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What drives risk-taking incentives embedded in bank executive compensation? Some international evidence☆

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ABSTRACT

This paper analyzes the country determinants of risk-taking incentives embedded in bank executive compensation using hand-collected international panel data on 135 publicly-traded banks in 26 countries. We exploit time-series changes in investor protection within a country and confirm that stronger protection leads to a higher vega. Moreover, the positive effect on vega is higher in countries where stronger bank competition and more extensive safety nets increase bank shareholders' risk-taking incentives. Our analysis controls for changes in bank regulation, systemic banking crises, and government bailouts. The results are robust to alternative specification models, alternative proxies for country determinants, and remain when we apply a more traditional cross-sectional analysis.

1. Introduction

Recent finance literature highlights that risk-taking incentives embedded in bank executive compensation were responsible for excessive risk-taking before the 2007–2009 global financial crisis (Fahlenbrach and Stulz, 2011; DeYoung et al., 2013; Cerasi and Oliviero, 2015). Proposals for legal reforms of bank compensation aiming to limit the risk-taking incentives embedded in bank executive compensation therefore emerge as a natural response (Kleymenova and Tuna, 2016; Cerasi et al., 2020). In this context, we provide new evidence on the country determinants of risk-taking incentives in bank executive compensation. In particular, we analyze the relevance of investor protection, market competition, and bank safety nets for pay-risk sensitivity, or vega, in the banking industry. This analysis is important because any legal reform would require prior knowledge about how such risk-taking incentives may arise in executive compensation. Moreover, knowledge of country determinants allows for regulation on bank compensation to take into account a country's institutional and regulatory characteristics.

Following previous studies, we use the vega of option packages granted to bank executives as the main proxy for the risk-taking incentives embedded in bank executive compensation (Chen et al., 2006; Bai and Elyasiani, 2013; DeYoung et al., 2013). We argue

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that investor protection, market competition, and safety nets might shape vega for several reasons. First, stronger investor protection increases the ability of shareholders to translate their risk-taking incentives into bank executive compensation. It is well-known that shareholders have more risk-taking incentives than managers as they are more diversified, at least in large companies, with respect to firm-specific wealth (Jensen, 1986). Therefore, we predict that stronger investor protection in a country is associated with a higher vega. Moreover, ownership structure and corporate governance may shape that influence. Higher ownership concentration reduces shareholder diversification and may diminish their risk-taking incentives. A lower proportion of independent directors on the board reduces the ability of shareholders to translate their risk-taking incentives into executive compensation. Because of this, we specifically analyze whether more concentrated ownership and/or lower presence of independent directors reduce the positive influence of investor protection on vega.

Second, the risk-taking incentives embedded in bank executive compensation depend not only on the ability of shareholders to translate their higher risk-taking incentives into executive compensation but also on country variables affecting shareholders' risk-taking incentives. For instance, an increase in the ability of shareholders to translate their risk-taking incentives into executive compensation will not increase vega if other country characteristics do not provide incentives to shareholders to undertake risky investments. Investor protection would be a necessary, but not sufficient condition. We focus on bank competition and safety nets because the banking literature highlights that these two variables increase the risk-taking incentives of bank shareholders (Keeley, 1990; Martinez-Peria and Schmukler, 2001). Therefore, we analyze whether the positive effect of investor protection on vega is higher in countries with more bank competition and more extensive bank safety nets.

We test the above predictions in a hand-collected international panel database on bank executive compensation for 135 publicly-traded banks across 26 countries over the 2003–2018 period. The use of an international sample of banks allows us to analyze the effect of country variables as determinants of bank executive compensation. We exploit time-series changes in investor protection within a country to apply a difference-in-differences (DID) analysis and to better control for endogeneity and omitted variables. The treatment group includes banks from 11 countries which experienced a total of 12 changes in investor protection. Banks from 15 countries without changes in investor protection act as the control group. We check that estimations meet the conditions for a DID analysis. Additionally, we analyze how bank competition and the extension of the bank safety net in a country shape the effect of investor protection on vega.

Our results are new in the literature because, to our knowledge, no previous papers have analyzed the importance of investor protection on executive vega or how this varies across countries depending on other national characteristics such as bank competition and the safety net. These results provide useful guidelines for designing more appropriate regulation of bank executive compensation in each country. In particular, the results confirm that the extent of risk-taking incentives embedded in executive compensation depends on the ability of bank shareholders to translate their incentives into executive compensation and on the particular risk-taking incentives of bank shareholders. The DID analysis indicates that an increase (decrease) in investor protection leads to an increase (decrease) in vega. We also find that differences across banks depending on their corporate governance are consistent with the importance of investor protection. In particular, the positive impact of investor protection on vega is higher in banks with more independent directors, i.e. in banks where a higher proportion of independent directors allows shareholders to better translate their risk-taking incentives into bank executive compensation. However, we do not find that higher ownership concentration significantly reduces the positive influence of investor protection on vega.

Additionally, our findings suggest the importance of bank competition and safety nets, because an increase in investor protection only leads to increases in vega in countries with higher bank competition and more extensive safety nets. These results are consistent with greater shareholders' risk-taking incentives in countries with higher bank competition and more extensive safety nets, and with investor protection increasing shareholders' ability to translate their risk-taking incentives into bank executive compensation.

The results are robust when we use an alternative control group based on a propensity score matching technique to reduce potential differences across the treatment and control banks before changes in investor protection. They are also robust to alternative controls and estimation methods. To mitigate concerns regarding confounding events, all regressions control for changes in regulations affecting bank executive compensation, for changes in capital regulation, and for systemic banking crises and bailouts. We additionally include individual bank effects in our regressions to control for omitted variables and fixed-year effects, and we cluster standard errors by country or bank. The results do not change when we apply Tobit estimates to consider that vega is censored at zero because there are banks that do not use stock options as a component of executive compensation.

The results do not change when we use alternative proxies for country variables, when we use the delta of option packages granted to executives as an alternative proxy for vega, or when we separately analyze increases and decreases in investor protection. We also check the robustness of the results exploiting cross-sectional differences in investor protection, bank competition, and the extension of safety nets across countries. Cross-sectional regressions confirm that stronger investor protection is associated with higher vegas, especially in countries with stronger bank competition, and more extensive bank safety nets.

The rest of the paper is organized as follows. Section 2 reviews the related literature and discusses the hypotheses. Section 3 describes the data and the variables. Section 4 explains the identification strategy. Section 5 presents the results and robustness checks. Finally, Section 6 provides the conclusions.

2. Related literature and hypotheses

Our paper relates to several strands of the literature. It relates to the literature studying the relative importance of the contracting and managerial entrenchment hypotheses to explain executive compensation. These two hypotheses are not mutually exclusive and corporate finance literature provides partial support for both of them in commercial and industrial firms.[1] The contracting hypothesis suggests that executive compensation results from shareholders and managers optimally setting incentive contracts given exogenous investment opportunities and risk. The managerial entrenchment hypothesis suggests that managers are able to establish executive compensation in line with their own interests. Both hypotheses focus on firm characteristics as potential determinants of executive compensation and pay less attention to country characteristics. Larger size is associated with higher vega (Guay, 1999), but the influence of financial leverage is less clear because Coles et al. (2006) and John et al. (2010) find a negative influence for financial leverage on vega whereas Guay (1999) finds a positive influence. Consistent with the contracting hypothesis, empirical evidence shows that greater opportunities for risky investments lead to higher vega in US executive compensation to encourage managers to take up such opportunities (Guay, 1999; Coles et al., 2006; Ge'Czy et al., 2007).[2] Empirical studies on the influence of corporate governance also provide evidence consistent with the contracting hypothesis. In particular, a greater presence of independent directors on boards or greater power of shareholders versus managers within corporate governance are associated with a higher vega and higher risk-taking, in both industrial firms (Mehran, 1995) and banks (Laeven and Levine, 2009; Pathan, 2009; Anginer et al., 2016). Higher ownership concentration is associated with a lower vega in industrial firms (Mehran, 1995), which is consistent with lower risk-taking incentives for less diversified shareholders. However, the literature on the importance of the contracting and managerial entrenchment hypotheses pays less attention to the significance of country characteristics. Our study complements that literature because we test whether a country characteristic, namely investor protection, improves the ability of bank shareholders to translate their risk-taking incentives into vega and how competition and the extent of the safety net in a country shape the influence of investor protection on vega.

Our paper also relates to law and finance literature. We provide new arguments for the importance of investor protection in the banking industry. This has been extensively highlighted in industrial and commercial firms by showing that better legal protection of outside shareholders is associated with greater stock market development and economic growth, higher valuation of listed firms, greater dividend payouts, lower concentration of ownership and control, and better capital allocation (Shleifer and Wolfenzon, 2002). However, whether investor protection plays a similar role in the banking sector is less clear because of the specific regulation and supervision that shape bank behavior. Caprio et al. (2007) show the importance of investor protection for increasing bank valuations in a sample of 244 banks from 44 countries. To our knowledge, only Abascal and González (2019) have previously explored the potential importance of investor protection for bank executive compensation. They show a greater reduction in vega, and in total and cash pay-risk sensitivity, after systemic banking crises in countries with stronger investor protection. This finding is consistent with a reduction in the investment risk-return opportunity set after the onset of the crisis and with the contracting hypothesis being more important in countries with stronger investor protection. However, none of those studies directly analyzes the relevance of investor protection as a determinant of vega and its interactions with other country characteristics.

We argue in this paper that investor protection may be an important determinant of vega because stronger protection increases the ability of bank shareholders to translate their particular risk-taking incentives into executive compensation. Because bank shareholders have greater risk-taking incentives than managers, as they are more diversified with respect to firm-specific wealth, we predict that stronger investor protection would increase the relative importance of the contracting hypothesis and would lead to a higher vega. In any case, corporate governance and ownership structures may lead to differences across banks within each particular country. Following previous evidence, greater presence of independent directors increases the comparative power of shareholders within the corporate governance structure of each bank. That would make it easier for the higher shareholders' risk-taking incentives to become higher vegas. In contrast, higher ownership concentration or a higher percentage of shares held by the main shareholder, reducing shareholder diversification with respect to firm-specific wealth, reduce shareholders' risk-taking incentives and would lead to lower vegas. Therefore, our first hypothesis is:

H1. Investor protection increases vega, especially in banks with more independent directors and less concentrated ownership.

We additionally argue that the particular risk-taking incentives of bank shareholders, and not only their ability to include their incentives in executive contracts, are important determinants of vega. In fact, investor protection will promote a higher vega only if shareholders have risk-taking incentives. For this reason, we specifically analyze two country characteristics traditionally highlighted by the banking literature as determinants of bank shareholders' risk-taking incentives: bank competition and the bank safety net in a country.

The traditional "competition-fragility" view suggests that more bank competition decreases profit margins and reduces banks' charter value, which increases a bank's risk-taking incentives (Keeley, 1990). Risky investments are a way of increasing expected returns in competitive markets. Moreover, competition and low charter values reduce the traditional benefits of avoiding bankruptcy and increase the incentives of bank shareholders to undertake risky investments. Keeley (1990), Levy-Yeyati and Micco (2007), Berger et al. (2009), Turk-Ariss (2010), Beck et al. (2013), Jiménez et al. (2013), and Forssbaeck and Shehzad (2015), among others, show a

[1] Frydman and Jenter (2010) survey the literature on executive compensation in commercial and industrial firms.

[2] More extensively, the literature shows that the relationship also exists in the other direction because firms with greater executive pay-risk sensitivity adopt riskier policies (Agrawal and Mandelker, 1987; DeFusco et al., 1990; Coles et al., 2006).

positive relationship between bank market competition and bank risk-taking in different geographical areas.[3]

Several papers provide direct empirical evidence on the influence of market competition on bank executive compensation. However, to our knowledge, all of them focus on US banks during the deregulation process after the 1970s. The deregulation of the US banking industry expanded banks' investment opportunities and led bank shareholders to incentivize managers to take up greater investment risk-return opportunities by increasing equity-based compensation after deregulation. Empirical studies find an increase in pay-performance sensitivity after deregulation (Crawford et al., 1995; Hubbard and Palia, 1995; Cuñat and Guadalupe, 2009; Hagendorff and Vallascas, 2011; DeYoung et al., 2013). A smaller number of banking studies analyze changes in pay-risk sensitivity. Chen et al. (2006) analyze the impact of deregulation on the relative importance of stock option-based compensation, and Bai and Elyasiani (2013) and DeYoung et al. (2013) focus on the effect of deregulation on vega. Consistent with higher benefits for shareholders of risk-taking in more competitive markets, they find that CEO pay-risk sensitivity increased from the late 1990s, when US banks were allowed to enter into investment banking and insurance activities.

We extend the above evidence by analyzing an international sample of banks and providing new evidence on how bank competition shapes the effect of investor protection on vega. We argue that bank competition increases shareholders' risk-taking incentives and their interest in incorporating them into bank executive compensation. Therefore, we expect that an increase in investor protection, i.e. in the ability of shareholders to translate their risk-taking incentives into executive compensation, would have a greater positive impact on vega in countries with higher bank competition, i.e. in countries where shareholders have more risk-taking incentives. Our second hypothesis is:

H2. More bank competition increases the positive impact of investor protection on vega.

Second, in addition to bank market competition, the extension of the bank safety net influences shareholders' risk-taking incentives. Risky, even negative, NPV investments transfer wealth from deposit insurance to bank shareholders. Insured depositors have little or no incentive to monitor banks' risk-taking because their investment is guaranteed. The lack of risk premium in the cost of deposits encourages shareholders to increase leverage and risk-taking investments in the bank. If risky projects pay off, the benefits accrue to shareholders and their losses are limited to their reduced equity contribution (Crawford et al., 1995). Empirical evidence shows that more generous deposit insurance increases the probability of banking crises (Demirguc-Kunt and Detragiache, 2002). Moreover, the usual adoption of an explicit blanket guarantee, forbearance, and government recapitalization and nationalization programs during banking crises reduce market discipline and, together with deposit insurance, contribute to making deposit interest rates less sensitive to bank risk (Martinez-Peria and Schmukler, 2001; Demirgüç-Kunt and Huizinga, 2004).

We extend the above evidence to the influence of the bank safety net on vega. We argue that a more extensive bank safety net in a country increases shareholders' risk-taking incentives and their interest in incorporating them into bank executive compensation. Therefore, we expect that an increase in investor protection, i.e. in the ability of shareholders to translate their risk-taking incentives into executive compensation, would have a greater positive impact on vega in countries with a more extensive bank safety net, i.e. in countries where shareholders have more risk-taking incentives. Our third hypothesis is:

H3. Larger bank safety nets increase the positive impact of investor protection on vega.

To our knowledge, only Crawford et al. (1995) provide evidence on the influence of the safety net on bank executive compensation. They show that banks with lower capitalization-ratios had greater increases in their pay-performance sensitivity after a deregulation process in the US in 1980 and 1981. This evidence is consistent with the higher risk-taking incentives provided by the safety net, because it is the shareholders of poorly capitalized banks that benefit most from wealth transfers from deposit insurance and taxpayers. However, they do not analyze the impact on vega or pay-risk sensitivity, which is a more suitable variable for capturing the risk-taking incentives embedded in bank executive compensation. They do not control for investor protection, nor do they use an international database with banks outside the USA or apply a DID analysis.

3. Data and variables

3.1. Data

We combined hand-collected data on bank executive compensation with information from Compustat's Capital IQ. Information on executive compensation for US banks from Capital IQ has traditionally been used in many empirical studies. We restrict the analysis to the 16 largest US listed banks to avoid overrepresentation of US banks in the international sample. These 16 banks represent more than 71% of total US bank assets at the end of 2010 (more than 66.5% at the end of 2018). Following Caprio et al. (2007) and Laeven and Levine (2009), we check that the results do not change when we reduce the sample of US banks to the 10 largest.

However, less data availability on bank executive compensation outside the US obliged us to combine Capital IQ with hand-collected data. Outside the US, we obtained information on compensation for 71 listed banks across 23 countries from Compustat's

[3] Although competition increases bank risk-taking incentives, there is an ongoing debate on the final effect of competition on credit risk because more bank market competition reduces interest rates on loans and induces borrowers to reduce their risk-taking (Boyd and De Nicolo, 2005). Therefore, the “competition-stability” view suggests that lower borrowers' risk reduces bank credit risk and may reduce overall bank risk. However, we focus on the “competition-fragility” view to analyze the impact of competition on vega because only this view refers to shareholders' risk-taking incentives. The “competition-stability” view refers to borrowers' risk-taking incentives.

Capital IQ. We reviewed annual reports for all the listed non-US banks and obtained information for an additional 129 listed banks across 38 countries. Combining both sources, our initial sample was made up of 200 banks across 43 countries outside the US over the 2003–2018 period. We initially included banks with some information on salary, cash bonuses, options granted, total variable, and total compensation. We excluded 46 banks from eight countries for which the lack of data on executive stock options prevented us from computing vega and delta (Bahrain, Bangladesh, Croatia, Czech Republic, Oman, Pakistan, Philippines, and Portugal). We also excluded 35 banks from 10 countries because of lack of data on stock performance or stock return volatility. The final sample for non-US banks is made up of 119 banks across 25 countries. They represent 75% of total bank assets in these countries at the end of 2010 (more than 65.6% at the end of 2018). Therefore, our full final sample on vegas and bank-level variables includes a maximum of 135 banks across 26 countries (119 non-US banks and 16 US banks). We also used annual reports to obtain bank-level data on the presence of independent directors and bank ownership. Information on other bank-level control variables comes from Capital IQ.

Country variables for investor protection, bank competition and the extension of safety nets come from several databases created by the World Bank. We identify a treatment group of 55 banks from 11 countries experiencing 12 changes in investor protection. Our control group includes 80 banks from 15 countries without changes in investor protection. Panel A of Table 1 shows the countries included in each group and the year of the change in investor protection for countries in the treatment group.

3.2. Variables and descriptive statistics

We now describe in detail the proxies for our main variables. Panel B in Table 1 reports the summary statistics for the main variables and the comparison of means for treatment and control banks in the full sample. Table A1 in the Appendix describes all the variables used in the empirical analysis and their sources. Table A2 in the Appendix reports their mean values per country.

a) *Risk-taking incentives embedded in bank executive compensation*

We focus on the sensitivity of pay to risk in executive contracts to capture the risk-taking incentives embedded in bank executive compensation. Specifically, we use the vega of the options granted annually to bank executives because the sensitivity of executives' stock-based wealth to volatility is driven primarily by stock options (Guay, 1999). We define vega as the change in the value of the executive's options granted for a 0.01 change in the standard deviation of the underlying stock returns. We use delta as an alternative proxy for bank risk-taking incentives embedded in executive compensation in our robustness checks. However, delta has limitations because its influence on manager risk-taking incentives is less clear. On the one hand, a higher delta links manager wealth to the value of the firm's stock and provides incentives to managers to undertake risky investments with positive NPV (DeYoung et al., 2013). On the other hand, a higher delta increases managerial risk aversion, which reduces managers' incentives to undertake risky investments, even with positive NPV (Knopf et al., 2002; Coles et al., 2006; Low, 2009; DeYoung et al., 2013). Because of this ambiguous link between delta and manager risk-taking incentives, we use vega as our main dependent variable and delta alone to check robustness. We define delta as the change in the dollar value of the executive stock option portfolio for a 0.01 change in stock price.

We value stock options using the Black and Scholes (1973) model modified by Merton (1973) to account for dividend payouts. We follow Guay (1999) and Core and Guay (2002) to estimate annual estimates of vega and delta. Vega is therefore the partial derivative of the option value with respect to stock-return volatility, multiplied by 0.01 times the number of options. Since vega and delta are highly skewed, we follow prior literature and use their natural logarithms (*Ln(Vega)* and *Ln(Delta)*). The same sensitivity measure is adopted in many recent studies including Knopf et al. (2002), Coles et al. (2006), DeYoung et al. (2013), and Bai and Elyasiani (2013).[4] Banks in four countries did not use stock options as a component of their executive compensation (Bosnia-Herzegovina, China, Finland, and Norway). We assume that both the vega and delta of banks in these four countries are zero.[5] Panel B of Table 1 shows that the mean values of vega and delta are statistically different across treatment and control banks.

b) *Investor protection and bank governance*

Our main proxy for investor protection is the investor protection index (*Investor protection*) drawn up by the World Bank. This index is the sum of the extent of disclosure index, the extent of director liability index, and the ease of shareholder suits index. The extent of disclosure index measures the approval and disclosure requirements of related-party transactions and has five components. The extent of director liability index measures when board members can be held liable for harm caused by related-party transactions and what sanctions are available; it has seven components. The ease of shareholder suits index measures how likely plaintiffs are to access internal corporate evidence and has six components. Each index may vary from 0 to 10, and the overall investor protection index may therefore range from 0 to 30. This index has been computed annually since 2006. It is suitable for DID analysis because it is mostly

[4] The parameters of the Black-Scholes formula are calculated using stock price volatility over the last year, the annual dividend yield of the stock using the year-end stock price, and the yield on the ten-year sovereign bond at the end of the year as the risk-free interest rate. The maturity of new option grants when information is missing about their time to maturity is set at 10 years. For options for which we could not obtain the exercise price, we set it at the average of the stock prices prevailing at the beginning and end of the year in which the option was granted. These assumptions are the same as in Guay (1999).

[5] We check that the results do not change when we exclude banks from these countries. China is in the treatment group whereas banks from Bosnia-Herzegovina, Finland, and Norway are in the control group.

Table 1
Summary statistics for the full sample.

Panel A. Countries in the treatment and control groups

Countries with a change in investor protection (treatment group)		Countries without changes in investor protection (control group)		
Country	Year and type of change in Investor protection			
Canada	2013 (+1)	Australia	Finland	Italy
China	2007 (+2)	Austria	France	Norway
Cyprus	2012 (+4)	Belgium	Germany	Singapore
India	2011 (+1)	Bosnia and Herzegovina	Hong Kong	Switzerland
Indonesia	2010 (+1)	Denmark	Ireland	United Kingdom
Malaysia	2014 (+1)			
Netherlands	2013 (+1)			
Poland	2007 (+1)			
Spain	2014 (+2)			
Sweden	2007 (+4); 2011 (+2)			
United States	2014 (−0,4)			

Panel B: Summary statistics for the full sample

	Obs. (1)	Mean (2)	Std. Dev. (3)	Median (4)	25th percentile (5)	75th percentile (6)	Treatment group (7)	Control group (8)
Ln(Vega)	1678	2.1165	3.3154	0	0	4.9272	3.5973***	1.1174
							(3.9210)	(2.3594)
Ln(Delta)	1678	0.8717	1.5680	0	0	1.2644	1.5336***	0.4252
							(1.9092)	(1.0797)
Investor protection	1678	20.1056	4.8934	19	16	25	22.0269***	18.8094
							(4.4007)	(4.7837)
% Independent directors	1387	0,6156	0.2714	0.6667	0.4286	0.8333	0.6718***	0.5719
							(0.2450)	(0.2827)
% Main shareholder	1164	0.3066	0.2683	0.1922	0.0892	0.5100	0.3260**	0.2967
							(0.2692)	(0.2675)
Boone	1388	−0.0630	0.1374	−0.0439	−0.0667	−0.0219	−0.0646***	−0.06194
							(0.1356)	(0.1387)
Concentration	1551	63.8025	18.1122	64.4985	54.6531	76.0261	53.7048***	70.4016
							(20.5115)	(12.5530)
Denied	954	0.0353	0.1645	0	0	0	0.0487***	0.0062
							(0.1908)	(0.0452)
Deposit Insurer Power	1572	1.8397	1.4728	2	1	4	2.9042***	1.1098
							(1.5707)	(0.8100)
Hazard	1566	4.9020	1.6732	5	4	6	4.5698***	5.1161
							(1.3951)	(1.9416)
PostFSBregulation	1678	0.4357	0.4458	0	0	1	0.5503	0.5259
							(0.6592)	(0.6367)
Capital regulation	1645	3.5965	1.8086	3	3	5	3.5651	3.6178
							(1.5144)	(1.9831)
PostSystemic	1678	0.2670	0.4425	0	0	1	0.2663	0.2675
							(0.4423)	(0.4428)
Postbailout	1678	0.3343	0.4719	0	0	1	0.2663***	0.3802
							(0.4423)	(0.4857)
Size	1678	10.9767	2.5708	11.5139	9.1592	13.0626	11.8026***	10.9767
							(2.0451)	(2.5708)
Equity	1678	0.0898	0.0780	0.0707	0.0513	0.1033	0.07946***	0.0968
							(0.0404)	(0.0948)
Ln (Returnvolatility)	1678	3.2947	0.5491	3.2412	2.9112	3.6138	3.2861	3.3005
							(0.5432)	(0.5532)
Ln (Performance)	1678	8.5440	2.3242	8.8976	6.8473	10.4247	9.3852***	7.9765
							(1.9739)	(2.3712)

Panel A separately reports countries with changes in investor protection (treatment group) and countries without changes in investor protection (control group). Panel B reports summary statistics for the main variables in the regression models. Columns (1)–(6) report summary statistics for the full sample. Columns (7)–(8) present univariate results comparing the mean values of variables for treatment and control banks. Standard deviations of each variable are reported in parentheses below the corresponding mean value in columns (7)–(8). ***, **, and * in column (7) indicate significance at the 1%, 5%, and 10% levels, respectively, for a *t*-test of whether the treatment and control groups in the full sample have equal means. Table A1 in the Appendix provides variable definitions.

constant over time and changes in it capture significant changes in country investor protection.

Panel A of Table 1 reports the changes in *Investor protection* in our sample. We identify 12 changes in investor protection in 11 countries included in our database of bank executive compensation over the 2006–2014 period. There were 11 increases in investor protection and only one decrease in investor protection in the US in 2014. The other 15 countries included in the study did not experience any change in investor protection, and banks in these countries are used as the control group.

We use two proxies for bank governance and ownership: 1) the proportion of independent directors (*% Independent directors*) proxies the independence of the board of directors to monitor bank managers following shareholders' interest, and 2) the proportion of shares owned by the main shareholder (*% Main shareholder*) proxies for the diversification of shareholders' wealth, negatively related to shareholders' risk-taking incentives. Information on these variables is hand-collected and comes from banks' annual reports.

c) *Bank competition*

We use three alternative proxies for countries' bank market power inversely related to bank competition: the Boone indicator, bank concentration, and the percentage of entry applications denied. First, the Boone indicator is an annual measure of the degree of competition based on profit-efficiency in the banking market (*Boone*). It is calculated as the elasticity of profits to marginal costs. An increase in the Boone indicator implies a deterioration in the competitive conduct of financial intermediaries. Data on the Boone indicator comes from the Global Financial Development Database (GFDD) drawn up by the World Bank. Second, as an indicator of bank concentration, we use the assets of the three largest commercial banks as a share of total commercial banking assets (*Concentration*). Annual information on bank concentration comes from the GFDD drawn up by the World Bank. Finally, we use the percentage of total entry applications denied (*Denied*) as a proxy for bank market power, inversely related to bank competition. This variable comes from the World Bank's Bank Regulation and Supervision Database (WBBRSD). The information was initially collected by the World Bank in the year 2000 and subsequently updated in 2003, 2007, 2011, and 2018. Therefore, like all variables obtained from the WBBRSD, this variable varies over time but not annually.

Higher values in these three variables indicate stronger bank market power and less bank competition. Panel B of Table 1 shows that the mean values of the three proxies for bank competition are statistically different across treatment and control banks.

d) *Bank safety net*

We use two alternative proxies for the moral hazard problems created by the bank safety net in a country. First, we use the authority of the deposit insurance (*Deposit insurer power)*. This variable takes a value of one for each affirmative answer to four questions intended to gauge the power of deposit insurance. These four questions capture: 1) if the deposit insurance has the bank intervention authority as part of its mandate, 2) if it has the legal power to cancel or revoke deposit insurance for any participating bank, 3) if it has the authority to take legal action against bank directors and officers, and 4) if it has ever taken any legal action against bank directors and officers. Data on this variable varies over time and comes from the WBBRSD. Values of *Deposit insurer power* may range from 0 to 4, with a higher value indicating less generous deposit insurance and less bank risk-taking incentives related to the moral hazard problems created by the existence of a deposit insurance.

Second, we use the aggregate index of moral hazard developed by Demirguc-Kunt and Detragiache (2002) to capture the moral hazard problems arising with each national deposit insurance scheme. This index (*Hazard*) is calculated by using principal component analysis based on eight binary variables. Each variable takes the value one in the following cases: 1) membership is mandatory, 2) nominal coverage limits are not specified, 3) coinsurance does not exist for any depositors, 4) deposit-insurance obligations are funded in some way, 5) funding comes partially or totally from government, 6) the system is partially or totally managed by the government, 7) foreign-denominated deposits are explicitly covered, 8) interbank deposits are formally guaranteed. All these characteristics are positively related to more generous deposit insurance and, therefore, a higher value of *Hazard* indicates greater moral hazard problems in a country. This index does not vary over time and may range from 0 to 8. Higher values of hazard indicate more generous deposit insurance and more risk-taking incentives of bank shareholders. Panel B of Table 1 shows that the mean values of both *Deposit insurer power* and *Hazard* are statistically different between treatment and control banks.

e) *Control variables*

Regressions include control variables at both country and bank-level. We control at country level for changes in regulation affecting bank executive compensation and capital, for systemic banking crises, and for government bailouts in a country. The Financial Stability Board (FSB) promoted a new regulation in 2011 called *Principles for Sound Compensation Practices and their Implementation Standards*. This new regulation aimed to align managers and directors' incentives with long-term profitability and to encourage prudent risk-taking (Cerasi et al., 2020). It was transposed into national regulation in 2011 for banks within FSB jurisdictions and EU countries. Controlling for this regulatory change in our estimations is important because Cerasi et al. (2020) find a reduction in the variable compensation after the introduction of the Principles and Standards of Sound Compensation Practices in 2011. They find this reduction both in banks within FSB jurisdictions and in banks outside the FSB perimeter. However, they do not analyze the impact on vega. We now define a dummy variable (*PostFSBregulation*) that takes the value one after 2011 for banks in countries within FSB jurisdictions and in the EU. This variable takes the value zero for banks in these countries before 2011 and it is always 0 for banks in countries outside of FSB jurisdictions and in non-EU countries.

We additionally control for changes in the regulation of bank capital. Minimum capital requirements are the main tool in banking regulation for increasing financial stability and the 2007–2009 global financial led regulatory reforms to strengthen capital requirements (Carletti et al., 2020; Anginer et al., 2023). We control for these regulatory reforms including the Capital regulatory index (*Capital regulation*) defined by Barth et al. (2004) and using data from the World Bank's Bank Regulation and Supervision surveys. This index is the sum of two measures of capital stringency (Overall capital stringency and Initial capital stringency) and may range from 0 to 9. In particular, we use 2003 Survey data for the year 2003, we use 2007 Survey data for the years 2004–2007, 2011 Survey data for the years 2008–2010, and 2018 Survey data for the years 2011–2018.[6]

As potential confounding events, we also control for systemic banking crises and government bailouts in a country including, respectively, *PostSystemic* and *PostBailout* in our regressions. *PostSystemic* is a dummy variable that takes the value one after the onset of a systemic banking crisis in a country. This variable always takes the value zero for banks in countries that did not experience a systemic banking crisis in our analysis period. Information on countries with systemic banking crises and their duration comes from Laeven and Valencia (2018).[7] We define *PostBailout* as a dummy variable that takes the value one after a bailout process in a country. Information on bailouts comes from Laeven and Valencia (2018) and Homar and van Wijnbergen (2017). These controls are important because Abascal and González (2019) find a reduction in bank executive vega after the onset of systemic banking crises associated with the reduction in the banks' investment opportunity set. Moreover, bailouts are usually associated with specific restrictions on banks that may limit executive compensation. We alternatively include *PostSystemic* and *PostBailout* in the regressions to avoid potential correlation problems because France, Italy, and Switzerland are the only countries with bailouts that did not experience systemic banking crises.

Finally, we include four bank-level control variables: the natural logarithm of bank assets (*Size*), the equity-to-total assets ratio (*Equity*), the natural logarithm of bank risk measured by the annual standard deviation of weekly stock returns (*Ln(returnvolatility)*), and the natural logarithm of bank performance measured as total shareholders' value (*Ln(Performance)*).[8]

4. Identification strategy

We focus on the effect of time-series exogenous legal changes in investor protection on executive vega. This approach allows us to define "quasi-natural experiments" and apply a DID methodology to overcome potential problems of omitted variables and endogeneity in traditional cross-sectional analyses. We focus on changes in investor protection but not on changes in bank competition or in the safety net because investor protection is the only variable for which we can identify specific and significant changes over time. Moreover, this variable captures the ability of bank shareholders to translate their risk-taking incentives into executive compensation, whereas bank competition and moral hazard created by the safety net affect the intensity of shareholders' risk-taking incentives. Our hypotheses establish that stronger investor protection, or greater shareholder ability to define executive compensation, leads to higher vega in countries where shareholders have more risk-taking incentives. For this reason, we focus on how bank competition and the safety net in a country shape the effect of investor protection on vega.

The research design is borrowed from Djankov et al. (2007), Acharya and Subramanian (2009), and Haselmann et al. (2010). We use the following specification to apply the DID test:

$$Ln\ (vega_{i\ t}) = \alpha_0 + \alpha_1\ ProtectionChange_{j\ t} + \alpha_2\ X_{j,t} + \alpha_3\ Z_{i\ t} + \mu_i + C_j + Y_t + \varepsilon_{i,t} \tag{1}$$

where i, j, and t refer, respectively, to bank, country, and year. *Ln(vega)* is the natural logarithm of the vega option packages granted to bank executives. *ProtectionChange* measures the change in investor protection in country j in year t. For a country j that underwent an investor protection increase in year m, *ProtectionChange* equals zero (one) for the years before (after) the change, i.e., for $t \leq m$ ($t \geq m + 1$). In contrast, for a country j that underwent an investor protection decrease in year m, *ProtectionChange* equals one (zero) for the years before (after) the change, i.e., for $t \leq m$ ($t \geq m + 1$). For countries that did not experience an investor protection change, *ProtectionChange* always equals zero.[9] Since *ProtectionChange* is defined as one (zero), one year after the change for countries that increased (decreased) their investor protection, β_1 measures the DID effect a year after the change. A positive value for β_1 would indicate a positive (negative) impact of the strengthening (weakening) of investor protection on vega.

X_{jt} is the set of country-level control variables including changes in regulation affecting bank executive compensation and capital, systemic banking crises, and government bailouts in a country; Z_{it} is the set of bank-level control variables including the natural logarithm of total assets, the equity ratio, the natural logarithm of annual standard deviation of the weekly stock returns, and the natural logarithm of bank performance.

We estimate model [1] using both fixed-effect and tobit estimators. μ_i, C_j, and Y_t denote, respectively, bank-, country-, and year-fixed effects. These effects are alternatively included in the regressions. Fixed-effects estimations including individual bank effects

[6] The 2011 Survey does not provide data on the capital regulatory index for Germany or Singapore. We use data from the 2007 survey for the 2008–2010 period in these two countries.

[7] We check that the results are similar when *Postsystemic* takes the value one only in years with a systemic banking crisis but not in all years after the onset of the systemic crisis.

[8] We follow previous studies by Jensen and Murphy (1990), Crawford et al. (1995), Cuñat and Guadalupe (2009), and Abascal and González (2019), among others, to define the bank-level control variables.

[9] We account for multiple changes in investor protection. For instance, Sweden underwent increases in investor protection in 2007 and 2011. We code *ProtectionChange* as zero before 2007, one for 2008–2011, and two thereafter. Acharya and Subramanian (2009), Haselmann et al. (2010) or Simintzi et al. (2015) used a similar type of coding for multiple changes in DID analyses.

Table 2
Propensity score matching (PSM). Comparison of means across the matched sample in year t-1.

Probit in the PSM		Comparison of means in year t-1		
	Probability of changing investor protection (ProtectionChange = 1)		Treatment group (Obs. = 55)	Control group (Obs. = 55)
	(1)		(2)	(3)
Size	0.0179	Ln(vega)	5.2633	6.4983
	(0.34)		(−1.39)	
Equity	−1.4222	Ln(delta)	2.4184	2.0275
	(−1.36)		(0.79)	
Ln (Return volatility)	−0.1903**	Size	11.6133	11.9666
	(−2.04)		(−0.82)	
Ln (Performance)	0.1232**	Equity	0.0682	0.0712
	(2.38)		(−0.33)	
Intercept	−0.401	Ln (Return volatility)	3.1344	3.1908
	(−0.95)		(−0.49)	
Bank-fixed effects	No	Ln (Performance)	9.1565	9.7156
			(−1.20)	
Year-fixed effects	Yes			
LRPseudo R^2	0.0646			
# observations	626			

This table reports the results of the propensity score matching model in column (1). We estimate the probit model by retaining all observations for treatment and control banks in year t-1 relative to the change in investor protection. The dependent variable in the probit model takes the value one for banks in the treatment group. Independent variables are the bank-level control variables included in model (1). Columns (2) and (3) report the means of the bank-level variables in treatment and control matched groups in year t-1. The bank-level variables are not statistically different across the treatment and control matched groups at the 10% significance level. t-statistics are in parenthesis. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

allow us to capture any unobserved differences among banks when they are time-invariant. We also use a tobit estimator because there are banks that do not use stock options as a component of executive compensation. In consequence, vega is censored at zero and the tobit estimator may be more suitable for giving unbiased estimates (Zhou and Swan, 2003). Country dummies control for country variables not included in the regressions when they are time invariant. These country-fixed effects are only included in regressions not including bank-fixed effects because bank-fixed effects subsume their effect. Therefore, they are included in Tobit estimations. Year-fixed effects are included in all the regressions and they control for the potential confounding impact of the crisis, for potential global trends in vega and for any global change in the macroeconomic environment that may affect compensation vega in all countries in a particular year. Since our treatment is defined at country level, we cluster standard errors by country. This clustering allows us to account for potential time-varying correlations in unobserved variables that affect different banks within a given country and to control for within-bank error term correlations over time (Bertrand et al., 2004; Petersen, 2009). We check that the results do not change, and are even more significant, when we cluster standard errors by bank.[10]

The DID approach requires the treatment and the control groups to be similar before the treatment. We therefore use as a robustness check a matched control group of banks by applying a propensity score-based matching technique following Serfling (2016). In a first step, we estimate a probit model with all observations for treatment and control banks in year t-1 relative to the change in investor protection. We use a binary dependent variable taking the value one in the first group of banks. Explanatory variables are the bank-level variables included in model [1], i.e., *Size*, *Equity*, *Ln(Return volatility)*, and *Ln (performance)*. The objective is to select banks in the matched control group that are ex-ante as likely to be affected by changes in investor protection as the banks in the treatment group. This procedure allows us to reduce endogeneity concerns in the changes in investor protection. In a second step, we obtain the propensity score. In a final step, for every treated bank, we find the bank with no changes in investor protection that has the closest propensity score (with replacement).

Table 2 reports the estimation results of the probit model and the means of the bank-level variables for the treatment and control groups in year t-1 in the matched sample. The sample means of bank-level variables for matched treated and control banks are not statistically different at the 10% level. This lack of significant differences indicates the usefulness of the matching procedure for identifying a control group similar to the treated group before the treatment. We additionally control for differences among banks in the treatment and control groups by including the bank-level variables as explanatory variables in all the DID regressions.

[10] We check that the main results do not change when we apply OLS estimations with country dummy variables and clusters of standard errors at bank level. This clustering is an alternative to bank-fixed effects to control for the time-series dependence created by the omission of significant time-invariant bank-level variables (Petersen, 2009).

5. Empirical analysis

5.1. Effect of changes in investor protection

Table 3 reports initial results for model [1]. Columns (1) and (4) report positive and statistically significant coefficients for *ProtectionChange* using both fixed effects and tobit estimates. The economic impact is also significant. For instance, using the coefficients in column (1), on average, banks increase their vega by 1.56 times relative to banks in the control group after an increase in investor protection.

The positive and significant coefficients of *ProtectionChange* remain in columns (2)–(3) and (5)–(6) when we additionally include *PostFSBregulation*, *Capital regulation* and *PostSystemic* or *Postbailout. PostFSBregulation* controls for the change in regulation, directly affecting bank executive compensation, brought about by the *Principles for Sound Compensation Practices and their Implementation Standards,* promoted by the FSB after 2011 in FSB jurisdictions and EU countries. The negative and significant coefficients of *PostFSBregulation* in all the estimations are consistent with this regulatory change being effective for reducing vega and the risk-taking incentives in executive compensation contracts. They are also consistent with the reduction in variable compensation found by Cerasi et al. (2020) after the introduction of this regulation in FSB and EU countries in 2011. The coefficients of *Capital regulation*, *PostSystemic* and *PostBailout* are negative but statistically insignificant at conventional levels in all the estimations.

The above results suggest that a strengthening (weakening) in investor protection increases (reduces) compensation vega. This positive relationship supports our hypothesis H1. After investor protection has been strengthened in a country, the ability of bank shareholders to translate their risk-taking incentives into bank executive compensation increases and leads to higher vega.

We analyze whether the effect of the change in investor protection varies depending on if there is an increase or a decrease in

Table 3
Vega and changes in investor protection.

	Fixed effects			Tobit		
	(1)	(2)	(3)	(4)	(5)	(6)
ProtectionChange	1.5571***	1.3340***	1.3238***	2.6400***	1.9291*	2.0263*
	(3.87)	(3.49)	(3.59)	(3.27)	(1.72)	(1.86)
PostFSBregulation		−1.3394***	−1.2791***		−4.7347***	−4.8226***
		(−2.93)	(−2.71)		(−3.30)	(−3.25)
Capital regulation		−0.0723	−0.0691		−0.0946	−0.0653
		(−0.65)	(−0.60)		(−0.35)	(−0.23)
PostSystemic		−0.6603			−1.7707	
		(−1.28)			(−0.88)	
PostBailout			−0.6305			−1.1127
			(−1.11)			(−0.60)
Size	0.0649	0.2007	0.2010	−0.5342	−0.2357	−0.2365
	(0.58)	(1.44)	(1.44)	(−0.93)	(−0.48)	(−0.48)
Equity	−0.3393	0.8975	0.7172	−0.7401	2.7913	2.5515
	(−0.31)	(0.64)	(0.52)	(−0.11)	(0.54)	(0.49)
Ln (Return volatility)	−0.6107***	−0.4473**	−0.4503**	−0.7563	−0.1494	−0.1893
	(−2.68)	(−2.42)	(−2.37)	(−1.01)	(−0.15)	(−0.19)
Ln (Performance)	0.2316**	0.2048*	0.1973**	1.4058***	1.3031***	1.3021***
	(2.06)	(1.95)	(1.96)	(3.06)	(3.09)	(3.04)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	No	No	No	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	No	No	No
Clustering	Country	Country	Country	Country	Country	Country
R^2	0.2137	0.2400	0.2373	0.1733	0.1922	0.1915
# Observations	1678	1678	1678	1678	1678	1678
# Banks	135	135	135	135	135	135

This table reports the results of model [1]. The dependent variable is the natural logarithm of vega *(Ln(vega))*. It is defined as the dollar change in the value of the annual options granted to bank executives for a 0.01 change in volatility of stock returns. *ProtectionChange* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after the increase (decrease). It always takes the value zero for countries that do not experience any change in investor protection. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic crises. Otherwise, it takes the value zero. *PostBailout* is a dummy variable that takes the value one after the year of the bailout for banks in countries experiencing bailouts. Otherwise, it takes the value zero. *Size*, *Equity*, *Ln(Returnvolatility)* and *Ln(Performance)* are the bank-level control variables. Bank- and country-level control variables are defined in the Appendix (Table A1). T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

Table 4
Vega and changes in investor protection: different types of changes.

	Ln(vega)							
		Fixed effects			Tobit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Change_Increase	1.5433***		1.3963***		2.8408***		2.2147**	
	(3.16)		(3.07)		(3.46)		(1.99)	
Change_Decrease	1.6287***		1.0119***		1.6816**		0.3750	
	(10.53)		(4.81)		(2.53)		(0.45)	
Change_Beforecrisis		1.1900***		0.7825**		3.1310***		1.6332*
		(3.05)		(2.30)		(2.92)		(1.66)
Change_Aftercrisis		1.7956***		1.6680***		2.7812*		2.8946*
		(3.02)		(2.85)		(1.95)		(1.90)
PostFSBregulation			−1.3558***	−1.3048***			−4.8013***	−4.9417***
			(−2.95)	(−2.97)			(−3.40)	(−3.79)
Capital regulation			−0.0718	−0.0275			−0.0910	−0.0510
			(−0.64)	(−0.21)			(−0.33)	(−0.17)
PostSystemic			−0.6567	−0.6557			−1.8486	−0.9852
			(−1.27)	(−1.36)			(−0.92)	(−0.53)
Size	0.0647	0.0161	0.2024	0.1936	−0.5180	−0.5283	−0.2046	−0.2442
	(0.58)	(0.09)	(1.45)	(0.87)	(−0.91)	(−0.94)	(−0.42)	(−0.50)
Equity	−0.3306	−0.4576	0.8763	0.4120	−0.9034	−0.8492	2.6044	2.1771
	(−0.30)	(−0.28)	(0.62)	(0.24)	(−0.14)	(−0.13)	(0.49)	(0.41)
Ln (Return volatility)	−0.6116***	−0.6073***	−0.4437**	−0.4587**	−0.7294	−0.7619	−0.0905	−0.2411
	(−2.71)	(−2.96)	(−2.43)	(−2.40)	(−0.69)	(−0.74)	(−0.09)	(−0.25)
Ln (Performance)	0.2320**	0.1890	0.2048*	0.1617*	1.3960***	1.3986***	1.2853***	1.2942***
	(2.07)	(1.65)	(1.94)	(1.72)	(3.05)	(3.06)	(3.07)	(3.03)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	No	No	No	No
Clustering	Country	Country	Country	Country	Country	Country	Country	Country
R^2	0.2144	0.2145	0.2355	0.2328	0.1737	0.1748	0.1932	0.1930
# Observations	1678	1678	1678	1678	1678	1678	1678	1678
# Banks	135	135	135	135	135	135	135	135

This table reports the results of model [1]. The dependent variable is the natural logarithm of vega *(Ln(vega))*. It is defined as the dollar change in the value of the annual options granted to bank executives for a 0.01 change in volatility of stock returns. *Change_Increase (Change_Decrease)* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after the increase (decrease). Otherwise, it takes the value zero. *Change_Beforecrisis* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after the increase (decrease) when the change in investor protection took place before 2008. Otherwise, it takes the value zero. *Change_Aftercrisis* is similar but identifies changes in investor protection taking place after 2008. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic crises. Otherwise, it takes the value zero. *PostBailout* is a dummy variable that takes the value one after the year of the bailout for banks in countries experiencing bailouts. Otherwise, it takes the value zero. *Size*, *Equity*, *Ln(Returnvolatility)* and *Ln(Performance)* are the bank-level control variables. Bank and country-level control variables are defined in the Appendix (Table A1). T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

investor protection. We use two separate dummy variables for each particular type of change in investor protection *(Change_Increase* and *Change_Decrease)*.[11] We additionally analyze potential differences between the effect of changes in investor protection before and after the onset of the global financial crisis by including two separate treatment variables depending on if the change happens before or after 2008 (*Change_Beforecrisis* and *Change_Aftercrisis*). Most of the changes in investor protection (9 out of 12) happened after the onset of the crisis, when regulatory changes in the banking sector were more diverse and intense. Therefore, significant coefficients for our treatment variables, both before and after the crisis, would reduce concerns regarding confounding effects after the onset of the global financial crisis.

We report the results in Table 4. The coefficients of the treatment variables are always positive and mostly statistically significant. Only the coefficient of *Change_Decrease* in column (7) is not statistically significant at conventional levels when we use tobit estimations. Therefore, these results suggest that there are no differences whether the change is an increase or a decrease in investor protection or whether the change in investor protection occurs before or after the onset of the global financial crisis. The coefficients of the control variables are similar to those reported in Table 3. *PostFSBregulation* has significant negative coefficients and *Capital*

[11] Only the US experienced a decrease, whereas all other countries in the treatment group increased their investor protection. Therefore, this separated analysis also captures the effect of any potential over-representation of US banks in our sample.

Table 5
Vega and changes in investor protection: matched sample.

	Fixed effects				Tobit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ProtectionChange	1.5592***	1.3071***			2.7080***	1.9917*		
	(4.00)	(3.60)			(3.44)	(1.91)		
Change_Increase			1.3637**				2.2897**	
			(3.13)				(2.16)	
Change_Decrease			1.0201***				0.4204	
			(3.81)				(0.51)	
Change_Beforecrisis				0.6699*				1.4726
				(1.67)				(1.14)
Change_Aftercrisis				1.7140***				2.9916**
				(2.87)				(1.92)
PostFSBregulation		−1.1715**	−1.1938**	−1.1751**		−4.0141**	−4.0947**	−4.1612***
		(−2.02)	(−2.04)	(−2.13)		(−2.35)	(−2.45)	(−2.84)
Capital regulation		−0.0580	−0.05669	0.0116		0.0835	0.0925	0.1087
		(−0.35)	(−0.34)	(0.06)		(0.22)	(0.24)	(0.26)
PostSystemic		−0.7847	−0.7730	−0.8114		−1.3329	−1.3866	−1.1926
		(−1.13)	(−1.12)	(−1.40)		(−0.57)	(−0.60)	(−0.51)
Size	0.1320	0.2691	0.2711	0.2170	−0.3562	−0.1067	−0.0816	−0.1275
	(1.00)	(1.45)	(1.47)	(0.71)	(−0.60)	(−0.22)	(−0.17)	(−0.26)
Equity	−0.2672	0.8819	0.8704	0.5899	−2.7043	1.0877	0.3233	0.2943
	(−0.14)	(0.40)	(0.40)	(0.21)	(−0.35)	(0.18)	(0.05)	(0.05)
Ln (Return volatility)	−0.6368**	−0.4640**	−0.4602**	−0.4461*	−1.4235	−0.8585	−0.7758	−0.9211
	(−2.37)	(−2.12)	(−2.13)	(−2.03)	(−1.27)	(−0.85)	(−0.77)	(−0.92)
Ln (Performance)	0.1733	0.1403	0.1405	0.1015	1.1568***	1.0878***	1.0781**	1.0855**
	(1.59)	(1.32)	(1.32)	(1.19)	(2.61)	(2.59)	(2.55)	(2.56)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	No	No	No	No
Clustering	Country	Country	Country	Country	Country	Country	Country	Country
R^2	0.2205	0.2431	0.2387	0.2319	0.1853	0.2012	0.2025	0.2032
# Observations	1368	1368	1368	1368	1368	1368	1368	1368
# Banks	110	110	110	110	110	110	110	110

This table reports the results of model [1] using the matched sample as the control group, i.e., comparing banks in reforming countries with the propensity score-based control group. The dependent variable is the natural logarithm of vega *(Ln(vega))*. *ProtectionChange* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after the increase (decrease). It always takes the value zero for countries that do not experience any change in investor protection. *Change_Increase (Change_Decrease)* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after the increase (decrease). Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic crises. Otherwise, it takes the value zero. *Size*, *Equity*, *Ln(Returnvolatility)* and *Ln(Performance)* are the bank-level control variables. Bank- and country-level control variables are defined in the Appendix (Table A1). T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

regulation and *PostSystemic* do not have statistically significant coefficients.[12]

5.2. Controlling for a matched sample

We check the robustness of the results using the matched control group of banks defined by a propensity score-based matching technique. The results in Table 5 are similar to those reported in Tables 3 and 4 using the full sample. The coefficients of *ProtectionChange* are always positive and significant. The positive and significant coefficients remain in column (3) when we use fixed-effects estimations and separate the treatment variable into two variables to capture a potential different effect for increases and decreases in investor protection. Similarly, the coefficients remain positive and significant in column (4) when we separate the treatment variable to distinguish changes in investor protection before and after 2008. Although positive, the coefficients of *Change_Decrease* and *Change_Beforecrisis* are not statistically significant at conventional levels when we use tobit estimations for results reported in columns (7) and (8) respectively.

The coefficients of *PostFSBregulation* remain negative in all the estimations. Similar to Tables 3 and 4 using the full sample, the coefficients of *Capital regulation* and *PostSystemic* are negative but insignificant. Therefore, the results for the matched sample confirm that a strengthening (weakening) in investor protection increases (reduces) vega after controlling for regulatory changes in bank

[12] We do not report results using *PostBailout* as an alternative control to *PostSystemic* in this table and in following ones to save space and because the results are similar.

executive compensation and systemic banking crises.

5.3. Parallel trends and exogeneity conditions

We check that the analysis meets the two conditions required to apply DID tests. First, the "parallel trends" condition implies that, in the absence of changes in investor protection, executive vega should be similar for both the treatment and control groups. Second, the change in investor protection should be exogenous with respect to vega, or changes in investor protection should be for reasons other than differences in the executive vega.

The parallel trends condition requires the existence of similar trends before the change in investor protection for both treatment and control groups. To test this condition, we follow Acharya et al. (2014), Serfling (2016) and Favara et al. (2021), and regress vega on a set of dummy variables indicating the year relative to the change in investor protection, for up to 5 years before and after the change. Therefore, $D^{j\ (+j)}$ equals one for banks in the jth year before the increase (decrease) in investor protection in their country, while $D^{+j\ (-j)}$ equals one for banks in the jth year after the increase (decrease) in investor protection. Otherwise, the dummy variables equal zero. Regressions include the bank- and country-level controls included in model [1], bank-fixed effects, and year-fixed effects, and cluster the standard errors at the country level. Specifically, we report estimated coefficients from the following regression:

$$Ln\ (vega_{i\ t}) = \alpha + \beta_1\ D_{jt}^{-5} + + \beta_2\ D_{jt}^{-4} + \ldots + \beta_{10}\ D_{jt}^{+5} + \alpha_1\ X_{j,t} + \alpha_2\ Z_{i\ t} + \mu_i + Y_t + \varepsilon_{i,t} \tag{2}$$

Panel A of Graph 1 presents the results using the full sample. The results are similar using the matched sample. The Y-axis plots the estimated coefficients on vega. The X-axis shows the year relative to the change in investor protection for +/− 5 years around the change. The vertical lines represent 90% confidence intervals of the coefficient estimates, adjusted for country-level clustering. Panel A shows that the parallel trends condition is verified because vega is not statistically different between treated and control banks before the change in investor protection. However, vega is significantly higher for treated banks after the increase in investor protection. Panel A also shows that the higher increase in vega happens two years after the change in investor protection whereas there is a reduction in vega three and four years after the change compared to two years after the change in investor protection. Panel B reports the results of model [2] but using the period −3/+3 or more years after the change in investor protection to analyze if the increase in vega remains three or more years after the change in investor protection. We now create dummy year variables indicating the year relative to the change in investor protection for up to 3 years before and after the change in investor protection, but the final time dummy (D3PLUS) takes a value equal to one for treated banks three or more years after the change in investor protection. Panel B shows that the positive impact on vega exists beyond the second year.

We also need to verify that the changes in investor protection are exogenous to executive vega. This condition is not guaranteed ex ante and changes in investor protection might be endogenous. For instance, authorities might aim to counteract high vegas and, therefore, high risk-taking incentives for managers, by strengthening investor protection. Stronger investor protection would allow shareholders to focus their risky investments on positive NPV projects and to reduce risky but negative NPV projects under high risk-taking incentives induced by high vegas. In this case, there would also be a positive relationship between a strengthening in investor protection and vega, but the causality would run from vega to investor protection.

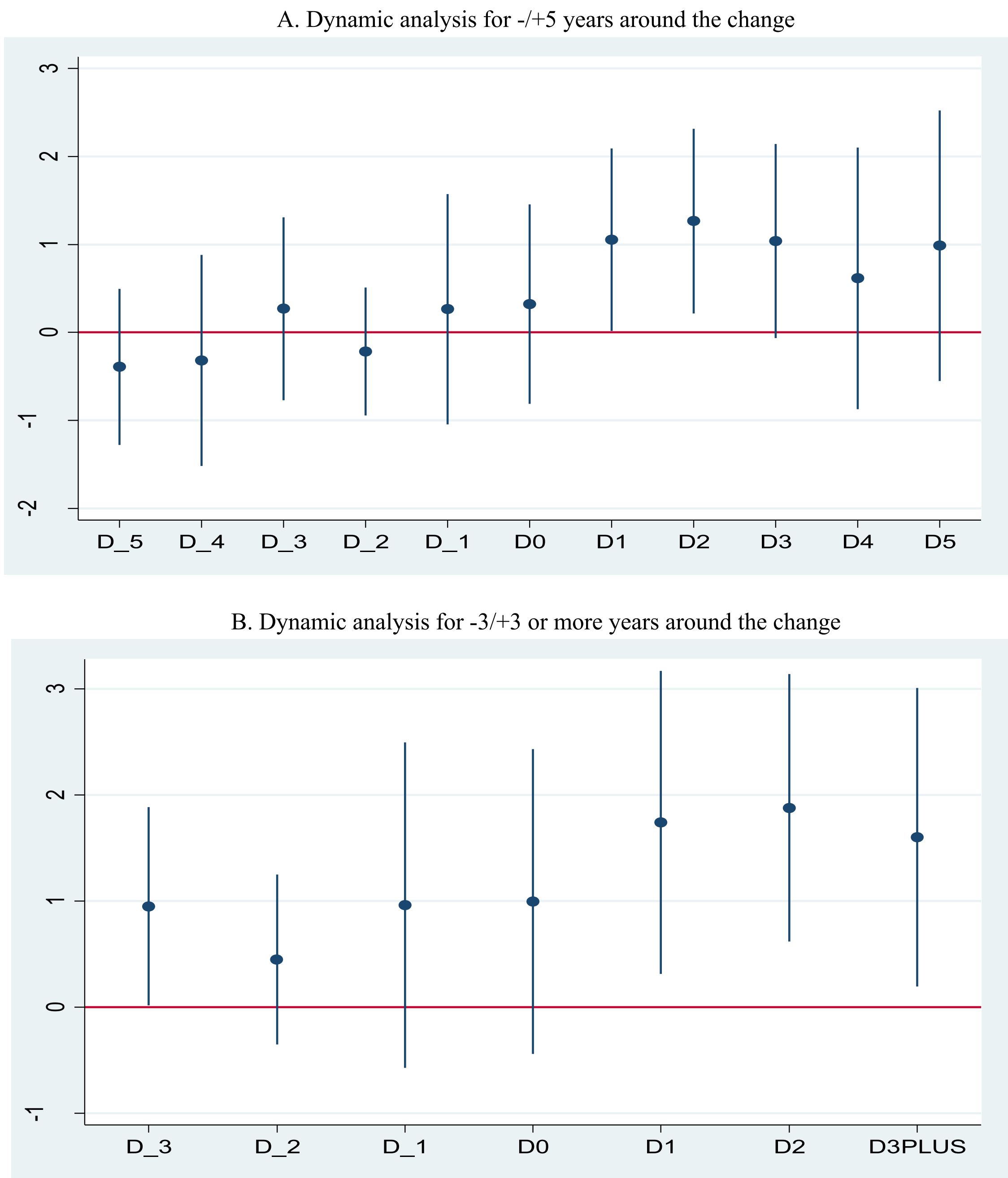
We now follow Bertrand and Mullainathan (2003) and Acharya and Subramanian (2009) to test the exogeneity of changes in investor protection by examining their dynamic effects. If the change in investor protection responds to a change in vega, then we might see an "effect" of the investor protection even prior to the change itself. For this reason, we break down the change in investor protection into three separate time periods. i) *ProtectionChange (−2,−1)*, which captures any effects from two years before to a year before the change; (ii) *ProtectionChange (0,1)*, which captures the effect in the year of the change and the year after the change; and (iii) *ProtectionChange (≥ 2)*, which captures the effect two years after the change and beyond. With this design, the coefficients of *ProtectionChange (−2,-1)* should be insignificant to verify the exogeneity assumption.

Table 6 reports the results. Columns (1)–(4) report the results for the full sample and columns (5)–(8) report the results using the propensity-scored based group as the control group. The coefficients of *ProtectionChange (−2,-1)* are non-significant at conventional levels in all the estimations. We also find that the coefficients of *ProtectionChange (0,1)* are positive but non-significant, whereas all the coefficients of *ProtectionChange (≥ 2)* are significant and positive at conventional levels. These results suggest that there is no positive relationship between investor protection and vega before the change in investor protection and that the causality runs from investor protection to vega and not vice versa. Moreover, they suggest that the change in vega following the change in investor protection is persistent over time.

5.4. The influence of board independence and ownership structure

We now analyze how board independence and ownership structure shape the influence of investor protection on vega. We use, respectively, the proportion of independent directors (*% Independent directors*) and the proportion of shares owned by the main shareholder (*% Main shareholder*) as proxies, and include interactions of these proxies with our treatment variable.[13] Table 7 reports the results for the full sample in Panel A and for the matched sample in Panel B. To save space, we do not report the coefficients for the

[13] We check that the results do not change when we use the proportion of shares owned by the three main shareholders instead of the main shareholder. Regressions use 122 banks because we did not get information for 13 banks on the composition of the board of directors and ownership structure.



Graph 1. The dynamic impact of investor protection on vega.
The figure shows the effect of the change in investor protection on vega using the full sample. The Y-axis plots the estimated coefficients on vega. The X-axis shows the year relative to the change in investor protection for −/+ 5 years around the change in Panel A and for −3/+3 or more years around the change in Panel B. The vertical lines represent 90% confidence intervals of the coefficient estimates from model [2]. Together with dummy variables capturing the year around the change in investor protection, regressions include the bank- and country-level controls included in model [1], bank-fixed effects and year-fixed effects, and cluster the standard errors at the country level.

bank-level control variables.

The coefficients of *ProtectionChange* are negative and significant, whereas the coefficients of the interaction *ProtectionChange* % Independent directors* are positive and significant in all the estimations. These coefficients indicate that an increase in investor protection only increases vega in banks where the presence of independent directors allows better compliance with shareholders' interests. Therefore, a higher proportion of independent directors acts as a complement of investor protection to allow shareholders to translate their higher risk-taking incentives into a higher vega. Our results are robust in both the full sample and the matched sample, and using

Table 6
Vega and changes in investor protection: Dynamic analysis.

	Full sample				Matched sample			
	Fixed effects		Tobit		Fixed effects		Tobit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ProtectionChange (−2,-1)	0.3520	0.0548	0.3704	−0.8848	0.3885	0.0520	0.3133	−0.8585
	(0.87)	(0.11)	(0.30)	(−0.58)	(1.08)	(0.11)	(0.25)	(−0.58)
ProtectionChange (0,1)	0.2289	0.2089	0.4559	0.6932	0.1520	0.1806	0.4541	0.6964
	(0.92)	(0.90)	(0.71)	(1.20)	(0.83)	(0.64)	(0.63)	(1.18)
ProtectionChange (≥ 2)	1.1406***	1.1584***	2.0393***	2.1706***	1.1583***	1.1529***	2.1526***	2.2058***
	(5.18)	(4.88)	(4.67)	(4.41)	(5.40)	(4.71)	(5.04)	(4.56)
PostFSBregulation		−1.3393***		−4.7839***		−1.1732**		−4.0614**
		(−2.86)		(−3.26)		(−1.96)		(−2.32)
Capital regulation		−0.0710		−0.0693		−0.0557		0.1177
		(−0.63)		(−0.26)		(−0.33)		(0.31)
PostSystemic		−0.6482		−1.8964		−0.7668		−1.4485
		(−1.27)		(−1.02)		(−1.11)		(−0.65)
Size	0.0636	0.1992	−0.5314	−0.2348	0.0764	0.2675	−0.3537	−0.1061
	(0.59)	(1.46)	(−0.92)	(−0.47)	(0.32)	(1.46)	(−0.59)	(−0.21)
Equity	−0.3105	0.8749	−0.7506	2.7625	−0.1450	0.8535	−2.7368	0.9893
	(−0.28)	(0.63)	(−0.12)	(0.53)	(−0.05)	(0.40)	(−0.35)	(0.16)
Ln (Return volatility)	−0.6118***	−0.4521**	−0.7595	−0.1530	−0.6076**	−0.4698**	−1.4264	−0.8566
	(−2.71)	(−2.42)	(−0.72)	(−0.15)	(−2.51)	(−2.12)	(−1.27)	(−0.86)
Ln (Performance)	0.2251**	0.2030*	1.4005***	1.3049***	0.1383	0.1386	1.1516***	1.0896**
	(2.08)	(1.95)	(3.04)	(3.03)	(1.39)	(1.32)	(2.58)	(2.54)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Bank-fixed effects	Yes	Yes	No	No	Yes	Yes	No	No
Clustering	Country	Country	Country	Country	Country	Country	Country	Country
R^2	0.2158	0.2424	0.1734	0.1926	0.2171	0.2454	0.1854	0.2016
# Observations	1678	1678	1678	1678	1368	1368	1368	1368
# Banks	135	135	135	135	110	110	110	110

This table reports the results of model [1]. The DID analysis compares different groups of banks: Columns (1)–(4) compare banks in reforming countries with banks in all non-reforming countries; Columns (5)–(8) compare reforming countries with the propensity score-based control group. The dependent variable is the natural logarithm of vega *(Ln(vega))*. It is defined as the dollar change in the value of the annual options granted to bank executives for a 0.01 change in volatility of stock returns. We break down the change in investor protection into several variables that capture dynamic effects. *ProtectionChange (−2,-1)* captures any effects from two years before to one year before the change; *ProtectionChange (0,1)* captures the effect in the year of the change and the year after the change; and *ProtectionChange (≥ 2)* captures the effect two years after the change and beyond. These variables always take the value zero for countries that do not experience any change in investor protection. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic banking crises. Otherwise, it takes the value zero. *Size*, *Equity*, *Ln(Returnvolatility)* and *Ln(Performance)* are the bank-level control variables. Bank and country-level control variables are defined in the Appendix (Table A1). T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

both fixed-effects and tobit estimates. The coefficients of the percentage of independent directors (*% Independent directors*) are positive and significant in the tobit estimations but are non-significant in the fixed-effects estimations. The significant positive coefficients are consistent with a higher percentage of independent directors allowing bank shareholders to translate their risk-taking incentives into higher vegas to a greater extent, even in countries with lower investor protection. These results are consistent with our H1 and with a higher proportion of independent directors increasing the power of shareholders within the corporate governance of each bank.

The results for the proportion of shares owned by the main shareholder are non-significant. Although mostly negative, the non-significant coefficients of *% Main shareholder* prevent us from concluding that lower risk-taking incentives of less diversified shareholders promote lower vegas. Similarly, the non-significant coefficients of *ProtectionChange* % Main shareholder* prevent us from concluding that lower risk-taking incentives of less diversified shareholders reduce the positive impact of increases in investor protection on vegas in our sample.

5.5. Delta and changes in investor protection

We check the robustness of the results using delta as an alternative dependent variable.[14] Table 8 reports the results using both the full sample and the matched sample. The coefficients of *ProtectionChange* are positive and significant in our basic estimations reported

[14] Delta has traditionally been used as a proxy for the incentives embedded in compensation packages although its influence on manager risk-taking incentives is less clear because there are two opposite effects. A higher delta increases the benefits for managers of undertaking risky projects with positive NPV but reinforces managerial risk aversion.

Table 7
Vega and changes in investor protection: the role of corporate governance.

	Full sample				Matched sample			
	Fixed effects		Tobit		Fixed effects		Tobit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ProtectionChange	−2.3243***	−2.1684**	−12.3307***	−10.7030***	−2.3955**	−2.3495**	−11.2286***	−10.4170***
	(−2.68)	(−2.27)	(−2.82)	(−2.89)	(−2.55)	(−2.47)	(−2.59)	(−2.75)
ProtectionChange* % Independent directors	5.0648***	5.2703***	20.9524***	19.5970***	5.0706***	5.2477***	19.6053***	18.7562***
	(3.82)	(3.47)	(3.73)	(4.09)	(3.67)	(3.46)	(3.54)	(3.86)
ProtectionChange* % Main shareholder		−0.3507		−2.5255		−0.1247		−1.5244
		(−0.77)		(−0.91)		(−0.27)		(−0.53)
% Independent directors	−0.7363	−0.4142	3.8562**	3.7811**	−0.9877	−0.5639	4.6242**	3.7625*
	(−0.66)	(−0.36)	(2.11)	(2.14)	(−0.77)	(−0.40)	(2.14)	(1.78)
% Main shareholder		−0.0142		0.7561		−0.3907		−0.6800
		(−0.04)		(0.52)		(−1.08)		(−0.46)
PostFSBregulation	−1.2693**	−1.1804**	−4.3426***	−4.2659***	−1.0225*	−0.8703	−3.8922***	−3.7347***
	(−2.45)	(−2.02)	(−3.92)	(−3.65)	(−1.69)	(−1.35)	(−3.03)	(−2.80)
Capital regulation	−0.06097	−0.1442	−0.4670	−0.4415	−0.3402	−0.1049	−0.5663	−0.5679
	(−0.50)	(−1.10)	(−1.63)	(−1.59)	(−0.18)	(−0.55)	(−1.63)	(−1.62)
PostSystemic	−0.7012	−0.5113	−2.2178	−2.1193	−0.8932	−0.8084	−2.2137	−2.4394
	(−1.29)	(−0.88)	(−1.41)	(−1.34)	(−1.32)	(−1.09)	(−1.23)	(−1.34)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Bank-fixed effects	Yes	Yes	No	No	Yes	Yes	No	No
Clustering	Country	Country	Country	Country	Country	Country	Country	Country
R^2	0.2818	0.2979	0.1796	0.1931	0.2768	0.3046	0.1881	0.2091
# Observations	1379	971	1379	971	1122	771	1122	771
# Banks	122	122	122	122	98	98	98	98

This table reports the results of model [1] incorporating additional corporate governance variables. The dependent variable is the natural logarithm of vega *(Ln(vega))*. *ProtectionChange* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after the increase (decrease). It always takes the value zero for countries that do not experience any change in investor protection. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic crises. Otherwise, it takes the value zero. *% Independent directors* is the proportion of independent directors. *% Main shareholder* is the proportion of shares owned by the main shareholder. All regressions include bank-level control variables although they are not reported to save space. The bank-level control variables are *Size*, *Equity*, *Ln(Returnvolatility)* and *Ln(Performance)*. Bank and country-level control variables are defined in the Appendix (Table A1). The DID analysis compares different groups of banks: Columns (1)–(4) compare banks in reforming countries with banks in all non-reforming countries; Columns (5)–(8) compare reforming countries with the propensity score-based control group. T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

in columns (1), (4), (7), and (10). These results are similar to the results in Table 3 using vega as the dependent variable. The dynamic analysis shows that the coefficients of *ProtectionChange (−2,-1)* are not statistically significant at conventional levels in any estimation. The only significant coefficients are those of *ProtectionChange (0,1)* and/or *ProtectionChange(≥ 2)* in columns (2), (5), (8), and (11). These results are also in line with those reported in Table 6 using vega as the dependent variable and confirm that causality runs from the change in investor protection to delta and not vice versa.

Similar to using vega in Table 7, the positive and significant coefficients of the interaction term *ProtectionChange* % Independent directors* in columns (3), (6), (9), and (12), indicate that a more independent board is associated with a greater positive impact of increases in investor protection on delta. The positive and significant coefficients of *% Independent directors* in columns (6) and (12) are also consistent with a greater presence of independent directors promoting a higher delta to better satisfy shareholders' interests. Similar to the results for vega, we find a non-significant effect for the proportion of shares owned by the main shareholders, because none of the coefficients of *% Main shareholder* or of its interaction with *ProtectionChange* are statistically significant at conventional levels.

Finding similar results using vega and delta as alternative dependent variables is consistent with the findings of DeYoung et al. (2013). The results suggest that banks tend to change pay-performance sensitivity in the same direction as pay-risk sensitivity when they aim to modify managers' risk-taking incentives.

5.6. *The influence of market competition and safety nets*

We now analyze whether the positive effect of the change in investor protection on vega varies across banks depending on competition and safety nets in a country. Higher bank competition and more extensive safety nets increase the benefits of risk-taking for bank shareholders. Therefore, we expect that an increase in the ability of shareholders to establish managerial compensation in line with their interests would have a greater positive impact on vega in countries with greater bank competition and more extensive safety nets. These predictions are formulated in our hypotheses H2 and H3. To test these hypotheses, we now include interaction terms between the treatment dummy variable and the particular proxy for bank market power and the safety net. Table 9 reports the results

Table 8
Delta and changes in investor protection.

	Full sample						Matched sample					
	Fixed-effects			Tobit			Fixed-effects			Tobit		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ProtectionChange	0.5759**		−1.2682**	0.7937*		−6.2101***	0.5445***		−1.3363**	0.7778*		−5.7687***
	(2.44)		(−2.27)	(1.84)		(−3.11)	(2.59)		(−2.36)	(1.92)		(−2.94)
ProtectionChange (−2,-1)		−0.0375			−0.4927			−0.0185			−0.4737	
		(−0.14)			(−0.59)			(−0.07)			(−0.63)	
ProtectionChange (0,1)		0.5638***			0.1104			0.5775***			0.0810	
		(3.88)			(0.45)			(3.96)			(0.32)	
ProtectionChange ($\geq$ 2)		0.4868*			1.1055***			0.4918*			1.0915***	
		(1.69)			(6.11)			(1.72)			(5.84)	
ProtectionChange * % Independent directors			2.7131***			10.7092***			2.62637***			9.9185***
			(3.12)			(4.18)			(3.16)			(3.93)
ProtectionChange * % Main shareholder			0.0731			−0.6865			0.1574			−0.2799
			(0.25)			(−0.51)			(0.62)			(−0.20)
% Independent directors			−0.1747			2.0544**			−0.2140			2.2126**
			(−0.30)			(2.48)			(−0.31)			(2.09)
% Main shareholder			0.1291			0.2082			−0.0461			−0.5731
			(0.96)			(0.30)			(−0.41)			(−0.79)
PostFSBregulation	−0.4547*	−0.5055***	−0.3636	−2.2166***	−2.2354***	−1.8675***	−0.3207	−0.5216	−0.1378	−1.7322***	−1.7480*	−1.5759***
	(−1.82)	(−2.96)	(−1.16)	(−5.01)	(−2.93)	(−3.36)	(−1.01)	(−1.13)	(−0.41)	(−3.87)	(−1.89)	(−2.57)
Capital regulation	−0.0212	−0.1156	−0.0910*	−0.0606	−0.0496	−0.2067*	−0.0026	−0.1374	−0.0590	0.0186	0.0317	−0.2398*
	(−0.45)	(−1.12)	(−1.70)	(−0.55)	(−0.41)	(−1.84)	(−0.04)	(−1.06)	(−0.82)	(0.14)	(0.20)	(−1.67)
PostSystemic	−0.3232	−0.3283	−0.2136	−0.9658*	−1.0459	−0.8485	−0.4338	−0.3207	−0.3958	−0.9286	−1.0112	−0.9078
	(−1.25)	(−1.43)	(−0.77)	(−1.84)	(−1.10)	(−1.11)	(−1.29)	(−1.06)	(−1.16)	(−1.63)	(−0.88)	(−1.06)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No
Clustering	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country
R^2	0.1572	0.1601	0.2092	0.2133	0.2137	0.2193	0.1416	0.1732	0.2292	0.2287	0.2292	0.2449
# Observations	1678	1678	971	1678	1678	971	1368	1368	771	1368	1368	771
# Banks	135	135	122	135	135	122	110	110	98	110	110	110

This table reports the results of model [1] using the natural logarithm of delta *(Ln(delta))* as the dependent variable. Delta is defined as the change in the dollar value of the executive stock option portfolio for a 0.01 change in stock price. *ProtectionChange* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after an increase (decrease). It always takes the value zero for countries that do not experience any change in investor protection. We break down the change in investor protection into several variables that capture dynamic effects. *ProtectionChange (−2,-1)* captures any effects from two years before to one year before the change; *ProtectionChange (0,1)* captures the effect in the year of the change and the year after the change; and *ProtectionChange ($\geq$ 2)* captures the effect two years after the change and beyond. These variables always take the value zero for countries that do not experience any change in investor protection. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic crises. Otherwise, it takes the value zero. *% Independent directors* is the proportion of independent directors. *% Main shareholder* is the proportion of shares owned by the main shareholder. All regressions include bank-level control variables although they are not reported to save space. The bank-level control variables are *Size*, *Equity*, *Ln(Returnvolatility)* and *Ln(Performance)*. Bank- and country-level control variables are defined in the Appendix (Table A1). The DID analysis compares different groups of banks: Columns (1)–(6) compare banks in reforming countries with banks in all non-reforming countries; Columns (7)–(12) compare reforming countries with the propensity score-based control group. T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

Table 9
Vega and changes in investor protection: differences depending on market power.

	Full sample						Matched sample					
	Fixed-effects			Tobit			Fixed-effects			Tobit		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ProtectionChange	1.0814***	1.7613**	0.7949	4.5178***	2.2640	3.6991**	0.9819***	1.6867*	0.6685*	4.4139***	−0.1062	3.8367**
	(2.57)	(2.10)	(1.62)	(3.72)	(0.53)	(2.28)	(2.57)	(1.92)	(1.67)	(3.23)	(−0.02)	(2.42)
ProtectionChange * Boone	0.5134			11.4316			0.6522			10.7591		
	(0.35)			(1.11)			(0.52)			(0.99)		
ProtectionChange * Concentration		−0.0099			0.0064			−0.0093			0.0444	
		(−0.55)			(0.07)			(−0.51)			(0.50)	
ProtectionChange * Denied			−0.0012			−1.1798*			0.0239			−1.2540**
			(−0.01)			(−1.93)			(0.30)			(−2.23)
Boone	−1.1808*			−1.5386			−1.6070**			−0.9004		
	(−1.65)			(−0.32)			(−2.05)			(−0.16)		
Concentration		−0.0291***			−0.1198**			−0.0424***			−0.1740***	
		(−2.70)			(−2.43)			(−4.37)			(−3.45)	
Denied			−0.0552**			−0.1397			−0.1127			−0.1764
			(−2.27)			(−1.18)			(−1.34)			(−0.89)
PostFSBregulation	−1.7460***	−1.4825***	−1.5219**	−4.6859**	−4.0963**	−6.0894***	−1.5421**	−1.2578**	−1.6473*	−3.9314	−3.4858*	−6.4693***
	(−3.47)	(−3.61)	(−2.43)	(−2.33)	(−2.48)	(−4.32)	(−2.24)	(−2.53)	(−1.79)	(−1.45)	(−1.68)	(−4.16)
Capital regulation	−0.0760	−0.1130	−0.0843	−0.7301	−1.0827**	−0.1246	−0.1052	−0.1300	−0.0338	−0.7509	−1.2632**	0.3032
	(−0.67)	(−0.97)	(−0.84)	(−1.47)	(−2.11)	(−0.31)	(−0.67)	(−0.78)	(−0.16)	(−1.34)	(−2.13)	(0.49)
PostSystemic	−1.0127*	−0.6503	−0.5735	−3.8188	−4.4963	−3.7758*	−1.4182**	−0.7772	−0.2261	−3.9683	−4.5814	−6.4683***
	(−1.81)	(−1.15)	(−1.02)	(−1.18)	(−1.51)	(−1.83)	(−2.06)	(−1.08)	(−0.33)	(−1.03)	(−1.39)	(−2.99)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No
Clustering	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country
R^2	0.2691	0.3131	0.2442	0.2108	0.2023	0.1588	0.2620	0.3249	0.2551	0.2159	0.2084	0.1672
# Observations	1388	1551	954	1388	1551	954	1149	1297	680	1149	1297	680
# Banks	129	129	78	129	129	78	105	105	55	105	105	55

This table shows how proxies for bank market power (*Boone, Concentration,* and *Denied*) shape the effect of investor protection on vega. Regressions follow model [1] adding an interaction term of the dummy treatment with each of the proxies for bank market power. Columns (1)–(6) report the results using the full sample and Columns (7)–(12) report the results using the matched control group selected by a propensity score-based technique. The dependent variable is the natural logarithm of vega *(Ln(vega))*. *ProtectionChange* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after an increase (decrease). It always takes the value zero for countries that do not experience any change in investor protection. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic crises. Otherwise, it takes the value zero. All regressions include bank-level control variables although they are not reported to save space. The bank-level control variables are *Size*, *Equity*, *Ln(Returnvolatility)* and *Ln(Performance)*. All the variables are defined in the Appendix (Table A1). T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

for interactions with proxies for bank market power and Table 10 reports the results for interactions with proxies for the safety net in a country. The lack of data reduces the number of banks in regressions depending on the country variable.

The coefficients of *ProtectionChange* in Table 9 remain positive and significant except in columns (3), (5) and (11). The *Boone*, *Concentration*, and *Denied* coefficients are always negative and mostly significant, suggesting that stronger bank market power is associated with lower risk-taking incentives for shareholders and lower vegas. However, most of the coefficients of the interaction of *ProtectionChange* with *Boone*, *Concentration*, and *Denied* are insignificant. Only the coefficients of *ProtectionChange***Denied* in columns (6) and (12) are negative and significant, suggesting that stronger bank market power, reducing shareholders' risk-taking incentives, diminishes the positive effect of an increase in investor protection on vega.

The results in Table 10 show significant positive coefficients for *ProtectionChange* and significant negative or insignificant coefficients for the interaction *ProtectionChange***Deposit insurer power* in columns (1), (3), (5), and (7). These coefficients suggest that stronger deposit insurer power, reducing moral hazard problems and the benefits for shareholders of risk-taking, diminishes the positive impact of increased investor protection on vegas. The coefficient of *Deposit Insurer power* is significant and negative in the fixed-effects estimation using the full sample, and negative but insignificant in other estimations. These negative coefficients are also consistent with stronger deposit insurer power reducing shareholders' risk-taking incentives and vega. Along the same line, the coefficients of the interaction term *ProtectionChange** *Hazard* are positive and mostly significant at conventional levels whereas the coefficients of *ProtectionChange* become insignificant in columns (2), (4), (6), and (8).[15] These coefficients are also consistent with our H3 because they indicate that a more generous deposit insurance system, increasing shareholders' risk-taking incentives, increases the positive impact of changes in investor protection on vegas. The coefficients of *Hazard* are positive and significant in the tobit estimations but are non-significant in the fixed-effect estimations. The above significant positive coefficients are consistent with more

Table 10
Vega and changes in investor protection: differences depending on moral hazard.

	Full sample				Matched sample			
	Fixed-effects		Tobit		Fixed-effects		Tobit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ProtectionChange	2.5040***	0.0661	12.7365***	−1.2944	2.7103***	0.1570	14.6169**	0.1790
	(3.18)	(0.15)	(2.59)	(−0.60)	(3.07)	(0.34)	(2.66)	(0.09)
ProtectionChange * Deposit insurer power	−0.2629		−2.0872*		−0.3220*		−2.5070**	
	(−1.44)		(−1.92)		(−1.69)		(−2.04)	
ProtectionChange * Hazard		0.4721***		1.1970*		0.4225***		0.6140
		(3.86)		(1.85)		(3.05)		(1.08)
Deposit insurer power	−0.2835**		−0.5009		−0.2426		−0.4105	
	(−1.95)		(−1.01)		(−1.61)		(−0.71)	
Hazard		0.2161		1.4224***		0.4515*		1.8863***
		(0.98)		(3.62)		(1.75)		(7.18)
PostFSBregulation	−1.3234***	−1.3236***	−3.3693**	−3.4488**	−1.1531**	−1.1664**	−2.6739	−3.0504
	(−2.94)	(−2.98)	(−2.11)	(−2.26)	(−2.01)	(−2.10)	(−1.18)	(−1.61)
Capital regulation	−0.0640	−0.1047	−0.8934*	−0.4959*	−0.0374	−0.0787	−1.0943*	−0.4009
	(−0.49)	(−0.85)	(−1.71)	(−1.65)	(−0.20)	(−0.42)	(−1.82)	(−1.26)
PostSystemic	−0.6530	−0.8488*	−4.6423	−3.8443**	−0.8031	−0.9581*	−5.1289	−3.3542*
	(−1.16)	(−1.68)	(−1.45)	(−2.06)	(−1.03)	(−1.82)	(−1.29)	(−1.74)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Bank-fixed effects	Yes	Yes	No	No	Yes	Yes	No	No
Clustering	Country	Country	Country	Country	Country	Country	Country	Country
R^2	0.2956	0.3775	0.1998	0.1982	0.3026	0.4298	0.2101	0.2074
# Observations	1572	1566	1572	1566	1279	1267	1279	1267
# Banks	128	131	128	131	104	106	104	106

This table shows how proxies for the safety net and moral hazard problems (*Deposit insurer power* and *Hazard*) shape the effect of investor protection on vega. Regressions follow model [1] adding an interaction term of the dummy treatment with each of the proxies for bank market power. The dependent variable is the natural logarithm of vega *(Ln(vega))*. It is defined as the dollar change in the value of the annual options granted to bank executives for a 0.01 change in volatility of stock returns. *ProtectionChange* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after the increase (decrease). It always takes the value zero for countries that do not experience any change in investor protection. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic crises. Otherwise, it takes the value zero. Although not reported to save space, all estimations include bank-level control variables (*Size, Equity, Ln(Returnvolatility)*, and *Ln(Performance))*. Bank- and country-level control variables are defined in the Appendix (Table A1). The DID analysis compares different groups of banks: columns (1)–(4) compare banks in reforming countries with banks in all non-reforming countries; columns (5)–(8) compare reforming countries with the propensity score-based control group. T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

[15] We report random-effects estimates but not fixed-effects estimates in regressions including *Hazard* (columns (2) and (6)) because *Hazard* does not vary over time and its effect would be subsumed by bank fixed-effects.

Table 11
Vega and changes in investor protection: Sub-samples depending on market power and moral hazard.

	Panel A. HIGH (Above the median)				
	Boone	Concentration	Denied	Deposit Insurer power	Hazard
	(1)	(2)	(3)	(4)	(5)
ProtectionChange	0.7579	1.5985	0.4751	1.5341	5.3755***
	(0.29)	(0.48)	(0.18)	(0.57)	(6.47)
PostFSBregulation	−2.3097	−0.2646	−2.6301	−3.4174	−4.4875**
	(−0.95)	(−0.17)	(−1.02)	(−1.08)	(−2.23)
Capital regulation	−1.1458**	−0.7838	−1.4167***	−1.3626***	−1.8110***
	(−2.20)	(−1.28)	(−2.62)	(−3.06)	(−4.25)
PostSystemic	−9.2678***	−13.9688***	−10.7773***	−13.2650***	0.3129
	(−3.68)	(−6.91)	(−4.13)	(−6.57)	(0.13)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	No	No	No	No	No
Clustering	Country	Country	Country	Country	Country
Pseudo R^2	0.2541	0.2439	0.2737	0.2846	0.1713
# Observations	860	1012	968	819	752
# Banks	71	84	81	67	57
	Panel B: LOW (Below the median)				
	Boone	Concentration	Denied	Deposit Insurer power	Hazard
	(1)	(2)	(3)	(4)	(5)
ProtectionChange	3.2550***	3.5000***	3.3760**	4.0807***	−2.4273
	(2.83)	(3.26)	(2.25)	(3.25)	(−1.14)
PostFSBregulation	−6.1115***	−8.4916***	−4.6120**	−5.0664***	−3.2203**
	(−3.01)	(−7.20)	(−2.30)	(−3.34)	(−2.48)
Capital regulation	0.5364	0.0520	0.3653	0.3552	0.3525
	(0.76)	(0.11)	(0.73)	(0.73)	(1.12)
PostSystemic	3.4659	3.0700	3.6612	2.0648	−5.8642***
	(1.03)	(1.10)	(1.22)	(0.63)	(−2.79)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	No	No	No	No	No
Clustering	Country	Country	Country	Country	Country
Pseudo R^2	0.1735	0.1618	0.1256	0.1555	0.1791
# Observations	818	666	710	859	926
# Banks	64	51	54	68	78

This table reports the tobit estimates of model [1] for different sub-samples of banks depending on whether bank market power and moral hazard problems caused by safety nets in a country are above (HIGH) or below (LOW) the median in the sample. Panel A (B) reports the results for the sub-sample above (below) the median. *Boone*, *Concentration*, and *Denied* are the proxies for bank market power. *Deposit Insurer power* and *Hazard* are the proxies for moral hazard problems. The dependent variable is the natural logarithm of vega *(Ln(vega))*. *ProtectionChange* takes the value zero (one) for years before an increase (decrease) in investor protection and one (zero) for years after the increase (decrease). It always takes the value zero for countries that do not experience any change in investor protection. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic crises. Otherwise, it takes the value zero. Although not reported to save space, all estimations include bank-level control variables (*Size, Equity, Ln(Returnvolatility)*, and *Ln(Performance))*. T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

generous deposit insurance, increasing shareholders' risk-taking incentives, leading to higher vegas.

We also apply a sub-sample analysis to study how competition and safety nets in a country shape the impact of investor protection on vega. We estimate model [1] separately in two sub-samples: HIGH and LOW. Using the full sample, we compute the mean value per country of each proxy for bank competition and safety net, and split both the treatment and control groups into two sub-samples around the median of the particular country variable. We use the indication HIGH (LOW) for the sub-sample of banks comparing the treatment banks above (below) the median of the particular proxy within the treatment group with the subsample of control banks above (below) the median within the control group. The median country is included in the HIGH or LOW sub-sample separately for the treatment and control groups aiming to define HIGH and LOW sub-samples of as similar a size as possible. Table 11 reports the results. Panel A reports the results for the subsample above the median and Panel B for the sub-sample below the median. To save space, we only report the coefficient of the treatment variable (*ProtectionChange*) using tobit estimations. Results are similar using fixed-effects estimations.

The results show that *ProtectionChange* only has significant and positive coefficients in the sub-samples where *Boone*, *Concentration*, *Denied,* and *Deposit insurer power* are LOW and *Hazard* is HIGH, i.e., in the sub-samples where low bank market power (high competition), low deposit insurer power or high moral hazard increase shareholders' risk-taking incentives. In these cases, the increase in investor protection allows shareholders to translate their greater risk-taking incentives into executive compensation to a greater extent. We do not find significant coefficients at conventional levels for *ProtectionChange* in the sub-samples of banks in countries with high bank market power or less bank competition, high deposit insurer power or low moral hazard. The lower risk-taking incentives of bank shareholders in these sub-samples may explain why an increase in investor protection does not cause an increase in vega. Although shareholders have a greater ability to translate their risk-taking incentives into executive compensation after the increase in investor protection, they are not interested in increasing the risk-taking incentives of bank directors when low competition, high deposit insurer power or low moral hazard promote low risk-taking incentives in bank shareholders. These results are consistent with our hypotheses H2 and H3.

5.7. A cross-country analysis of vega determinants

We now check whether the results remain when we apply a cross-sectional analysis to take advantage of the data variation across banks and countries in our sample. The availability of a panel data set allows us to control for unobserved bank and country time-invariant characteristics and to reduce concerns about omitted variables. We regress the vega on country (investor protection, bank competition, and bank safety net) and bank variables. We additionally include interaction terms to analyze how bank competition and the safety net in a country shape the effect of investor protection on vega. The basic model is:

$$\begin{aligned} Ln\ (vega_{it}) = \beta_0 + \beta_1\ Investor\ protection_{jt} + \beta_2\ Competition_{jt} + \beta_3\ Safety\ net_{jt} + \beta_4\ Investor\ protection_{jt}{}^{*}Competition_{jt} \\ + \beta_5\ Investor\ protection_{jt}{}^{*}Safety\ net_{jt} + \beta_6\ X_{j,t} + \beta_7\ Z_{i\ t} + C_j + Y_t + \varepsilon_{i,t} \end{aligned} \quad (3)$$

where i, j, and t refer, respectively to bank, country, and year. *Ln(vega)* is the natural logarithm of the vega option packages granted to bank executives. *Investor protection*$_{jt}$ is the proxy for investor protection in a country; *Competition*$_{jt}$ is the set of alternative variables measuring the country's bank market competition (*Boone*, *Concentration*, and *Denied*); *Safety net*$_{jt}$ is the set of two alternative proxies for the moral hazard problems created by the bank safety net (*Deposit insurer power* and *Hazard*); X_{jt} is the set of country-level control variables and Z_{it} is the set of bank-level control variables. We report results using a tobit estimator to address the fact that there are banks that do not use stock options as a component of executive compensation. When vega is censored at zero, the tobit estimator may be more suitable for giving unbiased estimates (Zhou and Swan, 2003). We include country (C_j) and time-fixed (Y_t) effects, and cluster standard error at country level in the reported tobit estimations.[16]

Table 12 reports the results. To save space, we do not report the coefficients of the bank-level control variables. The positive and significant coefficient of *Investor protection* in column (1) remains positive and significant in columns (2) and (3) when we control, respectively, for regulatory changes in bank executive compensation and capital, systemic banking crises, and bank governance and ownership. These positive and significant coefficients of *Investor protection* are consistent with investor protection increasing the ability of bank shareholders to translate their higher risk-taking incentives into executive compensation. The results are also consistent with investor protection increasing the importance of the contracting hypothesis versus the managerial entrenchment hypothesis because it allows bank shareholders to include their well-known risk-taking incentives in executive compensation by increasing vega. The positive and significant coefficient of *% Independent directors* in column (3) coincides with the results of the DID analysis reported in Table 7. This result is consistent with a greater presence of independent directors promoting higher vegas to better serve shareholders' risk-taking incentives. These results are consistent with our hypothesis H1.

The significant coefficients of the interaction terms, analyzing how country variables shape the influence of investor protection on vega, are consistent with the findings reported in Tables 9–11. The negative and significant coefficients of *Investor protection*Concentration* and *Investor protection*Denied* in columns (5) and (6) indicate that stronger bank market power, reducing shareholders' risk-taking incentives, diminishes the positive effect of investor protection on vega. The positive and significant coefficient of *Investor protection*Hazard* in column (8) suggests that greater shareholders' risk-taking incentives, associated with greater moral hazard problems in a country, increase the positive effect of investor protection on vega. We do not find significant coefficients for the interaction of *Investor protection* with *Boone* or with *Deposit insurer power*.

Also consistent with the DID analysis, we find that the FSB regulation on bank-executive compensation and systemic banking crises are associated with a subsequent reduction in vegas because we only find insignificant or significant negative coefficients for *Post-FSBregulation* and *PostSystemic*.

6. Conclusions

This paper provides new empirical evidence on the importance of investor protection, bank competition, and safety nets in a country for shaping the risk-taking incentives embedded in bank executive compensation. Our empirical study exploits time-series changes in investor protection within a country and applies a DID analysis to analyze the impact of the change in investor protection on the vega of the options granted to bank executives. We use an international bank-level database for a maximum of 135 banks from 26 countries over the 2003–2018 period.

We find that an increase in investor protection leads to an increase in vega, especially in banks with a higher percentage of independent directors. This result is consistent with investor protection increasing the ability of bank shareholders to translate their

[16] Although not reported to save space, we check that the results remain when we apply fixed- and random-effects estimations to control for unobserved and time-invariant bank effects or when we cluster standard errors at bank level.

Table 12
Investor protection and vega: a cross-sectional analysis.

		Investor protection						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Investor protection	0.4686**	0.47589*	0.4121***	0.4366**	1.1797***	0.1269	1.1028***	−0.3119**
	(2.27)	(2.40)	(3.52)	(2.34)	(2.30)	(0.82)	(2.77)	(−2.44)
% Independent directors			7.4126***					
			(3.37)					
% Main shareholder			−0.9369					
			(−0.60)					
Investor protection * Boone				0.3561				
				(0.40)				
Investor protection * Concentration					−0.0129*			
					(−1.74)			
Investor protection * Denied						−0.0092*		
						(−1.85)		
Investor protection * Deposit insurer power							−0.1485	
							(−1.61)	
Investor protection * Hazard								0.3081***
								(4.58)
Boone				−9.8457				
				(−0.53)				
Concentration					0.1706			
					(0.99)			
Denied						−5.8605		
						(−1.31)		
Deposit insurer power							1.9910	
							(1.17)	
Hazard								5.2680***
								(3.16)
PostFSBregulation		−3.6094*	−3.8560**	−4.3884*	−3.3843*	−6.1858***	−3.7870***	−3.5319**
		(−1.76)	(−2.17)	(−1.80)	(−1.81)	(−3.39)	(−3.16)	(−2.16)
Capital regulation		−0.4297	−0.2194	−0.5112	−0.8601**	−0.2464	−0.8763***	−0.0741
		(−1.00)	(−0.71)	(−1.16)	(−2.00)	(−0.71)	(−2.88)	(−0.27)
PostSystemic		−3.6094	−2.96506	−4.5253	−5.6508*	3.4335	−4.5720***	−3.6142**
		(−1.14)	(−1.13)	(−1.36)	(−1.94)	(1.44)	(−3.10)	(−2.22)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	Country	Country	Country	Country	Country	Country	Country	Country
Pseudo R^2	0.1692	0.1902	0.1833	0.2102	0.2010	0.1596	0.1985	0.1962
# Observations	1678	1678	971	1388	1551	954	1572	1566
# Banks	135	135	122	129	129	78	128	131

This table reports the tobit estimates of model [3]. The dependent variable is the natural logarithm of vega *(Ln(vega))*. It is defined as the dollar change in the value of the annual options granted to bank executives for a 0.01 change in volatility of stock returns. *Investor protection* is the investor protection index from the World Bank. *% Independent directors* is the proportion of independent directors. *% Main shareholder* is the proportion of shares owned by the main shareholder. *Boone*, *Concentration*, and *Denied* are the proxies for bank market power. *Deposit Insurer power* and *Hazard* are the proxies for moral hazard problems. *PostFSBregulation* takes the value one after 2011 for banks in countries within FSB jurisdictions and the EU. Otherwise, it takes the value zero. *Capital regulation* is an indicator of the stringency of bank capital requirements. *PostSystemic* is a dummy variable that takes the value one after the onset of the crisis for banks in countries suffering systemic crises. Otherwise, it takes the value zero. All regressions include bank-level control variables although they are not reported to save space. The bank-level control variables are *Size*, *Equity*, *Ln(Returnvolatility)* and *Ln(Performance)*. Bank and country-level control variables are defined in the Appendix (Table A1). T-statistics are in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

higher risk-taking incentives into executive compensation and with investor protection increasing the importance of the contracting hypothesis versus the managerial entrenchment hypothesis for explaining executive compensation. Moreover, the effect of investor protection on vega is heterogeneous across countries depending on variables that affect shareholders' risk-taking incentives. In particular, more bank competition and a more extensive bank safety net in a country, increasing the risk-taking incentives of bank shareholders, increase the positive impact of investor protection on vega.

Our results confirm that the particular risk-taking incentives of bank shareholders, and not only their ability to incorporate their incentives in executive contracts, are important determinants of vega because investor protection promotes a higher vega if shareholders have risk-taking incentives. The results are also robust to alternative model specifications and alternative proxies for bank competition and moral hazard problems created by bank safety nets.

In terms of policy implications, our results suggest that improving investor protection is useful for aligning shareholders' incentives and managerial compensation, reducing the possibilities of executive compensation facilitating managerial entrenchment. Therefore, regulation of bank executive compensation in countries with weaker investor protection should aim to align such compensation with long-term shareholder value because it may increase risk-taking by allowing managers to undertake investments with negative NPV. However, in countries with stronger investor protection, regulation on executive compensation should consider that risk-taking investments are more associated with higher expected returns following shareholders' interests. Our results also indicate that regulation limiting risk-taking incentives embedded in bank executive compensation in countries with stronger investor protection is particularly necessary when bank competition increases and/or authorities extend bank safety nets. These two variables increase shareholders' risk-taking incentives and, in countries with stronger investor protection, the risk-taking incentives embedded in bank executive compensation.

Data availability

Data will be made available on request.

Appendix A. Appendix

Table A1
Variable definitions and data sources

Name	Definition	Source
	Bank executive compensation	
Ln(vega)	The natural logarithm of vega. Vega is defined as the change in the dollar value of the annual options granted to bank executives for a 0.01 change in stock return volatility.	Hand-collected data and Capital IQ Database
Ln (delta)	The natural logarithm of delta. Delta is defined as the change in the dollar value of the executive stock option portfolio for a 0.01 change in stock price.	Hand-collected data and Capital IQ Database
	Investor protection	
Investor protection	The strength of investor protection index is the sum of the extent of disclosure index, extent of director liability index and ease of shareholder suits index. Scale from 0 to 30. Higher values indicate stronger investor protection. The *extent of disclosure index* measures the approval and disclosure requirements of related-party transactions. It has five components: (i) whether the managing director alone, the board of directors, or the general meeting of shareholders is the corporate body that can provide legally sufficient approval for the transaction (points are assigned depending on whether interested directors are permitted to vote or not); (ii) whether an external body (an independent auditor, for example) must review the transaction before it takes place; (iii) whether disclosure by the executive to the board of directors or the supervisory board is required; (iv) whether immediate disclosure of the transaction to the public, the regulator or the shareholders is required; and (v) whether disclosure in periodic filings (for example, annual reports) is required. The *extent of director liability index* measures when board members can be held liable for harm caused by related-party transactions and what sanctions are available. It has seven components: (i) whether shareholders can sue directly or derivatively for the damage the transaction causes to the company; (ii) whether a shareholder plaintiff can hold the executive liable for the damage the Buyer-Seller transaction causes to the company; (iii) whether a shareholder plaintiff can hold other executives and directors (the CEO, members of the board of directors or members of the supervisory board) liable for the damage the transaction causes to the company; (iv) whether the executive pays damages for the harm caused to the company upon a successful claim by the shareholder plaintiff; (v) whether the executive repays profits made from the transaction upon a successful claim by the shareholder plaintiff; (vi) whether the executive is disqualified upon a successful claim by the shareholder plaintiff; and (vii) whether a court can void the transaction upon a successful claim by a shareholder plaintiff. The *ease of shareholder suits index* measures how likely plaintiffs are to access internal corporate evidence. It has six components: (i) whether shareholders owning 10% of the company's share capital have the right to inspect the Buyer-Seller transaction documents before filing a suit; (ii) whether shareholders owning 10% of the company's share capital can request that a government inspector investigate the Buyer-Seller transaction without filing a suit; (iii) what range of documents is available to the shareholder plaintiff from the defendant and witnesses during trial; (iv) whether the plaintiff can obtain categories of relevant documents from the defendant without identifying each document specifically; (v) whether the plaintiff can directly examine the defendant and witnesses during trial (0–2); and (vi) whether the standard of proof for civil suits is lower than that for criminal cases. The index is computed based on the methodology in the DB06–14 studies.	World Bank Group, Doing Business project (http://www.doingbusiness.org/).
ProtectionChange	This measures the change in *Investor protection in country* j in year t. For a country j that underwent an investor protection increase in year m, *ProtectionChange* equals zero (one) for the years before (after) the change, i.e., for $t \leq m$ ($t \geq m + 1$). In contrast, for a country j that underwent an investor protection decrease in year m, *ProtectionChange* equals one (zero) for the years before (after) the change, i.e., for $t \leq m$ ($t \geq m + 1$). For countries that did not experience an investor protection change, *ProtectionChange* always equals zero.	World Bank Group, Doing Business project (http://www.doingbusiness.org/).
	Bank governance and ownership	

(*continued on next page*)

Table A1 (*continued*)

Name	Definition	Source
% Independent directors	Proportion of independent directors on the board at the end of the year.	Banks' annual reports
% Main shareholder	Proportion of shares owned by the main shareholder at the end of the year.	Banks' annual reports
	Bank competition	
Boone	The Boone indicator is the elasticity of profits to marginal costs. To obtain the elasticity, the log of profits (measured by return on assets) is regressed on the log of marginal costs. The estimated coefficient is the elasticity. The rationale behind the indicator is that higher profits are achieved by more efficient banks. Hence, the more negative the Boone indicator is, the higher the degree of competition because the effect of reallocation is stronger.	Global Financial Development Database (GFDD). World Bank
Concentration	Bank concentration is defined as the annual ratio of the assets of the three largest commercial banks to total commercial banking assets in a country.	Global Financial Development Database (GFDD). World Bank
Denied	The fraction of bank entry applications denied by authorities.	World Bank's Regulation and Supervision Database
	Safety nets	
Deposit insurer power	Variable based on the assignment of 1 (yes) or 0 (no) values to four questions assessing whether the deposit insurance (1) has the bank intervention authority as part of its mandate, (2) has the legal power to cancel or revoke deposit insurance for any participating bank, (3) has authority to take legal action against bank directors or officials, or (4) has ever taken any legal action against bank directors or officers. This variable ranges from 0 to 4, with higher values indicating more power.	World Bank's Regulation and Supervision Database
Hazard	Index of moral hazard drawn up using principal component analysis with eight binary variables. Each variable takes the value one in the following cases: 1) membership is mandatory, 2) nominal coverage limits are not specified, 3) coinsurance does not exist for any depositors, 4) deposit-insurance obligations are funded in some way, 5) funding comes partially or totally from the government, 6) the system is partially or totally managed by the government, 7) foreign denominated deposits are explicitly covered, 8) interbank deposits are formally guaranteed.	Demirguc-Kunt and Detragiache (2002).
	Country-level control variables	
PostFSBregulation	Dummy variable that takes the value one after 2011 for banks in countries within FSB jurisdictions and in the EU. This variable takes the value zero for banks in these countries before 2011 and it is always zero for banks in countries out of FSB jurisdictions and in non-EU countries.	Cerasi et al. (2020)
Capital regulation	A capital regulatory index defined as the sum of two measures of capital stringency: *Overall Capital Stringency,* which indicates whether there are explicit regulatory requirements regarding the amount of capital that a bank must have relative to various guidelines; and *Initial Capital Stringency,* which indicates whether the source of funds counted as regulatory capital can include assets other than cash or government securities and borrowed funds, as well as whether the sources are verified by the regulatory or supervisory authorities. *Capital regulation* may range in value from 0 to 9, with a higher value indicating greater stringency. Data varies over time but not annually because the data was collected in the years 2003, 2007, 2011, and 2018. We use 2003 Survey data for the year 2003, 2007 Survey data for the years 2004–2007, 2011 Survey data for the years 2008–2010, and 2018 Survey data for the years 2011–2018.	World Bank' s Bank Regulation and Supervision Database
PostSystemic	Dummy variable that takes the value one after the onset of a systemic banking crisis in a country. This variable always takes the value zero for banks in countries without a systemic banking crisis in our analysis period.	Laeven and Valencia (2018).
Postbailout	Dummy variable that takes the value one after a bailout process in a country. This variable always takes the value zero for banks in countries without bailouts.	Laeven and Valencia (2018); Homar and van Wijnbergen (2017).
Bank-level control variables		
Size	The natural logarithm of bank assets.	Capital IQ Database
Equity	The equity-to-total assets ratio.	Capital IQ Database
Ln(Returnvolatility)	The natural logarithm of annual standard deviation of weekly stock returns as the main proxy for bank risk.	Capital IQ Database
Ln(Performance)	The natural logarithm of bank performance. Performance is measured as the total shareholders' value, that is, the initial total value of the firm's equity in the first sample period capitalized year by year using the total gross returns of holding the stock during the relevant period, including the reinvestment of dividends.	Capital IQ Database

This table shows the definition of all the variables and their sources.

Table A2
Mean values per country

	Ln (Vega)	Ln (Delta)	Investor Protection	% Independent directors	% Main shareholder	Boone	Concentration	Denied	Deposit Insurer Power	Hazard	PostFSB regulation	Capital regulation	PostSystemic	Postbailout	Size	Equity	Ln (Returnvolatility)	Ln (Performance)
Australia	1.6506	0.5950	17	0.5341	0.2236	−0.3588	70.4381	0	2	1	0.4296	4	0	0	10.0067	0.0953	3.2465	7.9770
Austria	2.1148	0.7498	16	0.7911	0.2458	−0.0221	63.4443	16	0.375	8	0.5	4	0.5625	0.5625	12.4021	0.0668	3.5221	9.4027
Belgium	1.5328	0.3979	21	0.4415	0.1763	0.0116	76.6677	0	2	6	0.4286	3.5	0.5714	0.5714	11.8864	0.0846	3.5811	8.8905
Bosnia-Herzegovina	0	0	14					0	1.5	5	0	3.3333	0	0	11.7184	0.0825	3.9091	9.1569
Canada	5.9340	2.6939	25.3829	0.7483	0.19	−0.024	62.6948		4	5	0.5257	2.6571	0	0	11.0228	0.0651	3.0909	8.6017
China	0	0	14.7895	0.2693	0.4858						0.2631	3.7895	0	0	13.2856	0.0586	3.5512	11.1348
Cyprus	1.8391	2.1787	14.5714	0.375	0.0924	−0.0046	76.0261	0	0	5	0.2857	3.2857	0	0	10.6869	0.06875	3.8114	3.8947
Denmark	0.1521	0.0359	19	0.7128	0.2583	−0.0572	82.7266		0.4387	7	0.4311	1.6287	0.5090	0.5090	8.3817	0.0999	3.1674	5.9495
Finland	0	0	17	0.8033	0.2583	−0.0002	93.9853	16.67	0.75	6	0.5	2.75	0	0	8.3474	0.0492	3.1004	5.6261
France	1.0290	0.5401	16	0.3954	0.4232	−0.0338	61.0893	16.67	2	7	0.6575	5.1574	0	0.5278	10.8859	0.1274	3.3436	8.2423
Germany	0.5205	0.2668	15	0.6124	0.4372	−0.0270	73.1395		0.7227	5	0.5294	4.4706	0.5378	0.5378	10.8178	0.0742	3.2640	8.0086
Hong Kong	1.1405	0.1886	27	0.4116	0.3343	−0.0634	67.1888	0	1	4	0.5270	4.7432	0	0	10.7175	0.0991	3.1958	8.5775
India	3.5103	0.3831	17.4286	0.5730	0.3308	−0.0994	33.0410	0.64	1		0.4286	5.5714	0	0	11.7979	0.1030	3.5571	9.1568
Indonesia	0.4177	0.0424	17.2857	0.4592	0.6786	−0.0613	44.6610		2.5714	6	0.1428	5.5714	0	0	9.9891	0.1147	3.7807	8.5832
Ireland	1.6044	0.7502	26	0.4449	0.236	0.1470	73.4906	0	2.2727	7	0.3235	3.9412	0.3823	0.3823	11.5818	0.0569	3.8171	8.2931
Italy	1.7997	0.6402	17.25	0.7367	0.3066	−0.0245	56.9890	20.16	0.25	6	0.3889	2.2222	0	0.3055	10.2198	0.0926	3.2259	7.7715
Malaysia	0.2860	0.0208	26.2812	0.5191	0.2841	−0.0246	51.4763		2.6207	5	0	4.1250	0	0	10.7467	0.0878	2.8675	8.8586
Netherlands	1.4862	1.0069	13.3333	0.8916	0.2112	0.0309	85.8370	0	0.4286	4	0.3939	3.2121	0.4545	0.4545	8.7455	0.0910	3.3385	6.3176
Norway	0	0	19	0.4303	0.3930	−0.0060	93.9767	14.29	0.8333	5	0	4.4166	0	0	8.2742	0.0763	3.0492	4.7286
Poland	0.2456	0.0263	17.8780	0.6726	0.4817	−0.0800	39.7643	0	0	7	0.5854	3	0	0	10.4606	0.0879	3.3884	8.3665
Singapore	3.7162	0.4569	28	0.6660	0.3046	−0.0176	87.8746		1	3	0.5357	5.6428	0	0	12.0863	0.0982	2.9383	9.9884
Spain	0.6853	0.1957	16.7347	0.4808	0.3568	−0.3819	67.2164	9.09	2	7	0.7959	5.0408	0.5102	0.5102	12.9653	0.0639	3.4338	10.0925
Sweden	0.6280	0.2293	16.8846	0.7570	0.2319	−0.0415	93.4541	3.33	0.1304	6	0.4615	3	0	0	11.4086	0.0478	3.3114	8.8866
Switzerland	1.5367	1.1325	9	0.7830	0.2667	−0.0689	76.9298	0.01	0.7428	5	0.8	3.8571	0	0.6428	9.7312	0.1070	3.4281	7.5360
UK	1.4079	0.5056	24	0.5685	0.1900	−0.0447	53.0173		1	5	0.7073	3.0488	0.5935	0.5935	12.0536	0.1132	3.3425	9.9437
US	5.0524	2.1337	24.8814	0.6905	0.3858	−0.0508	32.9630	1.36	4	3	0.7035	3.7699	0.6195	0.6195	13.1073	0.0938	3.3298	10.7615

The table shows by country the mean value of each variable. The definition and source of each variable is indicated in Table A1.

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