Does corporate governance matter for investment banking?

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Abstract

This paper focuses on the impact of the corporate governance, using a plethora of measures, on the US investment bank performance over the 2000-2012 period. The end of the sample period offers a unique set of information, related to the credit crunch, that we model using a dynamic threshold analysis to reveal new insights into the relationship between corporate governance and bank performance under stress. Results show that the board size asserts a negative effect on performance consistent with the *'agency cost hypothesis',* in particular for banks with board size higher than ten members. Threshold analysis reveals that in the post-crisis period most of investment banks opt for boards with less than ten members, aiming to decrease agency conflicts that large boards suffer from. We also find evidence of a negative association between operational complexity and performance. Moreover, CEO power asserts a positive effect on performance in line with the *'stewardship hypothesis'*. In addition, an increase of the ownership held by the board has a negative impact on performance, predominantly present in banks below an identified threshold. On the other hand, banks with board ownership above the threshold value this effect turns positive, indicating an alignment between shareholders' and managers' incentives.

Keywords: Investment Banking, Corporate governance, Performance, Board size, CEO power, Board Ownership.

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1. Introduction

The liberalization and the globalization of financial services in combination with rapid advances in financial innovation have significantly broadened the variety of operations in which investment banks engage over the last two decades. Such operations include the issuance of debt or equity securities in the primary market, the financial advisory services, the trading of securities in the secondary market and asset back securitisation. As a result, the performance of investment banking industry, through complex and far reaching operations, has the utmost importance for the well functioning of global financial markets. Yet, few studies (Brunnermeier and Pederson, 2009; Adrian and Shin, 2010; Radic et al., 2012) appear to examine the underlying determinants of investment banks. This paper bridges this gap in the literature and further reveals a crucial link between corporate governance and performance.

No-where in the world investment banks' activities have been as influential as in the US economy. US investment banks captured more than half (58%) of the global investment banking revenues in 2012, while in the same year US investment banking accounted for 30% of the total US banking industry profits. Alas, investment banking has also been held accountable for the credit crunch in 2008 that hit the US and then spread globally. In fact, the credit crunch is a manifestation of the possible detrimental impact of investment banking on the financial market (Brunnermeier and Pederson, 2009; Demirguc-Kunt and Huizinga; 2010). Moreover, the US financial market towards the end of the last decade entered a period of unprecedented instability where the estimated losses due to subprime mortgages alone were between $400bn and $500bn (Demirguc-Kunt et al., 2012). As a result, also, investment banks went through some very dramatic changes. Bear Stearns was acquired by JP Morgan with the financial support of the Federal Reserve Bank, Merrill Lynch had to raise a substantial volume of capital to cover high realised losses on assets, whereas Lehman Brothers filed for bankruptcy. Demirguc-Kunt and Huizinga (2010) and Acharya and Richardson (2009) argue that part of the causes of the crisis should be traced to the considerably complex activities of investment banking. At times the level of complexity of an

investment bank's activities is so intricate that resembles a black box. The shift of financial institutions into high level of complex operations might have contributed to the crisis resulting in the underperformance of investment banks and the financial system as a whole (Demirguc-Kunt and Huizinga, 2010). [2] The fact is though that the degree of complexity of investment banking is closely related to the underlying corporate governance (Adams and Mehran, 2012). To this end, an inquest into the operation of investment banks necessitates a detail study of their corporate governance.

In this paper, we focus on the impact of the corporate governance on investment bank performance. Due to the crisis of 2007, the governance of financial institutions has been into the spotlight (Erkens et al., 2012; Fahlenbrach and Stulz, 2011; Beltratti and Stulz, 2012; Aebi et al., 2012; Pathan and Faff, 2013), whilst a growing perception about the detrimental role of corporate governance has gained support (Kirkpatrick, 2009). Coming up with a definition of corporate governance is not an easy task. Gillan and Starks (1998) define corporate governance as an internal mechanism that is closely linked to the system of acts, laws, and dynamics that control the operations of a firm. Corporate governance is as complex as investment banking operations and one needs to categorise its different mechanisms. Broadly speaking, there are five main components of corporate governance: board structure, CEO power, compensation, managerial incentives and operational complexity. In terms of board structure, the focus is on board size, board composition and gender diversity. The majority of the corporate governance literature relates to the board size and the board composition (Adams and Mehran, 2008; Andres and Vallelado, 2008; Guest, 2008; Pathan, 2009; Faleye and Krishnan, 2010; Tanna et al., 2011; Pathan and Faff, 2013). Gender diversity has not been under the microscope as, to the best of our knowledge, there is just one study that examines the relationship between the gender diversity and the performance of bank holding companies (Pathan and Faff, 2013).

Moreover, a significant amount of studies focuses on CEO duality as a proxy of the CEO power (Boyd, 1995; Baliga et al., 1996; Daily and Johnson, 1997; Dalton et al., 1998; Adams et al., 2005; Ballinger and Marcel, 2010).[3] Another proxy of the CEO power is the 'internally'

[2] Fernando et al. (2012) demonstrate that firms that had as their main equity underwriter Lehman Brothers suffered economically and their earnings experienced a substantial fall.

[3] CEO duality corresponds to the case where CEO is also the chairman of the board of directors and can influence the decision-making process of the board members.

hired CEO (May, 1995; Adams et al., 2005).[4] To the best of our knowledge, there is no study to examine the relationship between the 'internally' hired CEO and investment bank performance. Regarding the executive compensation, numerous studies (Hillgeist and Penalva, 2003; Bebchuk and Fried, 2003; Core et al., 2003; Frye, 2004; Brick et al., 2006) stress the presence of a significant relationship between CEO compensation and performance. Compensation is typically categorised into cash, that includes base salary and bonus, and equity compensation, that includes stock options and restricted stock grants and constitutes the long-term compensation form. However, the compensation of top executives (top management team, TMT) apart from the chief executive officer has received very little empirical attention due to the assumption that the compensation schemes of TMT are 'isomorphic' with those of CEO (Carpenter and Sanders, 2002). However, Finkelstein and Hambrick (1996) and Henderson and Fredrickson (2001) argue that there is no evidence to support the convergence between the compensation of CEO and that of TMT, while Hambrick (1995) shows that there is large gap among them. Given the ongoing debate, in our model we consider the compensation of both the TMT and the CEO.

Managerial incentives is also an important element of corporate governance. The vast majority of empirical work that focuses on managerial incentives is centred around the ownership held by executives (Morck et al., 1988; McConnell and Servaes, 1990; Pi and Timme, 1993). In addition, the 2007 financial crisis further highlighted the importance of the managerial incentives. Fahlenbrach and Stulz (2011) show that CEO incentives have not contributed to the 2007 meltdown of the banking industry as a whole. In addition to this, Beltratti and Stulz (2012) perform a cross-country comparison of financial institutions for the 2007-2008 period and find that banks with boards that hold high level of ownership operate worse than banks with boards that hold low level of ownership. Hence, the empirical evidence seems inconclusive regarding the impact of managerial incentives on performance and further investigation is warranted.

Lastly, the operational and organizational complexity of large banks has been proposed as one of the main causes of the financial crisis (Felsenthal, 2009).[5] As complexity increases there is need for additional independent board members so as to improve performance with the expertise they are supposed to bring (Adams and Mehran, 2012). However, an increase of

[4] 'Internally' hired CEO is the CEO who is the founder of company or has served before as a member of the boardroom. Hence, an 'internally' hired CEO' has a long term involvement with the firm.
[5] Operational complexity denotes the variety of activities that are related to a firm's operations (Child, 1972).

independent board members could raise free-riding problems from low attendance and low commitment at board and committee meetings (Jensen, 1993). Looking at the banking industry, Adams and Mehran (2012) find that there exists a negative relationship between the operational complexity and performance. However, there is no study that investigates the relationship between complexity and investment bank performance, in particular after controlling for board and committee meetings related variables.

In some detail, this study contributes to the literature in several ways. It is the first study to examine the impact of corporate governance on investment bank performance during the pre-crisis and post-crisis period. Secondly, we employ a plethora of corporate governance measures including: board structure, CEO power, compensation, managerial ownership and operational complexity. Thirdly, from a methodological point of view, we take into account endogeneity issues by using dynamic panel analysis. Lastly, for the first time we opt for a dynamic threshold model (Kremer et al., 2011) to investigate possible regime shifts during the crisis, in particular in relation to some key corporate governance determinants of investment bank performance. The advantage of this analysis is that different regimes could be endogenously identified from the underlying data generating process.

The end of the sample period offers a unique set of information, related to the credit crunch, that we model using a dynamic threshold analysis to reveal new insights into the relationship between corporate governance and bank performance under stress. Results show that the board size asserts a negative effect on performance consistent with the *'agency cost hypothesis'*, in particular for banks with board size higher than ten members. Threshold analysis reveals that in the post-crisis period most of investment banks opt for boards with less than ten members, aiming to decrease agency conflicts that large boards suffer from. We also find evidence of a negative association between operational complexity and performance. Moreover, CEO power asserts a positive effect on performance in line with the *'stewardship hypothesis'*. In addition, an increase of the ownership held by the board has a negative impact on performance, predominantly present in banks below an identified threshold. On the other hand, banks with board ownership above the threshold value this effect turns positive, indicating an alignment between shareholders' and managers' incentives.

The rest of the paper is structured as follows. Section 2 presents the hypotheses development and discusses the related literature review. Section 3 presents the data and Section 4 the methodology. Section 5 provides the empirical findings and Section 6 concludes.

2. Related literature and hypotheses development

2.1. Board size and bank performance

Agency theorists argue that a large board can be less efficient than a small board, as when the number of the board members increases agency conflicts rise as well (Jensen 1993; Lipton and Lorsch, 1992). Yermack (1996) and Eisenberg et al. (1998) finds that there is a negative relationship between board size and firm performance, as when boards are too big there is information asymmetry due to inefficient communication and cooperation costs. On the contrary, an earlier study by Pfeffer (1972) finds that board size is positively linked to the performance of firms that have large size. The reason being that large firms have a greater need of more board members who can legitimate the company to its external environment. Turning to the banking sector, the studies by Adams and Mehran (2008) and Andres and Vallelado (2008) find that there is positive relationship between board size and the ratio of bank market value-to-book value (Tobin's Q). There is no clear empirical evidence with respect to the impact of board size on performance, hence:

H_1: An increase in the number of board members could have a significant (positive or negative) effect on the performance of US investment banks.

2.2. Board composition and bank performance

Jensen and Meckling (1976) argue that more independent oriented boards are positively related with firm performance. Dalton et al. (1998) suggest that independent directors minimize managerial entrenchment risk through their expertise and objectivity in the decision making process. Anderson and Reed (2004) find that the performance of S&P500 firms is positively driven by the existence of more independent members in the boardroom. Evidence from the banking sector shows that an increase in the number of independent directors has a positive impact on return on the invested capital for a sample of European banks (Busta, 2007). Moreover, Tanna et al. (2011) find positive relationship between board composition and bank efficiency for seventeen UK banking institutions. On the contrary, there is theoretical background to support that there is no conflict between the interests of shareholders and managers (*'stewardship theory'* by Donaldson, 1990). This concept underlies that an increase in the proportion of non-independent directors (insiders) could

positively contribute to firm performance, as insiders have more experience and better firm-specific knowledge (Gomez-Mejia and Wiseman, 1997). Also, higher level of independence may result in infertile political activity by non-independent members that lessen the productivity of the outsiders and decreases the cooperation among the board members (Westphal, 1998, 1999). Coles' and Hesterly (2000) findings lend support to the *'stewardship theory'* as they show that insiders on the board improve stock performance when the chairman is independent. Our theoretical and empirical analysis shows that there is no general agreement on the impact of the board independence on performance, therefore:

H_2: An increase in the proportion of independent directors could have a significant (positive or negative) impact on the US investment bank performance.

2.3. Gender diversity and bank performance

Robinson and Dechant (1997) suggest that female directors are likely to be more committed to their duties and communicate better with the other board directors. In support of the view that women are more productive at this level of hierarchy, Eagly and Carli (2003) argue that the "glass ceiling" effect motivates females to be even more proficient in order to reach these kind of positions in a firm. The *'glass ceiling hypothesis'* explains the gender discrimination in a firm. Under this hypothesis, there is misperception that women have inferior skills than men and therefore they face additional hurdles to enter the market and hold a directorship (Martell, 1999; Baxter and Wright, 2000). The earlier study by Shrader et al. (1997) examine the impact of the women presence in the boardroom on the performance of 200 US firms and find that there is negative effect. On the contrary, Campbell and Minguez-Vera (2008) find a positive relationship between their gender diversity determinants and firm performance of non-financial firms in Spain.[6] In similar lines, Francoeur et al. (2008) suggest that policies to increase the proportion of female members in both the management and governance structures would improve firm performance. On the contrary, Adams and Ferreira (2009) find that there is no significant positive impact from the announcement of a woman directorship on stock performance. To the extent of our knowledge, empirical evidence from a banking perspective is scarce, as there is only one study by Pathan and Faff (2013) that have explored the impact of gender diversity on bank performance. They find that gender diversity, estimated as the percentage of total directors who are female, has a positive impact on bank

[6] The gender diversity is proxied by two different measures. A dummy variable which takes the value of 1 if there exists a woman in the boardroom, and the percentage of the female members in the board composition. The performance of firms is estimated by a measure similar to Tobin's Q.

performance. However, this relationship becomes weaker in the post-Sarbanes-Oxley Act period (2003-2006) and the period after the financial crisis (2007-2011). There is no general consensus on the impact of the female presence on performance as it depends more on the individual nature and needs of its corporation (Harrigan, 1981), thus:

H_3: An increase in the proportion of female board members could have a significant impact (positive or negative) on the performance of US investment banks.

2.4 CEO power and bank performance

CEO power could influence board decisions and reduce the independency of the board of directors. According to the *'entrenchment hypothesis'*, entrenchment risk occurs when managers obtain so much power and are able to use it to maximize their own utility rather than the value of shareholders (Weisbach, 1988; Finkelstein and D'Aveni 1994). Against this view, there is theoretical background termed as stewardship theory (Donaldson, 1990; Barney 1990) suggesting that a strong CEO would act as a good agent of company assets and firm would take advantage of the unity of direction and strong command and control that the powerful CEO would offer. Donaldson and Davis (1991) find positive relationship between CEO power, estimated as the CEO duality, and stock returns for 337 US firms in 1987. On the contrary, a study by Boyd (1995) lends support for the agency theory and finds that CEO duality has a negative impact on the return on equity of 192 US companies in 1980. Turning to the banking sector, Mishra and Nielsen (2000) find that for a sample of 89 commercial banks the CEO duality has a negative impact on their performance estimated by return on average assets and return on average equity. Our above discussion shows that there is no general agreement with regards to the impact of the CEO power on bank performance, therefore:

H_4: Higher CEO power could have a significant (positive or negative) impact on the US investment bank performance.

2.5. Executive compensation and bank performance

The executive compensation has attracted the interest of researchers as it could be perilous to the corporate governance of firms (Barro and Barro,1990; Zajac and Westphal, 1994; Hubbard and Palia, 1995; Crawford et al., 1995; Bedchuk et al., 2009). Compensation is typically categorised into two forms: 1) cash that includes base salary and bonus, and 2) equity compensation that includes stock options and restricted stock grants and constitutes the

long-term compensation form. Agency theorists argue that long-term form of compensation better aligns managers' and shareholders' incentives (Jensen and Murphy, 1990), as long-term pay normally reward managers when they meet firms' performance goals (Baysinger and Hoskisson, 1990). In similar lines, empirical research (Harris and Raviv, 1979; Grossman and Hart, 1983; Hillgeist et al., 2003; Frye 2004) shows that the tying of compensation, i.e. increase of equity-based compensation, to the firm performance motivates CEOs to make decisions that maximize corporate value. However, the compensation of top executives (top management team, TMT) apart from the chief executive officer has received very little empirical attention due to the assumption that the compensation schemes of TMT are 'isomorphic' with those of CEO (Carpenter and Sanders, 2002). However, Finkelstein and Hambrick, (1996) and Henderson and Fredrickson (2001) argue that there is no evidence to support the convergence between the compensation of CEO and TMT, while Hambrick (1995) shows that there is large gap among them. The above theoretical and empirical analysis shows that the association between the CEO equity-based compensation and performance could be positive, thus:

H_5: An increase in the CEO equity-based compensation could have a positive impact on the US investment bank performance, after controlling for TMT compensation.

2.6. Ownership and bank performance

Following Jensen and Meckling (1976) and Eisenhardt (1989), the distinction of the ownership and managerial control leads to the misalignment of shareholders' and board's interests. Corporate governance analysts generally claim that managers' interest are in line with shareholders' when the former have partial ownership of the company (Murphy, 1999). In support of this perception, Pi and Timme (1993) find that for non-chairman CEO of banks there is a positive relationship between ownership and performance. Lately, the financial crisis has motivated researchers to examine the corporate governance of banking entities in terms of managers' incentives over the period of the financial crisis. However, Fahlenbrach and Stulz (2011) find that there is no statistical evidence that the CEO incentives were not in line with the shareholders' interests in the period of financial crisis. Moreover, Beltratti and Stulz (2012) perform a cross-country comparison of financial institutions for the period 2007 to 2008. They stress that banks with higher proportion of board ownership operate worse than banks with less board ownership. The reason being that banks with boards of higher ownership have been positioned in ways that managers assumed that would maximize

shareholder wealth. However, this policy left banks exposed to high risk and had a negative effect on bank performance. Based on the theoretical and empirical background presented above, we assume:

H_6: An increase of managerial ownership could have a positive impact on the US investment bank performance.

2.7. Operational complexity and bank performance

Operational complexity denotes the variety of activities which are related to a firm's operations (Child, 1972). The higher the level of complexity is, the more apparent becomes the need of higher expertise and knowledge specific to the environment. This implies that co-ordination problems between specialists rise which correspondingly increase communication costs of the firm (Lawrence and Lorch, 1967). Moreover, as complexity increases firms' advisory needs increase as well (Adams and Mehran, 2012). This implies that firms might have more independent members in their boards so as to improve the expertise and knowledge to the firm. However, as director independency increases, the level of the attendance and effort of independent members on board and committee meeting decreases, resulting in the increase of the free-riding problems that large banks suffer from (Jensen, 1993). The above discussion shows that the association between operational complexity and performance could be negative after controlling for committee and board related variables, thus:

H_7: An increase of environmental complexity could have a negative impact on the US investment bank performance, after controlling for board and committee related variables.

3. Data and preliminary analysis

Our sample consists of the major 23 listed investment banks headquartered in the US with standard industry classification of 6211 and 6282. Our unbalanced panel dataset includes 203 observations over the period 2000-2012. The data are collected from DEF 14A proxy statements, 10-K annual reports, BANKSCOPE and Thomson Financial's Banker.

The corporate governance data are hand collected from DEF 14A proxy statements of annual meetings found in the SECs EDGAR filings. Following previous studies (Pathan, 2009; Adams and Mehran 2013; Pathan and Faff, 2013) governance data are measured from the date of the proxy statement. Financial information on investment banks are firstly sourced from Thomson Financial's Banker and secondly from 10-K annual reports of SEC'S filings

and BANKSCOPE. We include only the listed investment banks as information on corporate governance data are standardised through the SEC Edgar platform. Our main inclusion criterion is that we consider in the sample only financial institutions that their main source of income consists of fees, commission and trading revenues reflecting in that way their distinctive operational nature.

[INSERT TABLE 1 ABOUT HERE]

Our corporate governance data comprise five general dimensions; board structure, CEO power, compensation of the CEO and TMT, ownership of CEO and board members and operational complexity measures. In particular, we account for three board characteristics, namely board size, board composition and gender diversity. The first two variables have been extensively used in the corporate governance literature (Adams and Mehran, 2008; Andres and Vallelado, 2008; Staikouras et al., 2007; Busta, 2007; Tanna et al., 2011). The first represents the number of members that constitute the board, while the second refers to the proportion of independent members in the board. Gender diversity is the percentage of females in the boardroom (Shrader et al. 1997; Campel and Minguez-Vera, 2008; Francoeur et al, 2008; Adams and Ferreira, 2009).

We employ two measures of the CEO power; CEO duality and 'internally' hired CEO. CEO duality is a dummy that takes the value of 1 if the CEO chairs the board as well, and 0 otherwise (Rechner and Dalton, 1989, 1991; Donaldson and Davis, 1991; Daily and Dalton, 1992, 1993; Daily, 1995; Boyd, 1995; Baliga et al., 1996; Dalton et al., 1998; Ballinger and Marcel, 2010). CEO 'internally' hired is a dummy variable which takes the value of one 1 if the CEO is either the founder or has been member of the board before being moved to the CEO position, otherwise it takes the value of zero (Adams et al., 2005; Pathan, 2009; Fahlenbrach 2009). As additional CEO characteristics, we control for the CEO tenure and the CEO age. The CEO tenure is the natural logarithm of the years that the CEO have served in the same position (Mishra and Nielsen, 2000; Cornett et al., 2008; Pathan and Faff, 2013). Finally, the CEO age is the natural logarithm of the age that the CEO has (Mishra and Nielsen, 2000; Cornett et al., 2008).

In order to examine the impact of ownership on bank performance we use the number of shares hold by the CEO and TMT as the percentage of total outstanding number of bank's shares (Beltratti and Stulz, 2012; Aebi et al., 2012). We also control for the cash short-term incentives by employing the ratio of bonus over total cash compensation of the CEO and the

TMT (Fahlenbrach and Stulz, 2011). Moreover, we examine the impact of cash and equity compensation of CEO and TMT on investment bank performance. The natural logarithm of cash-based compensation includes the base salary and bonus while the natural logarithm of equity-based compensation includes restricted stock and stock options. Decomposition of the compensation has been used in a number of different studies so as to investigate differences on the impact of cash and equity compensation on firm performance (Baysinger and Hoskisson, 1990; Frye, 2004; Carpenter and Sanders, 2002).

We also examine the impact of operational complexity on bank performance. Operational complexity is proxied by the number of different business segments (Booth and Deli, 1999; Bushman et al., 2004; Linck et al., 2007) and subsidiaries (Adams and Mehran, 2012). Moreover, we control for the total outstanding number of board committees (Vafeas, 1999), the fees paid to the board committees and the number of audit committee meetings (Xie et al., 2003; Goodwin-Stewart and Kent, 2006).

Turning to the rest of the bank-specific determinants, we opt for a number of additional variables such as the ratio of equity to total assets as a proxy of leverage (Berger and Bonaccorsi di Patti, 2006). We also use the ratio of other earning assets over total assets in line with Beltratti and Stulz (2012) so as to capture the different nature of investment banks centered around equity issuance and underwriting activities. We also include the ratio of investment banking fees over total assets as this income reflects the main activity of investment banks (Radic et al., 2012). Lastly, we control for the insolvency risk, namely z-score, estimated as in Boyd's and Graham (1986).[7]

In our analysis we account for the regulatory mandates with the introduction of the Sarbanes-Oxley Act (SOX) in 2002 (Pathan and Faff, 2009) as a dummy, which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise. [8] We also impose a crisis dummy which takes the value of 1 if year is 2007-2010, 0 otherwise in order to account for the financial crisis period (Pathan and Faff, 2009; De Jonghe et al., 2012). Finally, in order to capture the market risk we use the Volatility Implied Index indicator (VIX). [9] This financial indicator suggests that higher levels of VIX reflect higher degrees of financial turmoil in US (Whaley, 2000).

[7] Z-score= (1+Average ROE)/Standard Deviation of ROE. The z-score has been used in recent banking studies (Lepetit et al., 2008; Radic et al., 2012).

[8] In particular, Section 301 of SOX Act obligates the audit committee to be comprised solely by independent members.

[9] VIX is the volatility implied index for Chicago Board Options Exchange Volatility Index. For the data collection we use Bloomberg database.

3.1 Descriptive Statistics

The descriptive statistics for the corporate governance variables are provided in Table 2.

[INSERT TABLE 2 ABOUT HERE]

The sample mean of board size in Panel A of Table 2 is 8.30, which is similar to that of 10 in Coles et al. (2008) and 9 in Francis et al. (2012). Moreover, our sample mean of gender diversity of 0.11 is comparable to that of 0.076 in Pathan and Faff (2013). Turning to the CEO characteristics, the sample mean of CEO duality is 0.72 while that of CEO 'internally' hired is 0.65 which is similar to that of 0.58 in Pathan and Skully (2010). The CEO age sample mean is 55.35 (years), which is comparable to that of 56.26 in Cornett et al. (2009). Also, the mean tenure of the CEO is 7.74 (years), which is similar to that of 8.85 in Pathan and Skully (2010). With regards to the ownership, the sample mean of board ownership is 12.27 %, which is comparable to that of 10.25% in Pathan and Skully (2010) and to that of 9.63% in Andershon and Fraser (2000). Our CEO ownership sample mean is 6.08% which is consistent to that reported (4.41%) by Pathan and Skully (2010). Our sample mean of the number of board committees is 3.32, which is consistent to that found (4.9) by Adams and Mehran (2003). Lastly, the sample mean of the total outstanding number of business segment is 3.04, which is comparable to that of 2.6 in Coles et al. (2008).

In Panel B of Table 2 we present some descriptive statistics of control variables, namely E/TA, FEES, EARN, Z-SCORE and VIX financial indicator. The sample mean of return on average equity, ROAE, in Panel C of Table 2 is 8.02% which is similar to the sample mean of 9.92% in Pathan and Faff (2013). Their sample mean (4.65%) of return on average assets, ROAA, is comparable to ours (1.96%). Moreover, our mean efficiency score for US investment banks is 0.65, which is similar to the sample mean of 0.66 in Radic et al. (2012).

Panel D shows an upward trend in the average percentage of independent members of the board over time, with a notable increase from 60% in 2003 to 69% in 2006. This increase is attributed to the independent board requirements imposed by SOX. Lastly, the mean of CEO ownership has been sharply reduced from 6.39% in 2007 to 2.84% in 2008.

4. Methodology

Four alternative proxies of performance are employed to examine the relationship between bank performance and corporate governance. These are return on average assets (ROAA) and

return on average equity (ROAE). ROAA is estimated as the net income before interest and taxes as a proportion of the average book value of total assets. ROAE is computed as net income after tax as a percentage of the average book value of total equity. These two financial ratios are standard in the literature as measures of banks' performance (Adams and Mehran, 2005; Pathan, 2009; Pathan and Faff, 2013). Moreover, we include pre-tax operating income (POI) as a percentage of the average total assets. Lastly, we also employ the parametric method of stochastic frontier analysis (SFA) to obtain profit efficiency scores as another proxy of investment banks performance (EFF).[10]

Given the literature discussion, we opt the following fixed effect regression model in order to test our hypotheses:

$$(Perform)_{i,t} = \left[a_0 + a_1(PSOX)_t + a_2(CRS)_t + \beta_j \sum_{j=1}^{n}(Corpor - Governance)_{i,t} + \gamma_j \sum_{j=1}^{1}(Control)_{i,t} + e_{i,t}\right] \quad (1),$$

where i signifies individual investment bank (i = 1,2,...,23) and t is the period that we cover (t = 2000,2001,. . . ,2012). α, β, γ are parameters to be estimated. $e_{i,t}$ is the error term. PSOX is a dummy variable which takes the value of 0 in the post SOX period (2000-2001) and 1 otherwise. CRS is a crisis dummy that takes the value of 1 if year is 2007-2010, and 0 otherwise. Corpor- Governance consists of five different dimensions of corporate governance variables 1) board size, board composition and gender diversity 2) CEO 'internally' hired, CEO duality, CEO age and CEO tenure 3) Cash and equity compensation of TMT and CEO 4) CEO/board ownership and CEO/TMT bonus as a percentage of total cash compensation and 5) number of business segments, number of subsidiaries, number of board committees, fees paid for the attendance of members in board committees and number of audit committee meetings. Perform is the dependent variable of the model and stands for the performance of investment banks estimated by ROAA , ROAE, POI and EFF. Control comprises a number of bank-specific and country level determinants.[11]

We also employ the two-step 'system' GMM estimator (Arrelano and Bover 1995; Blundell and Bond, 1998). [12] This two-step estimates of standard errors are likely to be downward biased (Blundell and Bond, 1998) and hence we follow a finite sample correction introduced

[10] For a formal explanation of the stochastic frontier analysis (SFA) see Appendix.
[11] For estimations that we employ EFF as a measure of bank performance ,we exclude from the regression models FEES and EARN control variables so as to avoid multicollinearity bias. For a formal exposition of the stochastic frontier analysis (SFA) see Appendix.
[12] For the GMM estimation we use Roodman (2006) "xtabond 2" specification in Stata.

by Windmeijer (2005). The estimates of the two-step system estimates are also tested via Hansen's diagnostic test for instrument validity and the test for second-order autocorrelation of error terms introduced by Arellano and Bond (1991). This model includes as independent variable one lag of performance and hence equation (1) takes the following transformation:

$$(Perform)_{i,t} = \left[a_0 + \varphi(Perform)_{i,t-1} + a_1(PSOX)_t + a_2(CRS)_t + \beta_j \sum_{j=1}^{n}(Corpor - Govern)_{i,t} + \gamma_j \sum_{j=1}^{1}(Control)_{i,t} + e_{i,t}\right] \quad (2)$$

5. Empirical Results

5.1. Panel Fixed Effect Models

Table 3 presents the results of the panel fixed effect analysis, where bank performance is a function of bank-specific and country-level variables.

[INSERT TABLE 3 ABOUT HERE]

With regard to the board size, we find a negative impact on performance at the 5% (Table 3, Model 1) and at the 10% level of significance (Table 3, Model 4). This result supports *'agency cost hypothesis'* by Jensen and Meckling (1976) suggesting that an increase in the members of the board could result in higher information asymmetry and communication costs. The effect of board size on investment bank performance remains negative (Table 3, Model 2 and 3) where ROAA and POI are employed as performance measures, but the coefficients are not statistically significant from zero. Regarding the board composition, we find that there is positive relationship between board independence and performance. The result is statistically significant at the 5% level (Table 3, Model 1, 3 and 4). The positive impact of board independence on bank performance is consistent with the *'agency cost hypothesis'* by Jensen and Meckling (1976) and previous studies (Anderson and Reed, 2004; Busta, 2007; Andres and Vallelado, 2008; Tanna et al., 2011) and shows that independent directors could minimize managerial entrenchment risk through their expertise and objectivity in the decision making process. We also find a negative relationship between gender diversity in the boardroom and bank performance at the 5% level of significance (Table 3, Model 4). This result is consistent with the study of Shrader et al. (1997) and implies that as female board members increase they reduce the opportunity of the inclusion of more skillful male directors.

Concerning the CEO power, we find CEO duality to have a positive impact on performance at the 5% level of significance (Table 3, Models 5,6,7 and 8). This finding confirms the *'stewardship hypothesis'* (Donaldson,1990; Barney, 1990) and suggests that the CEO who

chairs the board would act as a good agent of the firm and would offer unity of direction and strong control resulting in the improvement of firm performance. Our finding is consistent with a number of previous studies (Donaldson and Davis, 1991; Boyd, 1995; Brickley et al., 1997; He and Wang, 2009). Moreover, the fixed effect specifications reveal no robust empirical evidence between the association of the 'internally' hired CEO and performance. Also, we find some evidence of negative relationship between CEO tenure and bank performance at the 10% level of significance (Table 3, Model 6), as in the study of Haleblian and Finkelstein (1993). Finally, we also find that there is a negative effect of CEO age on bank efficiency at the 10% significance level (Table 3, Model 8).

[INSERT TABLE 4 ABOUT HERE]

Concerning the impact of CEO and TMT compensation on performance, the results show some variation depending on the different kinds of compensation, i.e., cash or equity-based compensation. We find that cash TMT compensation has a negative impact on bank performance (at the 1% level, Table 4 Model 1 and 3) while equity compensation exerts a positive impact on performance (at the 10% level, Table 4 Model 2). These findings are not surprising since cash compensation does not create sufficient incentives to executives to increase corporate value while equity compensation constitutes long-term pay and could align better incentives between executives and shareholders (Jensen and Murphy, 1998). Similarly, the CEO equity compensation has a positive impact on bank performance at the 5% significant level (Table 4, Model 4) as in the previous studies of Harris and Raviv (1979) and Grossman and Hart (1983). In contrast to TMT's findings, the CEO cash compensation asserts a positive relationship between pay and performance (at the 5% level of significance, Table 4 Model 1 and 3).

With reference to the CEO ownership, we find that there is a positive impact of the latter on bank performance at the 10% level (Table 4, Model 5 and 8) and the 5% (Table 4, Model 6 and 7) level of significance. Our findings support the idea that the partial ownership of CEO reduces the agency costs and aligns better shareholders' and managers' incentives resulting in a positive impact on bank performance (Murphy, 1999). On the contrary, we find that board ownership decreases bank performance (at the 1% level, Table 4 Model 5, at the 10% level, Table 4 Models 6 and 7 and at the 5% level, Table 4, Model 8). In similar lines, Beltratti and Stulz (2012) and Laeven and Levine (2009) find that banks with boards that hold higher ownership perform worse compare to banks with lower board ownership.

Beltratti and Stulz (2012) claim that board members with higher ownership position banks in a way that maximize shareholder value. However, this might have the adverse results as banks are exposed to high risk that could impact negatively on their performance. Moreover, we find that the TMT's bonus as a percentage of total cash compensation has a positive impact at the 1% (Table 4, Model 5) and the 5% significance level (Table 4, Model 6) on performance. This result is comparable with that of Fahlenbrach and Stulz (2011) as they find that banks that pay higher cash bonuses as a proportion of total compensation to their executives perform better that those that pay lower level of bonuses over total compensation during the period of financial crisis.

[INSERT TABLE 5 ABOUT HERE]

Regarding the operational complexity, we find that an increase in the number of subsidiaries reduces the performance (at the 1% level of significance, Table 5 Model 1). This implies that banks that have high operational complexity operate less efficiently as co-ordination problems between specialists rise which correspondingly increase communication costs of the bank (Lawrence and Lorch, 1967, Adams and Mehran). The fixed effect specifications reveal that there is a clear negative relationship between the number of standing board committees and bank performance (at the 5% level of significance, Table 5, Models 1,2 and 4). This implies that although an increase in the amount of task' delegation from board to committees might reduce the time and effort that boards devote as a group of directors, this could very likely rise the amount of the resources that the board should divert for the supervision of the increased number of outstanding committees (Vafeas, 1999). Lastly, we find that fees paid to the board committees are negatively associated to performance at the 5% (Table 5, Model 1 and 2) and 1% level of significance (Table 5 Model 3).

Turning to the rest of the bank-specific variables, we find that equity over total assets has negative impact on the performance at the 5% (Table 3 Model 1, 3 and 5; Table 4 Model 3,5 and 6; Table 5 Model 3) and the 10% (Table 4 Model 7 and 8; Table 5 Model 4). Our finding is consistent with the *'agency cost hypothesis'* by Jensen and Meckling (1976) which suggests than higher leverage (lower equity over total assets ratio) has a positive impact on bank performance. The reason being that higher leverage mitigate the agency costs from the outside equity that arise from the choice of investment (Myers, 1977), the risk of bank liquidation (Harris and Raviv, 1990) and the undertaken risk (Jensen and Meckling, 1976). We also find that an increase of investment banking fees as a percentage of total assets has a

positive impact on performance at the 10% (Table 5, Model 1) level of significance. Fees constitute the main source of income for investment banks, hence an increase of net income improve bank profitability (Beccalli, 2007; Micco et al., 2007; Lin and Yzhang, 2009). In addition, we find evidence that there is negative relationship between other earning assets over total assets ratio and investment bank performance at the 5% (Table 3 Model 1 and 3; Table 4 Model 3; Table 5 Model 1 and 3) and 10% (Table 3 Model 5; Table 4 Model 1,6 and 7) level of significance. The negative coefficient suggests that activities such as trading securities may induce higher risk of bank losses (Demirguc-Kunt and Huizinga, 2010). Lastly, we find that risk, proxied as z-score, shows that a decrease in risk has a strong positive effect on bank performance at the 1% significance level (Table 3, Model 2,3,6 and 7; Table 4, Model 2,3 and 5; Table 5, Model 2 and 3). This result lends support to the *'bad luck hypothesis'*, suggesting that there exists a negative relationship between risk and performance (see Berger and De-Young, 1997).[13]

We also find a strong negative effect of the VIX indicator on the performance, signifying that higher market volatility decreases performance which is consistent with previous studies (Boorke 1989; Miller and Noulas, 1997). Also, as it is expected, there is a negative impact of the financial crisis on investment bank performance (Pathan and Faff, 2013). Lastly, we find a strong negative impact of the PSOX period on performance, indicating that more board independency reduces the level of meeting attendance of the independent board members (Adams and Ferreira, 2011), resulting in the increase of the free-riding problems that large banks suffer from (Jensen, 1993).

5.2 Dynamic Panel Analysis

Tables 6,7 and 8 present the results of the dynamic panel analysis. The appropriateness of the two-step 'system' GMM estimator is held by the significant lag performance variable in all the corresponding models of Tables 6,7 and 8. Moreover, regarding basic diagnostics the test (AR(2)) for second-order autocorrelation in second differences and the Hansen J-statistics of over-identifying restrictions is insignificant (Tables 6,7 and 8).

[INSERT TABLE 6 ABOUT HERE]

[13] The reasoning being that if an unexpected event increases the risk of a bank, the bank would start to spend more resources in risk-monitoring operations (Berger and De-Young, 1997).

With regard to the board size our results further support the *'agency cost hypothesis'* by Jensen and Meckling (1976) and lends evidence for our fixed effect estimations. We find a strong negative impact of the board size on bank performance. The result remains robust at the 1% level (Table 6, Models 2 and 3) and at the 1% (Table 6, Models 4 and 4) level of significance. In similar lines with fixed effect specifications, we find that CEO duality has a positive impact on bank performance at the 5% (Table 6 Model 5) and 10% significance level (Table 6 Model 8) which is consistent with the '*stewardship hypothesis'* (Donaldson,1990; Barney, 1990). Although there is robust evidence to support that CEO duality has positive impact on bank performance, there is no empirical study to examine this relationship between the 'internally' hired CEO and bank performance. Our results show that there exists positive relationship between 'internally' hired CEO and bank performance (at the 1% level, Table 6 Model 6; at the 5%, Table 6 Model 5 and 7).

[INSERT TABLE 7 ABOUT HERE]

Turning to the compensation-based variables, our results further support our fixed effect specification. We find a negative impact of cash-based compensation of TMT on bank performance at the 10% level of significance (Table7 Model 1 and 2). Moreover, there exists a positive impact of equity compensation of TMT on bank performance at the 1% level of significance (Table 7, Model 2). As in previous section (5.1), we find that CEO cash compensation asserts a positive effect on investment bank performance at the 1% level of significance (Table 7, Model 1 and 3). Lastly, our results show that the equity-based compensation has a positive impact on bank performance. The result remain robust at the 5% (Table 7 Model 1 and 2) and 10% (Table 7 Model 4) significance level.

We also find that board ownership asserts a negative impact on bank performance at the 1% (Table 7 Model 5 and 6) and 5% (Table 7 Model 7). In similar lines with fixed effect specifications, CEO ownership has a positive impact on performance at the 5% (Table 7 Model 5) and 10% (Table 7 Model 7 and 8) significance level. Also, we find further evidence for the positive impact of CEO and TMT bonus as a percentage of total cash compensation on bank performance.

[INSERT TABLE 8 ABOUT HERE]

The dynamic panel estimations lend further support on the negative impact of operational complexity on bank performance. We find that both an increase of the number of different business segments and the total outstanding number of subsidiaries reduces bank

performance. The results are robust at the 1% (Table 8, Model 2 and 3) and 5% (Table 8, Model 2) level of significance respectively. Also, we find additional evidence that an increase of the number of committees reduces performance at the 10% (Table 8, Model 1,2 and 4) and 5% (Table 8, Model 3) significance level.

In terms of the rest of the bank-specific determinants, we find that an increase in leverage (decrease in the equity over total assets ratio) has a positive impact on performance. Consistent with fixed effect specifications, we find a positive impact of investment banking fees over total assets ratio on bank performance. Also, as in the previous section (5.1), the risk asserts a negative impact on bank performance which is consistent with the *'bad luck hypothesis'* by Berger and De-Young (1997). The dynamic panel analysis provides additional evidence of the negative and significant impact of other earning assets over total assets ratio on performance. We also find that the VIX indicator has a negative effect on bank performance. Lastly, we observe that both the financial crisis and PSOX period has a negative impact on investment bank performance.

5.3 Dynamic Threshold Analysis

In this section, we opt for the dynamic threshold methodology (Kremer et al., 2011) and investigate regime changes of important corporate governance variables with respect to investment bank performance. [14] We employ this econometric technique for two of the key variables of our previous (5.1 & 5.2) analysis. These are the board size and board ownership that we find them to be negatively associated to the US investment bank performance.

A study by Yemack et al. (1996) shows that there is a trade-off between advantages and disadvantages of large boards. On the one hand, large boards increase the monitoring and the expertise to deal with problems of the specific-firm environment. On the other hand, large boards decrease the control and the effective communication between the board members. Based on the above arguments, we believe that is essential to investigate regime changes of the board size effect on investment bank performance.

Furthermore, agency theory underlies that an increase of the board ownership better aligns incentives between the managers and shareholders (Jensen and Meckling, 1976; Eisenhardt, 1989; Murphy, 1999). Hence, boards that hold higher ownership are more likely to take decisions to increase the corporate value. However, our findings in the fixed and dynamic

[14] For a formal explanation of the dynamic threshold methodology see Appendix.

panel estimations indicate that an increase of board ownership decreases bank performance, as in Beltrazzi and Stulz (2011). To this end, the threshold analysis enable us to investigate, if and at which level, the board ownership asserts a positive impact on investment bank performance.

[INSERT TABLE 9 ABOUT HERE]

Our analysis finds a threshold value of the board size around ten.[15] This threshold value splits the sample into two regimes. The low regime with banks that have board size lower than ten members and the high regime with banks of more than ten members in their boards. The results indicate that there is a highly negative impact at the 1% level of the board size on investment bank performance for the high regime banks, as λ_2=-1.3778 (see Table 9). This finding is consistent with the *'agency cost hypothesis'* by Jensen and Meckling (1976). Moreover, the threshold value indicates that the board size of the investment banks should be less than ten members which is similar to the argument of Lipton and Lorsch (1992) that suggest the restraining of the membership of boards to ten people, with a desired size of eight or nine members. Regarding the impact of the board size on bank performance for the low regime banks, we still find a negative coefficient but the result is not statistically significant.

[INSERT TABLE 10 ABOUT HERE]

Moreover, Table 10 shows that the percentage of banks with large boards constantly increases and reaches the highest level (53%) in 2007. This implies that the majority of US investment banks underperformed with an increase of their board size above the threshold value of 10 board members. After the burst of the financial crisis, we observe a sharp decrease (27%) of the proportion of investment banks that had large boards indicating the need of these financial institutions to decrease agency costs from the high information asymmetry that large boards caused in the period of the financial turmoil.

[INSERT TABLE 11 ABOUT HERE]

Regarding the board ownership threshold analysis, we find a threshold value of 8.54312%. This value splits the sample into investment banks with boards that hold higher ownership (high regime) and those with boards that hold lower ownership (low regime). We find that for the banks in the low regime, an increase in the board ownership has a negative impact on performance at the 1% significance level (λ_1=-0.026). This result is similar to that of our

[15] We use the natural logarithm of the board size to perform our estimation. The threshold value that is equal to 10 members (exponential value of 2.30259)

fixed effect and dynamic panel estimations. However, it further reveals that the negative impact of board ownership refers only to banks that have lower levels of board ownership, that is below the threshold value. Turning to the high regime, which denotes banks of higher board ownership level, we find that there is a positive relationship between the board ownership and performance at the 5% level of significance (λ_2=0.116). This result is confirmed by the agency theory (Jensen and Meckling, 1976; Eisenhardt,1989) and a number of previous studies that indicate a positive impact of the managerial ownership on firm performance (Kosnik, 1990; Malatesta et al., 1988; Pi and Timme,1993).

[INSERT TABLE 12 ABOUT HERE]

Lastly, Table 12 shows that there is a constant increase over time in the percentage of banks that belong to the low regime which include banks with boards that hold lower levels of ownership. In the 2005-2007 period, we also observe that the majority of investment banks is classified in the high regime, indicating that during the financial crisis period investment banks opt to have high level of board ownership.

6. Conclusion

We find that there is a negative relationship between board size and performance. The threshold analysis reveals that this negative impact is enhanced when board size increases above the critical value of ten board members. This implies that above a threshold value the rising costs of monitoring and communication deteriorates the performance of investment banks, consistent with the *'agency cost hypothesis'* (Jensen, 1993). Adams and Mehran (2008) and Andres and Vallelado (2008) show that the impact of the board size on the performance of bank holding companies and commercial banks is found to be positive. Hence, investment banks appear to react differently compare to other banks with respect to the impact of board size on performance. Threshold analysis reveals that as a response to the 2007 crisis most of investment banks scaled down their boards aiming to reduce agency conflicts that banks with large boards suffer from. Also, we find evidence that the CEO power exerts a positive impact on bank performance which is consistent with the *'stewardship hypothesis'* (Donaldson, 1990; Barney, 1990). This indicates that investment banks perform better when the CEO chairs the board or has a long-term relationship with the bank. Thus, investment banks could benefit from of the unity of control that the powerful CEO would offer. Our result sheds new light and provide an alternative view to Mishra and Nielsen (2000) who argue that the CEO power could have a negative impact on the performance of commercial banks. We also find

evidence of a negative association between operational complexity and performance. With regards to the ownership held by the board we find, similarly to Beltratti and Stulz (2012), that it has a negative impact on performance, predominantly present in banks with board ownership below a threshold value. On the contrary, the impact of board ownership, above a threshold value, on investment bank performance turns to positive.

Our results, also in the light of the financial crisis, are of importance in particular for policy makers and market participants alike. In response to the severe financial crisis, regulators in US passed the Dodd-Frank Act (2010), a major financial reform that have a significant impact on corporate governance along other aspects of financial markets. Future regulatory mandates could look at the present evidence where investment bank performance rises with CEOs' power and boards' ownership above a threshold value. On the contrary, investment bank performance drops for boards with more than ten members and when there exists high level of operational complexity.

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Table 1. Definitions of variables used in the fixed effect and dynamic panel estimations.

Variables	Measures
Corporate governance (explanatory variables)	
Board size (BS)	The number of members in the board (we use the natural logarithm in the fixed effect and dynamic panel estimations)
Board composition % (IND)	The percentage of independent directors
Gender diversity(GD)	The percentage of female directors
CEO 'internally' hired (CEOIN)	A dummy that takes the value of 1 if the CEO is the founder or has a long term relationship with the bank, and 0 otherwise
CEO duality (CEODUAL)	A dummy that takes the value of 1 if the CEO chairs the board as well, and 0 otherwise
CEO tenure (CEOTEN)	The number of years that the CEO has served in the position (we use the natural logarithm in the fixed and dynamic panel estimations)
CEO age (CEOAGE)	The age of the CEO (we use the natural logarithm, in the fixed and dynamic panel estimations)
Executives' Compensation (bonus &base salary) (EXECASH)	The cash compensation of the top management team which includes base salary and bonus (we use the natural logarithm in the fixed and dynamic panel estimations)
Executives' Compensation (equity) (EXEEQ)	The equity compensation of the top management team which includes restricted stock and stock options (we use the natural logarithm in the fixed and dynamic panel estimations)
CEO Compensation (bonus &base salary) (CEOCASH)	The cash compensation of the CEO which includes base salary and bonus (we use the natural logarithm in the fixed and dynamic panel estimations)
CEO Compensation (equity) (CEOEQ)	The equity compensation of the CEO which includes restricted stock and stock options (we use the natural logarithm in the fixed and dynamic panel)
Executives' bonus incentive(EXEBON)	The ratio of bonus over executives' total cash compensation
CEO's bonus incentive (CEOBON)	The ratio of bonus over CEOs' total cash compensation
Board ownership % (BOARDOWN)	The percentage shares that the directors hold
CEO ownership % (CEOOWN)	The percentage shares that the CEO holds
Number of board committees (NBCOM)	The number of board committees (we use the natural logarithm in the fixed and dynamic panel estimations)
Fees paid for board meetings (FBCOM)	Fees paid to directors for attending the board committees (we use the natural logarithm in the fixed and dynamic panel estimations)
Number of audit committee meetings(NMAUD)	Number of meetings of audit committee (we use the natural logarithm in the fixed and dynamic panel estimations)
Number of Segments (SEG)	Number of different business segments (we use the natural logarithm in the fixed and dynamic panel estimations)
Number of Subsidiaries (SUBS)	Number of subsidiaries (we use the natural logarithm in the fixed and dynamic panel estimations)
Performance measures (dependent variables)	
1. Return on average assets (ROAA)	The net income before interest and taxes as a proportion of the average book value of total assets.
2. Return on average equity (ROAE)	The net income after tax as a percentage of the average book value of total equity
3. Pre-tax operating income (POI)	The pre-tax operating income as a percentage of the average total assets
4. Profit efficiency (EFF)	Efficiency scores obtained from the SFA
Other control variables	
Equity over total assets (E/TA)	The ratio of equity over total asset
Investment banking fees (FEES)	The ratio of net fees, commission and net trading income over total assets
Other earnings assets (EARN)	The ratio of trading securities, derivatives, treasury bills and bonds over total assets
Risk to default (RISK)	Z-score= (1+Average ROE)/Standard Deviation of ROE
Volatility Implied Index (VIX)	Chicago Board Options Exchange Volatility Index
Post Sarbanes-Oxley Act period (PSOX)	A dummy which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise.
Crisis period (CRS)	A dummy which takes the value of 1 if year is 2007-2010.

Table 2. Descriptive statistics of the variables employed in the fixed effect and dynamic panel regressions.

Variables	Mean	SD	MIN	MAX	Median
Panel A: Corporate governance variables					
BS	8.3	3.5	5	16	9
IND	0.66	0.25	0.4	0.92	0.71
GD	0.11	0.1	0	0.44	0.11
CEOIN	0.65	0.48	0	1	1
CEODUAL	0.72	0.49	0	1	1
CEOTEN	7.74	8.25	0	41	5
CEOAGE	55.35	8.18	39	72	56
BOARDOWN	12.27	15.43	0	67.21	6.68
CEOOWN	6.08	8.59	0.01	55.71	1.83
NBCOM	3.32	1.20	0	6	3
FBCOM	0.31	1.031	0	1,25	0
NMAUD	8.01	4.04	0	18	8
SEG	3.04	1.76	0	8	3
SUB	114.6	236.4	0	1255	15
EXECASH	16,500	20,700	0	139,000	7,897
EXEEQ	20,100	30,300	0	209,000	7,234
CEOCASH	4,303	6,063	0	41,200	1,950
CEOEQ	5,720	8,219	0	42,400	1,356
Panel B: Bank-specific and country level variables					
E/TA	0.2324	0.2456	0.0105	0.97	0.1022
FEES	0.4703	0.8905	0.0004	5.21	0.0676
EARN	0.6094	0.3765	0.0001	3.756	0.6638
RISK	3.0961	6.3524	-42.59	52.82	2.1066
VIX	20.97	7.5946	11.56	40	21.68
Panel C: Bank performance measures					
ROAE	8.02	29.77	-305.05	122.82	8.97
ROAA	1.96	11.73	-50.6	72.97	0.74
POI	3.32	14.99	-63.15	91.17	0.99
EFF	0.65	0.39	0.12	0.97	0.78

Panel D: Year by year corporate governance variables					
Year	**BS**	**IND**	**CEODUAL**	**CEOOWN**	**BOARDOWN**
2000	8.7	0.66	0.80	6.78	10.40
2001	8.2	0.65	0.92	5.68	9.75
2002	7.8	0.60	0.87	6.92	9.89
2003	7.4	0.60	0.80	6.91	11.11
2004	8.9	0.69	0.87	7.97	9.23
2005	8.5	0.68	0.81	7.45	9.64
2006	9.0	0.69	0.83	7.30	13.57
2007	8.5	0.66	0.82	6.39	14.20
2008	8.1	0.64	0.60	2.84	13.05
2009	8.4	0.66	0.59	7.35	14.84
2010	8.1	0.66	0.56	5.27	12.91
2011	8.0	0.66	0.47	4.08	14.57
2012	8.4	0.67	0.46	3.73	14.05

Notes: the Table reports the descriptive statistics of the variables employed in the fixed effect and dynamic panel regressions All the variables are in absolute values except the compensation determinants (EXECASH,EXEEQ,CEOCASH and CEOEQ) which are in million dollars. BS: the number of members in the board; IND: the percentage of independent directors; GD: the percentage of female directors; CEOIN: a dummy that takes the value of 1 if the CEO is the founder or has a long term relationship with the bank, and 0 otherwise; CEODUAL :a dummy that takes the value of 1 if the CEO chairs the board as well, and 0 otherwise; CEOTEN: the number of years that the CEO has served in the position; CEOAGE: the age of the CEO; BOARDOWN: the percentage shares that the directors hold; CEOOWN: the percentage shares that the CEO holds; NBCOM: the number of board committees; NMAUD: number of meetings of audit committee; FBCOM: fees paid to directors for attending the board committees; SEG: the number of different business segments; SUBS: Number of subsidiaries; EXECASH: the cash compensation of the top management team which includes base salary and bonus; EXEEQ: the equity compensation of the top management team which includes restricted stock and stock options; CEOCASH: the cash compensation of the CEO which includes base salary and bonus; CEOEQ: the equity compensation of the CEO which includes restricted stock and stock options; E/TA: equity over total assets; FEES: of net fees, commission and net trading income over total assets; EARN: ratio of trading securities, derivatives, treasury bills and bonds over total assets; RISK: Z-score= (1+AverageROE)/Standard Deviation of ROE; VIX: Volatility Implied Index (Chicago Board Options Exchange Volatility Index); ROAE: net income after tax as a percentage of the average book value of total equity; ROAA: net income before interest and taxes as a proportion of the average book value of total assets; POI: pre-tax operating income as a percentage of the average total assets; EFF: efficiency scores obtained from the SFA.

Table 3. Fixed effect panel regressions over the period 2000 to 2012 for US investment bank performance (board structure and CEO characteristics)

	Board Structure				CEO Characteristics			
VARIABLES	ROAE(1)	ROAA(2)	POI(3)	EFF(4)	ROAE(5)	ROAA(6)	POI(7)	EFF (8)
E/TA	-0.353**	-0.131	-0.613**	-0.374	-0.368**	-0.244	-0.346	-0.103
	(0.161)	(0.113)	(0.240)	(0.365)	(0.171)	(0.196)	(0.283)	(0.154)
EARN	-0.0183**	0.0167	-0.0370**	-	-0.0205*	0.0110	0.000483	-
	(0.00847)	(0.0165)	(0.0160)		(0.0103)	(0.0103)	(0.00435)	
FEES	-0.0132	-0.0252	0.00716	-	0.0120	-0.00809	0.00979	-
	(0.0171)	(0.0152)	(0.00861)		(0.0318)	(0.0105)	(0.0123)	
RISK	0.000997	0.00263***	0.0164***	0.000113	0.00213	0.00158***	0.00283***	0.000554
	(0.00199)	(0.000521)	(0.00496)	(0.00127)	(0.00240)	(0.000495)	(0.000497)	(0.00109)
PSOX	-0.0910***	-0.0307***	-0.0262*	-0.125***	-0.0374**	-0.0203*	-0.0149	-0.144***
	(0.0261)	(0.0109)	(0.0133)	(0.0346)	(0.0144)	(0.0108)	(0.0103)	(0.0431)
VIX	-0.00474***	-0.00209**	-0.00110**	-0.00447*	-0.00354**	-0.00151**	-0.000778	-0.00323
	(0.00120)	(0.000960)	(0.000518)	(0.00248)	(0.00165)	(0.000692)	(0.000685)	(0.00257)
CRS	-0.0605*	-0.0185*	-0.0262*	0.0868*	0.0464	0.0138	0.0107	0.0286
	(0.0313)	(0.0106)	(0.0128)	(0.0451)	(0.0356)	(0.00969)	(0.0148)	(0.0343)
BS	-0.0360**	-0.0205	-0.0238	-0.0548*	-	-		
	(0.0167)	(0.0193)	(0.0298)	(0.0290)			-	-
IND	0.141**	0.0251**	0.0238**	-0.0294	-	-		
	(0.0502)	(0.0109)	(0.0108)	(0.0214)			-	-
GD	0.0575	0.00110	-0.00240	-0.616**	-			
	(0.0373)	(0.0258)	(0.0174)	(0.236)		-	-	-
				(0.236)				
CEODUAL					0.0804**	0.0226**	0.0242**	0.219**
	-	-	-	-	(0.0373)	(0.0109)	(0.0126)	(0.0954)
CEOAGE					-0.0217	0.0205	0.0223	-0.0134*
	-	-	-	-	(0.0175)	(0.0326)	(0.0568)	(0.00773)
CEOTEN					-0.0217	-0.00807*	-0.00754	0.00191
	-	-	-	-	(0.0175)	(0.00409)	(0.00655)	(0.00520)
CEOIN	-	-	-	-	0.0205	0.00420	-0.0100	-0.00937
					(0.0517)	(0.00981)	(0.00822)	(0.185)
	(0.161)	(0.0628)	(0.0790)	(0.309)	(0.587)	(0.140)	(0.318)	(0.354)
F-test	10.14***	7.85***	62.93***	39.64***	5.60***	9.21***	16.34***	2.48*
Observations	203	203	203	203	203	203	203	203
R-squared	0.236	0.286	0.410	0.193	0.204	0.237	0.352	0.171
Number of banks	23	23	23	23	23	23	23	23

Notes: the Table reports the regression results based on a fixed effect model over the period 2000 to 2012. The dependent variable is the performance of investment banks 1) ROAE: net income after tax as a percentage of the average book value of total equity; 2)ROAA: net income before interest and taxes as a proportion of the average book value of total assets; 3)POI: pre-tax operating income as a percentage of the average total assets; 4)EFF: efficiency scores obtained from the SFA. As independent variables we employ BS: the number of members in the board; IND: the percentage of independent directors; GD: the percentage of female directors; CEOIN: a dummy that takes the value of 1 if the CEO is the founder or has a long term relationship with the bank, and 0 otherwise; CEODUAL :a dummy that takes the value of 1 if the CEO chairs the board as well, and 0 otherwise; CEOTEN: the number of years that the CEO has served in the position; CEOAGE: the age of the CEO; E/TA: equity over total assets; FEES: of net fees, commission and net trading income over total assets; EARN: ratio of trading securities, derivatives, treasury bills and bonds over total assets; RISK: Z-score= (1+AverageROE)/Standard Deviation of ROE; PSOX: dummy which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise; CRS: a dummy which takes the value of 1 if year is 2007-2010; VIX: Volatility Implied Index (Chicago Board Options Exchange Volatility Index). For Volatility Implied Index data (VIX-Chicago Board Options Exchange Volatility Index) we use Bloomberg database. To avoid collinearity problems with the selected variables, we first analyze correlations of all the selected variables. We check that there is not a high level of correlation between the variables used in the models. ***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 4. Fixed effect panel regressions over the period 2000 to 2012 for US investment bank performance (compensation and ownership)

	Compensation				Ownership			
VARIABLES	ROAE(1)	ROAA(2)	POI(3)	EFF(4)	ROAE(5)	ROAA(6)	POI(7)	EFF(8)
E/TA	-0.338	-0.121	-0.521**	-0.308	-1.008**	-0.580**	-0.357*	-0.322*
	(0.536)	(0.133)	(0.208)	(0.206)	(0.363)	(0.246)	(0.183)	(0.161)
EARN	-0.0178*	-0.00262	-0.00947**	-	-0.0151	-0.0210*	-0.0155*	
	(0.00885)	(0.00340)	(0.00445)		(0.0213)	(0.0104)	(0.00808)	
FEES	-0.0136	0.00509	0.00747	-	0.0108	0.0155	0.000524	
	(0.0217)	(0.00863)	(0.00925)		(0.0354)	(0.0114)	(0.00758)	
RISK	0.00210	0.00310***	0.0183***	0.000635	0.0860***	0.0134*	-0.0146	-0.000121
	(0.00219)	(0.000644)	(0.00478)	(0.00130)	(0.0271)	(0.00668)	(0.00858)	(0.00124)
PSOX	-0.0700**	-0.0224*	-0.0236	-0.177***	0.00134	-0.00273***	-0.00163***	-0.00500
	(0.0301)	(0.0127)	(0.0175)	(0.0389)	(0.00193)	(0.000418)	(0.000464)	(0.00329)
VIX	-0.00238*	-0.00128*	-0.000620	-0.00235	-0.00299*	-0.000470	-0.00142*	0.0642*
	(0.00117)	(0.000659)	(0.000692)	(0.00228)	(0.00173)	(0.000552)	(0.000774)	(0.0369)
CRS	0.0223	-0.00121	0.0116	0.0400	-0.0541**	0.0130	-0.0208*	0.0421
	(0.0293)	(0.0186)	(0.0124)	(0.0352)	(0.0240)	(0.00929)	(0.0109)	(0.0329)
EXECASH	-0.0389***	-0.00241	-0.00504***	0.0012	-	-	-	-
	(0.0109)	(0.00495)	(0.00156)	(0.0012)				
EXEEQ	0.00483	0.00169*	-7.27e-05	-0.00965	-	-	-	-
	(0.00341)	(0.000953)	(0.000645)	(0.00691)				
CEOCASH	0.0197**	0.00282	0.00957**	0.00951	-	-	-	-
	(0.00849)	(0.00634)	(0.00364)	(0.0134)				
CEOEQ	-0.00287	-0.000778	-0.000555	0.00301**	-	-	-	
	(0.00250)	(0.000386)	(0.000355)	(0.00148)				-
BOARDOWN	-	-	-	-	-0.00160***	-0.000923*	-0.00133*	-0.00597**
					(0.000516)	(0.000505)	(0.000650)	(0.00289)
CEOOWN	-	-	-	-	0.00340*	0.00206**	0.00164**	0.00689**
					(0.00170)	(0.000802)	(0.000608)	(0.00340)
EXEBON	-	-	-	-	0.00680***	0.000700**	0.000382	0.00565
					(0.00101)	(0.000308)	(0.000267)	(0.00435)
CEOBON	-	-	-	-	0.00122	-6.61e-05	-8.72e-05	-0.000482
					(0.000174)	(4.71e-05)	(4.21e-05)	(0.000374)
Constant	-0.453*	0.0240	-0.218***	0.854***	0.211***	0.0257	0.0490*	0.866***
	(0.247)	(0.243)	(0.0709)	(0.135)	(0.0538)	(0.0164)	(0.0243)	(0.111)
F-test	17.98***	5.79***	3.71***	3.93***	27.61***	6.87***	18.07***	3.73***
Observations	203	203	203	203	203	203	203	203
R-squared	0.301	0.262	0.395	0.105	0.350	0.404	0.263	0.144
Number of banks	23	23	23	23	23	23	23	23

Notes: the Table reports the regression results based on a fixed effect model over the period 2000 to 2012. The dependent variable is the performance of investment banks 1) ROAE: net income after tax as a percentage of the average book value of total equity; 2)ROAA: net income before interest and taxes as a proportion of the average book value of total assets; 3)POI: pre-tax operating income as a percentage of the average total assets; 4)EFF: efficiency scores obtained from the SFA. As independent variables we employ EXECASH: the cash compensation of the top management team which includes base salary and bonus; EXEEQ: the equity compensation of the top management team which includes restricted stock and stock options; CEOCASH: the cash compensation of the CEO which includes base salary and bonus; CEOEQ: the equity compensation of the CEO which includes restricted stock and stock options; BOARDOWN: the percentage shares that the directors hold; CEOOWN: the percentage shares that the CEO holds; EXEBON: bonus over executives' total cash compensation; CEOBON: bonus over CEOs' total cash compensation; E/TA: equity over total assets; FEES: of net fees, commission and net trading income over total assets; EARN: ratio of trading securities, derivatives, treasury bills and bonds over total assets; RISK: Z-score= (1+AverageROE)/Standard Deviation of ROE; PSOX: dummy which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise; CRS: a dummy which takes the value of 1 if year is 2007-2010; VIX: Volatility Implied Index (Chicago Board Options Exchange Volatility Index). For Volatility Implied Index data (VIX-Chicago Board Options Exchange Volatility Index) we use Bloomberg database. To avoid collinearity problems with the selected variables, we first analyse correlations of all the selected variables. We check that there is not a high level of correlation between the variables used in the models. ***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 5. Fixed effect panel regressions over the period 2000 to 2012 for US investment bank performance (governance complexity)

	Governance Complexity			
VARIABLES	ROAE(1)	ROAA(2)	POI(3)	EFF(4)
E/TA	-0.718	-0.150	-0.7454**	-0.322*
	(0.519)	(0.125)	(0.3360)	(0.161)
EARN	-0.0280**	0.0154	-0.04130**	
	(0.0129)	(0.0149)	(0.0178)	-
FEES	0.0629*	-0.0165	-0.0585	-
	(0.0335)	(0.0136)	(0.0991)	
RISK	0.00152	0.00303***	0.0017***	-0.000121
	(0.00207)	(0.000581)	(0.0045)	(0.00124)
VIX	-0.00508***	-0.00197*	-0.00987*	-0.00500
	(0.00118)	(0.000959)	(0.00528)	(0.00329)
CRS	-0.0686**	0.0175	-0.3128**	-0.0642*
	(0.0322)	(0.0112)	(0.1404)	(0.0369)
PSOX	-0.0698***	-0.0263***	-0.2084**	-0.123**
	(0.0206)	(0.00821)	(0.0865)	(0.0460)
NBCOM	-0.0194**	-0.0262**	0.0473	-0.240**
	(0.00859)	(0.0123)	(0.0807)	(0.115)
NMAUD	0.00103	0.00320	-0.00592	-0.0292
	(0.00358)	(0.00324)	(0.0108)	(0.0390)
FBCOM	-0.029**	-0.0401**	-0.04797***	0.0347
	(0.0104)	(0.0181)	(0.0108)	(0.0430)
SEG	0.0162	-0.0172	-0.0131	0.00761
	(0.0211)	(0.0279)	(0.0157)	(0.0905)
SUB	-0.00217***	-0.00280	-0.00265	0.0130
	(0.00062)	(0.00282)	(0.00293)	(0.0140)
Constant	0.0257	0.139**	0.137	1.201***
	(0.0164)	(0.0658)	(0143)	(0.179)
F-test	17.30***	14.98***	6.70***	5.37***
Observations	203	203	203	203
R-squared	0.404	0.334	0.472	0.185
Number of banks	23	23	23	23

Notes: the Table reports the regression results based on a fixed effect model over the period 2000 to 2012. The dependent variable is the performance of investment banks 1) ROAE: net income after tax as a percentage of the average book value of total equity; 2)ROAA: net income before interest and taxes as a proportion of the average book value of total assets; 3)POI: pre-tax operating income as a percentage of the average total assets; 4)EFF: efficiency scores obtained from the SFA. As independent variables we employ NBCOM: the number of board committees; NMAUD: number of meetings of audit committee; FBCOM: fees paid to directors for attending the board committees; SEG: the number of different business segments; SUBS: Number of subsidiaries; E/TA: equity over total assets; FEES: of net fees, commission and net trading income over total assets; EARN: ratio of trading securities, derivatives, treasury bills and bonds over total assets; RISK: Z-score= (1+AverageROE)/Standard Deviation of ROE; PSOX: dummy which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise; CRS: a dummy which takes the value of 1 if year is 2007-2010; VIX: Volatility Implied Index (Chicago Board Options Exchange Volatility Index). For Volatility Implied Index data (VIX-Chicago Board Options Exchange Volatility Index) we use Bloomberg database. To avoid collinearity problems with the selected variables, we first analyse correlations of all the selected variables. We check that there is not a high level of correlation between the variables used in the models. ***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 6. Dynamic panel regressions over the period 2000 to 2012 for US investment bank performance (board structure and CEO characteristics)

	Board Structure				CEO Characteristics			
VARIABLES	ROAE(1)	ROAA(2)	POI(3)	EFF(4)	ROAE(5)	ROAA(6)	POI(7)	EFF(8)
Lag performance	0.3539**	0.3405**	0.3612***	0.986***	0.2088**	0.1874**	0.4721**	0.976***
	(0.1426)	(0.1664)	(0.1207)	(0.142)	(0.0906)	(0.087)	(0.1974)	(0.178)
E/TA	0.3842	-0.5491**	-0.1291	-0.00016	-1.412***	-0.5543**	-0.6541**	0.00143
	(0.4728)	(0.2332)	(0.0916)	(0.00052)	(0.268)	(0.2681)	(0.2962)	(0.00119)
EARN	-0.0312	-0.0595***	0.0470	-	0.0319	-0.0317**	-0.0115	
	(0.0406)	(0.0205)	(0.0387)		(0.0420)	(0.0178)	(0.0207)	-
FEES	-0.0515	0.0240	0.0611**	-	0.5491***	0.3566	-0.0019	
	(0.0674)	(0.0486)	(0.0287)		(0.131)	(0.297)	(0.0415)	-
RISK	0.0007	-0.0007	0.0024	-3.15e-06	-0.0003	0.0004	0.0056	
	(0.0097)	(0.004)	(0.0037)	(9.49e-06)	(0.0047)	(0.0034)	(0.0035)	0.0005
PSOX	-0.0959**	-0.0397***	0.0398	0.00016	-0.0564***	-0.0981***	-0.0460	(0.0013)
	(0.0477)	(0.0151)	(0.0347)	(0.0001)	(0.0161)	(0.0272)	0.0750	-0.000135**
VIX	-0.0079**	-0.0043***	-0.0066**	-0.0000*	-0.0063**	-0.0067**	8.38e-06	(0.00059)
	(0.0031)	(0.0011)	0.0033	(9.77e-06)	(0.0027)	(0.0032)	(0.00590)	-0.00008*
CRS	-0.0906*	-0.0647**	-0.0942*	-0.0001**	0.0320	0.0431	-0.1286***	(0.00004)
	(0.0498)	(0.0329)	(0.0562)	(0.00005)	(0.0136)	(0.3281)	(0.0429)	0.00092
BS	0.01922	-0.0316***	-0.5018***	-0.00017*	-	-	-	-
	(0.0351)	(0.0096)	(0.1815)	(0.0001)				
IND	0.2335	-0.0468	-0.2072	-0.00033	-	-	-	-
	(0.3347)	(0.1247)	(0.2235)	(0.00051)				
GD	0.1131	0.0031	0.0855	0.0000	-	-	-	-
	(0.7499)	(0.0513)	(0.3851)	(0.00006)				
CEODUAL		-	-	-	0.2512**	0.2218	0.0035	0.00573*
					(0.1165)	(0.7688)	(0.0918)	(0.00294)
CEOAGE					0.3077	-0.1195	-0.0342	0.00315
	-	-	-	-	(0.2703)	(0.3716)	(0.2737)	(0.0105)
CEOTEN					-0.1493	0.3609	-0.0030	0.00015
	-	-	-	-	(0.0705)	(0.3522)	(0.0267)	(0.00012)
CEOIN	-	-	-	-	0.3960**	0.1759***	0.183**	0.0012
					(0.1875)	(0.0635)	(0.079)	(0.0019)
Constant	-0.1441	0.3732***	1.195***	-0.0011	-0.1271	0.5608	0.2348	0.00749
	(0.3266)	(0.0830)	(0.3613)	(0.0007)	(1.465)	(1.545)	(1.141)	(0.0404)
Wald chi2	216.22***	94.41***	335.68***	479.25***	133478.85***	73.56***	68.30***	145.39***
AR(1) test stat	-2.10**	1.69*	-1.69*	-2.27**	-1.96*	2.03**	-1.72*	-2.18**
AR(2) test stat	0.95	0.35	-0.32	-0.15	0.26	0.63	-1.03	-0.23
Hansen J-stat	1	0.675	0.907	0.482	0.674	0.984	0.889	0.897
Instruments	23	23	23	23	23	23	23	23
Observations	184	184	184	184	184	184	184	184
Number of banks	23	23	23	23	23	23	23	23

Notes: the Table reports the dynamic panel regression results for the period 2000 to 2012. The dependent variable is the performance of investment banks 1) ROAE: net income after tax as a percentage of the average book value of total equity; 2)ROAA: net income before interest and taxes as a proportion of the average book value of total assets; 3)POI: pre-tax operating income as a percentage of the average total assets; 4)EFF: efficiency scores obtained from the SFA. As independent variables we employ BS: the number of members in the board; IND: the percentage of independent directors; GD: the percentage of female directors; CEOIN: a dummy that takes the value of 1 if the CEO is the founder or has a long term relationship with the bank, and 0 otherwise; CEODUAL :a dummy that takes the value of 1 if the CEO chairs the board as well, and 0 otherwise; CEOTEN: the number of years that the CEO has served in the position; CEOAGE: the age of the CEO; E/TA: equity over total assets; FEES: of net fees, commission and net trading income over total assets; EARN: ratio of trading securities, derivatives, treasury bills and bonds over total assets; RISK: Z-score= (1+AverageROE)/Standard Deviation of ROE; PSOX: dummy which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise; CRS: a dummy which takes the value of 1 if year is 2007-2010; VIX: Volatility Implied Index (Chicago Board Options Exchange Volatility Index). For Volatility Implied Index data (VIX-Chicago Board Options Exchange Volatility Index) we use Bloomberg database. To avoid collinearity problems with the selected variables, we first analyze correlations of all the selected variables.

Table 7. Dynamic panel regressions over the period 2000 to 2012 for US investment bank performance (compensation and ownership)

	Compensation				Ownership			
VARIABLES	ROAE(1)	ROAA(2)	POI(3)	EFF(4)	ROAE(5)	ROAA(6)	POI(7)	EFF(8)
Lag Performance	0.3789**	0.4266*	0.3098***	0..954***	0.2074*	0.4392***	0.2592**	0.972***
	(0.1919)	(0.2245)	(0.0779)	(0.153)	(0.1142)	(0.0955)	(.1090)	(0.148)
E/TA	-1.956***	-0.3703*	0.0988	0.0007	-0.0118	-0.1747***	-0.4124**	-0.000693*
	(0.750)	(0.2125)	(0.0607)	(0.0010)	(0.2461)	(0.0642)	(0.2001)	(0.000413)
EARN	-0.0377	-0.0117	-0.0555	-	-0.0446***	-0.0255****	-0.0616***	-
	(0.084)	(0.0242)	(0.0926)		(0.0169)	(0.0086)	(0.0138)	
FEES	-0.0225	0.0079	-0.0059	-	0.0554*	0.0262*	0.0924***	-
	(0.0505)	(0.0440)	(0.0200)		(0.0278)	(0.0152)	(0.0175)	
RISK	0.0102*	0.0023	0.0018	0.00078	0.0088	0.0028	-0.0041	0.00006
	(0.0058)	(0.00256)	(0.0014)	(0.0011)	(0.0117)	(0.0019)	(0.0119)	(0.0005)
PSOX	0.0296	-0.0455	-0.035**	0.00092	-0.0952	-0.0538	-0.1125	0.00011
	(0.0435)	(0.1178)	(0.015)	(0.0022)	(0.1036)	(0.0766)	(0.1306)	(0.0003)
VIX	-0.0045*	-0.0026	0.0010	0.00040	-0.0066	-0.0107***	-0.0122***	-0.0000***
	(0.0024)	(0.00225)	(0.0031)	(0.00027)	(0.0058)	(0.0025)	(0.0037)	(0.0000)
CRS	-0.1245**	0.0534	-0.064*	-0.00066***	-0.1408***	-0.1020***	0.0500	-0.0001***
	(0.0624)	(0.0543)	(0.0362)	(0.00002)	(0.0360)	(0.0313)	(0.1102)	(0.0000)
EXECASH	-0.0483*	-0.1121*	0.0215	-0.00016	-	-	-	-
	(0.0265)	(0.0629)	(0.07055)	(0.0003)				
EXEEQ	-0.01853	0.0072***	-0.0089	0.000278	-	-	-	-
	(0.0117)	(0.00270)	(0.0146)	(0.0005)				
CEOCASH	0.0282***	-0.0730	0.00618***	0.000145	-	-	-	-
	(0.0089)	(0.0750)	(0.00115)	(0.000178)				
CEOEQ	0.0069**	0.0117**	0.00238	0.000327*	-	-	-	
	(0.0031)	(0.0052)	(0.0029)	(0.000184)				-
BOARDOWN	-	-	-	-	-0.0092***	-0.0042***	-0.0081**	0.00002
					(0.0022)	(0.0014)	(0.0040)	(0.00003)
CEOOWN	-	-	-	-	0.0118**	0.0021	0.0100*	0.00005*
					(0.0055)	(.0021)	(0.0056)	(0.00003)
EXEBON	-	-	-	-	-0.0060	-0.0182	0.0464*	0.00001***
					(0.0331)	(0.0146)	(0.0277)	(0.0000)
CEOBON	-	-	-	-	-0.0053	0.0024	0.0132	0.00001**
					(0.0441)	(0.0096)	(0.0181)	(0.0000)
Constant	0.8893	0.2944	0.129	1.72***	0.2622	0.4694***	0.3653	-2.80***
	(0.6705)	(0.2165)	(0.796)	(0.335)	(0.3894)	(0.1559)	(0.3599)	(0.0981)
Wald chi2	324.86***	52.12***	424.60***	412.24***	464.92***	253.27***	2979.09***	470.30***
AR(1) test stat	-1.72*	-1.86*	-2.04*	-2.20**	-2.16**	-1.97***	-2.32**	2.08**
AR(2) test stat	-0.06	0.26	-0.52	-0.73	-0.21	0.06	-1.44	0.14
Hansen J-stat	0.829	0.595	0.252	0.286	0.522	1	0.516	0.961
Instruments	23	23	23	23	23	23	23	23
Observations	184	184	184	184	184	184	184	184
Number of banks	23	23	23	23	23	23	23	23

Notes: the Table reports the dynamic panel regression results for the period 2000 to 2012. The dependent variable is the performance of investment banks 1) ROAE: net income after tax as a percentage of the average book value of total equity; 2)ROAA: net income before interest and taxes as a proportion of the average book value of total assets; 3)POI: pre-tax operating income as a percentage of the average total assets; 4)EFF: efficiency scores obtained from the SFA. As independent variables we employ EXECASH: the cash compensation of the top management team which includes base salary and bonus; EXEEQ: the equity compensation of the top management team which includes restricted stock and stock options; CEOCASH: the cash compensation of the CEO which includes base salary and bonus; CEOEQ: the equity compensation of the CEO which includes restricted stock and stock options; BOARDOWN: the percentage shares that the directors hold; CEOOWN: the percentage shares that the CEO holds; EXEBON: bonus over executives' total cash compensation; CEOBON: bonus over CEOs' total cash compensation; E/TA: equity over total assets; FEES: of net fees, commission and net trading income over total assets; EARN: ratio of trading securities, derivatives, treasury bills and bonds over total assets; RISK: Z-score= (1+AverageROE)/Standard Deviation of ROE; PSOX: dummy which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise; CRS: a dummy which takes the value of 1 if year is 2007-2010; VIX: Volatility Implied Index (Chicago Board Options Exchange Volatility Index). For Volatility Implied Index data (VIX-Chicago Board Options Exchange Volatility Index) we use Bloomberg database. To avoid collinearity problems with the selected variables, we first analyze correlations of all the selected variables.

Table 8. Dynamic panel regressions over the period 2000 to 2012 for US investment bank performance (governance complexity)

	Other Governance characteristics			
VARIABLES	ROAE(1)	ROAA(2)	POI(3)	EFF(4)
Lag performance	0.1844***	0.2800***	0.2229*	0.9762***
	(0.0676)	(0.1077)	(0.1180)	(0.119)
E/TA	0.2205	-0.4860**	-0.8901**	-0.0026*
	(0.4529)	(0.2027)	(0.3852)	(0.0014)
EARN	0.0114	0.0162	-0.0444	-
	(0.0104)	(0.0377)	(0.066)	
FEES	0.0178	-0.0369	0.0172	-
	(0.0208)	(0.0237)	(0.0624)	
RISK	0.0192***	0.0040	0.0019	0.0000*
	(0.0069)	(0.0028)	(0.0023)	(0.00001)
VIX	-0.0028	-0.0008	-0.0072***	-0.00003***
	(0.0022)	(0.0016)	(0.0024)	(0.00001)
CRS	-0.1503***	-0.0555**	-0.1187**	-0.00019***
	(0.0425)	(0.0263)	(0.0517)	(0.00006)
PSOX	-0.0914***	-0.0337	-0.0213	-0.00024*
	(0.0275)	(0.033)	(0.0481)	(00014)
NBCOM	-0.2694*	-0.2261*	-0.1477**	-0.00061*
	(0.1571)	0.1296	(0.0714)	(0.00036)
NMAUD	0.1732***	0.0405	-0.0102	0.00010
	(0.0553)	(0.0492)	(0.0495)	(0.00009)
FBCOM	0.00039	-0.0011	-0.7538*	0.00021
	(0.00565)	(0.0128)	(0.444)	(0.0015)
SEG	0.0312	-0.1873***	-0.2296***	-0.0003
	(0.0859)	(0.0491)	(0.0872)	(0.00025)
SUB	-0.0460	-0.02873**	0.0653	0.00011
	(0.0344)	(0.0137)	(0.0412)	(0.00008)
	-0.3371	-0.0025	0.7851***	-0.002**
Constant	(0.3374)	(0.1744)	(0.2867)	(0.0009)
Wald chi2	83.71***	554.62***	218.11***	479.23***
AR(1) test stat	-2.27**	-1.67*	-1.91*	-2.03**
AR(2) test stat	-0.37	-0.45	-0.14	0.51
Hansen J-stat	0.747	0.517	0.738	0.744
Instruments	23	23	23	23
Observations	184	184	184	184
Number of banks	23	23	23	23

Notes: the Table reports the dynamic panel regression results for the period 2000 to 2012. The dependent variable is the performance of investment banks 1) ROAE: net income after tax as a percentage of the average book value of total equity; 2)ROAA: net income before interest and taxes as a proportion of the average book value of total assets; 3)POI: pre-tax operating income as a percentage of the average total assets; 4)EFF: efficiency scores obtained from the SFA. As independent variables we employ NBCOM: the number of board committees; NMAUD: number of meetings of audit committee; FBCOM: fees paid to directors for attending the board committees; SEG: the number of different business segments; SUBS: Number of subsidiaries; E/TA: equity over total assets; FEES: of net fees, commission and net trading income over total assets; EARN: ratio of trading securities, derivatives, treasury bills and bonds over total assets; RISK: Z-score= (1+AverageROE)/Standard Deviation of ROE; PSOX: dummy which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise; CRS: a dummy which takes the value of 1 if year is 2007-2010; VIX: Volatility Implied Index (Chicago Board Options Exchange Volatility Index). For Volatility Implied Index data (VIX-Chicago Board Options Exchange Volatility Index) we use Bloomberg database. To avoid collinearity problems with the selected variables, we first analyze correlations of all the selected variables.

Table 9. Board size and performance

Investment banks		
Threshold estimate		
BS		2.30259
95% confidence interval		(2.197220 -2.397900)
Impact of board size		S.E
λ1	-0.0524	0.0461
λ2	-1.3778***	0.4162
Impact of covariates		S.E
E/TA	-0.538	0.505
RISK	0.0017	0.002
EARN	-0.0302**	0.0124
FEES	0.0459*	0.0246
IND	0.1314	0.1051
GD	-0.0951	0.157
PSOX	-0.0741**	0.0336
VIX	-0.0042***	0.0011
δ	-0.5948***	0.1637
Observations	184	
Low regime	117	
High regime	67	

Notes: the Table reports the estimations for the dynamic panel threshold model where we use all the available instruments. Each regime has at least 5% of the observations (Hansen, 1999). The threshold value of Board size variable for banks range between 2.1972 and 2.3973. We denote as dependent variable banks' ROAE ($[perform_{it}$), while as the threshold and the regime dependent variable we impose the BS (BS_{it}), which represents the natural logarithm of banks' board size. We assume m_{it} includes a number of explanatory variables. IND: the percentage of independent directors; GD: the percentage of female directors; E/TA: equity over total assets; FEES: of net fees, commission and net trading income over total assets; EARN: ratio of trading securities, derivatives, treasury bills and bonds over total assets; RISK: Z-score= (1+AverageROE)/Standard Deviation of ROE; PSOX: dummy which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise; VIX: Volatility Implied Index (Chicago Board Options Exchange Volatility Index). Following Bick (2007), the model accounts for regime dependent intercepts (δ).

Table 10. Dynamic Threshold Analysis: classification of investment banks into the two identified regimes based on threshold value of Board size.

Threshold: Board size													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2010**	**2011**
Low regime	70%	62%	64%	64%	67%	56%	56%	47%	73%	65%	75%	73%	62%
High regime	30%	38%	36%	36%	33%	44%	44%	53%	27%	35%	25%	27%	38%

Notes: Table shows the classification of the investment banks based on the Board size (natural logarithm) threshold value that we obtained following Kremer's et al. (2011) threshold model for dynamic panel.

Table 11.Board Ownership and performance

Investment banks		
Threshold estimate		
BOARDOWN		8.54313
95% confidence interval		(0.276317-23.428200)
Impact of Board ownership		S.E
λ1	-0.026***	0.0074
λ2	0.116**	0.0530
Impact of covariates		S.E
E/TA	-0.4462	0.3796
RISK	0.0022*	0.0012
EARN	-0.0163	0.0107
FEES	0.0423**	0.0205
CEOOWN	0.0055**	0.0026
EXEBON	0.0069***	0.0008
CEOBON	-0.0017***	0.0002
PSOX	-0.0716**	0.0312
VIX	-0.0021*	0.0011
δ	-0.0006	0.0010
Observations	184	
Low regime	94	
High regime	90	

Notes: the Table reports the estimations for the dynamic panel threshold model where we use all the available instruments. Each regime has at least 5% of the observations (Hansen, 1999). The threshold value of Board ownership variable for banks range between 0.276317 and 23.4282. We denote as dependent variable banks' ROAE ($[perform_{it}$), while as the threshold and the regime dependent variable we impose the BOARDOWN ($BOARDOWN_{it}$), which represents the percentage of bank's shares hold by the board members. We assume m_{it} includes a number of explanatory variables. Following Bick (2007), the model accounts for regime dependent intercepts (δ). CEOOWN: the percentage shares that the CEO holds; EXEBON: bonus over executives' total cash compensation; CEOBON: bonus over CEOs' total cash compensation; E/TA: equity over total assets; FEES: of net fees, commission and net trading income over total assets; EARN: ratio of trading securities, derivatives, treasury bills and bonds over total assets; RISK: Z-score= (1+AverageROE)/Standard Deviation of ROE; PSOX: dummy which takes the value of 0 if year is 2000-2001 and the value of 1 otherwise; VIX: Volatility Implied Index (Chicago Board Options Exchange Volatility Index).

Table 12. Dynamic Threshold Analysis: classification of investment banks into the two identified regimes based on threshold value of Board ownership.

Threshold: Board ownership													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2010**	**2011**
Low regime	70%	69%	50%	57%	53%	50%	44%	47%	53%	35%	50%	53%	46%
High regime	30%	31%	50%	43%	47%	50%	56%	53%	47%	65%	50%	47%	54%

Notes: Table shows the classification of the investment banks based on the Board ownership threshold value that we obtained following Kremer's et al. (2011) threshold model for dynamic panel.

Appendix

A.1. Stochastic Frontier Analysis

Stochastic frontier analysis (SFA) has been widely employed to all kind of industries and especially banking since its introduction by Aigner et al. (1977).[16] We use the fixed-effect specification where efficiency scores are independently and identically distributed (Greene, 2002).

More specifically, we use the following specification for the profit frontier:

$$TP_{it} = f(P_{it}, Y_{it}, N_{it}) + v_{it} + u_{it} \quad (3)$$

where TP_{it} is pre-tax profits for bank i in year t.[17] P_{it} is a vector of input prices, Y_{it} is a vector of outputs, N_{it} is a vector of fixed netputs. The term $v_{i,t}$ stands for the error term, while $u_{i,t}$ is bank inefficiency.

The translog profit function, opted in the paper, takes the form:

$$\begin{aligned} lnP_{i,t} = {} & \alpha_0 + \sum_i \alpha_i lnP_{i,t} + \sum_i \beta_i lnY_{i,t} + {}^1/_2 \sum_i \sum_j \alpha_{ij} lnP_{i,t} lnP_{j,t} + {}^1/_2 \sum_i \sum_j \beta_{ij} lnY_{i,t} lnY_{j,t} + \\ & + \sum_i \sum_j \delta_{ij} lnP_{i,t} lnY_{j,t} + \sum_i \zeta_i lnN_{i,t} + {}^1/_2 \sum_i \sum_j \zeta_{ij} lnN_{i,t} lnN_{j,t} + {}^1/_2 \sum_i \sum_j \theta_{ij} lnP_{i,t} lnN_{j,t} + \\ & + \sum_i \sum_j \kappa_{ij} lnY_{i,t} lnN_{j,t} + \mu_1 t + {}^1/_2 \mu_2 t^2 + \sum_i \nu_i t lnP_{i,t} + \sum_i \xi_i t lnY_{i,t} + \sum_i \rho_i t lnN_{i,t} + \\ & + u_{i,t} \pm v_{i,t} \end{aligned} \quad (4)$$

Ordinary linear homogeneity and symmetry limitations are employed. We estimate equation (3) with a maximum likelihood method parameterized based on the variance parameters: [18]

$$\sigma_\varepsilon^2 = \sigma_u^2 + \sigma_v^2$$
$$\text{and } \beta = \sigma_u^2 / \sigma_\varepsilon^2. \quad (5)$$

Following Sealey and Lindley (1977) we employ the '*intermediation'* approach so as to identify bank inputs and outputs. This approach assumes that banks use labour and capital in order to collect funds and transform them into loans and other earning assets. Hence, as inputs we employ the price of labour and physical capital. The price of labour is measured as the

[16] SFA starts with a profit function and evaluate the maximum profit frontier for the sample of banks. The advantage of this parametric methodology is that both the random error and inefficiency are combined in a composite error term (Berger and Humphrey, 1997).

[17] In order to deal with negative values of profits we follow the approach suggested by Bos and Koetter (2011). In particular, negative values of profits are replaced by the value of 1 in the left had side, while simultaneously we use a new variable, namely negative profit indicator at the right hand side. This indicator in case of losses takes the absolute value of negative profits while in case of positive profits takes the value of 1.

[18] We estimate bank-specific efficiency scores using the distribution of efficiency term conditional to the estimate of the composite error term as in Jondrow et al. (1982).

ratio of personnel expenses to total assets while the price of physical capital is measured as the ratio of operating expenses to fixed assets. Moreover, as the first output we use other earning assets that include trading securities, derivatives, treasury bills and bonds. Given the operational nature of investment banks, we use as a second output the total level of investment banking fees that include net commission, fees and trading gains (Radic et al., 2012). As a fixed netput, we use the total level of fixed assets.

A.2. Dynamic Panel Threshold Model

The dependent variable employed in the dynamic threshold technique is the performance measure ,ROAE, of investment banks. We use this econometric technique as it allows us to detect regime shifts of two corporate governance determinants, namely board size and board ownership, with respect to the performance of investment banks.[19]

Therefore our equation takes the following specification:

$$perform_{it} = \mu + \lambda_1 m_{it}\, I(q_{it} \leq \gamma) + \delta_1 I(q_{it} \leq \gamma) + \lambda_2 m_{it}\, I(q_{it} > \gamma) + \varepsilon_{it} \qquad (6)$$

where perform_{it} is the dependent variable (ROAE) and μ is the bank-specific fixed effect parameter. The two reverse regression slopes are λ_1 and λ_2 and are defined based on the assumption that that there exist two regimes. q_{it} stands for the threshold variable, γ is the threshold value which splits the observations into two regimes: 1) above the threshold value (high regime), and 2) below the threshold value (low regime). ε_{it} stands for the residual. I is the indicator term that signifies the regime specified by the threshold variable q_{it} and the threshold value γ. As Kremer et al. (2011), we use m_{it} as a vector of independent variables that includes one explanatory variable treated as endogenous and the other determinants as exogenous.[20] Moreover, Kremer et al. (2011) extends the Hansen's (1999) model by including the regime dependent intercept, δ_1. Following Bick (2007), ignoring the regime

[19] In this study, we use the model proposed by Kremer et al. (2011). That is an extension of the threshold methodology introduced by Hansen (1999). The extended method of Kremer et al. (2011) is built on the cross sectional technique of Caner and Hansen (2004), where GMM estimators are employed to account for endogeneity. As an extension to Caner and Hansen (2004) model, Kremer et al (2011) opt for a dynamic threshold methodology.

[20] We include all the explanatory variables of our fixed-effect and dynamic panel estimations apart from the CRS variable. The reason being that we opt for the threshold methodology in order to allow our data to determine this period of the turmoil through the identification of regime changes of important corporate governance variable with respect to bank performance, rather than arbitrarily impose the period of financial crisis with a CRS dummy.

intercepts would cause biased estimation of threshold value and the scale of the regimes' coefficients. [21]

[21] Kremer et al. (2011) employ the GMM estimator (Arellano and Bover, 1995) so as to avoid serial correlation in the residuals. Then, they measure a short type regression to obtain the predicted values of the endogenous variables using a function of instruments (Caner and Hansen, 2004). As a first step, the endogenous variable is replaced with the predicted values in equation (6). As a second step, threshold value is obtained via OLS method where the threshold variable has been replaced by its predicted values estimated in the first step. The threshold value is obtained so as to minimize the concentrated sum of squared errors (Chan, 1993; Hansen, 1997). Once threshold value has been determined, the regression slopes, λ_1 and λ_2 can be estimated by employing the GMM estimator Caner and Hansen, 2004).