing the regulatory environment and controls. ln(vega) is the logarithm of the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent to a 0.01 increase in volatility. ln(delta) is the logarithm of the sensitivity of CEOS' stock, option and restricted stock portfolio to a change in stock price. Official supervisory power measures the power of a country's regulator, Capital measures the regulatory approach towards bank capital, Independence the independence of the supervisor from litigations, private monitoring the extent to which banks are monitored by market participants other than the regulator, Restrict measures bank activity restrictions, Deposit Insurance the existence of an explicit deposit insurance scheme, minimum Capital ratio is the regulatory capital requirement, Shareholder rights is the Index of Djankov et al. (2008). Standard errors are clustered at the bank level.

Variable	ln(Vega)	ln(Delta)	ln(Vega)	ln(Delta)	ln(Vega)	ln(Delta)
ln(CEO tenure)	0.055	0.116***	0.019	0.088***	0.023	0.077***
	(0.05)	(0.02)	(0.05)	(0.02)	(0.09)	(0.01)
market-to-book	-0.299	0.191	-0.318	0.198**	-0.710*	0.196***
	(0.41)	(0.16)	(0.29)	(0.10)	(0.40)	(0.07)
ln(Salary)	1.993	0.169	3.740**	0.621	2.329	0.518*
	(1.32)	(0.41)	(1.80)	(0.46)	(1.69)	(0.31)
ln(total assets)	0.644**	0.624***	0.492**	0.572***	-2.049	0.479**
	(0.30)	(0.10)	(0.23)	(0.09)	(2.18)	(0.21)
Equity volatility	-6.089*	-1.134**	-5.568	-0.903*	-8.252*	-1.550***
	(3.60)	(0.53)	(3.45)	(0.54)	(4.29)	(0.49)
Official supervisory power	0.401*	0.151**	0.524*	0.004	0.521*	0.014
	(0.24)	(0.07)	(0.28)	(0.03)	(0.26)	(0.03)
Capital	-0.855	-0.288*	0.211	-0.039	-0.148	0.002
	(0.55)	(0.16)	(0.34)	(0.06)	(0.39)	(0.05)
Independence	2.241**	0.391*	1.879	0.095	2.437*	0.175
	(1.07)	(0.20)	(1.18)	(0.13)	(1.30)	(0.13)
private monitoring	-0.088	0.367	-1.245	-0.090	-0.257	0.056
	(0.90)	(0.26)	(0.86)	(0.07)	(0.81)	(0.10)
Restrict	0.235	0.199*	-0.735***	-0.092*	-0.236	-0.053
	(0.27)	(0.10)	(0.25)	(0.05)	(0.27)	(0.06)
Deposit insurance	0.751	0.987				
	(1.55)	(0.61)				
Minimimum capital ratio	3.894**	1.499**	1.571	0.448	0.181	-0.155
	(1.65)	(0.59)	(1.15)	(0.40)	(0.87)	(0.17)
Shareholder rights	-0.700	-0.225				
	(1.39)	(0.37)				
BHC	-0.876	1.023***	-0.227	1.354***		
	(0.97)	(0.28)	(0.91)	(0.26)		
Commercial bank	-1.409	0.986*	2.202	2.164***		
	(1.60)	(0.51)	(2.05)	(0.51)		
Investment bank	1.044	2.288***	4.154	3.709***		
	(1.64)	(0.64)	(2.62)	(0.66)		
Mortgage bank	0.452	1.234	2.153	1.916**		
	(3.89)	(0.81)	(3.96)	(0.74)		
Savings Bank	-14.181***	-3.245***	-11.025***	-1.197**		
	(1.57)	(0.67)	(1.79)	(0.50)		
Constant	-63.554**	-24.784**	-59.869*	-15.837**	24.507	-8.317
	(28.71)	(9.47)	(31.12)	(7.73)	(48.34)	(6.82)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	Yes	No	No
Bank FE	No	No	No	No	Yes	Yes
R^2	0.274	0.599	0.414	0.806	0.589	0.944
N	508	514	508	514	508	514

6.3.2 Corporate governance

Table 23 and Table 24 show regressions of compensation components on corporate governance variables. The limited sample size and little time variation in the corproate governance variables does not allow for a bank fixed effect regression, I include however country fixed effects and type dummies that capture the different business models of the sample banks. Table 23 includes only board specific governance variables and Table 24 also committee specific variables. I report them differently because not all banks do have a special compensation committee. The main findings are that board characteristics seem to matter relatively little for the structure of CEO compensation. neither the board composition nor the composition of the compensation committee has an impact on the level of vega. The compensation committee in particular does not seem to have an impact on any of the compensation variables casting doubt on whether these committees do fulfill there duties when setting CEO contracts. One interpretation could be that CEO pay is mostly set by consulting agencies which are active in almost all of the banks in the sample.

Consistent with the findings of Fahlenbrach (2008) for US companies there is a negative effect of board size on CEO incentive alignment through high delta contracts. This is consistent with both the entrenchment hypothesis and the complementarity hypothesis. If large boards are a proxy for weak governance than this could either allow the CEO to reduce incentive alignment or stronger governance would be needed to implement contracts with higher pay-for-performance sensitivities. The coefficients for the CEO being also chairman of the board and tenure are both significant and positive as in Fahlenbrach (2008). This is consistent with the substitution hypothesis, weaker governance is associated with higher pay-for-performance sensitivities. Consistent with this hypothesis is the negative sign on the coefficient for board meetings. More active boards are better able to monitor the CEO and alignment of CEO incentives to shareholders' incentives is less important. All in all I follow Fahlenbrach (2008) in his interpretation and conclude

that the substitution effect is probably what drives CEO incentives. The results in column three, where the ratio of bonus payments to total compensation is regressed on the same variables, go in the same direction. Weaker governance is associated with higher bonus payments and therefore better incentive alignment.

Total compensation, the independent variable in the last column is increasing with board independence and CEO tenure. The positive sign on tenure could be an indicator for entrenchment while the fact that more independent board grant higher total compensation would contradict this hypothesis. The positive sign on board independence is however again consistent with Fahlenbrach (2008) who interprets it as evidence that good corporate governance led to better performance and therefore higher payouts of incentive based pay. The positive impact of board independence on bonus payments corroborates this hypothesis.

Next I look at the decision to grant options and on the characteristics of those option grants. Although the compensation committee did not seem to play an active role when setting overall CEO incentives and compensation I would expect it to be more important when deciding whether to grant options and on the characteristics of these options.

Table 25 shows the corresponding regression analysis. Columns one to six are standard OLS regressions of the compensation components on controls. The last two columns depict logit regressions with a dummy taking value one if options or rights are granted and value zero otherwise as the dependent variable. In line with the substitution hypothesis a more active compensation committee seems to grant less options with lower vega and lower deltas. More independent committees are more likely to grant options with higher deltas. This is in line with the idea that it needs good corporate governance to implement contracts that align CEO incentives through options. The option characteristics, the attachment of vesting criteria, the moneyness of the option at grant date and the vesting period are regressed on

Table 23: Regression of CEO incentives on variables capturing the strength of corporate governance mechanisms and controls. ln(vega) is the logarithm of the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent to a 0.01 increase in volatility. ln(delta) is the logarithm of the sensitivity of CEOS' stock, option and restricted stock portfolio to a change in stock price. bonus ratio is the ratio of bonus payments to total compensation. ln(total compensation) is the logarithm of total compensation. # Board members is the number of directors on the board. Board independence is the ratio of independent board members. Female is the ratio of women on the board. Board meetings is the number of board meetings per year. CEO chairman is a dummy variable that takes value equal to one if the CEO and the chairman of the board are the same person. Standard errors are clustered at the bank level.

Variable	ln(Vega)	ln(Delta)	bonus ratio	ln(total compensation)
ln(CEO tenure)	-0.048	0.087***	0.007*	0.032***
	(0.17)	(0.02)	(0.00)	(0.01)
market-to-book	-0.783***	0.123**	-0.013**	-0.018
	(0.22)	(0.05)	(0.01)	(0.03)
ln(Salary)	1.004	0.607**	0.005	
	(1.62)	(0.28)	(0.04)	
ln(total assets)	0.168	0.226	0.001	0.329***
	(0.79)	(0.28)	(0.02)	(0.05)
Volatility	-9.931	-0.743**	-0.272***	-1.014***
	(7.25)	(0.36)	(0.08)	(0.36)
# Board members	-0.413	-0.072*	0.001	0.012
	(0.27)	(0.04)	(0.00)	(0.01)
Board independence	-4.111	1.227	0.165*	1.010***
	(5.90)	(0.82)	(0.09)	(0.34)
Female	-19.974	-0.780	-0.458*	-0.603
	(13.12)	(0.86)	(0.23)	(0.84)
Board meetings	-0.115	-0.034*	-0.007**	-0.007
	(0.19)	(0.02)	(0.00)	(0.01)
CEO chairman	-1.418	0.335*	0.097**	0.083
	(1.29)	(0.19)	(0.04)	(0.16)
BHC	-1.955	0.642***	0.291***	-0.242
	(1.32)	(0.22)	(0.05)	(0.15)
Commercial bank	0.469	2.735***	0.144***	-0.158
	(2.25)	(0.44)	(0.04)	(0.14)
Investment bank	-0.092	2.543**	0.764***	1.278***
	(3.64)	(1.08)	(0.10)	(0.36)
Savings Bank	-7.501	-0.734	0.115	-0.533
	(4.94)	(0.58)	(0.10)	(0.35)
return_{t-1}			0.083	0.367*
			(0.06)	(0.19)
Constant	6.856	-5.020	0.297	5.674***
	(28.95)	(6.57)	(0.53)	(1.43)
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
R^2	0.595	0.887	0.412	0.436
N	216	220	307	317

Table 24: Regression of CEO incentives on variables capturing the strength of corporate governance mechanisms and controls. ln(vega) is the logarithm of the sensitivity of CEOS' stock, option and restricted stock portfolio to a one percent to a 0.01 increase in volatility. ln(delta) is the logarithm of the sensitivity of CEOS' stock, option and restricted stock portfolio to a change in stock price. Bonus ratio is the ratio of bonus payments to total compensation. ln(total compensation) is the logarithm of total compensation. # Board members is the number of directors on the board. Board independence is the ratio of independent board members. Female is the ratio of women on the board. Board meetings is the number of board meetings per year. CEO chairman is a dummy variable that takes value equal to one if the CEO and the chairman of the board are the same person. Committee meetings is the number of compensation committee meetings per year. Committee members is the number of directors on the compensation committee. CEO committee member is a dummy that takes value one if the CEO is member of the compensation committee. Committee independence is the ratio of independent directors on the Committee. Standard errors are clustered at the bank level.

Variable	ln(Vega)	ln(Delta)	bonus ratio	ln(total compensation)
ln(CEO tenure)	0.185	0.094***	0.005	0.032***
	(0.19)	(0.03)	(0.00)	(0.01)
market-to-book	-0.964***	0.093*	-0.011*	-0.016
	(0.28)	(0.05)	(0.01)	(0.03)
ln(Salary)	0.422	0.438	-0.008	
	(1.61)	(0.30)	(0.04)	
ln(total assets)	-0.993	0.213	0.012	0.319***
	(0.81)	(0.31)	(0.02)	(0.06)
Volatility	-11.200	-0.790**	-0.276***	-1.009***
	(7.75)	(0.35)	(0.08)	(0.36)
# Board members	-0.459	-0.084**	-0.003	0.002
	(0.29)	(0.04)	(0.01)	(0.02)
Board independence	-6.265	1.312	0.068	0.618
	(5.32)	(0.90)	(0.13)	(0.39)
Female	-18.577	0.107	-0.464*	-0.650
	(14.63)	(0.89)	(0.23)	(0.85)
Board meetings	-0.161	-0.035*	-0.007**	-0.008
	(0.25)	(0.02)	(0.00)	(0.01)
CEO chairman	-1.978	0.373*	0.105**	0.057
	(1.45)	(0.20)	(0.04)	(0.19)
Committee meetings	-0.000	-0.033	0.001	0.013
	(0.29)	(0.03)	(0.01)	(0.03)
Committee members	0.624	0.080	0.009	0.043
	(0.39)	(0.05)	(0.02)	(0.07)
CEO committee member	-0.698	-0.269	0.037	-0.134
	(0.91)	(0.25)	(0.06)	(0.14)
committee independence	6.479	0.603	0.003	0.331
	(5.99)	(0.55)	(0.10)	(0.31)
BHC	-2.575	0.560**	0.273***	-0.255
	(1.58)	(0.22)	(0.06)	(0.16)
Commercial bank	-1.982	2.680***	0.142***	-0.123
	(2.71)	(0.52)	(0.05)	(0.16)
Investment bank	-6.817	2.279*	0.794***	1.258***
	(4.40)	(1.20)	(0.11)	(0.35)
Savings Bank	-10.473*	-1.196**	0.092	-0.513
	(6.08)	(0.52)	(0.10)	(0.37)
$return_{t-1}$			0.097	0.344
			(0.08)	(0.24)
Constant	40.878	-2.683	0.227	5.865***
	(29.75)	(7.38)	(0.54)	(1.49)
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
R^2	0.620	0.886	0.414	0.442
N	196	200	284	293

Table 25: Regression of CEO compensation characteristics on variables capturing the strength of corporate governance mechanisms and controls. ln(vega) granted is the logarithm of the sensitivity of an option grant to a one percent increase in volatility. ln(delta) granted is the logarithm of the sensitivity of CEOS' option grant to a change in stock price. Criteria is the percentage of grants with vesting criteria. Moneyness and vesting period are the corresponding option characteristic. BS value is the Black & Scholes value of the options granted. Option and Rights depict logit regressions of dummy taking value one if options or rights are granted. Standard errors are clustered at the bank level.

Variable	ln(Vega) granted	ln(Delta) granted	Criteria	Moneyness	Vesting period	fixed compensation	Option	Rights
ln(CEO tenure)	0.165	-0.003	-0.012	0.018	-0.014	-0.028	-0.036	-0.109
	(0.16)	(0.04)	(0.02)	(0.02)	(0.03)	(0.05)	(0.06)	(0.09)
market-to-book	-0.096	0.019	-0.021	-0.009	-0.198	-0.019	-0.250*	0.061
	(0.35)	(0.37)	(0.08)	(0.03)	(0.17)	(0.40)	(0.15)	(0.18)
ln(Salary)	0.186	0.286						
	(0.32)	(0.31)						
ln(total assets)	-0.348	-0.270	0.219	0.082*	-0.121	-0.411	0.073	-0.748
	(0.46)	(0.36)	(0.18)	(0.04)	(0.41)	(0.47)	(0.66)	(0.70)
Volatility	-0.192	0.144	0.123	-0.074	0.161	0.426	0.041	-0.926
	(0.75)	(0.64)	(0.19)	(0.09)	(0.47)	(0.68)	(0.93)	(1.54)
# Board members	-0.043	-0.031	0.011	-0.003	0.057	-0.047	-0.118	0.147
	(0.07)	(0.06)	(0.02)	(0.01)	(0.03)	(0.07)	(0.10)	(0.13)
Board independence	0.609	1.554	0.055	-0.136	1.808**	1.600	-2.165	4.918*
	(1.99)	(1.08)	(0.40)	(0.14)	(0.89)	(1.18)	(2.17)	(2.59)
Female	-2.798	-4.690**	1.048*	0.232	2.305**	-4.331*	1.998	1.293
	(2.16)	(2.07)	(0.58)	(0.21)	(0.99)	(2.34)	(3.57)	(4.98)
Board meetings	0.019	-0.018	0.011	0.007	-0.027	-0.012	-0.045	0.001
	(0.05)	(0.04)	(0.01)	(0.01)	(0.02)	(0.04)	(0.05)	(0.07)
CEO chairman	-0.866	0.038	0.054	-0.079	-0.610*	0.307	-0.304	3.379*
	(0.86)	(0.39)	(0.15)	(0.10)	(0.36)	(0.42)	(1.06)	(1.73)
Committee meetings	-0.167**	-0.110**	0.021	-0.006	-0.023	-0.105*	-0.207**	0.022
	(0.08)	(0.05)	(0.02)	(0.01)	(0.04)	(0.05)	(0.11)	(0.14)
Committee members	0.094	0.027	-0.007	0.027**	-0.255***	0.015	0.309*	-0.283
	(0.11)	(0.10)	(0.04)	(0.01)	(0.08)	(0.11)	(0.17)	(0.33)
CEO committee member	-0.496	-0.563	0.154	0.040	0.126	-0.610	0.524	1.564
	(0.40)	(0.34)	(0.13)	(0.03)	(0.17)	(0.39)	(0.67)	(1.13)
committee independence	0.979	1.527*	-0.488	-0.071	-0.804	1.490*	-1.951	1.898
	(1.04)	(0.80)	(0.32)	(0.12)	(0.57)	(0.84)	(1.80)	(3.55)
BHC	-1.191*	-1.088*	0.147	0.003	-0.295	-0.968	2.709***	4.014***
	(0.66)	(0.62)	(0.20)	(0.07)	(0.51)	(0.63)	(0.62)	(1.15)
Commercial bank	0.129	0.682	0.124	-0.150	-0.364	1.058	3.766***	6.534**
	(0.90)	(0.67)	(0.22)	(0.10)	(0.46)	(0.65)	(1.15)	(2.92)
Cooperative bank	0.117	1.054	-0.709**	-0.087	-0.328	1.789**	-0.437	
	(1.02)	(0.83)	(0.34)	(0.11)	(0.60)	(0.84)	(1.59)	
Investment bank	-0.465	-3.693**	0.515	0.916***	-2.999*	-4.483**	2.988	
	(1.99)	(1.69)	(0.88)	(0.22)	(1.76)	(2.05)	(3.13)	
salary			0.000	-0.000	0.000	0.000	0.000**	0.000**
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
return_{t-1}			-0.099	0.010	0.073	0.641	-0.823	-0.896
			(0.14)	(0.07)	(0.30)	(0.62)	(0.92)	(1.31)
Constant	17.310	12.357	-4.619	-0.937	6.101	22.200*	-1.862	5.280
	(14.05)	(9.93)	(4.85)	(1.23)	(10.78)	(12.99)	(16.20)	(16.58)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.594	0.689	0.645	0.404	0.726	0.673		
N	153	153	153	153	153	153	243	238

the governance variables in columns three to five. Large compensation committees grant more options which are more in the money at grant date and with smaller vesting periods, which would imply that weaker governance could lead to option characteristics which are more favorable to the CEO. Women on the board seem to be responsible for less option grants with lower values, smaller sensitivities to stock price movement, more vesting criteria and longer vesting periods. All in line with the evidence that women are more risk averse and less overconfident than men.

7 Conclusion

This paper uses a new unique dataset to address the topic of managerial compensation in the financial sector throughout the world. For the first time detailed data on CEO compensation in an international sample and detailed characteristics of the board and compensation committees of these boards can be used to assess the risk taking incentives of bank CEOs and their interaction with corporate governance and regulation.

First I describe the development of structure and level of executive compensation. The main findings are that cash compensation and bonuses have reached similar levels in most countries, long term incentive plans have been widely adapted and equity based compensation plays an increasingly important role. With very few exceptions CEOs from the US rely far more on equity based compensation than those of banks from any other country throughout the whole sample period. Also long-term bonus payments have been first adapted in the US.
After describing the main features of the dataset I try to explain bank risk taking with the structure of a CEO's compensation contract. The measure of CEO incentives are delta, the sensitivity of the CEOs portfolio to changes in stock prices and vega, the sensitivity of the portfolio to changes in stock price volatility. Delta is associated with less risk taking incentives and better alignment of CEO wealth to company performance. A CEO with high delta contracts is more exposed to the

performance of her bank and therefore tries to reduce risk, given that she is risk averse. High vega contracts on the other hand have the opposite effect, a CEO with such a contract profits from an increase in the volatility and has therefore an incentive to increase risk.
My results show that there is a link between CEO incentives and bank risk taking. Using simultaneous equation models I find that equity volatility, idiosyncratic risk and systematic risk increase in vega and decreases in delta. Similarly the distance-to-Default increases in delta and decreases in vega. When looking at bank policies I find that the non-interest income to total income ratio is higher for CEOs with high vega and low delta. This is consistent with the view that high non-interest income, is associated with riskier bank policies, e.g. more fee-based operations like investment banking or higher levels of securitization. Banks with higher delta choose higher capital levels but leave the Tier 1 ratio unchanged, which I interpret as evidence that leverage is another channel through which bank risk can be introduced, however limited by regulatory requirements.
Although coefficients are smaller than in studies on US banks I do not find that the US banks drive the results. It seems that the difference is more likely result of a smaller sample of mostly large US banks. I do not find that regulation has a direct impact on the effectiveness of the transmission of risk taking incentives into higher bank risk, but that banks in highly regulated countries are more active when rebalancing their CEO incentives depending on the level of bank risk.
In general the boards or compensation committees of bank do not seem to react strongly to bank risk when setting the compensation structure.

Having shown that compensation does effect bank risk and bank policies I look at the determinants of compensation components in detail. Although country effects do explain a large part of the variation in compensation, regulatory variables and corporate governance variables have some explanatory power too. As in Fahlenbrach (2008) I find that banks with weak corporate governance structures tend grant contracts with larger pay-for-performance components like high delta options and

large bonus payments, suggesting that strong corporate governance and high levels of pay-for-performance are substitutes.
The compensation committee does not have any impact on the level of incentive pay, bonus payments or total compensation. It seems however to be of importance when looking at the characteristics of the options granted. A weaker committee, i.e. with more committee members, tends to give the CEO options with a shorter vesting period and a lower exercise price. A more active committee grants less options with lower risk taking incentives and less exposure to changes in the banks' stock price. Women on the board lead to lower levels of option based pay and to option grants that are less favorable to the CEO.
Using several Worldbank indices to capture the strength and quality of regulation in each country and the change of it over time I find that stronger regulation or external monitoring does not substitute for equity incentives. On the contrary stronger regulation leads banks to grant more performance based pay, probably to counterbalance stricter supervisory restriction.

Especially in the light of the recent proposals on regulating CEO compensation in banking several important policy recommendations can be made. First, equity-based pay and a large fraction of long-term compensation components were predominantly used in the US, especially in the beginning of the sample period. Regulation that emphasizes these components will necessarily push compensation policies towards a more US based system. Second, the specific characteristics of equity based remuneration components matter for CEO risk taking incentives and should therefore be taken into account by regulators when assessing a bank's incentive structure. Third, strong supervisors are able to influence the way banks set their compensation structure. Bank boards are more active in balancing risk and incentives when regulation is strong but may also counteract strong supervision by setting higher risk taking incentives. Fourth, good corporate governance standards have been widely adopted and were, especially in the US, in place during the whole sample period without restricting CEO pay considerably. Focusing on easily measur-

able variables like board independence, the existence of a remuneration committee or board size does not seem to be a useful way to measure the boards' ability to align incentives with a bank's risk bearing capabilities. The FSB's suggestion to employ board members with expertise in risk management and compensation seems to go in the right direction.

A Sample banks

Table 26: Columns two to five show the period when information was disclosed on total compensation, cash bonuses, stock holdings and option holdings respectively.

Bank name	Total compensation	Bonus	Stock holdings	Option holdings
Aareal Bank Ag	2005-2008	2005-2008	NA	2005-2008
Abbey National Plc	1998-2004	1998-2004	1998-2004	1998-2004
ABN Amro Holding NV	2000-2007	2000-2007	2002-2006	1998-2007
Absa Group Ltd	2002-2008	2002-2008	2000-2008	2005-2008
Alliance & Leicester Plc	2002-2007	2002-2007	2002-2007	2000-2007
Allied Irish Banks plc	1999-2008	1999-2008	1997-2008	1997-2008
Anglo Irish Bank Corporation	2001-2008	2001-2008	2000-2008	2000-2008
American Express Company	1997-2008	1997-2008	1997-2008	1997-2008
Amsouth Bancorporation	2000-2005	2000-2005	2000-2005	2000-2005
Australia and New Zealand Banking Group	1998-2008	1998-2008	1998-2008	1998-2008
Banco Espaol de Crdito	2005-2008	2005-2008	NA	2004-2008
Banca Intesa	2001-2006	2001-2006	2002-2006	2001-2006
Banca Nazionale del Lavoro SpA	1998-2005	1998-2005	NA	1998-2005
Banco Popular Espanol	2005-2008	2005-2008	2000-2008	2000-2008
Banco Bilbao Vizcaya Argentaria SA	2003-2008	2002-2008	2002-2008	NA
Banco Santander SA	2002-2008	2002-2008	2001-2008	2000-2008
Bangkok Bank Pcl	2005-2008	NA	2005-2008	2005-2008
Bank Hapoalim BM	2003-2008	2003-2008	2008	NA
Bank Leumi Le Israel BM	2001-2008	2008	NA	2001-2008
Bank of America Corporation	1997-2008	1997-2008	1997-2008	1997-2008
Bank of China (Hong Kong) Limited	2004-2008	2004-2008	2007-2008	2000-2008
Bank of Ireland	2001-2008	2001-2008	1997-2008	1997-2008
Bank of Nova Scotia	1997-2008	1997-2008	1997-2008	1997-2008
Bank of Scotland Plc	1997-2001	1997-2001	1997-2001	1997-2001
Bank of Montreal	1997-2008	1997-2008	1997-2008	1997-2008
Barclays Plc	1997-2008	1997-2008	1997-2008	1997-2008
BB&T Corporation	1997-2008	1997-2008	1997-2008	1997-2008
Bear Stearns Companies Inc.	2000-2007	2000-2007	2000-2007	2000-2007
BNP Paribas	1999-2008	1999-2008	1999-2008	1997 -2008
Bradford & Bingley Plc	2000-2007	2000-2007	2000-2007	2000-2007
Canadian Imperial Bank of Commerce	1997-2008	1997-2008	1999-2008	1997-2008
Carnegie Investment Bank AB	2002-2008	2002-2008	2001-2008	2002-2008
Charter One Financial Inc.	2000-2003	2000-2003	2000-2003	2000-2003
Citigroup Inc	2000-2008	2000-2008	2000-2008	2000-2008
Comerica Inc	1997-2008	1997-2008	1997-2008	1997-2008
Commerzbank AG	2004-2008	2004-2008	NA	NA
Commonwealth Bank of Australia	1997-2008	1997-2008	1997-2008	1997-2008
Credit Agricole S.A.	2003-2008	2004-2008	2005-2008	2003-2008
Credit Industriel et Commercial	2005-2006	2005-2006	NA	2001-2006
Credit Lyonnais	1999-2003	1999-2003	NA	1999-2003
Credit Suisse Group AG	2007-2008	2007-2008	2007-2008	2000-2008
DBS Group Holding Ltd	2002-2007	2002-2007	2000-2007	1999-2007
Danske Bank A/S	2005-2008	2005-2008	NA	2001-2008
Deutsche Bank AG	2003-2008	2003-2008	2003-2008	2001-2008
Deutsche Postbank AG	2004-2008	2004-2008	NA	2004-2008
Dexia	2000-2008	2000-2008	2000-2008	2000-2008
DnB Nor ASA	1999-2008	1999-2008	1999-2008	1999-2008
Erste Group Bank AG	2004-2008	2004-2008	2003-2008	1999-2008
Federal National Mortage Association	1997-2008	1997-2008	1997-2008	1997-2008
Fifth Third Bancorp	1997-2008	1997-2008	1997-2008	1997-2008
First Rand Group	2001-2008	2001-2008	2001-2008	2001-2008
Fortis	2001-2008	2001-2008	2001-2008	1997-2008
Goldman Sachs Group Inc	1999-2008	1999-2008	1999-2008	1999-2008
Gruppo Monte dei Paschi di Siena	2007-2008	2007-2008	NA	2006-2008

HBOS Plc	2001-2008	2001-2008	2001-2008	2001-2008
HSCB Holdings Plc	1997-2008	1997-2008	1997-2008	1997-2008
Halifax Group Plc	1997-2000	1997-2000	1997-2000	NA
Hang Seng Bank Ltd.	2002-2008	2002-2008	2002-2008	2002-2008
Huntington Bancshares Inc	1997-2008	1997-2008	1997-2008	1997-2008
Hypo Real Estate Holding AG	2003-2008	2003-2008	NA	2003-2008
IKB Deutsche Industriebank	2005-2008	2005-2008	NA	2005-2008
ING Groep NV	2000-2008	2000-2008	2005-2008	1998-2008
Intesa Sanpaolo	2007-2008	2007-2008	2007-2008	2007-2008
Irish Life & Permanent plc	2000-2008	2000-2008	2000-2008	2000-2008
Israel Discount Bank Ltd	2001-2008	2008	NA	2001-2008
JP Morgan Chase & Co	1997-2008	1997-2008	1997-2008	1997-2008
KeyCorp	1997-2008	1997-2008	1997-2008	1997-2008
LBB Holding AG	2006-2008	2006-2008	NA	2006-2008
Lehman Brothers Holdings Inc	1997-2007	1997-2007	1997-2007	1997-2007
Lloyds Banking Group Plc	1997-2008	1997-2008	1997-2008	1997-2008
M&T Bank Corp.	2000-2006	2000-2006	2000-2006	2000-2006
Macquarie Group Limited	2000-2008	2000-2008	2000-2008	2000-2008
Malayan Banking BHD	2008	NA	2000-2008	2000-2008
Mediobanca Spa	2003-2008	2003-2008	2003-2008	2003-2008
Mellon Financial Corp.	2000-2006	2000-2006	2000-2006	2000-2006
Morgan Stanley	1997-2008	1997-2008	1997-2008	1997-2008
National Australia Bank Limited	1998-2008	1998-2008	1997-2008	1997-2008
National Bank of Canada	2002-2008	2002-2008	2002-2008	2002-2008
National City Corp.	2000-2007	2000-2007	2000-2007	2000-2007
Natixis	2002-2008	2003-2008	NA	2002-2008
Nedbank	2000-2008	2000-2008	2000-2008	2000-2008
Nordea Bank AB	2000-2008	2000-2008	2000-2008	2000-2008
Northern Rock Plc	1997-2008	1997-2008	1997-2006	1997-2000
Northern Trust Corporation	1997-2008	1997-2008	1997-2008	1997-2008
Oversea Chinese Banking	2002-2008	2002-2008	2001-2008	2001-2008
PNC Financial Corporation	1997-2008	1997-2008	1997-2008	1997-2008
Popular Inc	2000-2008	2000-2008	2000-2008	2000-2008
Regions Financial Corporation	1997-2008	1997-2008	1997-2008	1997-2008
Royal Bank of Canada	1997-2008	1997-2008	1999-2008	1997-2008
Royal Bank of Scotland Group Plc	1997-2008	1997-2008	1997-2008	1997-2008
Sampo Bank	2001-2008	NA	NA	2001-2008
Sanpaolo IMI	2001-2006	2001-2006	2005-2006	2001-2006
Skandinaviska Enskilda Banken AB	1997-2008	1997-2008	1998-2008	1997-2008
Societe Generale	2000-2008	2000-2008	2000-2008	1997-2008
SNS Bank	2003-2008	2003-2008	NA	2003-2008
St.George Bank	2002-2007	2002-2007	2002-2007	2002-2007
Standard Bank Group Ltd.	2000-2008	2000-2008	2000-2008	2000-2008
Standard Chartered Plc	1997-2008	1997-2008	1997-2008	1997-2008
State Street Corporation	1997-2008	1997-2008	1997-2008	1997-2008
Storebrand	2000-2008	2002-2008	2000-2008	2000-2008
SunTrust Banks Inc.	1998-2008	1998-2008	1998-2008	1998-2008
Svenska Handelsbanken	1998-2007	1998-2007	1997-2008	1997-2008
Swedbank AB	2001-2008	2001-2008	2002-2008	1999-2008
The Bank of East Asia Limited	2004-2008	2004-2008	2001-2008	2000-2008
Toronto Dominion Bank	1997-2008	1997-2008	1998-2008	1997-2008
Unionbancal Corp.	2000-2007	2000-2007	2000-2007	2000-2007
United Overseas Bank Ltd.	2002-2008	2002-2008	2000-2008	2000-2008
UBS AG	2008	2008	2008	2003-2008
US Bancorp	2001-2008	2001-2008	2001-2008	2001-2008
Wachovia Corp.	2000-2007	2000-2007	2000-2007	2000-2007
Washington Mutual Inc.	1997-2007	1997-2007	1997-2007	1997-2007
Wells Fargo & Company	1997-2008	1997-2008	1997-2008	1997-2008
Westpac Banking Corporation	1997-2008	1997-2008	1997-2008	1997-2008
Wing Hang Bank Limited	2004-2008	2004-2008	2000-2008	2000-2008

References

Abowd, J. M., Bognanno, M., 1995. International Differences in Executive and Managerial Compensation. NBER Chapters. National Bureau of Economic Research, Inc.

Ang, J., Lauterbach, B., Schreiber, B. Z., June 2002. Pay at the executive suite: How do us banks compensate their top management teams? Journal of Banking & Finance 26 (6), 1143–1163.

Baker, M. P., Gompers, P. A., 2002. The Determinants of Board Structure at the Initial Public Offering. SSRN eLibrary.

Barber, B. M., Odean, T., 2001. Boys will be boys: Gender, overconfidence, and common stock investment*. Quarterly Journal of Economics 116 (1), 261–292.
URL http://www.mitpressjournals.org/doi/abs/10.1162/003355301556400

Barro, J. R., Barro, R. J., October 1990. Pay, performance, and turnover of bank ceos. Journal of Labor Economics 8 (4), 448–81.

Barth, J. R., Caprio, G., Levine, R., 2004. Bank regulation and supervision: what works best? Journal of Financial Intermediation 13 (2), 205 – 248, bank Capital Adequacy Regulation under the New Basel Accord.

Barth, J. R., Caprio Jr, G., Levine, R., Apr. 2001. The regulation and supervision of banks around the world - a new database. Policy Research Working Paper Series 2588, The World Bank.
URL http://ideas.repec.org/p/wbk/wbrwps/2588.html

Bebchuk, L. A., Fried, J. M., 2004. Pay Without Performance: The Unfulfilled Promise of Executive Compensation. Harvard University Press, 2004.

Beltratti, A., Stulz, R. M., Jul. 2009. Why did some banks perform better during the credit crisis? a cross-country study of the impact of governance and regulation. NBER Working Papers 15180, National Bureau of Economic Research, Inc.

Berger, P. G., Ofek, E., Yermack, D., 1997. Managerial Entrenchment and Capital Structure Decisions. SSRN eLibrary.

Black, F., Scholes, M. S., May-June 1973. The pricing of options and corporate liabilities. Journal of Political Economy 81 (3), 637–54.

Burghof, H.-P., Hofmann, C., 2000. Executives' Compensation of European Banks - Disclosure, Sensitivity, and their Impact on Bank Performance.

Carroll, T. M., Ciscel, D. H., August 1982. The effects of regulation on executive compensation. The Review of Economics and Statistics 64 (3), 505–09.

Chen, C. R., Steiner, T. L., Whyte, A. M., March 2006. Does stock option-based executive compensation induce risk-taking? an analysis of the banking industry. Journal of Banking & Finance 30 (3), 915–945.

Cheng, I.-H., Hong, H., Scheinkman, J. A., July 2010. Yesterday's heroes: Compensation and creative risk-taking. Working Paper 16176, National Bureau of Economic Research.
URL http://www.nber.org/papers/w16176

Chesney, M., Stromberg, J., Wagner, A. F., 2010. Risk-Taking Incentives, Governance, and Losses in the Financial Crisis. SSRN eLibrary.

Coles, J. L., Daniel, N. D., Naveen, L., February 2006. Managerial incentives and risk-taking. Journal of Financial Economics 79 (2), 431–468.

Core, J., Guay, W., 1999. The use of equity grants to manage optimal equity incentive levels. Journal of Accounting and Economics 28 (2), 151 – 184.
URL http://www.sciencedirect.com/science/article/pii/S0165410199000191

Core, J., Guay, W., 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. Journal of Accounting Research 40 (3), 613–630.

Core, J. E., Holthausen, R. W., Larcker, D. F., 1999. Corporate governance, chief executive officer compensation, and firm performance. Journal of Financial Economics 51 (3), 371–406.
URL http://econpapers.repec.org/RePEc:eee:jfinec:v:51:y:1999:i:3:p:371-406

Demirg-Kunt, A., Kane, E. J., Laeven, L. A., 2006. Determinants of Deposit-Insurance Adoption and Design. SSRN eLibrary.

DeYoung, R., Peng, E. Y., Yan, M., Sep. 2009. Executive compensation and business policy choices at u.s. commercial banks. Tech. rep.

DeYoung, R., Roland, K. P., January 2001. Product mix and earnings volatility at commercial banks: Evidence from a degree of total leverage model. Journal of Financial Intermediation 10 (1), 54–84.

Djankov, S., La Porta, R., Lopez-de Silanes, F., Shleifer, A., June 2008. The law and economics of self-dealing. Journal of Financial Economics 88 (3), 430–465.
URL http://ideas.repec.org/a/eee/jfinec/v88y2008i3p430-465.html

Erkens, D., Hung, M., Matos, P., 2009. Corporate Governance in the 2007-2008 Financial Crisis: Evidence from Financial Institutions Worldwide. SSRN eLibrary.

Fahlenbrach, R., 2008. Shareholder Rights, Boards, and CEO Compensation. SSRN eLibrary.

Fahlenbrach, R., Stulz, R. M., Aug. 2009. Bank ceo incentives and the credit crisis. NBER Working Papers 15212, National Bureau of Economic Research, Inc.

Gropp, R., Vesala, J., Vulpes, G., 2002. Equity and Bond Market Signals as Leading Indicators of Bank Fragility. SSRN eLibrary.

Guay, W. R., July 1999. The sensitivity of ceo wealth to equity risk: an analysis of the magnitude and determinants. Journal of Financial Economics 53 (1), 43–71.

Hartzell, J. C., Starks, L. T., 2003. Institutional investors and executive compensation. The Journal of Finance 58 (6), 2351–2374.
URL http://dx.doi.org/10.1046/j.1540-6261.2003.00608.x

Houston, J. F., James, C., 1995. Ceo compensation and bank risk is compensation in banking structured to promote risk taking? Journal of Monetary Economics 36 (2), 405 – 431.

Hubbard, R. G., Palia, D., September 1995. Executive pay and performance evidence from the u.s. banking industry. Journal of Financial Economics 39 (1), 105–130.

Jensen, M. C., Murphy, K. J., 1990a. Ceo incentives - it's not how much you pay, but how. Journal of Applied Corporate Finance 3 (3), 36–49.

Jensen, M. C., Murphy, K. J., 1990b. Performance pay and top-management incentives. The Journal of Political Economy 98 (2), 225–264.

John, K., Qian, Y., 2003. Incentive features in ceo compensation in the banking industry. Economic Policy Review (Apr), 109–121.

Kashyap, A. K., Rajan, R. G., Stein, J. C., August 2008. Rethinking capital regulation. Tech. rep.

La Porta, R., de Silanes, F. L., Shleifer, A., Vishny, R. W., December 1998. Law and finance. Journal of Political Economy 106 (6), 1113–1155.

Landier, A., Sraer, D., Thesmar, D., Sep. 2010. Going for broke: New century financial corporation, 2004-2006. TSE Working Papers 10-199, Toulouse School of Economics (TSE).
URL http://ideas.repec.org/p/tse/wpaper/23478.html

Malmendier, U., Tate, G., December 2005. Ceo overconfidence and corporate investment. Journal of Finance 60 (6), 2661–2700.

Mehran, H., 1995. Executive compensation structure, ownership, and firm performance. Journal of Financial Economics 38 (2), 163 – 184.
URL http://www.sciencedirect.com/science/article/pii/0304405X9400809F

Mehran, H., Rosenberg, J. V., 2007. The Effect of Employee Stock Options on Bank Investment Choice, Borrowing, and Capital. SSRN eLibrary.

Murphy, K. J., 1985. Corporate performance and managerial remuneration : An empirical analysis. Journal of Accounting and Economics 7 (1-3), 11 – 42.

Murphy, K. J., 1998. Executive Compensation.

Petersen, M. A., 2009. Estimating standard errors in finance panel data sets: Comparing approaches. Review of Financial Studies 22 (1), 435–480.
URL http://rfs.oxfordjournals.org/content/22/1/435.abstract

Smith, C. W., Stulz, R. M., December 1985. The determinants of firms' hedging policies. Journal of Financial and Quantitative Analysis 20 (04), 391–405.

Stiroh, K., December 2006. New evidence on the determinants of bank risk. Journal of Financial Services Research 30 (3), 237–263.

Yermack, D., 1996. Higher market valuation of companies with a small board of directors. Journal of Financial Economics 40 (2), 185 – 211.
URL http://www.sciencedirect.com/science/article/pii/0304405X95008445

Chapter 2: CEO Overconfidence in Banking

Andrea Sironi* Felix Suntheim†

Abstract

Overconfident CEOs have systematically upward biased beliefs about the returns of their investment projects. Overconfidence is measured using a sample of international banks from 1997 to 2008 with full information on CEO option holdings. Ingersoll (2006) determines the optimal exercise time for undiversified option holders under realistic assumptions on risk aversion. Similar to Malmendier & Tate (2007) we classify CEOs as overconfident if they keep their options too long to be considered rational. We find that banks with overconfident CEOs did not perform worse during the financial crisis but have higher risk throughout the sample period. Active boards however seem to mitigate this effect.

*Bocconi University. E-mail: andrea.sironi@unibocconi.it
†Bocconi University. E-mail: felix.suntheim@unibocconi.it

1 Introduction

In this project we want to investigate bank policies and bank risk taking from a behavioral perspective. Motivated by an overall sentiment in the public press that describes bank CEOs as risk seeking individuals who where not able to assess the riskiness of their institutions correctly, we look at the CEOs level of overconfidence as an explanatory variable of bank risk.

Overconfident CEOs have systematically upward biased beliefs about the returns of their investment projects. This leads managers to undertake high risk and possibly value destroying projects when internal funds are sufficient. Clearly banks were engaged in such high risk activities in recent years. Tail risk has not been assessed correctly and financial institutions that seemed sound in the years before 2007 turned out to be heavily exposed to risky securities. The CEO as the ultimate decision maker is supposed to have some discretion over the riskiness of a bank and is therefore the subject of this study.

Anecdotal evidence for bank executives' failure to assess risks appropriately confirms this conjecture. Goldman Sachs CFO David Vilniar for example, famously said in the Financial Times in 2007 that

> We were seeing things that were 25-standard deviation moves, several days in a row.

To put that quote into perspective, Dowd et al. (2010) argue that just one 25-sigma event is as likely as winning the UK national lottery 22 times in a row. Clearly Mr. Vilniar exaggerated to convey to the reader that the bank was hit by a very rare event, however the sheer extent makes clear how banks' risk models were underestimating risks, or in other words were too confident about future outcomes.

In this study overconfidence is measured using a sample of international banks from 2000 to 2008 with full information on CEOs' option and stock holdings. In-

gersoll (2006) proposes a method to determine the optimal exercise point for an undiversified option holder under realistic assumptions on risk aversion. Our detailed option data with information on all option characteristics and on the exercise date allows us to value the options from a CEOs perspective and to calculate the optimal exercise time for each option in a CEOs' portfolio. Similar to Malmendier and Tate (2005) we classify CEOs as overconfident if they keep their options too long to be considered rational.

Several articles have looked at the role of CEO overconfidence on corporate policies. Hribar and Yang (2011) argue that managerial confidence manifests itself as excessive optimism about future firm performance, leading managers to issue upward biased earnings forecasts which they then miss. The authors use press articles in which the CEOs are called confident as their measure of overconfidence. However such an overconfidence measure is almost impossible to implement in an international study, considering the differences in press coverage among countries. Ben-David et al. (2007) measure overconfidence by asking S&P 500 CFOs to predict future stock market returns. They find that overconfidence and optimism are persistent over time for a given CFO. Those classified as overconfident invest more in capital expenditures, make more acquisitions, have more leverage and are less likely to distribute dividends. Merger plans of their firms are negatively received by the market. Malmendier and Tate (2005) argue that risk averse CEOs should reduce their exposure to company-specific risk by exercising options prior to expiration. They follow Hall and Murphy (2002) to derive the optimal exercise point under reasonable assumptions and specify a CEO who does not diversify as overconfident. Their sample spans 394 large US firms from 1980 to 1994. Based on the work of Heaton (2002) they conjecture that Overconfident CEOs overinvest if they have sufficient internal funds and are not disciplined by capital markets and corporate governance mechanisms. If they do not have sufficient internal funds they curb their investment because they are not willing to issue new equity, due to perceived undervaluation. In a second paper Malmendier and Tate (2008) relate CEO

overconfidence to the occurrence of value destroying mergers.

This is the first study to investigate the role of CEO overconfidence in banking, and furthermore in an international setting. The global setting allows us to look at the effect regulators have on the likelihood of appointing an overoptimistic CEO and on the monitoring of a bank with such a CEO. Moreover, a complimentary dataset with detailed information on board composition and board activity yields insights on the role of corporate governance with respect to these issues.

We first look at the performance of banks during the financial crisis depending on their CEO being overconfident. Using market based and accounting based performance measures we do not find any evidence of CEO overconfidence causing the outcome of the financial crisis. In a second step we investigate whether CEO overconfidence plays a role for determining bank risk. Using the standard deviation of equity returns and the distance-to-default as measures of bank risk we do find some evidence that more confident CEOs take on higher risks. Subsequent results show however that this effect is mitigated by a more active board. The decision to hire an overconfident CEO may depend both on the banks' internal corporate governance mechanisms and on the effectiveness of the regulatory environment. We address both issues by looking at the probability to hire an overconfident CEO depending on measures of regulatory strength and good corporate governance. We do not find any evidence of an influence of regulatory power on the decision to hire an overconfident CEO. However more independent board with a lower ratio of women tend to hire more often a CEO who is classified as overconfident.

The remainder of the paper is organized as follows. Section 2 describes the dataset and introduces the methodology used to classify CEOs as overconfident. Section 3 investigates the relationship between CEO overconfidence and bank risk, both during the financial crisis and over the whole sample period. Section 4 interacts the strength of the corporate governance mechanisms with the overconfident CEO's

ability to take on higher risks. It also explores the determinants of the decision to hire an overconfident CEO. Section 5 concludes.

2 Data

The data used for this article is taken from a previous study on CEO compensation in the financial service industry (Suntheim (2011)). It comprises detailed data on executive compensation of 113 international banks. The data items available are:

- Personal (CEO name, tenure)
- Cash remuneration (salary, bonus payments, long term incentive plans)
- Interest in the banks shares (direct or through restricted shares[1])
- Stock options (grant date, vesting date, exercise price, exercise date, performance criteria)

The sample comprises all banks that provide detailed information on CEO compensation and that were among the largest 250 banks by total assets in the year 2000. Therefore by construction the sample banks are very large international institutions with rather strict disclosure rules. This may imply implicit too-big-to-fail guarantees and possibly better corporate governance mechanisms.

Table 1 shows summary statistics of the sample banks, it can be highlighted again that the sample consists of the very largest banks worldwide.

For a smaller sample of 85 banks we supplement this data with information on corporate governance practices for each bank The data items available cover the following areas:

[1]Restricted shares are share grants tied to performance or vesting criteria.

Table 1: This table provides summary statistics for the 113 sample banks over the years 2000-2008. Total risk is the annualized 120 day moving window standard deviation of equity returns. Idiosyncratic risk is the standard error from an industry CAPM model with the STOXX Global 1800 Banks index as market index. Distance to Default is defined as the number of standard deviations the value of assets is away from default with the face value of debt as default point and one year maturity.

Variable	Mean	Std. Dev.	N
Total risk	0.343	0.277	899
Idiosyncratic risk	0.018	0.012	895
Distance to default	2.551	10.365	714
Non-interest income / net income	1.704	10.958	862
Total capital ratio	0.048	0.445	892
T1 ratio	0.09	0.03	782
Total assets ($000s)	375,194,245	519,604,602	892
Market-to-book	1.949	1.691	886

- Is the CEO member of the board of directors, and if yes is she the chairman of the board?
- General information on the board of directors (number of directors, number of independent directors, fraction of female directors, number of board meetings.)
- Information on the remuneration committee (Has a remuneration committee been implemented? Is the CEO member of the committee or does she attend its meetings? Is the CEO chairman of the committee? Number of committee meetings, number of independent directors on the committee.

Table 2 contains summary statistics of the board characteristics. The average number of board members varies from 8 in Finland to 19 in Germany and Spain. The frequency of board meetings varies from 7 to 47, implying possibly large differences in monitoring activities of boards. Boards are dominated by men all over the world, with higher numbers especially in the Scandinavian and German speaking countries. Most banks have established a committee that deals specifically with managerial compensation. These committees meet between one and ten times per

year, have mainly independent members and mostly meet without the presence of the CEO.

Stock market data comes from CRSP for US banks and Compustat for all other banks. Bank balance sheet data is taken from Bureau van Dijk's Bankscope database. The indexes describing the regulatory environment are constructed using the procedure developed by Barth et al. (2001). The data is available through the Worldbank for 2001, 2003 and 2007.

2.1 Subjective option pricing model

To classify a CEO as overconfident we use an approach similar to Malmendier and Tate (2005). A CEO is considered overconfident if she exercises her option later than it would be rational under reasonable assumptions on risk aversion and diversification. To estimate the optimal exercise time for each CEO's option package we use a methodology first introduced by Ingersoll (2006). It allows us, different to Malmendier and Tate (2005), to compute the optimal exercise time for each option grant at each point in time individually.

Ingersoll (2006) derives an explicit solution to the option pricing problem of an undiversified individual holding an option that can be exercised after a certain vesting period and that is possibly tied to performance criteria. The model is based on the following assumptions:

First, the CEO lives infinitely long[2] and maximizes her expected utility with constant relative risk aversion γ:

$$\frac{1}{\gamma}\int_0^\infty \exp -\rho t C + t^\gamma dt.$$

Second, as in the standard Black-Scholes model there are no transaction costs or

[2]the infinite lifetime assumption can be relaxed.

Table 2: Board characteristics for the top five banks of each country if available from 2000 to 2008. CEO on board is the percentage of banks in which the CEO is part of the board. Independence is the percentage of independent board members as reported by the bank. Women on board gives the percentage of female board members. Compensation committee is the percentage of banks which have a compensation committee. CEO on committee is the percentage of banks in which the CEO attends compensation committee meetings or is member of the compensation committee. Committee independence is the percentage of independent board members in the compensation committee as reported by the bank.

Country	# Board members	# Board meetings	CEO on board	Indep.	Women on board	Comp. committee	Committee meetings	CEO on committee	Committee indep.	N
Australia	10	11	98%	83%	17%	100%	6	20%	98%	41
Austria	17	7	0%		23%	44%	1	0%		9
Belgium	17	8	100%	43%	8%	100%	3	19%	63%	16
Canada	17	13	100%	88%	20%	100%	6	29%	100%	42
Denmark	18	14	0%	100%		50%	2	0%		8
Finland	8	13	100%	59%	9%	75%	5	0%	94%	8
France	18	8	46%	37%	6%	100%	4	0%	62%	35
Germany	19	7	0%		20%	23%	4	0%		13
Hong Kong	15	7	100%	42%	5%	92%	3	0%	76%	25
Ireland	14	10	100%	68%	9%	100%	5	0%	100%	26
Israel	15	31	0%		15%	32%	6	0%		22
Italy	18	16	71%	57%	4%	59%	2	0%	47%	17
Malaysia	11	17	100%	49%	6%	100%	10	11%	56%	9
Netherlands	11	9	0%	93%	8%	95%	4	5%	100%	22
Norway	10	19	0%	81%	36%	56%	5	0%	100%	16
Singapore	12	8	100%	68%	5%	100%	3	54%	68%	24
South Africa	18	7	94%	59%	10%	100%	4	55%	69%	33
Spain	19	11	75%	48%	11%	71%	7	0%	87%	28
Sweden	12	15	85%	58%	29%	93%	5	12%	75%	41
Switzerland	10	47	0%	90%	20%	100%	7	0%	100%	3
Thailand	19	12	100%	37%	5%	100%	6	0%	33%	1
UK	17	11	100%	52%	11%	100%	6	0%	92%	42
USA	14	12	95%	85%	17%	100%	7	0%	100%	40
Total	15	12	74%	64%	14%	88%	5	12%	84%	521

short sale constraints allowed, an assumption that is standard in the basic option pricing literature. Third, the CEO holds a constant fraction $\underline{\theta}$ of her wealth in the stock of her bank. This assumption can be justified either by explicit minimum stock requirements, as they are common in many banks or by the amount of a CEO's wealth and human capital that is tied voluntarily to the stock market performance of her employer. Although no data on total CEO wealth is available the amount of stock and option holdings of most sample CEOs is large in absolute terms. We follow Malmendier and Tate (2005) and assume this fraction of wealth in the bank's stock to be 66%. Moreover a coefficient of constant relative risk aversion of five is assumed, consistent with findings in the behavioral finance literature.

The stockholding constraint forces an extra risk upon the CEO but not all of this risk is relevant since by adjusting the rest of the portfolio the CEO can eliminate some of it. Important for the subjective value of the option is therefore not the absolute value of stocks held but the excess holding restriction θ. If this constraint is not binding the subjective and objective value of the option are identical as are the optimal exercise dates. Considering however the large stockholdings of the average CEO and the small percentage each banks' stock would contribute to the market portfolio it is reasonable to assume that the constraint binds.

The extra risk imposed on the CEO through the stockholding constraint can be potentially traded away partially. Ingersoll (2006) assumes a factor structure on asset returns with the factors being traded assets such that the CEO has the ability to trade away some of the risks. As suggested by Ingersoll (2006) we assume a very simple factor model and use the residuals of the CAPM to get an estimate of residual risk.[3] This would be correct for a manager that hedges only against market risks but does not take into account other risk factors, for example industry or country risks.

[3]Market index is the S&P 500

The manager holds therefore a fraction of her wealth in the banks' stock, a fraction in the factor portfolios and the remainder in the risk free asset. The optimal portfolio choice can then be determined and a closed form solution to the subjective option pricing problem is derived. The solution resembles the standard Black and Scholes formula with adjustments made to both dividend yield and to the risk free rate.

While standard american options on non-dividend paying stocks are optimally held till maturity it may well be the case that incentive options of an undiversified CEO are exercised well before this point in time. The decision to exercise the option early is however endogenous and therefore standard option pricing formulas cannot be used. Ingersoll (2006) uses for this reason the barrier-derivative approach which has been shown to be an accurate approximation and which can incorporate vesting conditions. The idea behind the barrier-derivative approximation here is to determine the optimal exercise policy, by using the class of constant exercise policies. This approximation yields a lower bound to the actual option value.[4] The approximate value of an unvested option is given as

$$C \geq \max_{k} C_{barr}(S, t, T, k)$$

where C_{barr} is the value of the barrier option with vesting constraint, k is the barrier at which the option will be exercised. The option will therefore be exercised after vesting occurs, as soon as the option hits the barrier k or at maturity if the option is in the money. S is the stock price and T the time to maturity.

The optimal exercise time can be calculated by choosing the stock price at which exercising the option would be optimal from the CEO's perspective and then estimating the expected time when this price would be reached.

[4]errors have been found to be approximately 0.11%-0.2% for 10-year options

2.2 Construction of the overconfidence variable

A CEO is defined as overconfident if the optimal exercise barrier is hit and the option has vested but the CEO does not exercise the option in her portfolio. Since each CEO has several options in her portfolio there are numerous ways to specify a CEO as overconfident and we are reporting various specifications in the following analysis. Our ten overconfident measures are defined as follows: (1) At least 50% of the CEOs option packages have hit the optimal exercise barrier once but have not been exercised. (2) The barrier has been hit once for at least 75% of the CEO option packages. (3) In order to control for vesting criteria we require stock options to be 50% over the optimal exercise barrier. At least 50% of the options must have hit this more stringent exercise barrier. (4) 75% of the CEO's options must have been exercised late according to the more stringent measure. (5) An option is classified as overdue when the barrier has been hit for more than twelve consecutive months. In some cases CEOs may be restricted to specific exercise periods during a year. This requirement should make sure that the CEO is actually able to exercise the options in her portfolio. 50% of the options need to be exercised early according to this criterion. (6) As (5) but requiring 75% of the options to be exercised early. (7) 50% of the options need to be for twelve months 50% above the threshold. (8) 75% of the options need to be for twelve months 50% above the threshold. (9) 50% need to hit the threshold computed with an alternative risk aversion coefficient of three. (10) 75% need to hit the threshold computed with an alternative risk aversion coefficient of three.
Moreover we require each CEO to have at least five exercisable option packages in her portfolio during the sample period. Table 3 summarizes the definitions of the different overconfidence dummies.

There are two possible alternative explanations for late exercise of CEO stock options. First, CEOs may try to influence markets by sending a costly signal about the expected future performance of the bank and about the CEOs commitment to the bank. However Malmendier and Tate (2005) argue that option exercise is not

Table 3: Definition of overconfidence dummies

Variable name	Definition
Overconfidence1	At least 50% of the CEOs option packages have hit the optimal exercise barrier once but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of five.
Overconfidence2	At least 75% of the CEOs option packages have hit the optimal exercise barrier once but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of five.
Overconfidence3	At least 50% of the CEOs option packages have hit a barrier 50% above the optimal exercise barrier once but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of five.
Overconfidence4	At least 75% of the CEOs option packages have hit a barrier 50% above the optimal exercise barrier once but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of five.
Overconfidence5	At least 50% of the CEOs option packages have hit the optimal exercise barrier once but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of three.
Overconfidence6	At least 75% of the CEOs option packages have hit the optimal exercise barrier once but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of three.
Overconfidence7	At least 50% of the CEOs option packages have hit the optimal exercise barrier for twelve consecutive months but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of five.
Overconfidence8	At least 75% of the CEOs option packages have hit the optimal exercise barrier for twelve consecutive months but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of five.
Overconfidence9	At least 50% of the CEOs option packages have hit a barrier 50% above the optimal exercise barrier for twelve consecutive months but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of five.
Overconfidence10	At least 75% of the CEOs option packages have hit a barrier 50% above the optimal exercise barrier for twelve consecutive months but have not been exercised. The optimal exercise barrier is computed assuming a constant relative risk aversion coefficient of five.

perceived as a very relevant signal by traders, compared to CEOs active trading decisions in company stocks. For this reason we do not take into account changes in stock holdings of the CEO. A second possible explanation could be insider information of bank CEOs. Again Malmendier and Tate (2005) do not find any evidence of positive abnormal returns of CEOs exercising their options late.

Table 4 shows summary statistics by country. Overall there are 153 CEOs employed at the sample banks during the years 2000-2008 and we classify between 33 and 3 of those CEOs as overconfident, depending on which measure of overconfidence we use.

3 Overconfidence and bank risk

In this section we use the previously defined overconfidence measures to investigate the effect on bank risk. First, we look at the performance of the sample banks during the financial crisis, then at the riskiness of the banks assets over the whole time period 2000 till 2008.

3.1 Bank performance during the financial crisis

In a first step we investigate the effect overconfidence has on banks' performance during the financial crisis. We expect that more confident CEOs may have invested in high risk assets before the financial crisis, assuming that they would be able to outperform the market, such a behavior could have led to worse performance during the financial crisis. Tables 5, 6 and 7 show regressions of banks' returns in terms of stock market and accounting performance, depending on the overconfidence measure and controls. Stock market returns are measured beginning with the Lehman collapse till the end of 2008. Accounting performance is defined as return on assets and return on equity from the second half of 2007 till the end of 2008. The time period and the selected performance measures are chosen in line with the papers by

Table 4: Summary statistics on CEO overconfidence. A CEO is considered overconfident if she exercies her options late. CEOs is the number of CEO per country. Overconfidence measure 1-10 show the number of overconfident CEOs according to each measure of overconfidence.

		Overconfidence measure									
Country	CEOs	1	2	3	4	5	6	7	8	9	10
Australia	10	5	3	1	0	6	2	2	1	0	0
Austria	1	0	0	0	0	0	0	0	0	0	0
Belgium	4	1	0	0	0	0	0	0	0	0	0
Canada	9	7	1	2	1	5	1	5	1	1	1
France	8	2	1	0	0	2	1	1	1	0	0
Germany	9	0	0	0	0	0	0	0	0	0	0
Hong Kong	5	1	0	0	0	1	0	1	0	0	0
Ireland	7	2	2	1	1	2	2	2	2	1	1
Israel	3	0	0	0	0	0	0	0	0	0	0
Italy	6	0	0	0	0	0	0	0	0	0	0
Malaysia	1	0	0	0	0	0	0	0	0	0	0
Netherlands	4	0	0	0	0	0	0	0	0	0	0
Norway	1	0	0	0	0	0	0	0	0	0	0
Singapore	4	2	1	0	0	2	1	0	0	0	0
South Africa	5	3	1	1	1	1	1	1	1	2	1
Spain	5	0	0	0	0	0	0	0	0	0	0
Sweden	12	0	0	0	0	0	0	0	0	0	0
Switzerland	2	0	0	0	0	0	0	0	0	0	0
UK	19	2	0	0	0	2	0	2	0	1	0
USA	35	8	3	1	0	5	3	4	1	0	0
Total	153	33	12	6	3	26	11	18	7	5	3

Beltratti and Stulz (2009) and Fahlenbrach and Stulz (2009). Control variables are the market-to-book ratio the capital ratio, bank size and the delta and vega of the CEO option portfolio.

The results show that none of the performance measures depends consistently on the CEO's level of overconfidence. If any, there seems to be some evidence that more confident CEOs even performed better during the crisis. However considering the small sample size and the few significant results this evidence is far from being conclusive. When looking at the control variables we see that as one would expect more capitalized banks performed better during the crisis. Similar to the findings in Suntheim (2011) CEO with high vega and low delta contracts where based in banks that performed worse during the crisis. This is in line with a risk incentive story, where high risk taking incentives led CEOs to take on more risk that unwound during the financial crisis. However these results do not appear to be significant when looking at banks' stock market performance. Possible explanations for that could be that markets discounted systemic banks beyond what would appear on their balance sheets.

3.2 Bank risk and CEO overconfidence

Having concluded that there is no evidence of bank CEOs' overconfidence impacting the way banks performed during the financial crisis we look more carefully at the way overconfidence has been associated with bank risk throughout the whole sample period. Our measures of risk are the annualized standard deviation of equity returns measured over a 120 trading day window and the distance-to-default, defined as the number of standard deviations the value of assets is away from default. The default point used is the face value of debt with an assumed maturity of one year. The distance-to-default has been shown to be a leading indicator of bank fragility (Gropp et al. (2002)).

Table 5: Regression of bank performance on overconfidence dummy and control variables. Return is the stock market return from July 2007 till December 2008, Control variables are the market-to-book ratio the capital ratio, bank size and the delta and vega of the CEO option portfolio. The measures of overconfidence are based on a minimum requirement of late option exercises. The measures with odd numbers are based on a 33% cutoff, the measures with even numbers are based on a 66% cutoff. All variables are measured in 2006. Each regression contains bank specialization fixed effects and country fixed effects. Standard errors in parentheses are clustered at the country level.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
overconfidence1	0.109**									
	(0.0448)									
overconfidence2		0.109								
		(0.0639)								
overconfidence3			0.0751							
			(0.0573)							
overconfidence4				0.167						
				(0.123)						
overconfidence5					0.155**					
					(0.0686)					
overconfidence6						0.142***				
						(0.0203)				
overconfidence7							0.145			
							(0.0899)			
overconfidence8								0.0307		
								(0.113)		
overconfidence9									0.167	
									(0.123)	
overconfidence10										0.167
										(0.123)
capital ratio	5.551***	5.341**	5.420***	5.518***	5.305***	5.494**	4.757***	5.354***	5.518***	5.518***
	(1.712)	(1.934)	(1.591)	(1.721)	(1.659)	(2.080)	(1.517)	(1.558)	(1.721)	(1.721)
mtb	0.0807***	0.0785***	0.0732***	0.0747***	0.0779***	0.0789***	0.0782***	0.0756***	0.0747***	0.0747***
	(0.0177)	(0.0173)	(0.0173)	(0.0161)	(0.0180)	(0.0171)	(0.0175)	(0.0154)	(0.0161)	(0.0161)
ln(ta)	0.0254	0.0132	0.0143	0.0170	0.0252	0.0166	0.0173	0.0171	0.0170	0.0170
	(0.0185)	(0.0159)	(0.0167)	(0.0172)	(0.0170)	(0.0131)	(0.0212)	(0.0177)	(0.0172)	(0.0172)
ln(vega)	-0.00428	-0.00518	-0.00555	-0.00549	-0.00487	-0.00523	-0.00408	-0.00517	-0.00549	-0.00549
	(0.0162)	(0.0162)	(0.0153)	(0.0152)	(0.0166)	(0.0161)	(0.0167)	(0.0154)	(0.0152)	(0.0152)
ln(delta)	-0.0549	-0.0429	-0.0395	-0.0401	-0.0536	-0.0435	-0.0506	-0.0422	-0.0401	-0.0401
	(0.0629)	(0.0701)	(0.0697)	(0.0688)	(0.0650)	(0.0697)	(0.0684)	(0.0670)	(0.0688)	(0.0688)
Constant	-1.081	-0.817	-0.858	-0.933	-1.118	-0.914	-0.787	-0.904	-0.933	-0.933
	(1.146)	(1.037)	(0.954)	(1.057)	(1.051)	(1.059)	(1.138)	(1.057)	(1.057)	(1.057)
Observations	65	65	65	65	65	65	65	65	65	65
R-squared	0.530	0.520	0.514	0.515	0.542	0.526	0.526	0.512	0.515	0.515
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialization dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: Regression of the return on assets between the 3rd quarter 2007 and the 4th quarter 2008 on overconfidence dummy and control variables. Return is the stock market return from July 2007 till December 2008, Control variables are the market-to-book ratio the capital ratio, bank size and the delta and vega of the CEO option portfolio. The measures of overconfidence are based on a minimum requirement of late option exercises. The measures with odd numbers are based on a 33% cutoff, the measures with even numbers are based on a 66% cutoff. All variables are measured in 2006. Each regression contains bank specialization fixed effects and country fixed effects. Standard errors in parentheses are clustered at the country level.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
overconfidence1	0.000880									
	(0.00280)									
overconfidence2		0.00643								
		(0.00855)								
overconfidence3			0.00302							
			(0.00433)							
overconfidence4				-0.00122						
				(0.00444)						
overconfidence5					0.00779***					
					(0.00123)					
overconfidence6						0.00643				
						(0.00855)				
overconfidence7							0.0158***			
							(0.00488)			
overconfidence8								0.0140		
								(0.0120)		
overconfidence9									-0.00122	
									(0.00444)	
overconfidence10										-0.00122
										(0.00444)
capital ratio	-0.679***	-0.679***	-0.678***	-0.681***	-0.687***	-0.679***	-0.756***	-0.693***	-0.681***	-0.681***
	(0.162)	(0.185)	(0.160)	(0.161)	(0.161)	(0.185)	(0.133)	(0.186)	(0.161)	(0.161)
mtb	0.00575***	0.00589***	0.00562***	0.00571***	0.00580***	0.00589***	0.00594***	0.00573***	0.00571***	0.00571***
	(0.000744)	(0.000526)	(0.000523)	(0.000644)	(0.000671)	(0.000526)	(0.000443)	(0.000585)	(0.000644)	(0.000644)
ln(ta)	-0.00310*	-0.00330**	-0.00322**	-0.00316*	-0.00282*	-0.00330**	-0.00304**	-0.00263	-0.00316*	-0.00316*
	(0.00147)	(0.00153)	(0.00150)	(0.00152)	(0.00145)	(0.00153)	(0.00129)	(0.00161)	(0.00152)	(0.00152)
ln(vega)	-0.00109*	-0.00109	-0.00110*	-0.00109*	-0.00108	-0.00109	-0.000962	-0.00106	-0.00109*	-0.00109*
	(0.000586)	(0.000643)	(0.000590)	(0.000601)	(0.000648)	(0.000643)	(0.000767)	(0.000668)	(0.000601)	(0.000601)
ln(delta)	0.00537**	0.00546**	0.00555**	0.00544**	0.00502**	0.00546**	0.00453*	0.00534*	0.00544**	0.00544**
	(0.00205)	(0.00247)	(0.00230)	(0.00236)	(0.00212)	(0.00247)	(0.00222)	(0.00260)	(0.00236)	(0.00236)
Constant	0.0580	0.0623	0.0601	0.0597	0.0503	0.0623	0.0702	0.0474	0.0597	0.0597
	(0.0419)	(0.0433)	(0.0379)	(0.0397)	(0.0420)	(0.0433)	(0.0439)	(0.0359)	(0.0397)	(0.0397)
Observations	58	58	58	58	58	58	58	58	58	58
R-squared	0.466	0.468	0.466	0.466	0.473	0.468	0.485	0.471	0.466	0.466
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialization fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Regression of the return on equity between the 3rd quarter 2007 and the 4th quarter 2008 on overconfidence dummy and control variables. Return is the stock market return from July 2007 till December 2008, Control variables are the market-to-book ratio the capital ratio, bank size and the delta and vega of the CEO option portfolio. The measures of overconfidence are based on a minimum requirement of late option exercises. The measures with odd numbers are based on a 33% cutoff, the measures with even numbers are based on a 66% cutoff. All variables are measured in 2006. Each regression contains bank specialization fixed effects and country fixed effects. Standard errors in parentheses are clustered at the country level.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
overconfidence1	-0.104									
	(0.126)									
overconfidence2		0.00591								
		(0.129)								
overconfidence3			0.0747							
			(0.0989)							
overconfidence4				-0.101						
				(0.0730)						
overconfidence5					0.0684					
					(0.0844)					
overconfidence6						0.00591				
						(0.129)				
overconfidence7							0.257**			
							(0.0951)			
overconfidence8								0.207		
								(0.243)		
overconfidence9									-0.101	
									(0.0730)	
overconfidence10										-0.101
										(0.0730)
cap_ratio	-21.09***	-20.98***	-20.94***	-21.08***	-21.04***	-20.98***	-22.22***	-21.17***	-21.08***	-21.08***
	(3.328)	(3.387)	(3.420)	(3.371)	(3.338)	(3.387)	(2.579)	(3.850)	(3.371)	(3.371)
mtb	-0.00105	0.00355	0.00108	0.00385	0.00420	0.00355	0.00714	0.00374	0.00385	0.00385
	(0.0292)	(0.0235)	(0.0236)	(0.0267)	(0.0273)	(0.0235)	(0.0225)	(0.0254)	(0.0267)	(0.0267)
ln(ta)	-0.0909**	-0.0841**	-0.0856**	-0.0846**	-0.0810**	-0.0841**	-0.0820**	-0.0762*	-0.0846**	-0.0846**
	(0.0347)	(0.0366)	(0.0358)	(0.0366)	(0.0371)	(0.0366)	(0.0336)	(0.0368)	(0.0366)	(0.0366)
ln(vega)	-0.0342***	-0.0337***	-0.0341***	-0.0336***	-0.0337***	-0.0337***	-0.0317**	-0.0332***	-0.0336***	-0.0336***
	(0.00836)	(0.00920)	(0.00899)	(0.00941)	(0.00946)	(0.00920)	(0.0111)	(0.0105)	(0.00941)	(0.00941)
ln(delta)	0.184***	0.174***	0.176***	0.172***	0.170***	0.174***	0.159***	0.172***	0.172***	0.172***
	(0.0325)	(0.0393)	(0.0374)	(0.0399)	(0.0363)	(0.0393)	(0.0351)	(0.0424)	(0.0399)	(0.0399)
Constant	1.864*	1.714*	1.731*	1.746*	1.632	1.714*	1.888*	1.535	1.746*	1.746*
	(0.909)	(0.970)	(0.925)	(0.938)	(1.007)	(0.970)	(0.926)	(0.884)	(0.938)	(0.938)
Observations	58	58	58	58	58	58	58	58	58	58
R-squared	0.466	0.463	0.464	0.464	0.464	0.463	0.472	0.465	0.464	0.464
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialization fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 8 and 9 show the regressions of the different measures of risk on the overconfidence measures and control variables. The control variables are the market-to-book ratio, the logarithm of total assets and the banks' capital ratio. The market-to-book ratio controls for differences in investment opportunities. The capital ratio controls for bank leverage and is defined as total equity divided by total assets. The log of total assets proxies for bank size. Large banks are more diversified than small banks but may take on higher risks because of implicit "too big to fail" guarantees. All regressions contain country fixed effects, year fixed effects and specialization fixed effects. Bank specialization is defined according to the Bankscope classifications, which group banks into investment banks, commercial banks, bank holding companies, mutual banks, savings banks and mortgage banks. Standard errors are clustered at the country level.

Table 8 shows for six out of the ten overconfidence measures a significantly positive effect on banks' standard deviation of equity returns. Results are more robust for the more stringent overconfidence measure, with significant coefficients for the overconfidence measures (6) to (9). Table 9 gives a similar picture with the distance-to-default as our measure of risk. Five out of ten overconfidence measures have a significantly negative effect on the distance-to-default, with the more stringent measures being the significant ones. For most of the measures the 75% cutoff criterion is related to banks' proximity to default. Larger banks with higher market-to-book ratios have lower levels of risk. The relationship between bank size and risk may be due to too-big-to-fail guarantees or to higher levels of diversification. As one would expect banks with more equity capital have lower levels of bank risk and are farer away from default.

To conclude this section, we like to point out that there seems to be some evidence that CEOs' overconfidence actually makes bank chose riskier policies which then leads to higher bank risk and higher levels of bank fragility.

Table 8: Regression of the standard deviation of equity on overconfidence dummy and control variables. Control variables are the market-to-book ratio the capital ratio, bank size and the delta and vega of the CEO option portfolio. The measures of overconfidence are based on a minimum requirement of late option exercises. The measures with odd numbers are based on a 33% cutoff, the measures with even numbers are based on a 66% cutoff. Each regression contains bank specialization fixed effects and country fixed effects. Standard errors in parentheses are clustered at the country level.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
overconfidence1$_{t-1}$	0.0147									
	(0.0116)									
overconfidence2$_{t-1}$		0.0258								
		(0.0156)								
overconfidence3$_{t-1}$			0.0252*							
			(0.0144)							
overconfidence4$_{t-1}$				0.0432**						
				(0.0204)						
overconfidence5$_{t-1}$					0.0168					
					(0.0133)					
overconfidence6$_{t-1}$						0.0281*				
						(0.0156)				
overconfidence7$_{t-1}$							0.0251*			
							(0.0132)			
overconfidence8$_{t-1}$								0.0403*		
								(0.0199)		
overconfidence9$_{t-1}$									0.0442**	
									(0.0189)	
overconfidence10$_{t-1}$										0.0261
										(0.0205)
mtb	-0.0158*	-0.0159*	-0.0160*	-0.0157*	-0.0158*	-0.0159*	-0.0158*	-0.0156*	-0.0156*	-0.0157*
	(0.00866)	(0.00858)	(0.00870)	(0.00842)	(0.00861)	(0.00860)	(0.00851)	(0.00839)	(0.00841)	(0.00850)
ln(ta)	-0.0103	-0.0112	-0.0101	-0.00933	-0.0101	-0.0105	-0.0109	-0.0106	-0.0104	-0.00986
	(0.00876)	(0.00888)	(0.00923)	(0.00896)	(0.00898)	(0.00900)	(0.00885)	(0.00874)	(0.00894)	(0.00910)
capital ratio	-0.949*	-0.961*	-0.972**	-0.946**	-0.967**	-0.983**	-0.991**	-1.013**	-0.939*	-0.969**
	(0.466)	(0.465)	(0.459)	(0.449)	(0.455)	(0.453)	(0.468)	(0.437)	(0.489)	(0.451)
Constant	0.647**	0.668**	0.649**	0.632**	0.637**	0.657**	0.667**	0.661**	0.657**	0.647**
	(0.239)	(0.242)	(0.248)	(0.240)	(0.245)	(0.241)	(0.241)	(0.234)	(0.241)	(0.243)
Observations	783	783	783	783	783	783	783	783	783	783
R-squared	0.732	0.733	0.732	0.733	0.732	0.733	0.733	0.733	0.733	0.732
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialization fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: Regression of the distance to default on equity overconfidence dummy and control variables. Control variables are the market-to-book ratio the capital ratio, bank size and the delta and vega of the CEO option portfolio. The measures of overconfidence are based on a minimum requirement of late option exercises. The measures with odd numbers are based on a 33% cutoff, the measures with even numbers are based on a 66% cutoff. Each regression contains bank specialization fixed effects and country fixed effects. Standard errors in parentheses are clustered at the country level.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
overconfidence1$_{t-1}$	-0.128									
	(0.109)									
overconfidence2$_{t-1}$		-0.293*								
		(0.144)								
overconfidence3$_{t-1}$			-0.245							
			(0.156)							
overconfidence4$_{t-1}$				-0.470*						
				(0.253)						
overconfidence5$_{t-1}$					-0.0585					
					(0.126)					
overconfidence6$_{t-1}$						-0.251*				
						(0.136)				
overconfidence7$_{t-1}$							-0.179			
							(0.144)			
overconfidence8$_{t-1}$								-0.397**		
								(0.170)		
overconfidence9$_{t-1}$									-0.441**	
									(0.186)	
overconfidence10$_{t-1}$										-0.367
										(0.240)
mtb	0.215**	0.216**	0.217**	0.214**	0.215**	0.217**	0.215**	0.214**	0.214**	0.214**
	(0.0840)	(0.0839)	(0.0851)	(0.0821)	(0.0836)	(0.0841)	(0.0829)	(0.0821)	(0.0820)	(0.0821)
ln(ta)	0.182**	0.194**	0.182**	0.174**	0.179**	0.185**	0.186**	0.187**	0.186**	0.180**
	(0.0729)	(0.0747)	(0.0762)	(0.0705)	(0.0738)	(0.0747)	(0.0730)	(0.0722)	(0.0724)	(0.0742)
capital ratio	27.45***	27.57***	27.76***	27.37***	27.55***	27.81***	27.81***	28.16***	27.26***	27.85***
	(4.334)	(4.458)	(4.338)	(3.937)	(4.014)	(4.229)	(4.294)	(4.061)	(4.593)	(4.234)
Constant	-3.968*	-4.240*	-4.048*	-3.845*	-3.962*	-4.101*	-4.137*	-4.160**	-4.118*	-4.035*
	(2.064)	(2.079)	(2.088)	(1.903)	(2.068)	(2.037)	(2.067)	(1.986)	(1.988)	(2.009)
Observations	701	701	701	701	701	701	701	701	701	701
R-squared	0.773	0.774	0.773	0.774	0.772	0.773	0.773	0.774	0.775	0.773
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialization fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

4 Overconfidence, corporate governance and regulation

In this section we look more closely on the interaction between corporate governance mechanisms and the way CEO overconfidence influences bank risk.

4.1 Corporate governance and overconfidence and bank risk

Having established some evidence for overconfident bank CEOs to be employed in riskier banks, we would expect that corporate governance systems would be put in place to make sure that the overconfident CEO does not take on too much risk. Our measure of a more active board is the number of board meetings per year that we then interact with our overconfidence measure. The sample employed is slightly different to the one used in the previous section. Corporate governance variables are available only for a subset of banks, i.e. for the top five banks of each country during the period 2000 till 2008. The sample is therefore considerably smaller but does not suffer from a larger concentration in some sample countries, in particular in the United States.

Table 10 and Table 11 show regressions of the risk measure on the different overconfidence measures and on the interaction between the number of board meetings and the overconfidence measures. The control variables are suppressed for the sake of a better presentability. First of all we see that the effect of overconfidence on bank risk seems to be stronger in this subset of the sample. All the overconfidence dummies have a significantly positive effect on the standard deviation of equity returns and a significantly negative effect on the distance-to-default. This might be due to the particular set of larger banks or because of the lower representation of US banks. For example it is possible that due to some unidentified institutional setup US banks are less inclined to increase risk when their CEO is overconfident. Second more frequent past board meetings are associated with higher levels of risk in the subsequent period. This may be due to a change in banks' focus on more risky

business segments that would then also require a higher level of board oversight. Most interesting however is that the interaction between the number of board meetings and the overconfidence dummy is associated with a decrease in the riskiness of the bank. This result holds true both for the standard deviation of equity and for the distance-to-default. It is direct evidence for the boards' ability to mitigate risk taking incentives of the CEO by improving oversight over the bank.

4.2 Corporate governance regulation and CEO turnover

In this section we explore the impact corporate governance and supervisory power have on the decision to hire an overconfident CEO. We expect that both regulation and the strength of the board have an impact on the decision to hire a CEO who is overconfident. Although the type of the CEO may not be easily verifiable both regulators and board members may try to select a CEO with characteristics that match their own incentives. The effect of regulation could be twofold: First, a stronger regulator may be able to prevent an excessively confident CEO from being put in place and therefore reduce the likelihood of an overconfident CEO being hired. Second, banks' shareholder may try to compensate for stronger regulation by employing a CEO who takes on higher risks, which then could be an overconfident CEO. From a boards perspective an overconfident CEO may be well aligned with shareholders' interests to increase bank risk, given implicit guarantees and the existence of deposit insurance schemes. On the other hand banks' boards do have a risk controlling function which could reduce the boards incentive to hire a more confident CEO.

Table 12 shows results of probit regressions of a CEO dummy on controls and measures of corporate governance and regulation. The dependent variable takes value one if a new CEO is hired and she is overconfident, zero if she is not. Due to the small sample size just a subset of the overconfidence dummies could be used for this regressions and results have to be viewed with caution, given the rather small sample, especially for a probit regression. The control variables used are the

Table 10: Regression of the standard deviation of equity on overconfidence dummy, corporate governance interaction and control variables. The corporate governance variable is the number of board meetings in each year. The following control variables are included but not reported: the market-to-book ratio, the capital ratio, bank size. The measures of overconfidence are based on a minimum requirement of late option exercises. The measures with odd numbers are based on a 50% cutoff, the measures with even numbers are based on a 75% cutoff. Each regression contains bank specialization fixed effects and country fixed effects. Standard errors in parentheses are clustered at the country level.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$overconfidence1_{t-1}$	0.331**									
	(0.117)									
$overconfidence2_{t-1}$		0.420***								
		(0.147)								
$overconfidence3_{t-1}$			0.425*							
			(0.245)							
$overconfidence4_{t-1}$				0.600***						
				(0.180)						
$overconfidence5_{t-1}$					0.364**					
					(0.139)					
$overconfidence6_{t-1}$						0.504**				
						(0.199)				
$overconfidence7_{t-1}$							0.489***			
							(0.106)			
$overconfidence8_{t-1}$								0.638***		
								(0.162)		
$overconfidence9_{t-1}$									0.576***	
									(0.0836)	
$overconfidence10_{t-1}$										0.600***
										(0.180)
$overconfidence1_{t-1}$Xlnboardmeetings$_{t-1}$	-0.144**									
	(0.0551)									
$overconfidence2_{t-1}$Xlnboardmeetings$_{t-1}$		-0.180**								
		(0.0678)								
$overconfidence3_{t-1}$Xlnboardmeetings$_{t-1}$			-0.176*							
			(0.0996)							
$overconfidence4_{t-1}$Xlnboardmeetings$_{t-1}$				-0.256***						
				(0.0860)						
$overconfidence5_{t-1}$Xlnboardmeetings$_{t-1}$					-0.152**					
					(0.0643)					
$overconfidence6_{t-1}$Xlnboardmeetings$_{t-1}$						-0.214**				
						(0.0932)				
$overconfidence7_{t-1}$Xlnboardmeetings$_{t-1}$							-0.200***			
							(0.0499)			
$overconfidence8_{t-1}$Xlnboardmeetings$_{t-1}$								-0.270***		
								(0.0781)		
$overconfidence9_{t-1}$Xlnboardmeetings$_{t-1}$									-0.248***	
									(0.0414)	
$overconfidence10_{t-1}$Xlnboardmeetings$_{t-1}$										-0.256***
										(0.0860)
Observations	394	394	394	394	394	394	394	394	394	394
R-squared	0.744	0.742	0.740	0.741	0.743	0.742	0.745	0.742	0.745	0.741
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialization fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 11: Regression of the distance-to-default on overconfidence dummy, corporate governance interaction and control variables. The corporate governance variable is the number of board meetings in each year. The following control variables are included but not reported: the market-to-book ratio, the capital ratio, bank size. The measures of overconfidence are based on a minimum requirement of late option exercises. The measures with odd numbers are based on a 50% cutoff, the measures with even numbers are based on a 75% cutoff. Each regression contains bank specialization fixed effects and country fixed effects. Standard errors in parentheses are clustered at the country level.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$overconfidence1_{t-1}$	-2.309**									
	(0.978)									
$overconfidence2_{t-1}$		-3.111**								
		(1.106)								
$overconfidence3_{t-1}$			-3.166							
			(2.168)							
$overconfidence4_{t-1}$				-4.429**						
				(1.755)						
$overconfidence11_{t-1}$					-2.879***					
					(0.961)					
$overconfidence5_{t-1}$						-2.912*				
						(1.507)				
$overconfidence6_{t-1}$							-2.421			
							(1.953)			
$overconfidence7_{t-1}$								-2.711*		
								(1.500)		
$overconfidence8_{t-1}$									-3.216	
									(1.943)	
$overconfidence9_{t-1}$										-2.964***
										(0.752)
$overconfidence1_{t-1} X lnboardmeetings_{t-1}$	1.001**									
	(0.374)									
$overconfidence2_{t-1} X lnboardmeetings_{t-1}$		1.329***								
		(0.466)								
$overconfidence3_{t-1} X lnboardmeetings_{t-1}$			1.371							
			(0.899)							
$overconfidence4_{t-1} X lnboardmeetings_{t-1}$				1.907**						
				(0.855)						
$overconfidence11_{t-1} X lnboardmeetings_{t-1}$					1.269**					
					(0.556)					
$overconfidence5_{t-1} X lnboardmeetings_{t-1}$						1.328**				
						(0.610)				
$overconfidence6_{t-1} X lnboardmeetings_{t-1}$							0.993			
							(0.865)			
$overconfidence7_{t-1} X lnboardmeetings_{t-1}$								1.159*		
								(0.573)		
$overconfidence8_{t-1} X lnboardmeetings_{t-1}$									1.363	
									(0.855)	
$overconfidence9_{t-1} X lnboardmeetings_{t-1}$										1.190***
										(0.361)
Observations	352	352	352	352	352	352	352	352	352	352
R-squared	0.798	0.798	0.795	0.795	0.795	0.798	0.795	0.797	0.795	0.798
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialization fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

market-to-book ratio, bank size and the banks' capital ratio. Measures of board quality are the ratio of independent directors to the total number of directors, the ratio of women on the board and the size of the board. The number of independent board members and the size of the board are both measures of board effectiveness or board quality. Core and Guay (1999) argue that large boards are less effective in monitoring the CEO. Similar independent board members may be more powerful in monitoring the CEO. Women have been found to be less overconfident and more risk averse than men (Barber and Odean (2001)). The two measures of regulatory strength used are Independence and Official Supervisory Power. The former measures to which degree supervisory authorities are independent from the government and legally protected from the banking system, the latter measures the degree to which supervisory authorities may intervene in the banking system.

The results in Table 12 suggest that the regulatory environment does not matter for the decision to hire an overconfident CEO. None of the regulatory indexes shows up significant in any of the specifications. Corporate governance mechanisms however seem to matter, a large ratio of female directors reduces the likelihood of a new CEO being overconfident, in line with the initial hypothesis. Weaker and somehow contradictory are the results on board independence and board size. A more independent board seems to be more likely to hire an overconfident CEO while the likelihood is reduced by a smaller board. However the results on board size are just weakly significant. The positive coefficients of board independence are in line with the hypothesis that stronger boards are better able to align banks' incentives with shareholders' incentives, which in this case translates to higher risk taking by a more confident CEO.

5 Conclusion

This study introduces a new, behavioral perspective on bank risk taking. We use a well established subjective option pricing methodology to estimate the optimal exer-

Table 12: Probit regression of a dummy that takes value one if the new CEO is overconfident and value zero otherwise on controls and measures of corporate governance and regulation. The dependent variable takes value one if a new CEO is hired and she is overconfident, zero if she is not. Female is the percentage of women on the board, CEO boardmember is a dummy that takes value one if the CEO is member of the board, independence is the ratio of independent board members to total board members. Official is an index of supervisory power. Independence measures the independence of the regulator. The column number identifies the overconfidence measure used. Standard errors in parentheses are clustered at the country level.

VARIABLES	(1)	(2)	(5)	(6	(7)
mtb	-0.776	-0.0210	-1.480*	-0.0210	-0.868
	(0.675)	(0.0545)	(0.885)	(0.0576)	(1.094)
ln(ta)	-0.0281	0.309	-0.212	0.309	-0.390
	(0.264)	(0.310)	(0.292)	(0.252)	(0.562)
capital ratio	21.46	17.10	3.423	17.10	15.60
	(14.62)	(19.01)	(14.99)	(16.67)	(20.00)
board independence	2.877**	1.110	4.873***	1.110	6.629*
	(1.443)	(1.033)	(1.584)	(1.009)	(3.451)
female	-4.123	-11.63***	-14.19***	-11.63***	-10.50*
	(3.313)	(4.467)	(4.969)	(4.131)	(5.909
board size	0.119*	-0.0907	0.135*	-0.0907	0.214*
	(0.0636)	(0.0735)	(0.0794)	(0.0805)	(0.118)
Official	-0.112	-0.00738	-0.0126	-0.00738	0.131
	(0.0944)	(0.116)	(0.0942)	(0.142)	(0.136)
Independence	-0.159	0.208	-0.247	0.208	0.286
	(0.398)	(0.539)	(0.495)	(0.358)	(0.554)
Constant	-1.527	-9.206	3.692	-9.206	0.560
	(7.675)	(9.041)	(7.964)	(7.157)	(15.97)
Observations	45	45	45	45	45

cise point for the options in a bank CEOs' portfolio. This option pricing methodology takes into account the CEO's ability to diversify her stockholdings but also the CEO's underdiversification and risk aversion. We then classify CEOs as overconfident if they fail to exercise their options optimally, i.e. if they exercise their options too late. Overconfident CEOs may underestimate risks and therefore invest in high risk projects. To test this hypothesis we relate our overconfidence measures with measures of bank risk and with banks' performance during the financial crisis. While we do not find any evidence of overconfidence causing the banks' crisis performance, we do find that banks with overconfident CEOs have higher standard deviations of equity returns and a lower distance-to-default. A comprehensive dataset about corporate governance mechanisms at the bank level allows us then to interact measures of board quality with our overconfidence measure. We find that an active board, i.e. a board that meets more frequently, mitigates the effect of overconfidence on bank risk. We then try to capture the effect that good corporate governance and regulatory power has on the decision to hire an overconfident CEO. We find some evidence that a higher ratio of female board members to the total number of board members reduces the likelihood of hiring an overconfident CEO. The quality of regulation has no significant impact on this hiring decision. Overall this paper presents some evidence that behavioral characteristics of bank CEOs may actually influence bank performance and therefore ultimately also the stability of the financial system.

References

Barber, B. M., Odean, T., 2001. Boys will be boys: Gender, overconfidence, and common stock investment*. Quarterly Journal of Economics 116 (1), 261–292.
URL http://www.mitpressjournals.org/doi/abs/10.1162/003355301556400

Barth, J. R., Caprio Jr, G., Levine, R., Apr. 2001. The regulation and supervision of banks around the world - a new database. Policy Research Working Paper Series 2588, The World Bank.
URL http://ideas.repec.org/p/wbk/wbrwps/2588.html

Beltratti, A., Stulz, R. M., Jul. 2009. Why did some banks perform better during the credit crisis? a cross-country study of the impact of governance and regulation. NBER Working Papers 15180, National Bureau of Economic Research, Inc.

Ben-David, I., Graham, J. R., Harvey, C. R., December 2007. Managerial overconfidence and corporate policies. Working Paper 13711, National Bureau of Economic Research.
URL http://www.nber.org/papers/w13711

Core, J., Guay, W., 1999. The use of equity grants to manage optimal equity incentive levels. Journal of Accounting and Economics 28 (2), 151 – 184.
URL http://www.sciencedirect.com/science/article/pii/S0165410199000191

Dowd, K., Woods, M., Cotter, J., Humphrey, C., Apr. 2010. How unlucky is 25-sigma? Working Papers 200838, Geary Institute, University College Dublin.
URL http://ideas.repec.org/p/ucd/wpaper/200838.html

Fahlenbrach, R., Stulz, R. M., Aug. 2009. Bank ceo incentives and the credit crisis. NBER Working Papers 15212, National Bureau of Economic Research, Inc.

Gropp, R., Vesala, J., Vulpes, G., 2002. Equity and Bond Market Signals as Leading Indicators of Bank Fragility. SSRN eLibrary.

Hall, B. J., Murphy, K. J., February 2002. Stock options for undiversified executives. Journal of Accounting and Economics 33 (1), 3–42.

Heaton, J. B., Summer 2002. Managerial optimism and corporate finance. Financial Management 31 (2).
URL http://ideas.repec.org/a/fma/fmanag/heaton02.html

Hribar, P. ., Yang, H., 2011. CEO Overconfidence and Management Forecasting. SSRN eLibrary.

Ingersoll, J. E., 2006. The subjective and objective evaluation of incentive stock options. Journal of Business 79 (2), 453–488.
URL http://econpapers.repec.org/RePEc:ucp:jnlbus:v:79:y:2006:i:2:p:453-488

Malmendier, U., Tate, G., December 2005. Ceo overconfidence and corporate investment. Journal of Finance 60 (6), 2661–2700.

Malmendier, U., Tate, G., July 2008. Who makes acquisitions? ceo overconfidence and the market's reaction. Journal of Financial Economics 89 (1), 20–43.
URL http://ideas.repec.org/a/eee/jfinec/v89y2008i1p20-43.html

Suntheim, F., 2011. Managerial compensation in the financial service industry.

Chapter 3: Social Networks in the Banking Sector

Joel F. Houston* Jongsub Lee† Felix Suntheim‡

Abstract

Social networks have been shown to be an important factor of managerial decision making and therefore to influence corporate policies. In the light of the financial crisis we look at the social networks of the largest international banks and on how they influence bank policies and the overall stability of the financial system. Our analysis comprises the social connections of board members and top executives of 100 banks from 16 countries for the period 2000-2010. Information submitted through the network can either lead to destabilizing group-think or create valuable benefits for the connected banks. We find that connected banks have higher equity correlations before and lower correlations during and after the crisis. This is in line with the hypothesis that connected banks invested in similar assets but rewound their positions once the crisis hit. We also find that banks which are more central with respect to the network lend more on the interbank market. They have higher systematic risk before but lower systematic risk during and after the crisis. Overall those banks performed better during the crisis.

*University of Florida. E-mail: joel.houston@ufl.edu
†University of Florida. E-mail: jongsub.lee@ufl.edu
‡Bocconi University. E-mail: felix.suntheim@unibocconi.it

1 Introduction

The financial crisis has remarkably shown the importance of interconnections between financial institutions for the soundness of the whole economic system. We have witnessed how an inflated U.S. subprime mortgage market together with the emergence of new financial instruments has led to negative spillover effects in markets allover the world. Although these new financial instruments allowed banks to diversify risks they also increased the similarities of banks' portfolios and therefore the vulnerability of banks to common shocks. Such effect have been modeled for example by Allen and Gale (2000) and Freixas et al. (2000), who show that a shock to one institution can lead to the default of institutions throughout the entire system.

In order to assess the stability of the financial system it is of utmost importance to understand the nature of systemic risk. Financial institutions may be interwined both from the asset side and the liability side, through lending and borrowing on the interbank market, by holding similar portfolios or by relying on the same depositors. Several authors have estimated the effect of contagion through the interbank market by looking at interbank loans and deposits. Upper and Worms (2004) estimate that in a worst case scenario the failure of one German bank may cause the bankruptcy of 15% of the German banking system. Several other markets have been studied subsequently with differing results. However the results of this stream of literature most likely underestimate the effects of contagion due to methodological issues and data limitations. Allen et al. (2010) show how banks that are diversifying their risks can generate a network structure that is more fragile when a shock occurs. Such a mechanism seems very much in line with the banking system that was heavily exposed to similar risks before the financial crisis, made possible by the emergence of financial instruments such as credit default swaps and collateralized loan obligations.

In this paper we try to add to the growing literature on systemic risk and networks in banking by looking at the social connections between bank board members. Information transmitted through the personal network of board members may be

a driver of bank interconnections, both through the interbank market and through investment decisions. Fracassi (2009) shows that socially related firms make similar investment decisions. In the same vein we believe that bank managers might make investment decisions according to their social network. Word-to-mouth or -paraphrased more positively information- submitted through the board network might have led bank managers to invest in similar assets or to engage in similar projects, either directly for example by joint loan syndication or indirectly by buying each others collateralized loan obligations. Related to this, there is some evidence for the importance of social networks in investment decisions by Cohen et al. (2007), who find that fund managers invest more heavily in firms they are connected to. Besides increasing asset commonality social ties between board members may also affect banks' interbank market activity. Mobius and Szeidl (2007) argue that relationships between individuals generate trust that can be used as collateral to mitigate moral hazard in a lender-borrower relationship. Empirically, Engelberg et al. (2010) find that the the presence of a personal connection between a firm and a lender reduces borrowing costs and increases the amount lent. Our hypothesis is therefore that the social ties among board members may facilitate the interbank market activity of banks, which can be favorable in times of market dry ups, but can also increase the level of systemic risk in general.

Using information on the social ties between board members of very large international financial institutions we find that social connections seem to matter for the risk exposures and the interconnectedness of these institutions both before and during the financial crisis. The strength of the social connection between two banks drives their equity return correlations up, an effect that is reduced beginning with the onset of the financial crisis. We believe that word-to-mouth made bank managers first invest in assets with similar risk-return profiles, and that the social network also triggered a reduction of of these holdings as soon as the financial crisis hit. This is in line with aggregate measures of social connectivity among banks being a leading indicator of aggregated equity return correlations. When looking at the

complete network structure we see that socially central banks are more systemic, have higher systematic risk before the crisis and reduced levels of systematic risk during and after the crisis. We consider these findings as consistent with our view that information transmitted through the social network made bank managers take on similar risks that we can then observe in the market. The effect of the network on the interbank market is asymmetric, socially central banks lend more to their peers than banks that are located on the perimeter of the network.

The social network approach to the banking system gives important insights into the understanding of banking networks and leads to various policy implications. We show that bank board members and their social connections have an impact on bank risk and therefore also on bank stability. Including information on board members' social ties into a macroprudential bank supervision framework might therefore be beneficial for assessing the systemic risk of a particular institutions. A supervisory authority concerned about high levels of interconnectedness in its banking system might moreover try to limit the number of connected board members.

The remainder of the paper is organized as follows. Section 2 quickly summarizes the literature on networks in finance. In section 3 the dataset used is described, and the main methodologies employed to identify the strength of the social network are introduced. Section 4 describes the development of the social banking network over time. Afterwards the sections 5 and 6 analyze the effect of social connections on the correlations of equity returns, bank risk and systemic risk. Section 7 concludes.

2 Literature

Although the literature on social networks in finance has grown rapidly over the last few years, it is still at an early stage. Especially empirical analyses have long been limited due to data constraints.
Most research on networks in finance has concentrated on contagion in financial

systems and on the impact of social connections on corporate governance.
Allen and Gale (2000) and Freixas et al. (2000) provide theoretical models explaining the propagation of shocks through the financial system. In particular, Allen and Gale (2000) show under a setup a la Diamond and Dybvig (1983) how the failure of a bank can trigger the failurte of the whole banking system through interbank market linkages. The authors show that tighter networks are more immune to such a contagion effect. Cifuentes et al. (2005) explore liquidity risk in interconnected institutions under regulation and with assets that are marked to market. In such a setup small shocks can lead to bank failures through contagion. Empirically several authors have estimated the effect of contagion through the interbank market. For example Upper and Worms (2004) estimate for Germany that in a worst case scenario the failure of one bank may cause the bankruptcy of 15% of the system.
Another strand of the literature looks at social networks and different corporate finance policies. Duchin and Sosyura (2011) investigate the role of social networks with respect to division managers' behavior regarding internal capital markets. They find that managers with social ties to the CEO receive more capital for their divisions. Engelberg et al. (2010) find for a sample of US firms that the presence of a personal connection between the firm and the lender reduces borrowing costs. Connected syndicates lend more on average and require less covenants. Personally connected borrowers' long-term credit ratings improve compared to their unconnected counterpart borrowers. Firms completing deals with connected banks experience substantially higher stock returns than those borrowing from unconnected syndicates. In contrast to this Ferreira and Matos (2011) look at an international sample and argue that banks are more likely to act as lead arrangers, charge higher interest rate spreads and face less credit risk after origination when they have some role in a firm's governance. Banks lend more to firms to which they have governance links. Fracassi (2009) looks at corporate finance policies and how they are impacted by social networks. He finds that the more social connections two companies share with each other, the more similar is their level of investment. Companies positioned more centrally in the universe of social networks invest in a less idiosyncratic way.

The corporate governance literature has focused mainly on the relationship between compensation and social ties. Engelberg et al. (2009) for example find that an additional connection to an executive or director outside a firm increases a CEO's compensation by over $17,000 on average. Hwang and Kim (2008) document that 87% of boards are conventionally independent, but that only 62% are conventionally and socially independent. Compensation is lower and more sensitive to performance when the board is socially independent.
Mergers and Acquisitions seem to be another area of corporate finance in which social ties play an important role. Cai and Sevilir (2009) report that M&A transactions between firms with board connections generate higher announcement returns, smaller takeover premiums, fees paid to investment banks are lower, subsequent firm performance is higher and CEO turnover lower. Fracassi and Tate (2011) find CEO with more director ties to reduce firm value and to engage in value destroying M&As because they face less monitoring by boards.
On the asset pricing side Cohen et al. (2007) argue that portfolio managers place larger bets on firms they are connected to through a social network and perform significantly better on these holdings relative to their non-connected holdings.

3 Data and variables

To create a dataset representing the social network of directors and key executives of major international banks we use the information provided by Boardex. The database contains complete information on the vitae of board members and top management of listed European, North American and Australian companies. We aim at covering the most important financial institutions worldwide and therefore include the 100 largest banks by total assets in the year 2003 in our sample. Table 1 gives a quick picture of the main characteristics of our sample banks, which are large in terms of size, with total assets above $ 400 million on average.

Boardex also provides details on the structure of the board of each bank. Currently we know the size of each board, the role of each board member, their age,

Table 1: Summary statistics for the period 2000-2010.
ΔCoVaR is a proxy for systemic risk as defined by Adrian and Brunnermeier (2008). ROA is the average return on assets. Capital ratio is the ratio of total equity capital to total assets. Non-interest ratio is the ratio of operation non-interest income to net income. Sigma is the annualized daily standard deviation of equity returns over a 250 day window. The market-to-book ratio is the ratio of market value to book equity. Interbank ratio is the ratio of assets to liabilities lend and received from banks.

Variable	**Mean**	**Std. Dev.**	**N**
ROA	0.737	0.924	548
capital ratio	12.564	2.368	479
non-interest ratio	2.587	11.896	548
deposit ratio	0	0	516
total assets (million US$)	507.78	625.37	548
market-to-book ratio	1.994	1.711	548
interbank ratio	88.513	85.676	295
loans to banks by total assets	0.092	0.085	521
deposits from banks by total assets	0.145	0.088	340
sigma	0.399	0.273	567
Beta	1.019	0.406	570
equity returns July 2007-December 2008	-0.599	0.222	571
ΔCoVaR	-2.991	2.898	571
CoVaR	-10.298	5.757	571

gender, education and nationality.

We supplement the Boardex relationship data with accounting information from Bankscope and equity prices from CRSP for North American banks and Compustat World for European and Australian Banks. Summary statistics are provided in Table 1. All variables have been Winsorized at the 1% level.

3.1 Pairwise connections

Boardex allows us then to retrieve all the connections between board members and non-board key executives[1] of each bank pair. Connections are established either through past or present membership on the board of a public company, a private company, a government institution or a medical institution. Moreover two people are considered connected if they were active members of a charity at the same time. To avoid double counting one individual cannot contribute more than one connection between two banks. We then create the following two measures of connectedness: *sni* is the sum of all connections between two banks, established both through current or past employment. *key1* on the other hand is the number of connections through a key executive, which we classify as the CEO, the CFO, the executive chairman, an executive director or the chief risk officer. Although past board memberships ensure some level of social connectivity, a more conservative way to classify two people as connected is to consider current connections only. Therefore *csni* and *ckey1* are the number of connections through current board membership.

The database spans the time-period 1997 to 2010 although coverage is only improving over time and becomes complete from 2003 on. In the years 1997 till 1999 only European institutions have been covered. Table 2 depicts how the sample changes over time and the average values of the different connectivity measures. We see that the number of bank pairs increased till 2003 because of improvements of

[1]Non-board key-executives are the CEO or the CFO.

the database's coverage and decreased thereafter because of bank failures or merges during the financial crisis. In Appendix A we provide a complete list of all sample banks and of the periods they are covered in our database.

Table 2: Summary statistics of bank connections.
sni is the total number of connections between two banks, csni the number of connections through current employment, key1 the number of connections between key executives, ckey1 the number of connections between key executives through current employment. Key executives are the CEO, the CFO, the executive chairman, an executive director or the chief risk officer.

Year	sni (mean)	csni (mean)	key1 (mean)	ckey1 (mean)	#
1997	0.27	0.15	0.11	0.09	342
1998	0.32	0.24	0.16	0.14	506
1999	0.33	0.22	0.12	0.11	1,980
2000	0.21	0.14	0.07	0.06	5,700
2001	0.24	0.14	0.08	0.07	6,972
2002	0.26	0.15	0.09	0.07	7,656
2003	0.23	0.12	0.08	0.07	9,506
2004	0.24	0.11	0.07	0.06	9,120
2005	0.25	0.11	0.07	0.05	8,930
2006	0.29	0.12	0.08	0.06	8,372
2007	0.29	0.12	0.08	0.06	7,482
2008	0.33	0.12	0.11	0.08	5,700
2009	0.33	0.12	0.10	0.08	4,970
2010	0.34	0.13	0.12	0.10	4,692
Total	0.27	0.13	0.09	0.07	81,928

Changes in sample composition are of no concern for our analysis of the behavior of different bank pairs, but it may effect the way measures of network centrality and clustering are computed. We will address this point in more detail in the following section.

3.2 Centrality measures

We construct several measures of centrality that capture how each bank is positioned in the network, how much information flows through each bank. Each centrality measure can theoretically be computed based on one of the four abovementioned definitions of connectedness, for the time being we restrict ourselves however to the full measure of connectivity, sni. Each centrality measure is constructed on a bank year level, so that we end up with an unbalanced panel for the years 2000 till 2010. The network measures are:[2]

- Degree centrality
  The number of links a node in the network has. This is the most basic centrality measure that captures the immediate exposure of each bank to the network.

- Betweenness centrality
  The number of shortest paths between all bank pairs that a bank lies on. It is a measure of centrality and of information that flows through a bank. Different to the degree centrality measure it captures not only the local importance of a node but is a useful measure for the overall importance of a bank in the network. P_{ij} denotes the number of shortest paths from bank i to bank j. Let $P_{ij}(k)$ then denote the number of shortest paths that bank k lies on. Betweenness for bank k is then defined as

$$\sum_{i,j:i\neq j,k\notin i,j} \frac{P_{ij}(k)}{P_{ij}}$$

- Closeness centrality
  The mean distance between bank i and all other banks were distance is defined as the shortest path. If D_{ij} is the length of the shortest path between bank i

[2]The measures are computed using Hirotaka Miura's network package for Stata and are computed as described in its documentation.

and bank j, then closeness is defined as

$$\frac{n-1}{\sum_{j \neq i} D_{i,j}}$$

Closeness can be seen as a measure of the speed with which information spread through the network from a specific bank.

- Eigenvector centrality
  Gives large values to those banks that have many links, links that are important or both.

Summary statistics for the centrality measures are provided in Table 3. On average Investment banks place themselves at a more important position in the network than other banks, according to the measures of eigenvector centrality, closeness centrality and degree centrality. Surprisingly the average investment bank has a lower value for betweenness centrality than the average sample bank. Institutions classified as savings banks are on average more peripheral to the network. Table 4 shows the correlations of the four different centrality measures. As can be seen the in Table 2 and Appendix A the composition of banks in our sample changes over time, which might effect our measure of centrality in a mechanical way. For this reason we restrict the sample to the years 2000 till 2010 and run robustness tests keeping only banks that are present during the whole sample period.

3.3 Clustering

To get an idea of how tightly connected a network is we can calculate the average overall clustering coefficient for each year. The general idea behind this coefficient is to relate the number of transitive relations in the network to the overall network size. A relation between three banks is transitive if bank A is connected to bank B, bank B to bank C and C to bank A. The clustering coefficient is then the sum of all such triplets over the sum of all possible triplets. Let A be the adjacency matrix

Table 3: Summary statistics of the four different centrality measures by bank specialization.
Betweenness centrality is the number of shortest paths between all bank pairs that a bank lies on. Degree centrality denotes the number of links a node in the network has. Closeness centrality is defined as the mean distance between a bank and all other banks were distance is defined as the shortest path. Eigenvector centrality gives large values to those banks that have many links, links that are important or both. All measures are calculated based on social connections between banks according to sni. The centrality measures are not weighted. Specialization are as reported by Bankscope. Sample period is 2000-2010.

Specialisation	Mean			
	Betweenness	Eigenvector	Closeness	Degree
Bank Holding Companies	0.0146	0.0981	0.4868	0.2004
Commercial Banks	0.0142	0.0869	0.4956	0.1919
Investment Banks	0.0070	0.1185	0.5384	0.2171
Savings Bank	0.0022	0.0281	0.4283	0.0779
Total	0.0141	0.0939	0.4892	0.1959

Table 4: Correlation matrix of the four different centrality measures.
Betweenness centrality is the number of shortest paths between all bank pairs that a bank lies on. Degree centrality denotes the number of links a node in the network has. Closeness centrality is defined as the mean distance between a bank and all other banks were distance is defined as the shortest path. Eigenvector centrality gives large values to those banks that have many links, links that are important or both. All measures are calculated based on social connections between banks according to sni. The centrality measures are not weighted. Sample period is 2000-2010.

Variables	Betweenness	Eigenvector	Degree	Closeness
Betweenness	1.000			
Eigenvector	0.576	1.000		
Degree	0.560	0.938	1.000	
Closeness	0.365	0.708	0.780	1.000

then the overall clustering coefficient is defined as

$$c(A) = \frac{\sum_{i,j\neq i,k\neq j,k\neq i} A_{ij}A_{ik}Ajk}{\sum_{i,j\neq i,k\neq j,k\neq i} A_{ij}A_{ik}}.$$

Averaging this coefficient over the total number of vertices yields the average overall clustering coefficient. The clustering coefficient captures the extent to which the overall network contains localized clusters of dense connectivity. A network can have a low global density but still have a high clustering coefficient. In general clustering is thought to increase the information transmission capacity of a network. First, densely connected clusters ensure that information travels quickly through the cluster and therefore through the network if clusters are connected. The multiple connections between banks in a cluster also increase the quality and likelihood of the information received. Banks can compare the information that they receive from different connected banks and identify distortions or incompleteness.

4 Banking networks and the financial system

The described dataset gives us now the possibility to describe connections of board members in the international financial system, how these board networks evolved over time and to analyze whether there is a relationship between the connections of board members and the way banks function. In this section we will primarily focus on the first two points, while the next two sections will try to deepen the understanding of the last point.

Figures 1 - 3 show the whole network at three different points in time (2003, 2007, 2010). The thicker the line between two banks the more connections these two institutions have. We can see that the network has roughly two heavily interconnected centers formed by large banking corporations, a European and an American one. Grouped around these two centers are smaller banks that seem to form more regional centers. Over time we can see that less banks are outside the banking network, seven

in 2003, five in 2006 and three in 2010. A first eyeball also suggests that the network becomes denser over time, although a more rigorous analysis is needed to verify this.

One major motivation for looking at banking networks is to get an idea of how levels of interconnectedness in the banking system relate to measures of overall financial stability. As a first simple proxy for systemic risk in the financial sector we look at the average pairwise correlations of equity returns among our sample banks for each year. When the network as a whole becomes tighter information is likely to spread faster and banks may be more likely to take similar actions. Therefore a negative shock to some banks is more likely to lead to a systemic crisis involving the other banks in the network.

To get an idea of how tightly connected a network is we can calculate the average overall clustering coefficient for each year. The clustering coefficient captures the extent to which the overall network contains localized clusters of dense connectivity. In general clustering is thought to increase the information transmission capacity of a network. First, densely connected clusters ensure that information travels quickly through the cluster and therefore through the network if clusters are connected. The multiple connections between banks in a cluster also increase the quality and likelihood of the information received. Banks can compare the information that they receive from different connected banks and identify distortions or incompleteness.

The correlation between each pair of banks is measured in two different ways. First, we calculate the weekly pairwise correlation over a 52 weeks window at year-end for each bank pair. Second, we estimate an industry CAPM by regressing banks' daily equity returns on a global banking index.[3] Then we calculate the weekly pairwise correlations of the residuals over a 52 weeks window for each bank pair. These partial correlations show how the idiosyncratic, i.e. not driven by the banking sector, components of return move together. We expect that the average equity correlations

[3]We use the STOXX Global 1800 Banks index.

Figure 1: The banking network in the year 2003. Thicker lines indicate more connections between two financial firms.

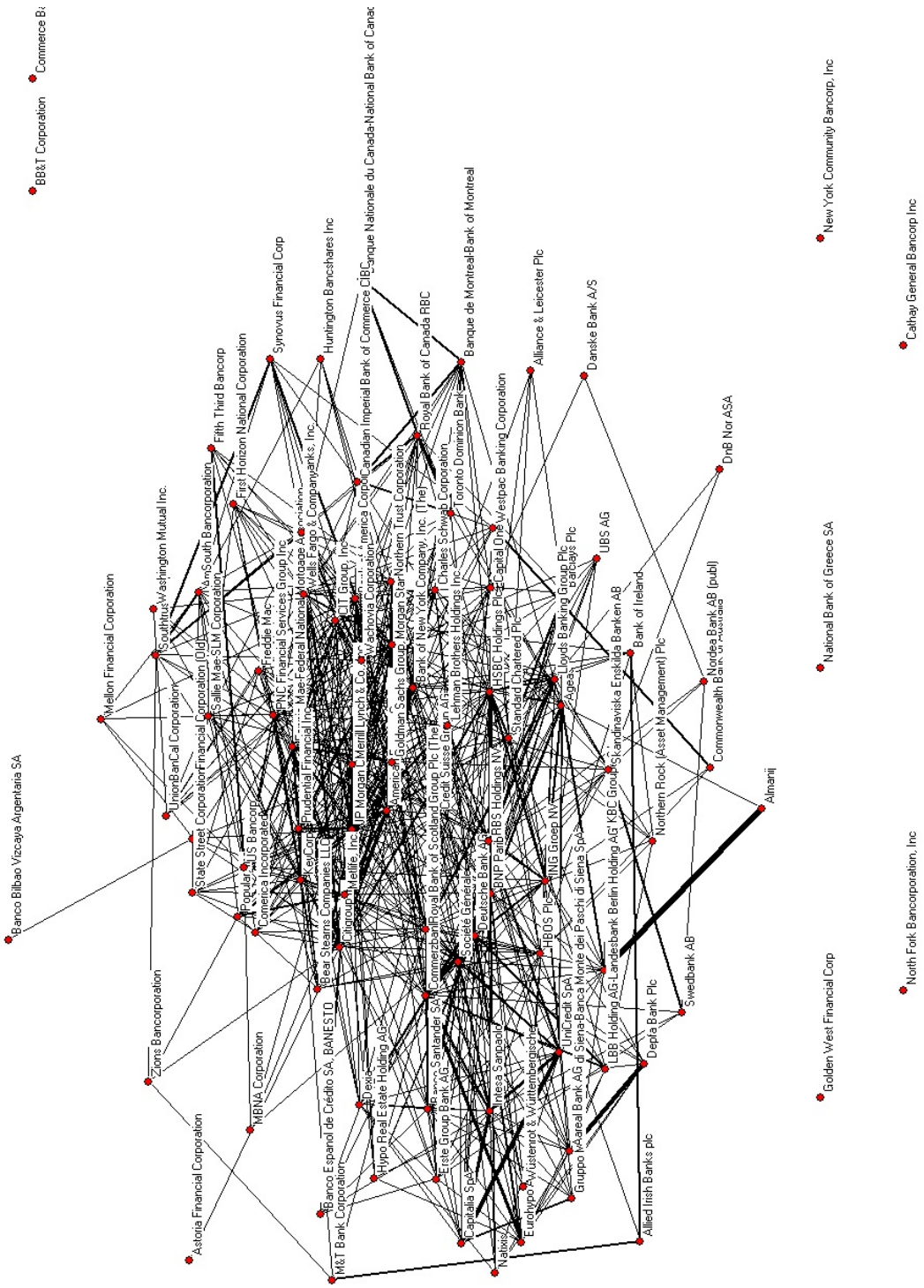


Figure 2: The banking network in the year 2007. Thicker lines indicate more connections between two financial firms.

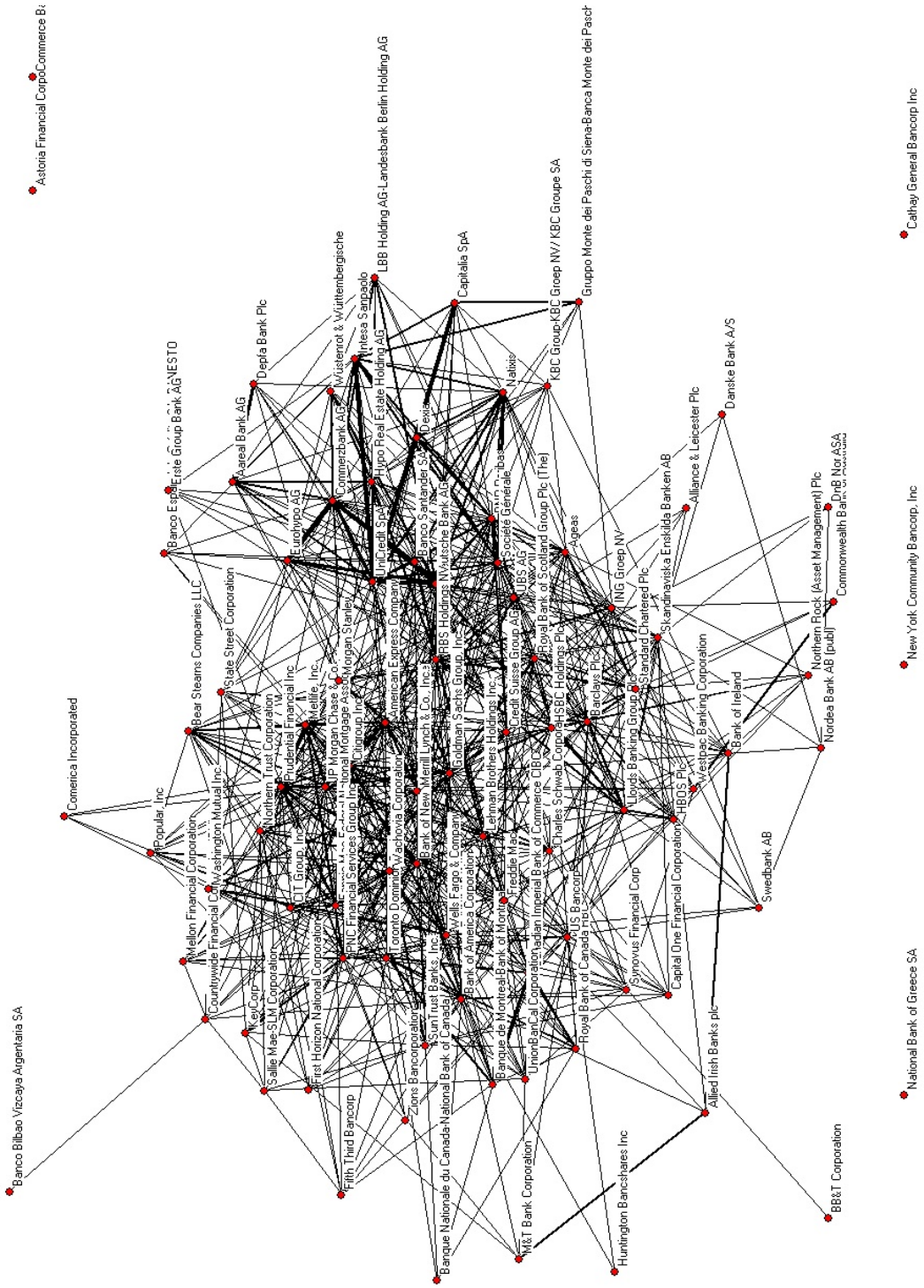
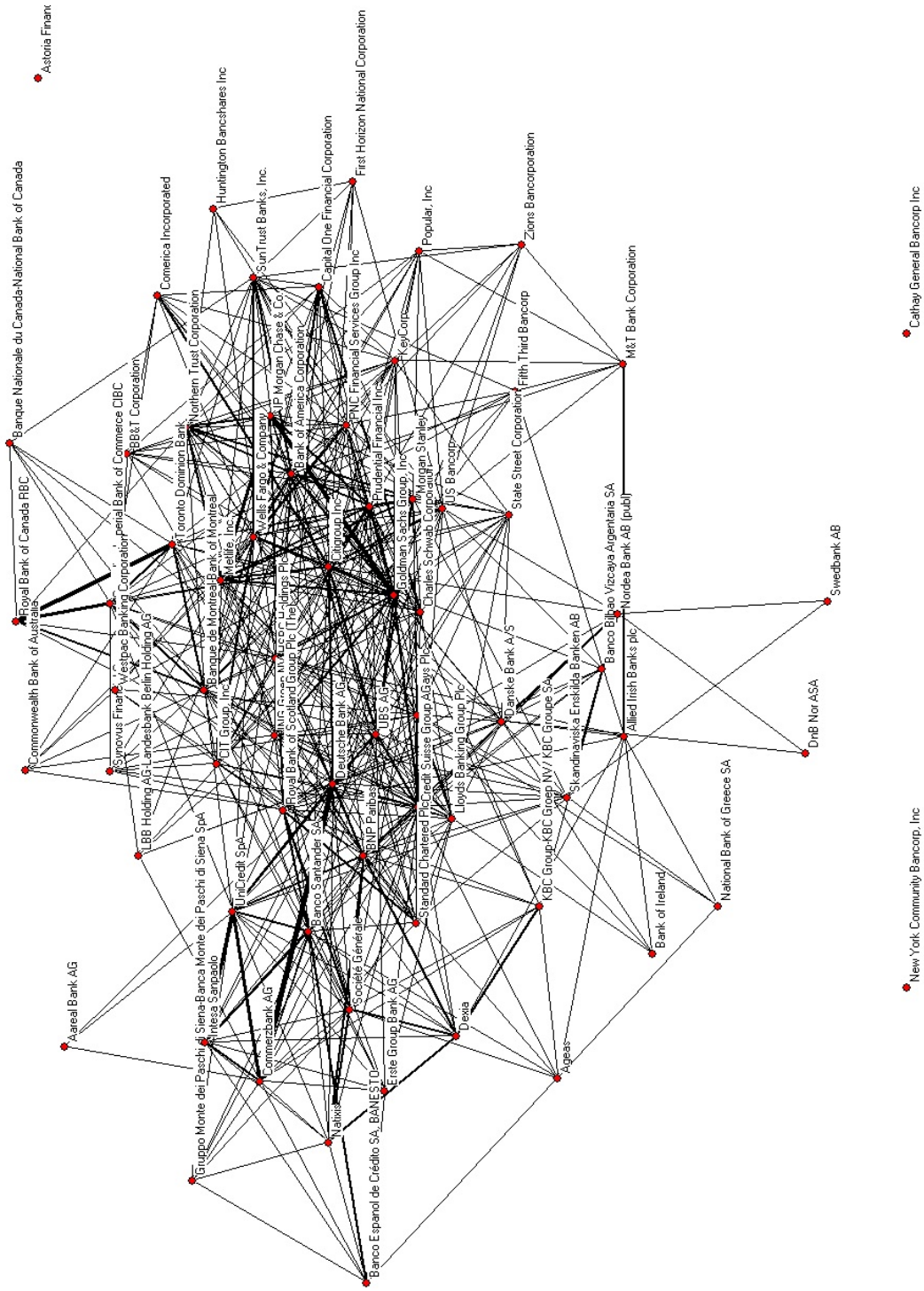


Figure 3: The banking network in the year 2010. Thicker lines indicate more connections between two financial firms.



increase in network tightness because information spreads faster in a more deeply connected network.

A first impression of how bank connectedness changes over time can be seen in Figure 4. It shows the average pairwise correlation, the average clustering coefficient and the average number of pairwise connections over the sample period. While connectedness seems to have increased steadily over time, correlation fluctuates more heavily with high levels around the financial crisis. We then decompose network measures and correlations in pairs inside the US (figure 5), bank pairs in the rest of the world (figure 6) and pairs between US and non-US banks (figure 7). In the last case the clustering coefficient has necessarily a value of zero because no closed triplets can be formed by construction. We see that the average number of connections is increasing over time in the US. In general both clustering coefficient and the number of connections roughly move together with the average correlation. Residual correlation however moves together with the overall correlation in the US, but not in the rest of the world.

Overall we have shown how the interconnectedness of banks on the board member level increased over time and how the level of social connectivity is related to the average level of pairwise correlations. The next two sections will look more carefully into this issue and we will try to show that the social networks of bankers have impacted the actual interbank connectivity.

5 Pair models

The pair model allows us to address the question whether two banks that are socially more connected behave more similar in terms of their business strategy and therefore expose themselves to similar risks. We think that this is an important contribution in the light of the discussion about systemic banks and contagion effects in the banking sector. If the social network of bank directors results in the implemen-

Figure 4: The average pairwise correlation in relationship to measures of connectivity for the whole sample. *mean* r52 are the average unconditional pairwise correlations of weekly equity returns. *mean* abn_r52 are the average pairwise correlations of the residuals from the regression of weekly equity returns on the STOXX Global 1800 Banks index. Both are calculated over a 52 weeks window. *mean* clustering is the average overall clustering coefficient. *mean* sni the average number of pairwise connections. Sample period is from 2010 to 2010.

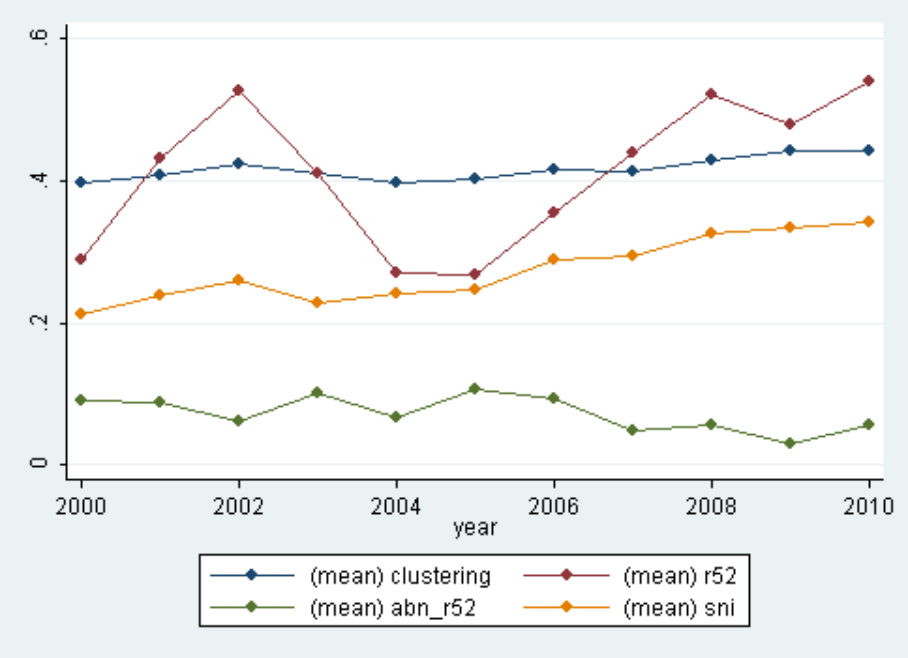


Figure 5: The average pairwise correlation in relationship to measures of connectivity for the US sample only. (mean) r52 are the average unconditional pairwise correlations of weekly equity returns. (mean) abn_r52 are the average pairwise correlations of the residuals from the regression of weekly equity returns on the STOXX Global 1800 Banks index. Both are calculated over a 52 weeks window. (mean) clustering is the average overall clustering coefficient. (mean) sni the average number of pairwise connections. Sample period is from 2010 to 2010.

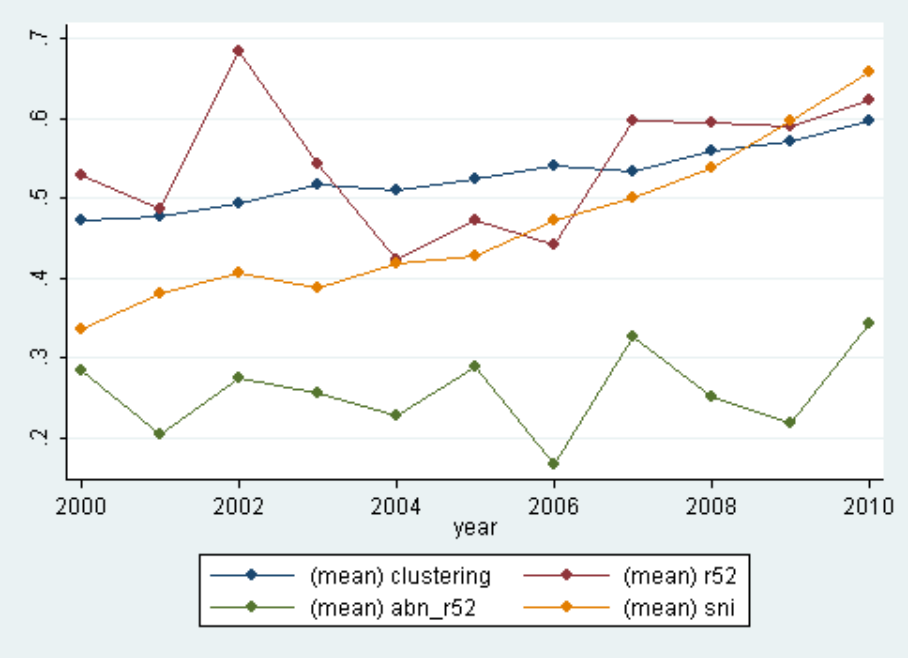


Figure 6: The average pairwise correlation in relationship to measures of connectivity. Non-US banks only. (mean) r52 are the average unconditional pairwise correlations of weekly equity returns. (mean) abn_r52 are the average pairwise correlations of the residuals from the regression of weekly equity returns on the STOXX Global 1800 Banks index. Both are calculated over a 52 weeks window. (mean) clustering is the average overall clustering coefficient. (mean) sni the average number of pairwise connections. Sample period is from 2010 to 2010.

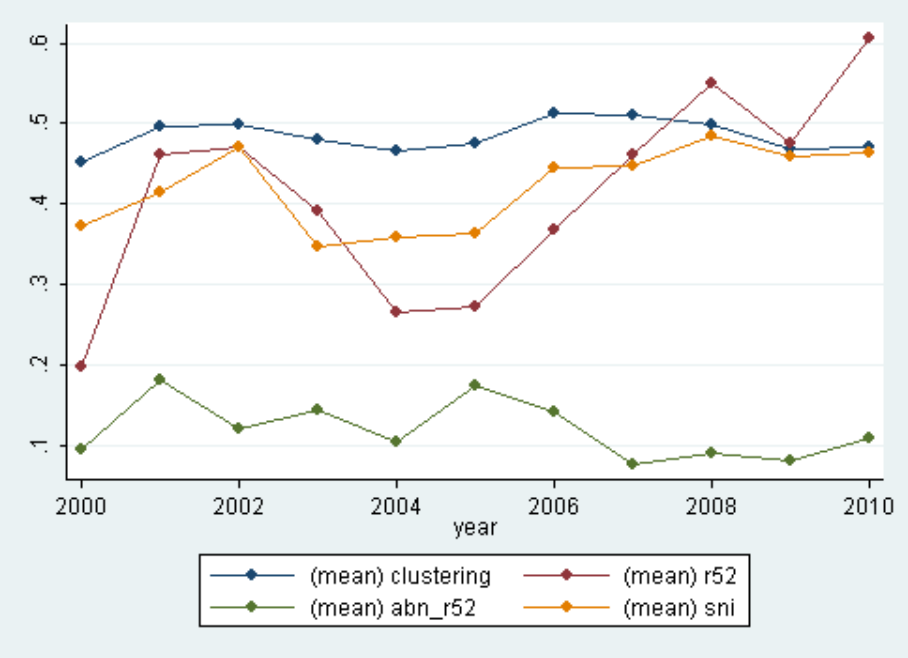
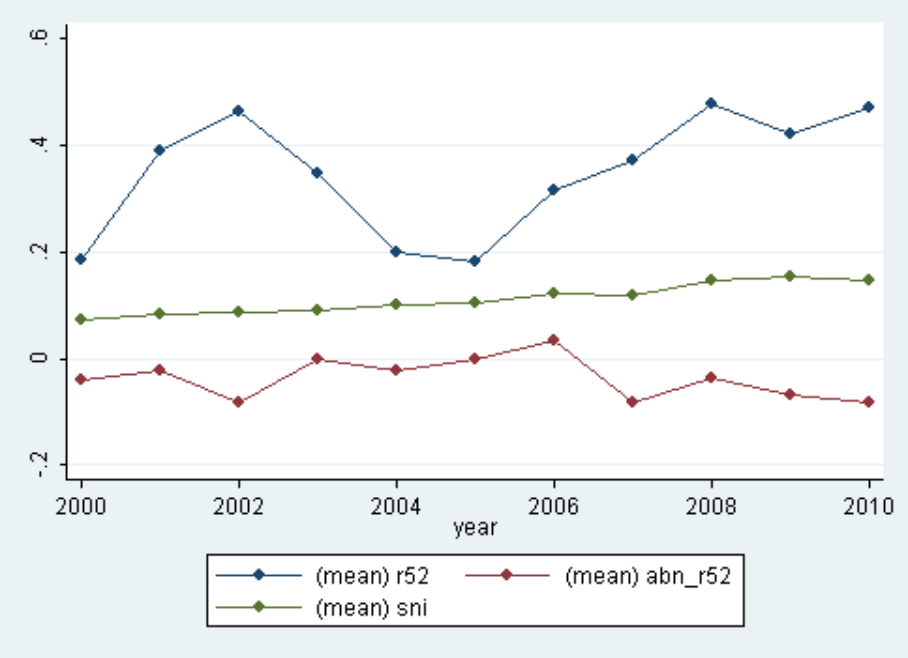


Figure 7: The average pairwise correlation in relationship to measures of connectivity. Only connections between US banks and Non-US banks. (mean) r52 are the average unconditional pairwise correlations of weekly equity returns. (mean) abn_r52 are the average pairwise correlations of the residuals from the regression of weekly equity returns on the STOXX Global 1800 Banks index. Both are calculated over a 52 weeks window. (mean) clustering is the average overall clustering coefficient. (mean) sni the average number of pairwise connections. Sample period is from 2010 to 2010.



tation of strategies with similar risk characteristics, extreme events are more likely to affect a large number of banks.

To test this hypothesis we form all pairs of sample banks which results in more than 4840 bank pairs for which we measure the strength of the connection through the network measures introduced in the previous section.

5.1 Equity correlation

We calculate pairwise equity correlations between each pair of banks by using the weekly pairwise correlation over a 52 weeks window at year-end. We expect that the average equity correlations increase in network tightness because information spreads faster in a more deeply connected network.

To control for leverage we construct leverage dummies in the following sense: First we calculate the 33th percentile and the 66th percentile of banks capital ratios per year. The six dummies (hh, hm, hl, mm, ml, ll) take value one depending on the leverage of both banks, high(h), middle(m) or low(l), and zero otherwise.

Countrydummy and typedummy take value one if both banks of a pair are from the same country or have the same specialization as reported by Bankscope. Standard errors are clustered at the pair level and the regressions include year dummies.

Some social connections might be more important than others, for example the social connection of a member of a very large board should be less important than the connection of a board member on a small board, just because the influence of the individual is probably higher on a smaller board. By the same token we would expect key executives and executive board members to matter more because their ability to change corporate policies is higher. To address these point we scale all our measures of social connectivity by the average size of the board of the bank pairs.

In addition we look separately at connections of key executives only.

To address the effect the financial crisis had on the relationship between connectedness and correlations we include a dummy for the years 2007-2010 and the corresponding interaction term with our measure of social connectedness. The effect of the financial crisis on the relationship between the network and equity correlations is not clear. Information transmission through the social network might lead banks to invest in similar assets before the crisis and to sell the same assets during and after the crisis. We should then see a positive relation between our measures of connectivity in the years before 2007 and a negative relationship afterwards. In normal times a higher level of connectedness should be associated with similar policy choices and as a consequence with higher equity correlations, but the same does not need to be true in a period of crisis. Markets discounting all financial firms similarly could drive correlations up, and poorly performing banks may be inclined to change the composition of their boards rapidly which could reduce the social connectedness of banks.

First the level of correlation is regressed on the level of social connectivity. We expect that higher levels social interactions between the board members of two banks lead to an exchange of information that eventually results in the implementation of similar business strategies and the adoption of a similar attitude towards risk taking.

Endogeneity is certainly an issue when looking at the impact of the social network on the equity correlation. For example a shock to banks investment opportunities, maybe driven through changes in regulation or financial development, could then drive both correlations and the social connection of two banks. Banks facing the new investment environment hire new directors with a specific skill set that matches this new environment. We try to address this issue in several ways. Pair dummies absorb any unobservable omitted variable at the bank pair level. This way we can take into account the possibility that there is a time invariant bank pair character-

istic that asks for certain board members which are then present at both boards. Moreover we look not only on the effect the level of social connectedness has on the level of correlation, but also try to exploit the time-series component of our panel. The change in correlation is regressed on the change in connections. If an increase of the number of connections has a positive coefficient it is harder to argue that unobserved bank-pair specific effects drive the results.

Regression results in Table 5 show how the level of social connectivity influences bank pair equity correlations. For the period 1997-2006 the effect is positive and statistically significant both with and without pair fixed effects. The effect changes however during and after the financial crisis, depending on the specification it becomes smaller or even negative. When using the lagged network measure instead of the contemporaneous one, the pre-crisis effect becomes insignificant in the pair fixed effect specification. Looking at columns three and four moreover suggests that the results are not only driven by the key-executives, but by the whole board.

Table 6 shows a very similar picture for the changes of correlations regressed on the changes in connectedness. For the period 1997-2006 the effect is positive and statistically significant both with and without pair fixed effects. But it reverses during and after the financial crisis, in line with the idea of the presence of some kind of group-think regarding investment decisions.

All in all the regression of equity correlations on the strength of social ties seems to support the hypothesis that banks were following similar investment strategies which then drove their correlations. A positive relationship before 2006 and a negative relationship afterwards is in line with this hypothesis. The result that is most robust in all the different specification is the negative impact of connections on correlations in the years 2007-2010.

Table 5: Pair model
Regression of pairwise equity correlations on measures of social connectedness. Dependent variable are the unconditional pairwise correlations of weekly equity returns, calculated over a 52 weeks window. sni is the total number of connections between two banks. key is the number of connections between key executives. Key executives are the CEO, the CFO, the executive chairman, an executive director or the chief risk officer. Both measures are scaled by the average size of the board of the bank pair. Country takes value one if both banks come from the same country and zero otherwise. Type takes value one if both banks have the same specialization according to Bankscope and zero otherwise. Crisis takes value one for the years 2007 till 2010 and zero otherwise. hh, hm, mm, hl, ml, ll are dummies for banks pairs with similar leverage. Standard errors are clustered at the bank pair level. *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level.

VARIABLES	(1)	(2)	(3)	(4)
sni	0.745***	0.0501		
	(0.0607)	(0.0453)		
key			1.922***	0.144
			(0.259)	(0.166)
crisisXsni	-0.363***	-0.302***		
	(0.0593)	(0.0490)		
crisisXkey			-0.813***	-0.692***
			(0.263)	(0.217)
crisis	0.191***	0.252***	0.187***	0.247***
	(0.00365)	(0.0170)	(0.00359)	(0.0170)
country	0.148***		0.157***	
	(0.00433)		(0.00436)	
type	0.0394***		0.0388***	
	(0.00374)		(0.00383)	
hh	0.0106*	-0.0139***	0.0102	-0.0141***
	(0.00624)	(0.00520)	(0.00632)	(0.00522)
hm	0.0220***	-0.00841*	0.0213***	-0.00834*
	(0.00576)	(0.00474)	(0.00582)	(0.00475)
hl	0.00429	-0.00605	0.00327	-0.00607
	(0.00579)	(0.00476)	(0.00585)	(0.00477)
ml	0.0159***	0.00120	0.0150***	0.00116
	(0.00523)	(0.00441)	(0.00527)	(0.00442)
mm	0.0402***	-0.00209	0.0396***	-0.00194
	(0.00604)	(0.00507)	(0.00609)	(0.00508)
Constant	0.279***	0.293***	0.285***	0.295***
	(0.00574)	(0.0172)	(0.00579)	(0.0172)
Observations	77,336	77,336	77,336	77,336
R-squared	0.360	0.617	0.353	0.617
Pair fixed effect	No	Yes	No	Yes
Year fixed effect	Yes	Yes	Yes	Yes

Table 6: Pair model
Regression of the change in pairwise equity correlations on the change in measures of social connectedness. Dependent variable are the changes of unconditional pairwise correlations of weekly equity returns, calculated over a 52 weeks window. Dsni is the change in the total number of connections between two banks. Dkey is the change in the number of connections between key executives. Key executives are the CEO, the CFO, the executive chairman, an executive director or the chief risk officer. Both measures are scaled by the average size of the board of the bank pair. Country takes value one if both banks come from the same country and zero otherwise. Type takes value one if both banks have the same specialization according to Bankscope and zero otherwise. Crisis takes value one for the years 2007 till 2010 and zero otherwise. hh, hm, mm, hl, ml, ll are dummies for banks pairs with similar leverage. Standard errors are clustered at the bank pair level. *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level.

VARIABLES	(1)	(2)	(3)	(4)
Dsni	0.120*	0.141*		
	(0.0726)	(0.0816)		
Dkey			0.131	0.156
			(0.230)	(0.255)
crisis X Dsni	-0.387***	-0.414***		
	(0.113)	(0.128)		
crisis X Dkey			-0.925**	-0.944**
			(0.384)	(0.434)
crisis	-0.0503***	-0.0616***	-0.0503***	-0.0612***
	(0.00460)	(0.0201)	(0.00461)	(0.0201)
country	-0.0134***		-0.0135***	
	(0.00118)		(0.00117)	
type	0.00195**		0.00197**	
	(0.000916)		(0.000914)	
hh	-0.0260***	-0.0544***	-0.0262***	-0.0547***
	(0.00354)	(0.00694)	(0.00354)	(0.00695)
hm	-0.0242***	-0.0424***	-0.0243***	-0.0425***
	(0.00362)	(0.00651)	(0.00362)	(0.00651)
hl	-0.00994***	-0.0215***	-0.0100***	-0.0217***
	(0.00358)	(0.00634)	(0.00358)	(0.00634)
ml	-0.00686	-0.0100	-0.00701	-0.0102
	(0.00447)	(0.00631)	(0.00448)	(0.00631)
mm	-0.0216***	-0.0303***	-0.0216***	-0.0304***
	(0.00487)	(0.00737)	(0.00487)	(0.00737)
Constant	0.111***	0.127***	0.111***	0.127***
	(0.00435)	(0.0207)	(0.00435)	(0.0207)
Observations	67,974	67,974	67,974	67,974
R-squared	0.180	0.203	0.180	0.203
Pair fixed effect	No	Yes	No	Yes
Year fixed effect	Yes	Yes	Yes	Yes

6 Centrality model

While the pair model explains how the strength of the relationship between two banks influences their policy decisions and therefore their exposure to the same kind of risks, the centrality model tests how the position of the bank in the network as a whole impacts bank performance and bank behavior. The key question we try to answer is whether connectedness creates destabilizing group-think or if banking networks are beneficial. A central position in the network means that more information flows through a bank and that the bank is more important regarding the diffusion of information to the rest of the network.

The different centrality measures capture how the bank is positioned in the network and how much information flows through each bank. Betweenness captures how much information flows through a bank. Degree centrality is the number of connections a bank has and therefore how large its direct impact on other banks might be. Closeness is the mean distance between the bank and all other banks in the network, it can be seen as a measure of how much influence a bank can have on all the other banks in the network. Eigenvector centrality is another measure of how bank's importance in the network.

6.1 Interbank market activity

First we test if banks which are more central in the network are more active on the interbank market. Dependent variables are the ratio of bank deposits to total assets and the ratio of bank loans to total assets. On the right hand side we have one of the four centrality measures, the market to book ratio, bank size, country dummies, specialization dummies and year dummies. Standard errors are clustered at the country level. We expect that banks which are more connected find it easier to borrow on the interbank market and have more information available about other banks and are therefore more willing to lend to other banks. This information

advantage should be especially pronounced when markets 'dry up'.

Table 7 shows how much banks were willing to lend on the interbank market depending on their position in the network. We see for three of the four centrality measure a significantly positive coefficient, banks with a central position in the banking network lend more to their peers than those banks that have a peripheral position. We believe that the information flowing through these well connected banks allows them to increase their lending. Table 8 shows the corresponding results for deposits received by banks. Surprisingly we do not see any significant effect, banks that are central in the network therefore lend more to other banks but do not receive more deposits. They seem to be able to use information that arrives through the network to increase lending but do not send signals that would increase the bank deposits received.

Table 9 shows that more important banks in the network have higher ratios of interbank assets to interbank liabilities which is consistent with the previous findings. It seems that a central position in the network allows banks to lend more to other banks, probably because of superior information.

Introducing fixed effects turns the coefficients insignificant. Network position is a very persistent variable that can almost be considered a bank characteristic. Regressions of the changes in bank deposits but not the changes in bank loans on the change in centrality yield positive and significant coefficients.

We are concerned that banks entering and exiting the sample may bias our results by influencing the centrality measures in a mechanical way. We therefore repeat the analysis of this section for the subsample of banks that were present during the full period, i.e. from 2000 till 2010. The results remain unchanged.

Table 7: Centrality model
Regression of the level of loans received from banks divided by total assets on the different centrality measures. Dependent variable is the ratio of loans and advances to banks to total assets. Betweenness centrality is the number of shortest paths between all bank pairs that a bank lies on. Degree centrality denotes the number of links a node in the network has. Closeness centrality is defined as the mean distance between a bank and all other banks were distance is defined as the shortest path. Eigenvector centrality gives large values to those banks that have many links, links that are important or both. All measures are calculated based on social connections between banks according to sni. mtb is the market-to-book ratio, ln(TA) the logarithm of total assets. The sample period is 2000 till 2010. Standard errors are clustered at the country level. *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level.

VARIABLES	(1)	(2)	(3)	(4)
betweenness	0.572			
	(0.336)			
eigenvector		0.335***		
		(0.113)		
closeness			0.149***	
			(0.0120)	
degree				0.168**
				(0.0641)
mtb	0.00828	0.00827	0.00840	0.00834
	(0.0115)	(0.0103)	(0.0108)	(0.0104)
ln(ta)	0.00144	-0.00611*	-0.00366	-0.00645**
	(0.00350)	(0.00293)	(0.00402)	(0.00283)
Constant	-0.0221	0.108	0.0137	0.119
	(0.129)	(0.106)	(0.138)	(0.100)
Observations	820	820	820	820
R-squared	0.203	0.223	0.227	0.222
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Specialization FE	Yes	Yes	Yes	Yes

Table 8: Centrality model
Regression of the level of deposits received from banks divided by total assets on the different centrality measures. Dependent variable is the ratio of deposits received from banks to total assets. Betweenness centrality is the number of shortest paths between all bank pairs that a bank lies on. Degree centrality denotes the number of links a node in the network has. Closeness centrality is defined as the mean distance between a bank and all other banks were distance is defined as the shortest path. Eigenvector centrality gives large values to those banks that have many links, links that are important or both. All measures are calculated based on social connections between banks according to sni. mtb is the market-to-book ratio, ln(TA) the logarithm of total assets. The sample period is 2000 till 2010. Standard errors are clustered at the country level. *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level.

VARIABLES	(1)	(2)	(3)	(4)
betweenness	-0.396			
	(0.519)			
eigenvector		-0.161		
		(0.151)		
closeness			-0.0996	
			(0.0802)	
degree				-0.0585
				(0.0681)
mtb	-0.00718***	-0.00763***	-0.00760***	-0.00753***
	(0.00235)	(0.00227)	(0.00230)	(0.00226)
ln(Ta)	0.00348	0.00592	0.00427	0.00435
	(0.00663)	(0.00673)	(0.00491)	(0.00645)
Constant	-0.00413	-0.0420	0.0237	-0.0169
	(0.156)	(0.152)	(0.115)	(0.148)
Observations	514	514	514	514
R-squared	0.564	0.565	0.565	0.563
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Specialization FE	Yes	Yes	Yes	Yes

Table 9: Centrality model
Regression of the ratio of interbank assets to interbank liabilities on the different centrality measures. Betweenness centrality is the number of shortest paths between all bank pairs that a bank lies on. Degree centrality denotes the number of links a node in the network has. Closeness centrality is defined as the mean distance between a bank and all other banks were distance is defined as the shortest path. Eigenvector centrality gives large values to those banks that have many links, links that are important or both. All measures are calculated based on social connections between banks according to sni. mtb is the market-to-book ratio, ln(TA) the logarithm of total assets. The sample period is 2000 till 2010. Standard errors are clustered at the country level. *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level.

VARIABLES	(1)	(2)	(3)	(4)
betweenness	702.2			
	(415.0)			
eigenvector		243.4*		
		(114.7)		
closeness			140.2**	
			(61.39)	
degree				121.3**
				(49.91)
mtb	-1.266	-0.404	-0.611	-0.382
	(2.844)	(2.849)	(2.918)	(2.778)
ln(TA)	-25.91**	-27.33**	-24.34**	-28.15**
	(11.31)	(10.18)	(8.642)	(10.59)
Constant	625.2**	640.2***	536.3***	659.0***
	(215.8)	(195.4)	(170.5)	(202.5)
Observations	454	454	454	454
R-squared	0.467	0.467	0.465	0.468
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Specialization FE	Yes	Yes	Yes	Yes

6.2 Financial crisis period and bank risk

In this subsection we look at banks performance during the financial crisis depending on their social connectedness. On the one hand we expect that well connected banks had better access to funding and possibly also better information, which should have allowed higher performances during the crisis. On the other hand one might argue that group-think and herding behavior before the onset of the financial crisis led connected banks to take on similar risks which then turned out to be higher than expected. Under such a scenario a less connected bank might have performed better than a well connected bank simply because it was not exposed to the same risks.

First of all we do not find any significant impact of network centrality on the total risk and the idiosyncratic risk of a bank. Total risk is measured as the annualized standard deviation of equity returns over 250 trading days. Idiosyncratic risk is the Root mean squared error of a regression of bank returns on a worldwide banking index.

As can be seen in Table 10 systematic risk however is increasing in network centrality in the period before 2007 but decreasing during and after the financial crisis. Group think might have led banks to expose themselves to similar risks in the years before the crisis. During the crisis however the position in the network did not influence banks' exposure to systematic risk, possibly because more central banks were better informed and unwound their positions in risky assets. This is in line with our findings in section 5, where we have shown that pairwise equity correlations of banks were increasing in the degree of social connectedness before the crisis, but decreasing thereafter. We think that group think and social interactions made banks act similarly with respect to their investment decisions which manifests in higher correlations and higher systematic risk before the crisis, and a reduction of those during and after the crisis.

So far our analysis does however not allow any conclusion on whether tightened

Table 10: Centrality model.
Regression of systematic risk on the different centrality measures. Dependent variable is the beta coefficient from a regression of daily equity returns on the STOXX Global 1800 Banks index over a 250 day moving window. Betweenness centrality is the number of shortest paths between all bank pairs that a bank lies on. Degree centrality denotes the number of links a node in the network has. Closeness centrality is defined as the mean distance between a bank and all other banks were distance is defined as the shortest path. Eigenvector centrality gives large values to those banks that have many links, links that are important or both. All measures are calculated based on social connections between banks according to sni. mtb is the market-to-book ratio, ln(TA) the logarithm of total assets. Crisis takes value one for the years 2007 till 2010 and zero otherwise. The sample period is 2000 till 2010. Standard errors are clustered at the country level. *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level.

VARIABLES	(1)	(2)	(3)	(4)
betweenness	4.105***			
	(1.477)			
eigenvector		1.316***		
		(0.472)		
closeness			0.266	
			(0.178)	
degree				0.613**
				(0.265)
crisis X betweenness	-4.596*			
	(2.448)			
crisis X eigenvector		-1.679***		
		(0.590)		
crisis X closeness			-0.261	
			(0.227)	
crisis X degree				-0.720**
				(0.286)
crisis	0.128*	0.223***	0.201	0.216**
	(0.0659)	(0.0836)	(0.125)	(0.0851)
mtb	-0.00306	-0.00262	-0.00535	-0.00244
	(0.0118)	(0.0113)	(0.0115)	(0.0115)
ln(TA)	0.0522***	0.0509**	0.0633***	0.0505**
	(0.0198)	(0.0204)	(0.0203)	(0.0214)
capital ratio	0.0287***	0.0293***	0.0289***	0.0292***
	(0.00894)	(0.00910)	(0.00918)	(0.00912)
Constant	-0.583	-0.612	-0.892**	-0.615
	(0.408)	(0.410)	(0.424)	(0.418)
Observations	715	715	715	715
R-squared	0.323	0.330	0.314	0.325
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Specialization FE	Yes	Yes	Yes	Yes

network connections in bankers' social space have a positive impact, both on the individual bank's performance and and on the financial sector as a whole. To address these issues we investigate also banks' performance during the financial crisis. In line with the literature[4] crisis performance is defined as stock market returns in the period July 2007 till December 2008. While we would have liked to use a measure of bank failure during the crisis, the large variety of the different bailout measures adopted in the countries of our sample makes this virtually impossible. The average bank in our sample lost about 60% of its market value during this period, however with a high standard deviation of around 22%.

In Table 11 we report the results of a regression of crisis returns on our measures of centrality. We find significantly positive coefficients for betweenness, eigenvector, and degree centrality but a negative and insignificant coefficient for closeness centrality. Keeping in mind the small sample size for this regressions we take this as evidence that banks which were more central in the network performed better during the crisis. Presumably because they were able to unwind there positions in risky assets more quickly and possibly through their ability to be more active on the interbank market. An alternative explanation could be that the socially central banks were also regarded as systemically more important by regulators and the government and therefore either received explicit government aid or could profit from implicit guarantee. In the next section we go therefore one step further and explore the impact of being a socially central bank on the stability of the financial system by looking at measures of systemic risk.

6.3 Systemic risk

While individual bank's centrality in the network seems to have had positive effects on its performance during the crisis we are also interested to know whether tighter networks lead to greater systemic risk for the banking system. The question

[4]see for example Beltratti and Stulz (2009).

Table 11: Centrality model
Regression of equity returns during the financial crisis on the different centrality measures in year 2006. Crisis returns as defined as the returns on equity from July 2007 till December 2008. Betweenness centrality is the number of shortest paths between all bank pairs that a bank lies on. Degree centrality denotes the number of links a node in the network has. Closeness centrality is defined as the mean distance between a bank and all other banks were distance is defined as the shortest path. Eigenvector centrality gives large values to those banks that have many links, links that are important or both. All measures are calculated based on social connections between banks according to sni. mtb is the market-to-book ratio, ln(TA) the logarithm of total assets. All explanatory variables are from 2006. Standard errors are clustered at the country level. *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level.

VARIABLES	(1)	(2)	(3)	(4)
betweenness	2.628***			
	(0.710)			
eigenvector		0.897**		
		(0.312)		
closeness			-0.250	
			(0.156)	
degree				0.503***
				(0.160)
ln(TA)	-0.0807***	-0.0910***	-0.0360*	-0.100***
	(0.0141)	(0.0175)	(0.0197)	(0.0187)
mtb	0.0831***	0.0818***	0.0831***	0.0818***
	(0.00844)	(0.00703)	(0.0116)	(0.00747)
Constant	0.668**	0.838**	-0.0815	1.017**
	(0.258)	(0.317)	(0.337)	(0.338)
Observations	50	50	50	50
R-squared	0.581	0.588	0.583	0.593
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Specialization FE	Yes	Yes	Yes	Yes

is whether more connected banks are more systemic, i.e. does the collapse of a connected bank have a more severe impact on the stability of the financial system than the collapse of a less connected institution. In order to address this issue we use the $\Delta CoVar$ measure introduced by Adrian and Brunnermeier (2008). $\Delta CoVar$ is defined as the difference between the Value at Risk of the banking sector, conditional on one individual bank being in distress and the Value at risk of the banking sector conditional on this bank operating in its median state. More formally, using the same notation as Adrian and Brunnermeier (2008), the value at risk of the financial system conditional upon bank i performing at its worst q% quantile ($CoVar_q^{system|i}$) is defined as

$$Prob(R^{system} \leq CoVar_q^{system|i} | R^i = VaR_q^i) = q,$$

where R^{system} is the return of the banking system, R^i the return of bank i and VaR_q^i the Value at Risk of bank i at the q% quantile. Similarly the value at risk of the financial system conditional upon bank i performing at its 50% quantile ($CoVar_q^{system|i,median}$) is defined as

$$Prob(R^{system} \leq CoVar_q^{system|i,median} | R^i = VaR_{median}^i) = q$$

and therefore bank i's contribution to systemic risk is defined as

$$\Delta CoVaR_q^i = CoVar_q^{system|i} - CoVar_q^{system|i,median}.$$

It measure the contribution of bank i to systemic risk when being in distress compared to when being in a normal state. We estimate $\Delta CoVar$ following Adrian and Brunnermeier (2008) at the 1% level by running quantile regressions on weekly data for each bank. First we predict each individual bank's VaR at the 1% level and at the median level using a vector of lagged state variables. Time varying $VaR_{1\%}^i$ and $VaR_{50\%}^i$ are then calculated as the fitted values from these regressions. We then estimate the Value at Risk of the banking sector conditional on the same lagged state variables and on the contemporaneous performance of each individual bank

and use $VaR^i_{1\%}$ and $VaR^i_{50\%}$ to calculate $CoVar^{system|i}_{1\%}$ and $CoVar^{system|i,median}_{1\%}$. $\Delta CoVaR^i_{1\%}$ is then the difference between the two. The state variables correspond mainly to those used by Adrian and Brunnermeier (2008): Market volatility is the 60 day standard deviation of S&P 500 returns, market returns are proxied for with weekly S&P 500 returns, the difference between the three month LIBOR rate and the three month Treasury bill rate measures market liquidity risk, interest rate risk is the change of the three month Treasury bill rate, the change in the yield curve slope is the the change in the difference between the 10 year Treasury rate and the three month Treasury rate, default risk is proxied by the change in the credit spread between BAA rated corporate bonds and the ten year Treasury rate.

Table 1 depicts summary statistics on our systemic risk measure, which shows that the average value of ΔCoVaR is smaller than reported in Adrian and Brunnermeier (2008), who however look at a much longer sample of US banks only.

Table 12 shows how the contribution of each bank to systemic risk depends on the centrality in the network. In line with our hypothesis coefficients of the different centrality measures are all negative and for three out of four measures significantly different from zero.

7 Conclusion

In this paper we have shown the importance of board connections for the functioning of the global financial system. Using data on the connections of board members of major international banks we have first depicted the extent of interlinkages in the financial system. The bank board network has tightened over time and the average number of bank connections has been rising over the last ten years. We see that the geographic location plays an important role as a determinant of a banks position in the network, but we also find that there are many links between banks

Table 12: Centrality model
Regression of the systemic risk measure $\Delta CoVaR$ on the different centrality measures. Betweenness centrality is the number of shortest paths between all bank pairs that a bank lies on. Degree centrality denotes the number of links a node in the network has. Closeness centrality is defined as the mean distance between a bank and all other banks were distance is defined as the shortest path. Eigenvector centrality gives large values to those banks that have many links, links that are important or both. All measures are calculated based on social connections between banks according to sni. mtb is the market-to-book ratio, ln(TA) the logarithm of total assets. The sample period is 2000 till 2010. Standard errors are clustered at the country level. *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level.

VARIABLES	(1)	(2)	(3)	(4)
betweenness	-32.44**			
	(13.55)			
eigenvector		-13.01***		
		(4.034)		
closeness			-3.231*	
			(1.690)	
degree				-5.967**
				(2.120)
mtb	-0.0436	-0.0566	-0.0204	-0.0569
	(0.0915)	(0.0657)	(0.0841)	(0.0700)
noninterest	0.00335	0.00542*	0.00239	0.00467*
	(0.00187)	(0.00262)	(0.00397)	(0.00244)
ln(TA)	0.364**	0.559**	0.238	0.532**
	(0.121)	(0.188)	(0.180)	(0.200)
Constant	-7.916***	-10.95***	-4.469	-10.62***
	(1.965)	(3.032)	(2.726)	(3.255)
Observations	548	548	548	548
R-squared	0.448	0.460	0.443	0.454
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Specialization FE	Yes	Yes	Yes	Yes

in different geographic centers. This purely descriptive evidence of a tightening of the social network in banking led us to the question whether there are any real consequences of such a social proximity. Herding behavior or the transmission of information through the network may lead to similar investment decisions and the resulting asset commonality could increase the vulnerability of the whole system to shocks. As a first indicative result we documented that the average correlation of equity returns among our sample banks has been moving together with measures of network tightness and with the average levels of social connectivity. To deepen our understanding of the mechanism through which social connectivity may drive bank similarity we regressed the pairwise equity correlations on measures of the strength of board connectivity. We found that socially closer banks have higher levels of equity correlations but that this effect decreases during and after the financial crisis. From our perspective this is evidence for bank managers buying similar assets during the buildup of the financial crisis and selling those assets during and after the crisis. It seems plausible that the intensity of social interactions between bank board members was a driving force of such a behavior. We then looked at the position of each bank in the board network. More central banks were exposed to more information and must have had a higher impact on the behavior of other banks through their connections. And indeed we find that the position in the network is an important determinant for various measures of systemic risk and of interbank market activity. We found that socially central banks lend more to their peers on the interbank market but do not receive higher levels of deposits from other banks. Superior information about other banks in the network may allow this kind of behavior. From a systemic risk perspective we see that central banks had higher levels of systematic risk before the crisis but lower levels during and after the crisis. Again, the position in the network may have led banks to increase their positions in the same assets during the years 2000 till 2006, but may have also allowed them to reduce these positions as soon as the crisis hit. Not surprisingly we find that board centrality is also a good determinant of systemic risk, socially central banks are more systemic than banks that are on the perimeters of the social network.

A Sample banks

Name	Start	End
Aareal Bank AG	2002	2010
Ageas	2000	2010
Alliance & Leicester Plc	2000	2007
Allied Irish Banks plc	2000	2010
Almanij	2000	2003
AmSouth Bancorporation	2000	2005
American Express Company	2000	2009
Astoria Financial Corporation	2000	2010
BB&T Corporation	2000	2010
BNP Paribas	2000	2010
Banco Bilbao Vizcaya Argentaria SA	2000	2010
Banco Espanol de Cr.dito SA, BANESTO	2000	2010
Banco Santander SA	2000	2010
Bank of America Corporation	2000	2010
Bank of Ireland	2000	2010
Bank of New York Company, Inc.	2000	2006
National Bank of Canada	2003	2010
Banque de Montreal-Bank of Montreal	2003	2010
Barclays Plc	2000	2010
Bear Stearns Companies LLC	2000	2007
CIT Group, Inc	2003	2010
Canadian Imperial Bank of Commerce CIBC	2003	2010
Capital One Financial Corporation	2000	2010
Capitalia SpA	2002	2006
Cathay General Bancorp Inc	2003	2010
Charles Schwab Corporation	2000	2010
Citigroup Inc	2000	2010

Comerica Incorporated	2000	2010
Commerce Bancorp, Inc.	2000	2006
Commerzbank AG	2000	2010
Commonwealth Bank of Australia	2003	2010
Countrywide Financial Corporation	2000	2007
Credit Suisse Group AG	2000	2010
Danske Bank A/S	2001	2010
Depfa Bank Plc	2002	2006
Deutsche Bank AG	2000	2010
Dexia	2000	2010
DnB Nor ASA	2003	2010
Erste Group Bank AG	2000	2010
Eurohypo AG	2002	2007
Fannie Mae-Federal National Mortgage Association	2000	2008
Fifth Third Bancorp	2000	2010
First Horizon National Corporation	2000	2010
FleetBoston Financial Corporation	2000	2002
Freddie Mac	2001	2008
Golden West Financial Corp	2000	2005
Goldman Sachs Group, Inc	2000	2010
Gruppo Monte dei Paschi di Siena	2000	2010
HBOS Plc	2001	2007
HSBC Holdings Plc	2000	2010
Huntington Bancshares Inc	2000	2010
Hypo Real Estate Holding AG	2003	2008
ING Groep NV	2000	2010
Intesa Sanpaolo	2001	2010
JP Morgan Chase & Co.	2001	2010
KBC Group-KBC Groep NV/ KBC Groupe SA	2000	2010
KeyCorp	2000	2010

LBB Holding AG-Landesbank Berlin Holding AG	2000	2010
Lehman Brothers Holdings Inc.	2000	2007
Lloyds Banking Group Plc	2000	2010
M&T Bank Corporation	2000	2010
MBNA Corporation	2000	2004
Mellon Financial Corporation	2000	2006
Merrill Lynch & Co., Inc.	2000	2008
Metlife, Inc.	2000	2010
Morgan Stanley	2000	2010
Natixis	2000	2010
New York Community Bancorp, Inc	2000	2010
Nordea Bank AB	2000	2010
North Fork Bancorporation, Inc	2000	2005
Northern Rock Plc	2000	2007
Northern Trust Corporation	2000	2010
PNC Financial Services Group Inc	2000	2010
Popular, Inc	2000	2010
Prudential Financial Inc	2001	2010
RBS Holdings NV	2000	2007
Royal Bank of Canada RBC	2003	2010
Royal Bank of Scotland Group Plc	2000	2010
Skandinaviska Enskilda Banken AB	2000	2010
Soci.t. G.n.rale	2000	2010
Southtrust Corporation	2000	2003
Standard Chartered Plc	2000	2010
State Street Corporation	2000	2010
SunTrust Banks, Inc.	2000	2010
Swedbank AB	2000	2010
Synovus Financial Corp	2000	2010
Toronto Dominion Bank	2003	2010

UBS AG	2000	2010
US Bancorp	2001	2010
UniCredit SpA	2000	2010
UnionBanCal Corporation	2000	2007
Wachovia Corporation	2001	2007
Washington Mutual Inc.	2000	2007
Wells Fargo & Company	2000	2010
Westpac Banking Corporation	2003	2010
W.stenrot & W.rttembergische	2000	2009
Zions Bancorporation	2000	2010

References

Adrian, T., Brunnermeier, M. K., 2008. Covar. Staff Reports 348, Federal Reserve Bank of New York.
URL http://ideas.repec.org/p/fip/fednsr/348.html

Allen, F., Babus, A., Carletti, E., 2010. Financial connections and systemic risk. Economics Working Papers ECO2010/30, European University Institute.
URL http://ideas.repec.org/p/eui/euiwps/eco2010-30.html

Allen, F., Gale, D., February 2000. Financial contagion. Journal of Political Economy 108 (1), 1–33.
URL http://ideas.repec.org/a/ucp/jpolec/v108y2001i1p1-33.html

Beltratti, A., Stulz, R. M., Jul. 2009. Why did some banks perform better during the credit crisis? a cross-country study of the impact of governance and regulation. NBER Working Papers 15180, National Bureau of Economic Research, Inc.

Cai, Y., Sevilir, M., 2009. Board Connections and M A Transactions. SSRN eLibrary.

Cifuentes, R., Shin, H. S., Ferrucci, G., 04/05 2005. Liquidity risk and contagion. Journal of the European Economic Association 3 (2-3), 556–566.
URL http://ideas.repec.org/a/tpr/jeurec/v3y2005i2-3p556-566.html

Cohen, L., Frazzini, A., Malloy, C., May 2007. The small world of investing: Board connections and mutual fund returns. NBER Working Papers 13121, National Bureau of Economic Research, Inc.
URL http://ideas.repec.org/p/nbr/nberwo/13121.html

Diamond, D. W., Dybvig, P. H., June 1983. Bank runs, deposit insurance, and liquidity. Journal of Political Economy 91 (3), 401–19.
URL http://ideas.repec.org/a/ucp/jpolec/v91y1983i3p401-19.html

Duchin, R., Sosyura, D., 2011. Divisional Managers and Internal Capital Markets. SSRN eLibrary.

Engelberg, J., Gao, P., Parsons, C. A., 2009. The Value of a Rolodex: CEO Pay and Personal Networks. SSRN eLibrary.

Engelberg, J., Gao, P., Parsons, C. A., 2010. Friends with Money. SSRN eLibrary.

Ferreira, M. A., Matos, P. P., 2011. Universal Banks and Corporate Control: Evidence from the Global Syndicated Loan Market. SSRN eLibrary.

Fracassi, C., 2009. Corporate Finance Policies and Social Networks. SSRN eLibrary.

Fracassi, C., Tate, G. A., 2011. External Networking and Internal Firm Governance. Journal of Finance, Forthcoming.

Freixas, X., Parigi, B. M., Rochet, J.-C., 2000. Systemic risk, interbank relations, and liquidity provision by the central bank. Proceedings, 611–640.
URL http://ideas.repec.org/a/fip/fedcpr/y2000p611-640.html

Hwang, B.-H., Kim, S., 2008. It Pays to Have Friends. Journal of Financial Economics (JFE), Forthcoming.

Mobius, M., Szeidl, A., May 2007. Trust and social collateral. NBER Working Papers 13126, National Bureau of Economic Research, Inc.
URL http://ideas.repec.org/p/nbr/nberwo/13126.html

Upper, C., Worms, A., August 2004. Estimating bilateral exposures in the german interbank market: Is there a danger of contagion? European Economic Review 48 (4), 827–849.
URL http://ideas.repec.org/a/eee/eecrev/v48y2004i4p827-849.html