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Shareholder protection and bank executive compensation after the global financial crisis

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ABSTRACT

We use a hand-collected international database to analyze the change in the risk-taking incentives embedded in bank executive compensation after the onset of the global financial crisis. Our results reveal a reduction in both the risk sensitivity of stock option grants (vega) and total and cash pay-risk sensitivities in countries suffering systemic banking crises. This reduction is greater in countries with strong shareholder protection, especially in banks with good corporate governance, solvent banks, and banks that suffered a reduction in their specific investment opportunity set. The regressions control for government intervention, banking development, and crisis intensity. Our results confirm that the contracting hypothesis is more relevant in countries with stronger shareholder protection, and provide support for measures improving shareholder rights in the approval of bank executive compensation.

1. Introduction

The recent global financial crisis has placed bank executive compensation under the spotlight for policy makers and academics as one of the main components of the incentive structure that might have led bank managers to take excessive risks before the crisis (Fahlenbrach and Stulz, 2011; DeYoung et al., 2013; Cerasi and Oliviero, 2015). However, to our knowledge, there has been no evaluation of whether the risk-taking incentives embedded in bank executive compensation changed after the onset of the global financial crisis. Nor has the importance of the shareholders' incentives and government interventions driving such potential changes been evaluated. Our paper aims to provide empirical evidence on these aspects by answering the following main questions. Have the risk-taking incentives embedded in bank executive compensation changed since the onset of the global financial crisis? Were any such changes driven by shareholders' incentives and/or government interventions? What is the role of shareholder protection in such changes? Answers to these questions would provide new evidence on the determinants of bank executive compensation and help in the policy debate on how to regulate it.

The literature traditionally uses two hypotheses to explain executive compensation: the *contracting* and the *managerial entrenchment* hypotheses (Smith and Watts, 1992; Cheng et al., 2015). 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 may explain the risk-taking incentives of bank executive compensation immediately before the onset of the global financial crisis. Under the contracting hypothesis, expansion of the investment risk-return opportunity set before the crisis led bank shareholders to increase pay-risk sensitivity to encourage bank executives to search out and invest in risky positive net present value (NPV) projects (DeYoung et al., 2013; Bai and Elyasiani, 2013). Under the managerial entrenchment hypothesis, entrenched managers established executive compensation that was misaligned with long-term shareholder value, resulting in risk-taking and leading to the global financial crisis (Bai and Elyasiani, 2013). The literature analyzing bank executive compensation before the crisis focuses on its impact on risk-taking without specifically analyzing the importance of the contracting or

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the managerial entrenchment hypotheses (Fahlenbrach and Stulz, 2011; Bai and Elyasiani, 2013; Cerasi and Oliviero, 2015). DeYoung et al. (2013) is an exception providing support for the contracting hypothesis.

We use a hand-collected international database of bank executive compensation for 181 publicly-traded banks across 34 countries over the 2003-2011 period to analyze the change in the risk-taking incentives embedded in executive compensation after the onset of the crisis. Our empirical study uses the recent global financial crisis as an exogenous shock potentially affecting banks' investment opportunities. We focus on banks in countries suffering systemic banking crises as they suffer the most negative consequences of the crisis (the treatment group), and use banks in countries without systemic crises as the control group.

We focus on the change in pay-risk sensitivity and not in pay-performance sensitivity because the former captures the risk-taking incentives embedded in executive compensation better than the latter.[1] For this reason, and similar to us, Chen et al., (2006); Bai and Elyasiani (2013), and DeYoung et al. (2013) focus on pay-risk sensitivity to analyze risk-taking incentives embedded in managerial compensation in banks. We use alternative measures of pay-risk sensitivity. 1) We apply a traditional difference-in-differences (DID, henceforth) analysis comparing the vega of option packages granted to bank executives before and after the onset of systemic banking crises. Banks in countries without systemic banking crises act as a control group. 2) We compare the sensitivity of total and cash (salary + bonus) compensation to bank risk before and after the onset of the global financial crisis separately for banks in countries with and without systemic banking crises.

The contracting hypothesis predicts a greater reduction in the risk-taking incentives of bank shareholders in banks suffering systemic crises if banks in these countries experience a greater reduction in their investment opportunity set. Predictions based on the managerial entrenchment hypothesis are less clear. On the one hand, entrenched managers may not respond to crises and investment opportunity change. In this case, vega would not change after the onset of the crisis. On the other hand, a higher probability of bank failure during the crisis increases the probability of managers being fired and, therefore, may reduce their "entrenchment". In consequence, managers may have incentives to increase their short-term compensation but reduce bank risk-taking to prevent any government intervention or takeover from imposing losses on both managers and shareholders. In this case, the prediction for the change in vega after the onset of the crisis would be similar for the managerial entrenchment and the contracting hypotheses because managers' and shareholders' risk-taking incentives would converge.

The lack of clear differences in the predictions makes it difficult to separate the influence of each hypothesis by only analyzing the change in pay-risk sensitivity after the onset of the crisis. However, the availability of an international database allows us to provide new empirical evidence on the relevance of the contracting hypothesis by exploiting differences in shareholder protection across countries. Shareholder protection affects the ability of shareholders to induce changes in executive compensation. Therefore, if the global financial crisis changed shareholders' risk-taking incentives, the contracting hypothesis would predict a greater change in bank executive compensation in countries with stronger shareholder protection.

We provide additional evidence on the relevance of shareholders' incentives for influencing bank executive compensation by analyzing differences across banks in the change in pay-risk sensitivity depending on bank governance arrangements, the bank-specific change in the investment opportunity set, and bank solvency. Shareholders in banks with higher ownership concentration or a more independent board are more able to induce changes in executive compensation following changes in shareholders' risk-taking incentives. Therefore, a greater change in bank executive compensation following the change in shareholders' incentives in these banks would again be consistent with the contracting hypothesis. Moreover, if the contracting hypothesis is relevant, we should find a higher reduction in pay-risk sensitivity in banks with a greater decline in their investment opportunity set and in more solvent banks.

Our results show that banks in countries suffering systemic banking crises reduced both the vega of stock options granted and total and cash pay-risk sensitivities following a reduction in the investment opportunity set after the onset of the crisis. However, we do not find an average reduction in pay-risk sensitivity in countries without systemic banking crises. The results are consistent with the contracting hypothesis because we find differences depending on countries' shareholder protection. We only find a reduction in pay-risk sensitivity in countries suffering systemic crises in which shareholder protection is above the median in our sample. In fact, banks in countries suffering systemic banking crises but with shareholder protection below the median did not experience a significant change in pay-risk sensitivity after the onset of systemic crises. Again consistent with the contracting hypothesis, we find that the reduction in pay-risk sensitivity after the onset of systemic crises in countries with strong shareholder protection is greater in banks with higher ownership concentration and more independent directors, in banks experiencing a greater reduction in investment opportunities, and in more solvent banks.

Our analysis controls for alternative explanations. First, countries with systemic banking crises also experienced the greatest intervention by authorities during the global financial crisis. For this reason, we need to analyze if contracting theory is important after controlling for government intervention. We control for government intervention by identifying the banks that received government financial support and were affected by limitations on their executive pay. The impact of shareholder protection remains after controlling for government intervention on bank executive compensation. Government intervention is associated more with a reduction in the level of compensation than with a change in pay-risk sensitivity. Second, differences in shareholder protection across countries might be correlated with other national characteristics so we might wrongly attribute to shareholder protection an influence ultimately caused by other country characteristics. For this reason, we control for bank development and the intensity of the crisis in a country. Moreover, we check that other country variables do not have similar effects to those found for shareholder protection. In particular, we check that cross-country differences in the intensity of insurer power and official supervision are not related to the change in pay-risk sensitivity when we use them as placebo variables. Finally, we control for omitted bank-level variables by including bank-fixed effects and check that the results are robust when we use alternative specifications and cluster standard errors at the country or bank level.

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

[1] High pay-risk sensitivity makes risk more valuable to managers because their compensation increases with stock return volatility. However, high pay-performance sensitivity may either reduce risk-taking incentives by making managers more risk-averse (Smith and Stulz, 1985) or increase risk-taking incentives by linking manager wealth to the value of the firm's stock and increasing the benefits that risk-shifting to debtholders generates for equity-holders and managers (Coles et al., 2006; DeYoung et al., 2013).

2. Hypotheses and related literature

2.1. Hypotheses

We argue that we can test the relevance of the contracting hypothesis for executive pay by analyzing changes in pay-risk sensitivity in an international sample of banks after the onset of the global financial crisis. This is because the contracting hypothesis predicts specific changes in pay-risk sensitivity depending on country shareholder protection, bank governance, and the change in the bank-specific investment opportunity set.

Countries suffering systemic crises experienced the most negative consequences of the crisis and the most severe potential change in the opportunity investment set. The change in investment opportunities may modify the incentives of bank shareholders to undertake risky investments. For instance, a reduction in the investment risk-return opportunity set after the onset of the crisis might reduce the benefits for bank shareholders of risk-based schemes because such schemes increase the probability that risky but non-positive NPV investments may be undertaken. For this reason, the contracting hypothesis clearly predicts a reduction in pay-risk sensitivity following a reduction in the investment opportunity set after the onset of the crisis. Predictions by the entrenchment hypothesis are not so straightforward. Entrenched managers may not respond to the investment opportunity change so no change in pay-risk sensitivity might be consistent with the managerial entrenchment hypothesis. However, we cannot rule out the possibility that entrenched managers may also aim to reduce bank risk-taking after the onset of the crisis. A higher probability of bank failure during the crisis increases the probability of managers being fired and, therefore, reduces their "entrenchment". In consequence, managers may have incentives to increase their short-term compensation but reduce bank risk-taking to avoid any government intervention or takeover that might impose losses on both managers and shareholders. In this case, a reduction in pay-risk sensitivity following a reduction in the investment opportunity set after the onset of the crisis would be consistent with both the contracting and the managerial entrenchment hypotheses. As the predictions of both hypotheses on the change in pay-risk sensitivity may not differ, we cannot only use the change in pay-risk sensitivity to discriminate between them.

However, the existence of differences across countries depending on shareholder protection may provide specific evidence on the relevance of the contracting hypothesis. Stronger shareholder protection would increase the ability of shareholders to transfer changes in their risk-taking incentives to bank executive compensation. It would make a reduction in risk-taking incentives embedded in bank executive compensation more likely, following shareholders' interests, if there is a reduction in the investment opportunity set after the onset of the crisis. However, a greater reduction in pay-risk sensitivity in countries with stronger shareholder protection would not be consistent with entrenched managers aiming to reduce risk-taking after the onset of the crisis because entrenchment would be lower, not higher, in such countries. For this reason, a greater reduction in pay-risk sensitivity the stronger the country's shareholder protection would only be consistent with the predictions of the contracting hypothesis.

Moreover, differences across banks in the change in pay-risk sensitivity may provide additional evidence for the relevance of the contracting hypothesis. First, higher ownership concentration and a more independent board would reduce managerial entrenchment and would increase the ability of bank shareholders in countries with strong shareholder protection to transfer changes in their risk-taking incentives to bank executive compensation. Therefore, a greater reduction in pay-risk sensitivity following a potential reduction in the investment opportunity set in banks with higher ownership concentration and more independent boards would be consistent with the contracting hypothesis. Second, banks have different strategies and operate in different sub-markets. In consequence, they probably undergo different changes in post-global crisis investment opportunities that also cause differences in the change in shareholders' risk-taking incentives across banks in a particular country. For this reason, the contracting hypothesis predicts a greater reduction in the pay-risk sensitivity of bank executive pay after the onset of the crisis in countries with strong shareholder protection, the greater the reduction in the bank-specific investment opportunity set. By contrast, if executive compensation is established by entrenched managers, they may reduce risk-taking incentives embedded in compensation to reduce the probability of bank failure after the onset of the crisis, but the potential reduction would be less dependent on the change in the investment opportunity set. Finally, differences in bank solvency may cause differences across banks in the change in shareholders' risk-taking incentives. The crisis increased the number of financially distressed banks, and it is well-known that shareholders of distressed banks have incentives to invest in risk-increasing negative-NPV projects. This is commonly called "gambling for resurrection" (see Gorton and Winton (2003) for a review) and may even lead shareholders of distressed banks to increase pay-risk sensitivity after the onset of the crisis, even with a reduction in the positive NPV investment opportunities. A greater reduction in pay-risk sensitivity in more solvent banks following a possible reduction in their investment opportunity set would therefore be consistent with the contracting hypothesis. However, it does not allow the managerial entrenchment hypothesis to be ruled out because entrenched managers may change their risk-taking incentives depending on bank solvency in a similar way to shareholders. Entrenched managers in distressed banks might increase risk-taking to reduce the probability of intervention or takeover whereas entrenched managers in more solvent banks would find it optimal to reduce risk-taking to preserve their positions.

Not mutually exclusive to the contracting and managerial entrenchment hypotheses, government intervention may have shaped the change in bank executive compensation after the onset of the crisis. Initially, policy makers imposed limits on the compensation of executives in banks that received taxpayer support during systemic banking crises. Subsequently, policy makers aimed to impose long-term restrictions on bank executive compensation (Kleymenova and Tuna, 2016). As such government measures aimed to reduce bank risk-taking incentives, they might have also caused reductions in the risk-taking incentives embedded in executive compensation after the onset of the crisis. For this reason, we control for government intervention in the regressions. Anyway, the contracting and the government intervention hypotheses differ in some predictions. As government intervention during the crisis focuses more on financially-distressed banks, we expect a greater reduction in the risk-taking incentives in executive compensation in less solvent banks if government interventions are the main driver changing bank executive compensation. However, under the contracting hypothesis, shareholders of less solvent banks may have incentives to "gamble for resurrection," so we would expect a smaller reduction or even an increase in pay-risk sensitivities if shareholders' incentives are the drivers changing bank executive compensation.

2.2. Related literature

The paper relates to several strands of the literature. First, it relates to the literature analyzing the determinants of bank executive compensation. Corporate finance literature provides partial support for both the contracting hypothesis and the managerial entrenchment hypothesis, without entirely ruling out any of

these hypotheses in commercial and industrial firms.[2] Literature has also extensively analyzed the relationship between executive compensation and corporate risk-taking, showing that the relationship exists in both directions. Firms with greater risk-taking opportunities tend to adopt greater executive pay-risk sensitivity (Guay, 1999; Coles et al., 2006; Ge'Czy et al., 2007), and firms with greater executive pay-risk sensitivity adopt riskier policies (Agrawal and Mandelker, 1987; DeFusco et al., 1990; Coles et al., 2006). These studies also show that stock option grants are associated with greater pay-risk sensitivity and, therefore, more corporate risk-taking. However, pay-performance sensitivity is positively associated with the amount of stock grants (and, to a lesser extent, stock options grants) included in executive compensation packages. Empirical evidence shows that pay-performance sensitivity is not clearly associated with risk-taking incentives because it does not impact on risk-taking (Low, 2009; Dong et al., 2010) or may even reduce it (Guay, 1999; Knopf et al., 2002; Coles et al., 2006; DeYoung et al., 2013). Moreover, there is empirical evidence showing that executive compensation affects not only risk-taking but also a wide set of corporate policies such as investment (Cai and Vijh, 2007), dividends (Fenn and Liang, 2001), and earnings management (Burns and Kedia, 2006).

However, less attention has been paid to executive compensation in banks because the traditional higher level of regulation on banks limited the use of compensation to encourage risk-taking (Bai and Elyasiani, 2013; DeYoung et al., 2013). Under stricter regulation in the US banking industry before the 1970s, executive compensation was not structured to encourage risk-taking (Smith and Watts, 1992; Houston and James, 1995). This appears to have changed with industry deregulation expanding banks' investment opportunities. Shareholders seem to incentivize managers to take up greater investment risk-return opportunities by increasing equity-based compensation and pay-performance sensitivity after deregulation (Crawford et al., 1995; Hubbard and Palia, 1995; Cuñat and Guadalupe, 2009; Hagendorff and Vallascas, 2011). A smaller number of banking studies analyze changes in pay-risk sensitivity. To our knowledge, only Chen et al. (2006); Bai and Elyasiani (2013) and DeYoung et al. (2013) found that CEO pay-risk sensitivity increased as from the late 1990s, when US banks were allowed to enter into investment banking and insurance activities. These changes are consistent with the contracting hypothesis.

Second, the paper relates to the law and finance literature by giving an additional argument for the relevance of shareholder protection in the banking industry. This relevance 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 shareholder protection plays a similar role in the banking sector is less clear because of the specific regulation and supervision that shape bank behavior. Despite such bank regulation and supervision, Caprio et al. (2007) specifically show the relevance of shareholder protection for increasing bank valuations in a sample of 244 banks across 44 countries.

The potential relevance of shareholder protection for bank executive compensation remains almost unexplored. Suntheim (2010) and Cerasi et al. (2015) use international data sets to explain the influence of bank executive compensation on stock market performance and volatility during the global financial crisis. Suntheim (2010) shows that banks with higher pay-performance sensitivity performed better after the onset of the crisis, while banks with higher pay-risk sensitivity performed worse. Different results are obtained by Cerasi et al. (2015). Consistent with Fahlenbrach and Stulz (2011) for US banks, they find that greater pay-performance sensitivity at the end of 2006 is not related on average to either the drop in stock returns or higher stock price volatility during the financial crisis. They only observe this relationship in banks with a lower ownership concentration.

None of the above studies analyzes the influence on bank executive compensation of differences across countries in shareholder protection. We now contribute to the law and finance literature by analyzing how shareholder protection shapes the impact of systemic banking crises on the risk-taking incentives embedded in bank executive compensation. Our analysis allows us to provide evidence on the relevance of the contracting hypothesis for explaining bank executive compensation. We additionally provide empirical evidence on how government interventions affected pay-risk sensitivity in countries that suffered systemic banking crises.

3. Methodology and data

3.1. Empirical strategy

The identification strategy uses systemic banking crises as an exogenous shock to bank executive compensation. Countries with systemic banking crises suffer the most negative consequences of the crisis, and are the countries where the most severe change in the set of investment opportunities co-exists with the greatest intervention by authorities in bank management and executive compensation. Only banks in countries with systemic banking crises experienced injections of capital and nationalizations accompanied by explicit limits on executive compensation during the global financial crisis (Laeven and Valencia, 2012). For these reasons, they are a suitable scenario for testing the relative importance of the contracting hypothesis and the impact of government intervention on bank executive compensation. Banks in countries without systemic banking crises act as the control group to better control for any omitted variables when we compare executive pay-risk sensitivity before and after the onset of systemic banking crises.

We apply a traditional DID analysis to compare the vega before and after the onset of systemic banking crises. We test the following specification:

$$Ln(vega_{it}) = \alpha_0 + \alpha_1 Crisys + \alpha_2 Post_{jt} + \alpha_3 Crisys_j * Post_{jt} + \sum \gamma_z Y_{it}^z + \mu_i + \varepsilon_{it} \quad (1)$$

where i indexes banks, j indexes countries, and t indexes years. *Ln(vega)* is the natural logarithm of the vega option packages granted to bank executives. $Crisys_j$ is a dummy variable coded as 1 for all banks in countries that have experienced systemic banking crises, and 0 for all banks that have not experienced a systemic banking crisis. $Post_{jt}$ is the dummy variable identifying the period after the onset of the global financial crisis in country j. Y_{it}^z 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 check that the results do not change if the last two bank-level variables are not included in the regressions.

The coefficient α_3 captures the change in vega after the onset of the crisis in countries that have suffered systemic crises, using banks in countries that have not suffered a systemic crisis as the control group. We estimate model [1] using both a fixed-effect estimator and a tobit estimator. The fixed-effect model controls

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

for unobservable bank characteristics if they are time-invariant (μ_i). In these estimations, we do not report a coefficient for *Crisys* because it does not vary over time and its effect is subsumed by the fixed effects. 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). Since our crisis treatment is defined at country level, we cluster standard errors by country and check that the results do not change if we cluster standard errors by bank. [3]

We also analyze separately the change in the sensitivity of total and cash (salary + bonus) compensation to bank risk after the onset of the global financial crises for banks in countries with and without systemic banking crises. We estimate this pay-risk sensitivity for each group of banks using equivalent regressions to those used by Jensen and Murphy (1990); Crawford et al. (1995), and Cuñat and Guadalupe (2009), among others, to estimate the pay-performance sensitivity of executive compensation.[4] Our first baseline specification is:

$$\begin{aligned} Ln\,(W_{it}) &= \alpha_0 + \alpha_1 Post_{jt} + \alpha_2\, Ln(Returnvolatility)_{it} \\ &+\alpha_3\, Ln\,(Performance_{it}) \\ &+\alpha_4\, Post_{jt} * Ln(Returnvolatility_{it}) \\ &+\alpha_5\, Post_{jt} * Ln(Performance_{it}) \\ &+\sum \gamma_z X_{it}^z + \mu_i + \varepsilon_{it} \end{aligned} \tag{2}$$

where $Ln\,(W_{it})$ is the natural logarithm of total or cash executive compensation of bank i in year t. $Post_{jt}$ is the dummy variable identifying the period after the onset of the global financial crisis in country j $Ln\,(Returnvolatility_{it})$ is the natural logarithm of bank risk measured by the annual standard deviation of the weekly stock returns. $Ln\,(Performance_{it})$ is the natural logarithm of bank performance measured as total shareholders' value. X_{it}^z i s the set of bank-level control variables including the natural logarithm of total assets and the equity ratio. We additionally include bank-fixed effects (μ_i) in all the regressions to control for all sources, observed and unobserved, of time-invariant variation in executive compensation across banks. We perform several robustness tests and report that results do not change when standard errors are clustered at the country or at the bank level.

The coefficient α_1 captures the change in the fixed component of bank executive compensation after the onset of the global financial crisis. A negative coefficient of α_4 indicates a reduction in pay-risk sensitivity of bank executive compensation after the onset of the global financial crisis and would be consistent with a reduction in the risk-taking incentives of executive compensation. α_5 captures the change in pay-performance sensitivity. Given that the dependent variables as well as performance and risk are in natural logarithms, the estimated coefficients can be directly read as elasticities (Murphy, 1986; Cuñat and Guadalupe, 2009). Therefore, α_4 (α_5) measures the percentage change in pay associated with a percentage change in stock return volatility (shareholders' value). We make several extensions of the basic models to capture differences across countries depending on shareholder protection and government intervention on executive compensation.

3.2. Data and sample selection

The most difficult task in an international study on bank executive compensation is obtaining information outside the US. We combined hand-collected data on bank executive compensation with information from Compustat's Capital IQ. For each bank, we obtained information on the salary, cash bonus, options granted, total variable, and total compensation for all the executives following the criteria of the International Accounting Standards (IAS 24.17-IAS 24.19). We define total compensation as salary, bonus, total value of restricted stock granted, total value of options granted and long-term incentive payout (Hall and Liebman, 1998; John et al., 2010). We estimated total variable compensation as the difference between total compensation and salary.

Outside the US, we obtained information on compensation from Compustat's Capital IQ for 71 listed banks across 23 countries. We revised annual reports for all the remaining listed non-US banks and obtained information for an additional 129 listed banks across 38 countries. Therefore, our initial sample was made up of 200 banks across 43 countries. We only considered publicly-traded banks that had at least one observation in both the pre-crisis and post-crisis periods. For this reason, we ruled out two banks that were observed in the pre-crisis years but disappeared during the crisis because of mergers and acquisitions or insolvency. We excluded 33 banks from 10 countries because of lack of data on country shareholder protection, stock performance or stock return volatility. Therefore, the final sample for non-US banks is made up of 165 banks across 33 countries. They represent 74% of total bank assets in these countries at the end of 2006. Information on executive compensation for US banks has traditionally been used in many empirical studies and comes from Compustat's Capital IQ. 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 75% of total US bank assets at the end of 2006. Following Caprio et al. (2007) and Laeven and Levine (2009), we checked that the results do not change when we reduce the sample of US banks to the 10 largest banks. Therefore, we obtained data on total and cash compensation for a maximum of 181 banks across 34 countries (165 non-US banks and 16 US banks). The lack of data to compute the vega of stock options reduced our sample to 135 banks (119 non-US banks and 16 US banks) in regressions using vega as a proxy for risk-taking incentives embedded in bank executive compensation. All the banks excluded in regressions using vega belong to the control group, i.e., they are banks in countries without systemic banking crises.

3.3. Variables and descriptive statistics

We now describe in detail the proxies for our main variables. Table A1 in the Appendix describes all the variables used in the empirical analysis and their sources. Table 1 reports overall descriptive statistics and correlations for our main variables and all bank-level variables. Table A2 in the Appendix reports their average values per country.

3.3.1. Option vega and delta

We use vega of the options annually granted to bank executives as a proxy for risk-taking incentives embedded in executive compensation 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. Although the risk-taking incentives associated

[3] Our models are suitable to provide unbiased estimates even with omitted bank-level variables. For instance, corporate governance variables and the exposure of bank revenues to foreign investments are omitted in the regressions. As these variables are usually stable over time, a fixed-effects model or clustering standard errors by bank would be suitable for controlling for the time-series dependence of residuals created by their omission. Moreover, clustering standard errors by country accounts for correlations within a country and is unbiased in the presence of an unobserved country effect (Petersen, 2009).

[4] The comparison of results between banks in countries with and without systemic banking crisis allows us to use the banks in countries without such a crisis as the control group and to apply a similar procedure to the traditional DID approach.

Table 1
Descriptive statistics and correlations. Panel A reports the overall descriptive statistics and Panel B reports correlations between all the variables. The definition and source of each variable is indicated in Table A1 in the Appendix.

Panel A: Descriptive statistics

	Ln (vega)	Ln (delta)	Ln (total compensation)	Ln (salary+ cashbonus)	Ln (Return-volatility)	Ln (Performance)	ZscorePre	ZscorePost	DiffQ	Mortgage	Crisys	Post	Rights	Anti-self-dealing	Intervention	Size	Equity	% main shareholder	% independent directors
Mean	2.4322	0.9858	15.2953	14.5273	3.3979	8.1182	1.4457	1.9630	-0.2689	0.1704	0.4161	0.5158	70.6456	0.5660	0.0666	10.5187	0.0879	0.3319	0.6089
Std. Dev.	3.2361	1.5087	1.5214	1.1691	0.5710	2.2975	3.1013	4.9462	2.5738	0.1877	0.4930	0.4999	30.6668	0.2395	0.2495	2.6024	0.0861	0.2736	0.2447
Median	0	0	15.2449	14.6074	3.3847	8.1599	0.3350	0.3638	-0.6088	0.1007	0	1	90	0.54	0	10.6961	0.0666	0.2011	0.6307
Minimum	0	0	10.2996	10.0779	0.8095	1.9555	-1.5916	-8.2363	-4.3265	0	0	0	0	0.2	0	1.5675	-0.5895	0.025	0.0714
Maximum	9.7506	7.4533	19.5726	18.7518	5.7557	16.1365	18.2364	31.5271	27.5275	0.9022	1	1	90	1	1	16.0558	0.7069	0.9895	0.9500

Panel B: Correlations

	Ln(vega)	Ln(delta)	Ln (total compensation)	Ln(salary+ cashbonus)	Ln(Returnvolatility)	Ln(Performance)	ZscorePre	ZscorePost	DiffQ	Mortgage	Crisys	Post	Rights	Anti-self-dealing	Intervention	Size	Equity	% main shareholder
Ln(delta)																		
Ln(total compensation)	0.4978***	0.3705***																
Ln (Salary+cashbonus)	0.311***	0.2089***	0.8642***															
Ln (Returnvolatility)	-0.1733***	-0.1229***	-0.0287	0.0062														
Ln(Performance)	0.4191***	0.2175***	0.6214***	0.4816***	-0.0953***													
ZscorePre	0.0984***	0.0941***	-0.0215	-0.0523*	-0.1299***	0.392												
ZscorePost	0.2229***	0.0001	0.1462***	0.1041***	-0.1710***	0.1745***	0.4602***											
DiffQ	-0.0398	-0.0704**	-0.1426***	-0.1014***	0.0682**	0.0111	-0.1075***	-0.0282										
Mortgage	0.1149***	0.1308***	0.1558***	0.1135***	0.0260	0.0485*	0.1620***	0.1032***	-0.0561**									
Crisys	0.0509	0.0405	0.2192***	0.1508***	-0.0289	0.1375***	-0.2219***	-0.2883***	-0.0865	-0.0185								
Post	-0.1745***	-0.1850***	0.0583**	0.1109***	0.4845***	-0.0273	-0.0421	-0.0309	0.0284	-0.0162	0.0004							
Rights	0.1943***	0.2215***	0.3869***	0.3498***	-0.1195***	0.1052***	0.0740***	-0.0726***	-0.1065***	0.1767***	0.3556***	-0.0616**						
Anti-Self-Dealing	0.1710***	0.0700**	0.1354***	0.0009	-0.0168	0.2125***	0.2229***	0.2229***	-0.0139	0.1046***	-0.0840***	0.0059	0.1981***					
Intervention	0.1967***	0.2883***	0.2883***	0.1584***	0.2261***	0.2481***	-0.0542**	-0.1049***	0.0121	0.0454*	0.2763***	0.2455***	0.1167***	0.0868**				
Size	0.3375***	0.1480***	0.5345***	0.4307***	0.0120	0.8703***	0.1668***	0.1102***	-0.0407	0.0873***	0.1254***	0.0959***	-0.0201	0.119***	0.2279***			
Equity	-0.0483	0.0303	-0.0615**	-0.0630**	0.0322	-0.2187***	-0.1253***	-0.1186***	-0.0460*	-0.1046***	0.0105	-0.0081	0.1376***	0.081***	0.0211	-0.4637***		
% main shareholder	-0.1287***	-0.1552***	0.0720***	0.1185***	-0.1618***	-0.0264	-0.1848***	-0.0038	-0.1497***	0.1022***	0.4364***	-0.0660	0.6917***	0.2040***	-0.1236***	-0.0725***	0.0555**	
% independent directors	-0.0511	0.2200***	-0.0657**	-0.3920	0.2258***	-0.0218	0.1356***	-0.0609**	-0.0302	-0.0107	0.0504*	0	0.0055	0.0543*	0.0315	-0.0027	0.0012	0.0596**

with delta are not clear, we also report the change in delta because it has traditionally been used as a proxy for the convergence of interests between managers and shareholders. We define delta as the change in the dollar value of executive wealth for a 0.01 change in stock price.

We value stock options using the Black-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. Delta equals delta from options plus delta from stock holdings. Since vega and delta are highly skewed, we follow prior literature and use their natural logarithm. 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).[5] The lack of data on stock options granted to executives prevents us from computing vega and delta in 8 countries not suffering systemic banking crises (Bahrain, Bangladesh, Croatia, Czech Republic, Oman, Pakistan, Philippines, and Portugal). Banks in 4 countries not suffering systemic banking crises did not use stock options as a component of their executive compensation (Bosnia-Herzegovina, China, Finland, and Norway). We assume that vega and delta in these banks are zero both before and after the onset of the crisis.

3.3.2. Bank executive compensation

We additionally use executive pay-risk sensitivity with respect to both total compensation (including equity and non-equity based compensation) and cash compensation (including only non-equity compensation). First, we use total compensation, which is defined as the sum of salary, bonus, total value of restricted stock granted, total value of stock options granted, long-term incentive payouts, and other annual payments. In the analysis we include banks reporting total executive compensation although they do not report separate information for each component. Second, we use cash compensation (salary + cash bonus) following, among others, Murphy (1986); Crawford et al. (1995), and Cuñat and Guadalupe (2009). Salary and cash bonus are considered as short-term remuneration, and cash bonuses are paid on the basis of past short-term profits. These non-equity incentive payments have been most heavily criticized by regulators as not being related to long-term profitability (Financial Services Authority (FSA, 2009). These compensation variables are in 2006 US dollars.

3.3.3. Bank risk, performance, solvency, and investment opportunities

We use the annual standard deviation of weekly stock returns as the main proxy for bank risk. We measure bank performance as total shareholders' value, and define it as the initial total value of the banks' 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 (Crawford et al., 1995; Cuñat and Guadalupe, 2009). We use the natural logarithm of both variables (*Ln(Returnvolatility)* and *Ln(Performance)*).

We use the Z-score as a proxy for bank solvency. Z-score equals the return on assets plus the capital asset ratio divided by the standard deviation of asset returns. We compute the standard deviation of the return on assets using annual data for the pre-crisis period (*ZscorePre*) and the post-crisis period (*ZscorePost*). A higher Z-score indicates that a bank has a lower probability of insolvency.[6] We use two proxies for the change in a bank's investment opportunities: 1) the difference in the average annual market-to-book equity ratio between the period after the onset of the crisis and the period before the onset of the crisis (*DiffQ*). The annual market-to-book equity ratio is a traditional proxy for investment opportunities. Therefore, higher negative (positive) values for these differences would indicate a greater reduction (increase) in the bank's investment opportunities after the onset of the crisis. The negative average value of this variable reported in Table 1 is consistent with an average reduction in investment opportunities in our sample of banks. 2) We additionally use the ratio of commercial real estate and family mortgage loans to total assets at the end of 2006 as a proxy for the change in a bank's investment opportunity set (*Mortgage*). We assume that banks with higher values for this ratio immediately before the onset of the crisis suffered a greater negative change in their investment opportunity set. Family mortgage and commercial real estate loan defaults were the root of the global financial crisis in countries like the US, Ireland or Spain. The reduction in growth opportunities in this particular segment of the loan market after the onset of the crisis leads us to consider that banks with more commercial real estate and family mortgage loans immediately before the onset of the crisis possibly suffered a greater negative impact on their investment opportunity set after the onset of the crisis.

3.3.4. Identifying banking crises

We use two crisis dummy variables: *Crisys* is a dummy variable that takes the value zero for banks in the control group, i.e., banks in countries without systemic banking crises, and the value one for banks in countries with systemic crises. Data come from Laeven and Valencia (2012). *Post* is a dummy variable that takes the value one for the period after the onset of the crisis. Otherwise, it takes 0. Following Laeven and Valencia (2012), we consider 2007 as the starting year of the crisis for the UK and US, and 2008 for the remaining countries. We use a period of at least four years around the onset of the crisis. Therefore, we compare bank executive compensation between the periods 2003-2006 and 2007-2011 for the UK and US, and between the periods 2003-2007 and 2008-2011 for the remaining countries suffering systemic banking crises. A period of several years before and after the onset of the crisis is needed to capture the lagged impact of the crisis on bank executive compensation. Anyway, we check that the results do not change when we define alternative dates for the periods before and after the onset of the crisis. Specifically, we use 2009-2011 as the period after the onset of the crisis to better capture a potential delay in the effect of the crisis on the change in bank executive compensation and also follow Demirgüç-Kunt et al. (2015) in considering 2008-2011 as the period after the onset of the crisis for all the countries.

3.3.5. Shareholder protection

We use two main proxies for country shareholder protection: the property rights and the anti-self-dealing indexes. We use the index of property rights (*Rights*) from the Index of Economic Freedom constructed by the Heritage Foundation. This is a relatively broad index of property rights that is available for a large set of countries and has been used by other researchers (for example, La Porta et al., 2006). It ranges from 10 to 90 in our sample, with higher values indicating stronger protection of property rights. The anti-self-dealing index (*Anti-self-dealing*), created by Djankov et al.

[5] 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).

[6] Laeven and Levine (2009), among others, have recently used the *Z-score* as a proxy for bank insolvency risk in cross-country studies.

(2007), measures the degree to which minority shareholders are protected from large shareholders engaging in self-dealing transactions that benefit large shareholders at the expense of small ones. The anti-self-dealing index captures both the strength of anti-self-dealing laws and their enforcement. It ranges from zero to one, with higher values indicating stronger legal protection of minority shareholders. We do not have information on the anti-self-dealing index for 5 countries (Bahrain, Bangladesh, Bosnia-Herzegovina, Cyprus, and Oman). Therefore, our sample is reduced to 157 listed banks and 29 countries in regressions using this variable as the proxy for shareholder protection. The values of *Rights* and *Anti-self-dealing* refer to the end of 2006 to reduce endogeneity concerns for changes in these variables after the onset of the global financial crisis.[7]

3.3.6. Government intervention

We define the dummy variable *Intervention* that takes the value 1 for banks that were affected by government limitations on executive compensation after the onset of the global financial crisis. Otherwise, it takes 0. We collected information on banks receiving government financial support from the web sites of the national central banks and of the government authorities providing financial support to banks. According to Laeven and Valencia (2012), countries with systemic banking crises experienced government interventions not only in the form of liquidity support and blanket guarantees but also in the form of nationalizations and significant restructuring costs. Countries with borderline crises also experienced government liquidity support and blanket guarantees but not significant nationalizations or restructuring costs. Nationalizations and significant restructuring costs in countries with systemic banking crises were accompanied by limits on executive compensation. Therefore, *Intervention* mostly takes the value 1 for banks in countries with systemic banking crises. For instance, the second round of capital injections in troubled US banks under the Troubled Asset Relief Program (TARP) was made contingent on executive pay limits. The German and Spanish governments explicitly limited CEO remuneration to a maximum of half a million Euro per year, including a bonus payment in banks receiving government financial support.[8]

3.4. Changes in compensation, risk, performance, and investment opportunities

Table 2 reports by country the change in the mean values after the onset of the crisis for our variables of vega, delta, executive compensation, risk, performance, and investment opportunities. The change is defined as the difference between the values in the post and pre-crisis periods (POST-PRE). Panel A shows in column (2) a statistically significant reduction in vega after the onset of the crisis in countries suffering systemic banking crises. The mean of the reduction in the natural logarithm of vega is 1.6942. All of these countries experienced an average reduction in vega that is only non-significant at conventional levels in Spain. However, banks in countries without systemic banking crises did not experience an average reduction in vega after the onset of the crisis. The mean value of the change (-0.5295) is not statistically significant at conventional levels. However, there are differences across countries because we find that banks in 8 countries experienced an average significant reduction in vega whereas banks in four countries experienced an average significant increase.

Column (3) shows a statistically significant reduction in delta for banks in all countries with systemic banking crises. Similar to vega, the behavior of delta was more diverse in countries without systemic crises because banks in nine such countries reduced their delta whereas banks in three of them increased it.

Panel A shows in column (4) that banks in countries suffering systemic banking crises did not change on average their total bank executive compensation because the difference between the level in the post and pre-crisis periods is not statistically significant. However, column (5) shows that they increased total cash compensation (salary + cash bonus), with a statistical significance of one per cent, after the onset of the crisis. This suggests substitution of a higher cash compensation for a lower equity compensation in the variable package. Panel B shows that bank executive pay in countries without systemic banking crises follows a different pattern. On average, they increased not only their cash compensation but also total compensation, and the differences between post and pre-crisis are significant at the one percent level.

Column (6) shows that banks in both groups increased on average their annual stock return volatility, although the increase is statistically higher for banks in countries with systemic banking crises. Regarding performance, banks in countries suffering systemic banking crises on average reduced their performance after the onset of the crisis, whereas banks in countries without systemic crises did not on average experience a significant change in their performance. Therefore, banks in countries suffering systemic crises increased their risk and reduced on average their performance whereas banks in countries not suffering systemic crises experienced a lower increase in risk and did not reduce their performance.

The results for the change in banks' investment opportunities (*DiffQ*) are consistent with a greater reduction in the investment opportunity set after the onset of the crisis in countries suffering systemic banking crises. Column (8) shows that, whether in countries with or without systemic crises, all banks experienced an average reduction in Tobins' q after the onset of the crisis. However, the reduction in Tobins' q is higher for banks in countries suffering systemic crises (-0.5326) than for banks in countries not suffering such crises (-0.0809). Seven of the nine countries suffering systemic crises experienced a reduction in Tobins' q after the onset of the crisis that is statistically significant at the one percent level. Banks in Austria did not experience a significant reduction and only banks in Belgium experienced a significant increase in Tobins' q after the onset of the crisis. Consistent with an average lower reduction in Tobins' q in countries without systemic banking crises, we find that banks in 14 countries did not experience a significant change in Tobins' q, seven countries experienced a significant reduction in Tobin's q, and banks in four countries on average increased their Tobins' q.

4. Empirical results

4.1. Preliminary analysis

We initially check that the treatment and control groups meet the "parallel trends" condition for a DID analysis. The probability of suffering systemic banking crises must not be driven by differences in bank executive compensation before the crisis or, in the absence of treatment, pay-risk sensitivity should be similar for treatment and control groups. To check this, we estimate our baseline regres-

[7] Although not reported, we additionally check that the results do not change when we use the investor protection indicator defined by La Porta et al. (2006) as the principal component of the three following indexes: 1) disclosure requirements, 2) liability standards, and 3) antidirector rights. The lack of data for 10 countries reduces our sample to 135 banks across 24 countries so we give priority to the results for *Rights* and *Anti-self-dealing*.

[8] None of the publicly-traded Spanish banks included in our sample was affected by these limitations because government support in Spain focused on savings banks. UBS is the only case in our sample affected by government limitations on executive compensation in a country without systemic crises.

Table 2

Descriptive statistics. This table reports by country the difference between the average of the particular variable after the onset of the crisis and its average in the pre-crisis period (POST-PRE). The pre-crisis period is 2003-2006 for UK and US, and 2003-2007 for the remaining countries. Panel A reports the data for countries with systemic banking crises and Panel B for countries without systemic banking crises. *Ln(vega)* is the natural logarithm of the dollar change in the value of the annual options granted to bank executives for a 0.01 change in stock return volatility. Ln(delta) is the natural logarithm of the change in the dollar value of executive wealth for a 0.01 change in stock price. *Ln(total compensation)* is the natural logarithm of total bank executive compensation. *Ln(salary+cash bonus)* is the natural logarithm of salary plus cash bonus. *Ln(Returnvolatility)* is the natural logarithm of the standard deviation of weekly stock returns. *Ln(Performance)* is the natural logarithm of total shareholders' value, that is, the initial total value of the firm in the first sample period capitalized year by year using the total gross returns of holding the stock during the relevant period. *DiffQ* is the difference in the average annual market-to-book equity ratio between the periods after the onset of the crisis (Q_{POST}) and before it (Q_{PRE}). Compensation variables are in 2006 US dollars. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

Panel A. Countries with systemic banking crises

	#Obs	Ln (vega) POST-PRE	Ln(delta) POST-PRE	Ln(total compensation) POST- PRE	Ln(salary+cash bonus) POST-PRE	Ln(Returnvolatility) POST-PRE	Ln(Performance) POST–PRE	DiffQ Q_{POST}-Q_{PRE}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Austria	27	-3.3366***	-1.4131***	0.0990 **	0.2665 ***	0.1488	- 0.3949 ***	-0.0486
Belgium	24	-3.8407***	-1.0842***	- 0.2658 ***	0.1153 *	1.1565 ***	1.1973 **	10.0674***
Denmark	116	-0.3679***	-0.1110***	0.1627 ***	0.2360 ***	0.8475 ***	- 0.7496 ***	-0.6839***
Germany	78	-1.4798***	-0.8181***	- 0.0237	0.2472 ***	0.2914 ***	- 0.3080 ***	-0.7342***
Ireland	26	-2.6835***	-0.8582***	- 0.4802 ***	- 0.1901 **	1.7570 ***	- 1.9690 ***	-1.8668***
Netherlands	27	-1.5228***	-1.1061***	0.2511 ***	0.3419 ***	0.2876 ***	0.1957	-1.0461***
Spain	47	-0.4884	-0.6123***	0.1473 ***	0.2308 ***	0.8735 ***	- 04557 ***	-0.7522***
UK	107	-3.2355***	-1.4184***	0.0934 **	- 0.0787 *	0.6301 ***	- 0.2533 ***	-0.8589***
US	141	-1.6037***	-0.9367***	- 0.2069 ***	0.1186 ***	1.0002 ***	- 0.5114 ***	-1.5283***
Mean		-1.6942***	-0.8190***	- 0.0078	0.1350***	0.7686***	- 0.4375 ***	-0.5326***

Panel B. Countries without systemic banking crises

	#Obs	Ln(vega) POST-PRE	Ln(delta) POST-PRE	Ln(total compensation) POST- PRE	Ln(salary+cash bonus) POST-PRE	Ln(Returnvolatility) POST-PRE	Ln(Performance) POST–PRE	DiffQ Q_{POST}-Q_{PRE}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Australia	106	-0.8677***	-0.6226***	0.4929 ***	0.5810 ***	0.4572 ***	0.4002 ***	-0.2902
Bahrain	6			0.1043	0.2153	0.0970	- 0.2447	0.7053
Bangladesh	23			0.2163 ***	0.3774 ***	- 0.0381	0.9310 ***	3.5450***
Bosnia-Herzegovina	6	0	0	0.2101	0.1712	0.7100	- 1.2408	-0.3271
Canada	96	0.3578***	0.1983	0.2472 ***	0.4462 ***	0.4974 ***	0.0808 **	-0.4129***
China	29	0	0	0.3035 ***	0.3676 ***	0.1366 ***	- 0.0973 *	1.1492***
Croatia	21			0.1723 **	0.4580 ***	0.1328 **	- 0.1302 **	-0.6033***
Cyprus	6	0.5523	-1.8605***	0.0814	- 0.4097	0.6780	- 1.3462	-0.0011
Czech Republic	8			0.0530	0.6962	0.3894	0.1471	0.0100
Finland	9	0	0	0.7575	0.7575	0.4744	- 0.0093	-0.4784
France	68	-1.6899***	-0.9526***	- 0.2397 ***	- 0.1490 **	0.6200 ***	- 0.3294 ***	-0.3627***
Hong Kong	78	-1.1438***	-0.5264***	0.2032 ***	0.1897 ***	0.5585 ***	- 0.1730 ***	-0.3363***
India	25	-1.4776	0.0847**	0.8668 ***	0.6218 ***	0.1629 ***	0.7510 ***	0.0208
Indonesia	14	0.6265***	0.0636***	0.5990 ***	0.1745 ***	0.1186 ***	0.3210 ***	1.1543***
Italy	38	-0.9278***	-0.3487***	0.5653 ***	0.7407 ***	0.5770 ***	- 0.7021 ***	-0.4421***
Malaysia	27	0.6108**	0.0722***	0.6930 ***	0.1465 ***	- 0.1495 **	0.5671 ***	0.1436
Norway	54	0	0	0.5715 ***	0.6629 ***	0.4899 ***	- 0.2786 ***	-0.3120***
Oman	12			0.6200 ***	0.4619 ***	0.2275 ***	0.1651	1.2828***
Pakistan	45			1.2580 ***	1.3552 ***	0.0924 ***	- 0.5667 ***	-0.2722***
Philippines	6			0.6110	0.5641	0.1209	0.2768	1.2143
Poland	50	-0.1101***	-0.0165***	0.3952 ***	0.4121 ***	0.2216 ***	0.0827 **	0.0326
Portugal	6			- 1.1271	- 0.3287	0.6519	- 1.4279	-0.0543
Singapore	15	-4.7115***	-1.2352***	0.0516 ***	0.5770 ***	0.4219 ***	0.1530 ***	0.1182
Sweden	45	-0.5773**	-0.6437***	0.2313 ***	0.3113 ***	0.6783 ***	- 0.7030 **	-1.0799***
Switzerland	39	0.3894**	0.3574**	- 0.0273	0.1586 **	0.2117 ***	0.0517	0.0494
Mean		-0.5295	-0.3203***	0.3539***	0.4250***	0.3869***	- 0.0169	-0.0809*

Table 3

Pre-crisis differences between the treatment and control groups. This table reports results analyzing differences in pay-risk sensitivity between the control and the treatment group during the pre-crisis period. The pre-crisis period is 2003-2006 for UK and US, and 2003-2007 for the remaining countries. *Ln(vega)* is the natural logarithm of the dollar change in the value of the annual options granted to bank executives for a 0.01 change in stock return volatility. *Ln(total compensation)* is the natural logarithm of total bank executive compensation. *Ln(salary + cash bonus)* is the natural logarithm of salary plus cash bonus. *Crisys* is a dummy variable identifying banks in countries suffering a systemic banking crisis after 2007. *Ln(Returnvolatility)* is the natural logarithm of the standard deviation of weekly stock returns. *Ln(Performance)* is measured as total shareholders' value, that is, the initial total value of the firm in the first sample period capitalized year by year using the total gross returns of holding the stock during the relevant period. We use its natural logarithm. *Size* is the natural logarithm of total bank assets. *Equity* is the ratio of equity to total bank assets. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	Using only pre-crisis data									
	Ln(vega)								Ln(total compensation)	Ln(salary+cash bonus)
	OLS				Tobit				Fixed effects	Fixed effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Crisys	0.2150	0.2150	0.0788	0.0788	0.3040	0.3040	0.0886	0.0886		
	(0.23)	(0.46)	(0.10)	(0.17)	(0.18)	(0.34)	(0.06)	(0.10)		
Ln(Returnvolatility)			-0.2735	-0.2735			-0.1274	-0.1274	-0.2042	-0.0280
			(-0.48)	(-0.68)			(-0.10)	(-0.15)	(-1.32)	(-0.23)
Ln(Performance)			0.9401***	0.9401***			1.3721**	1.3721***	0.4877***	0.4390***
			(3.01)	(3.86)			(2.30)	(2.72)	(3.80)	(4.83)
Size	0.6296***	0.6296***	-0.1626	-0.1626	1.2949***	1.2949***	0.0889	0.0889	0.1228	0.0944
	(4.61)	(7.06)	(-0.68)	(-0.81)	(3.73)	(6.77)	(0.18)	(0.21)	(1.35)	(0.94)
Equity	5.3094**	5.3094**	1.6829	1.6829	14.2478***	14.2478***	6.6117	6.6117	-0.3489	-0.2629
	(2.50)	(2.51)	(1.29)	(1.11)	(2.69)	(3.36)	(1.47)	(1.63)	(-0.52)	(-0.42)
Intercept	-4.1546**	-4.1546***	-2.5809	-2.5809	-14.2101***	-14.2101***	-11.9435*	-11.9435***	10.2357***	10.2255***
	(-2.70)	(-4.17)	(-1.23)	(-1.60)	(-3.11)	(-5.83)	(-1.71)	(-3.06)	(11.70)	(10.76)
Crisys * Ln(Returnvolatility)									0.2493	0.0729
									(1.45)	(0.52)
Crisys * Ln(Performance)									0.0197	-0.1037
									(0.11)	(-0.73)
Bank-fixed effect	No	No	No	No	No	No	No	No	Yes	Yes
Cluster country-level	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes
Cluster bank-level	No	Yes	No	Yes	No	Yes	No	Yes	No	No
R^2	0.2264	0.2264	0.2779	0.2779	0.063	0.0633	0.073	0.0726	0.4418	0.2060
# Obs	483	483	483	483	483	483	483	483	690	690
# Banks	130	130	130	130	130	130	130	130	181	181

sions (models [1] and [2]), using data only for the period before the onset of the global financial crisis. Columns (1) - (8) in Table 3 report the results for differences in vega between the two groups before the onset of the crisis using, respectively, OLS and Tobit estimators. The coefficients of *Crisys* are not significant at conventional levels in either OLS or Tobit estimations, whether *Ln(Returnvolatility)* and *Ln(Performance)* are included as control variables or not, or whether standard errors are clustered at the country or at the bank level. The non-significant coefficients of *Crisys* indicate that there were no differences in vega between the treatment and the control groups of banks before the onset of the crisis. [9]

Columns (9) - (10) show the results for differences in total and cash pay-risk sensitivities between banks in countries with and without systemic crises. We report results using a fixed-effects model and clustering standard errors at the country level. We find similar results when standard errors are clustered at the bank level. The non-significant coefficients of *Crisys*Ln(Returnvolatility)* in both columns indicate that there are no differences in total and cash pay-risk sensitivities before the onset of the crisis between both groups of banks. Moreover, the significant positive coefficients of *Ln(Performance)* and the non-significant coefficients of *Ln(Returnvolatility)* suggest that bank executive compensation before the onset of the crisis on average included a variable component related to bank performance but not to bank return volatility in both groups of banks. The non-significant coefficients of *Crisys*Ln(Performance)* indicate that there were no differences in total or cash pay-performance sensitivities before the onset of the crisis between both groups of banks. Although not reported, similar non-significant coefficients are obtained for *Crisys*Ln(Returnvolatility)* and *Crisys* Ln(Performance)* when each interaction term is separately included in the regressions.

These results suggest that potential differences in bank executive compensation between the two groups of banks after the onset of the crisis were not caused by differences before the onset of the crisis. This confirms the suitability of a DID methodology for analyzing the impact of systemic crises on executive pay-risk sensitivity using banks in countries without systemic banking crises as the control group. Moreover, the results for the period before the onset of the crisis are consistent with findings by Falenbrach and Stulz (2011). They show in a sample of US banks that there is no relationship between the structure of bank CEOs' equity incentives before the crisis and the performance of their banks during the crisis. Banks with higher option compensation and a larger fraction of compensation in cash bonuses for their CEOs did not perform worse during the crisis. Cerasi et al. (2015) find similar results for a sample of 116 banks in 26 countries.

4.2. Changes in pay-risk sensitivity after the onset of systemic banking crises

We now analyze the change in pay-risk sensitivity after the onset of systemic crises. Table 4 reports the results for the change in the vega of stock options granted to bank executives applying a traditional DID analysis in columns (1) - (6). Columns (7) - (10) report the change in vega separately for banks with and without systemic banking crises. The coefficients are the same whether standard errors are clustered by country or by bank, although their level of significance is lower in the latter case.

The significant and negative coefficients of *Post* in columns (1) and (2) suggest an average reduction in vega after the onset of the global financial crisis for the whole sample. The significant and negative coefficients of *Post* and *Crisys*Post* in both columns suggest that the reduction in vega is greater in countries that suffered systemic banking crises. The effect of *Crisys* is subsumed by the fixed effects in these estimations. The coefficients are economically meaningful. For instance, the coefficients in column (1) imply that the average *Ln(vega)* dropped by 68.75% after the onset of the crisis for banks in countries not suffering systemic crises, whereas the average *Ln(vega)* dropped by 105.64% for banks in countries suffering a systemic banking crisis. Tobit estimates in columns (4) and (5) suggest a less clear reduction in vega. Only the negative coefficient of *Post* in column (5) is significant at conventional levels, suggesting an average reduction in vega after the onset of the crisis in all countries, whether they suffered a systemic crisis or not. Although negative, the coefficients of *Crisys*Post* are not significant at conventional levels in columns (4) and (5). The coefficients remain in columns (3) and (6) when we include the interaction *Crisys*Post*Intervention* to control for government intervention.

A greater reduction in vega after the onset of the crisis in countries suffering systemic banking crises is confirmed when we analyze separately the change in vega in each group of banks. Using the fixed-effects estimator, the coefficient of *Post* is significant and negative for each group of banks, but the greater coefficient for banks in countries with systemic crises in column (7) suggests a greater reduction in vega in these banks. Using the Tobit estimator, we only find a reduction in vega in banks in countries with systemic crises because the coefficient of *Post* is significant in column (8) but not in column (10).

Table 5 reports the results for the change in total and cash pay-risk sensitivities. We separately analyze the change in banks in countries with and without systemic baking crises.[10] The results confirm a reduction in pay-risk sensitivity in countries that suffered systemic crises. The negative and significant coefficient of *Post*Ln(Returnvolatility)* in column (2) suggests a reduction in total pay-risk sensitivity in these countries. The negative, but minimally non-statistically significant coefficient of *Post*Ln(Returnvolatility)* in column (4) suggests a less clear reduction in cash pay-risk sensitivity in countries suffering systemic crises. However, the coefficients of *Post*Ln(Returnvolatility)* are clearly non-significant for banks in countries without systemic crises in columns (6) and (8).

The non-significant coefficient of *Post* in column (1) and its positive and significant coefficient in column (3) suggest that the reduction in pay for banks that suffered a systemic crisis comes from a reduction in equity-based compensation. This result is consistent with the reduction in total pay-risk sensitivity shown in column (2) and with the reduction in vega shown in Table 4 for these banks. The coefficients of *Ln(Performance)* are positive and mostly significant at conventional levels in both groups of banks. Only the coefficient in column (1) is not significant. These coefficients suggest that compensation packages included a significant variable component related to bank performance in both groups of banks before the onset of the global financial crisis. The coefficients of *Ln(Returnvolatility)* are mostly non-significant and only the coefficient in column (1) is significant and negative at conventional levels. Executive compensation in both groups of banks is, therefore, not related on average to bank return volatility before the onset of the global financial crisis. The coefficients of *Post*Ln(Performance)* are similar to those found for *Post*Ln(Returnvolatility)*, and suggest that pay-risk and

[9] We apply an OLS and not a fixed-effects model in columns (1) - (4) because *Crisys* is time invariant and its influence would be subsumed by the fixed effects.

[10] Given the similarity of the results and to save space, we do not report the results with standard errors clustered at bank level. As the fixed-effect model controls for residual dependence in a given bank over the years created by an unobserved bank effect, we report results with standard errors clustered at country level to control for any additional correlation of residuals within a country created by an unobserved country effect. Anyway, we check that the results are similar in all the estimations whether we cluster standard errors at bank or country level.

Table 4

Changes in vega after the onset of the global financial crisis. This table reports the results of model [1] using both fixed effects and tobit estimators. The dependent variable is *Ln(vega)* defined as the natural logarithm of the dollar change in the value of the annual options granted to bank executives for a 0.01 change in stock return volatility. *Crisys* is a dummy variable identifying banks in countries suffering a systemic banking crisis after 2007. *Post* is a dummy variable that takes value one after the onset of the global financial crisis and zero otherwise. *Intervention* is a dummy bank variable that takes value one for banks with government intervention on executive compensation, and 0 otherwise. *Ln(Returnvolatility)* is the natural logarithm of the standard deviation of weekly stock returns. *Ln(Performance)* is measured as total shareholders' value, that is, the initial total value of the firm in the first sample period capitalized year by year using the total gross returns of holding the stock during the relevant period. We use its natural logarithm. *Size* is the natural logarithm of total bank assets. *Equity* is the ratio of equity to total bank assets. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	All banks						Banks in countries with systemic crises		Banks in countries without systemic crises	
	Fixed effects			Tobit			Fixed effects	Tobit	Fixed effects	Tobit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Crisys				0.2843	0.2843	0.3717				
				(0.17)	(0.30)	(0.40)				
Post	-0.6875**	-0.6875**	-0.6907***	-1.9685	-1.9685***	-1.8936***	-1.4554**	-3.3882*	-0.8692**	-1.6612
	(-2.18)	(-2.78)	(-2.78)	(-1.50)	(-2.85)	(-2.82)	(-2.95)	(-1.77)	(-3.27)	(-1.02)
Crisys* Post	-0.9689*	-0.9689*	-0.8975**	-1.2865	-1.2865	-3.4603***				
	(-1.82)	(-2.65)	(-2.19)	(-0.86)	(-1.35)	(-3.19)				
Crisys*Post*Intervention			-0.2536			5.3185***				
			(-0.45)			(3.52)				
Ln(Returnvolatility)	-0.2845	-0.2845	-0.2677	0.0044	0.0044	-0.2869	-0.4804**	0.1325	0.1178	-0.8708
	(-1.57)	(-1.52)	(-1.49)	(0.00)	(0.01)	(-0.45)	(-2.29)	(0.13)	(0.63)	(-0.56)
Ln(Performance)	0.0157	0.0157	0.0274	1.1783*	1.1783*	0.9130*	-0.2591	1.4243	0.6342**	0.5076
	(0.07)	(0.07)	(0.13)	(1.85)	(2.39)	(1.90)	(-1.37)	(1.59)	(2.71)	(0.79)
Size	0.4617*	0.4617*	0.4574*	0.1755	0.1755	0.2581	0.1303	0.4108	0.4541***	0.3044
	(1.84)	(1.79)	(1.79)	(0.33)	(0.39)	(0.59)	(0.30)	(0.49)	(3.07)	(0.57)
Equity	-0.8827	-0.8827	-0.8203	6.7013	6.7013	5.5406	2.3458	16.2020**	-2.6199***	2.8963
	(-0.43)	(-0.41)	(-0.38)	(1.13)	(1.44)	(1.22)	(0.34)	(2.09)	(-3.62)	(0.44)
Intercept	-1.0434	-1.0434	-1.1524	-12.0869*	-12.0869*	-9.6210***	5.5617	-17.7105**	-7.4353***	-4.9674
	(-0.38)	(-0.40)	(-0.44)	(-1.93)	(-3.71)	(-2.92)	(1.31)	(-2.24)	(-3.33)	(-0.66)
Bank-fixed effect	Yes	Yes	Yes	No	No	No	Yes	No	Yes	No
Cluster country-level	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Cluster bank-level	No	Yes	No	No	Yes	No	No	No	No	No
R^2	0.1214	0.1214	0.1218	0.0597	0.0597	0.0691	0.1889	0.1112	0.0793	0.0247
# Obs	994	994	994	994	994	994	488	488	506	506
# Banks	135	135	135	135	135	135	63	63	72	72

Table 5
Change in total and cash pay-risk sensitivity in the treatment and control groups. This table reports the results of model [2] separately for banks in countries with and without systemic banking crises. *Ln(total compensation)* is the natural logarithm of total bank executive compensation. *Ln(salary + cash bonus)* is the natural logarithm of salary plus cash bonus. *Post* is a dummy variable that takes value one after the onset of the global financial crisis and zero otherwise. *Ln(Returnvolatility)* is the natural logarithm of the standard deviation of weekly stock returns. *Ln(Performance)* is measured as total shareholders' value, that is, the initial total value of the firm in the first sample period capitalized year by year using the total gross returns of holding the stock during the relevant period. *Intervention* is a dummy bank variable that takes value one for banks with government intervention on executive compensation, and 0 otherwise. We use its natural logarithm. *Size* is the natural logarithm of total bank assets. *Equity* is the ratio of equity to total bank assets. All regressions include bank fixed effects, and standard errors are clustered by country. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	Countries with systemic banking crises				Countries without systemic banking crises			
	Ln(total compensation)		Ln(salary+cash bonus)		Ln(total compensation)		Ln(salary+cash bonus)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	0.0722	1.2687***	0.0864**	0.7641**	0.3417***	0.5081	0.3978***	0.3549
	(0.64)	(4.51)	(2.43)	(2.58)	(3.44)	(1.30)	(4.00)	(0.89)
Ln(Returnvolatility)	-0.1851*	-0.0158	-0.0758	0.0221	-0.0935	-0.0748	-0.0122	-0.0136
	(-2.17)	(-0.16)	(-1.12)	(0.48)	(-1.07)	(-0.59)	(-0.14)	(-0.13)
Ln(Performance)	0.0838	0.1741**	0.0469**	0.0963**	0.2465***	0.2505***	0.1939***	0.1878***
	(1.37)	(2.62)	(2.84)	(3.06)	(4.89)	(4.48)	(3.70)	(3.70)
Post * Ln(Returnvolatility)		-0.1377*		-0.0822		-0.0254		-0.0064
		(-2.11)		(-1.75)		(-0.21)		(-0.07)
Post * Ln(Performance)		-0.0930***		-0.0511		-0.0102		0.0082
		(-3.60)		(-1.79)		(-0.31)		(0.22)
Size	0.2673**	0.2817***	0.3775***	0.3858***	0.1045	0.1011	0.0666	0.0705
	(2.95)	(4.25)	(6.33)	(6.74)	(1.19)	(1.21)	(0.85)	(0.95)
Equity	0.4539	0.8968**	2.6090***	2.8534***	-0.7356	-0.7327	-0.4325	-0.4277
	(1.03)	(3.32)	(3.93)	(4.26)	(-1.08)	(-1.10)	(-0.63)	(-0.62)
Intercept	12.6118***	11.1226***	10.2003***	9.3664***	12.2142***	12.1577***	12.0475***	12.0606***
	(13.23)	(16.88)	(13.39)	(14.16)	(17.63)	(16.86)	(17.40)	(15.13)
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster country-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.6880	0.7170	0.6282	0.6351	0.2246	0.2250	0.2227	0.2230
# Obs	593	593	593	593	832	832	832	832
# Banks	71	71	71	71	110	110	110	110

pay-performance sensitivities move in the same direction after the onset of systemic banking crises. The reduction in pay-risk sensitivity in countries suffering systemic banking crises is also significant in economic terms and greater than the reduction in pay-performance sensitivity. For instance, estimates in column (2) imply that the sensitivity of total compensation to the volatility of stock returns decreased by 13.77% whereas the sensitivity of total pay to bank performance decreased by 9.30% after the onset of systemic banking crises.

We find additional differences for both groups of banks. The positive and significant coefficients of *Post* in columns (5) and (7) indicate an average increase in the level of fixed compensation after the onset of the global financial crisis in banks in countries that did not suffer systemic banking crises. However, banks in countries suffering systemic banking crises experienced a smaller increase because the coefficient of *Post* is non-significant in column (1). In column (3), although it is positive and significant, it is lower than in columns (5) and (7).

4.3. Shareholder protection, government intervention, and changes in pay-risk sensitivity

The reduction in pay-risk sensitivity after the onset of systemic crises described in the previous section is consistent with shareholders' incentives driving the change to adapt executive pay to reduced growth opportunities but we cannot rule out the possibility that entrenched managers may have been the drivers of the reduction in pay-risk sensitivity. A higher probability of bank failure during the crisis provides managers with incentives to increase their short-term compensation, and their risk-taking incentives may converge with shareholders' interests in avoiding the losses that both managers and shareholders suffer in case of bank failure. Moreover, government interventions may also be a partial or complete driver of the reduction in pay-risk sensitivity when they aim to curb misaligned managerial compensation.

We now test the relevance of the contracting hypothesis by analyzing whether the change in pay-risk sensitivity after the onset of the crisis is related to differences in shareholder protection across countries. We argue that shareholder protection increases the probability that shareholders' incentives drove the change in executive compensation after the onset of the crisis because shareholders in countries with stronger protection should be more able to incorporate their incentives in executive contracts. Therefore, the contracting hypothesis predicts a greater reduction in pay-risk sensitivity following the reduction in the investment opportunity set after the onset of the crisis in countries with stronger shareholder protection. Not mutually exclusive to the contracting and managerial hypotheses, the government intervention hypothesis predicts a greater reduction in pay-risk sensitivity in banks affected by government limitations on executive compensation.

We split our sample in two groups around the median of each proxy for shareholder protection and analyze differences in the change in vega. We use two proxies for shareholder protection: the property rights index (*Rights*) and the anti-self-dealing index (*Anti-self-dealing*).[11] Table 6 reports the results. All the estimations control for government intervention, countries' bank development and the intensity of the crisis in them. The fixed-effects model subsumes the level effect of country variables and *Intervention* because they are measured once per country or bank, and do not vary over time. Columns (1) - (4) report the results for banks in countries above the median of shareholder protection (*HIGH Shareholder protection*), whereas columns (5) - (8) report the results for countries below the median (*LOW Shareholder protection*).

[11] We check that the results do not change when we apply an OLS model, including country level variables, and clustering standard errors by banks to control for any potential correlation of residuals in a given bank over the years created by an unobserved bank effect.

Table 6
Shareholder protection, government intervention, and the change in vega. This table reports the results of model [1] using both fixed effects and tobit estimators in alternative sub-samples depending on country shareholder protection. The dependent variable is *Ln(vega)* defined as the natural logarithm of the dollar change in the value of the annual options granted to bank executives for a 0.01 change in stock return volatility. *Crisys* is a dummy variable identifying banks in countries suffering a systemic banking crisis after 2007. *Post* is a dummy variable that takes value one after the onset of the global financial crisis and zero otherwise. *Shareholder protection* refers to the particular proxy for shareholder protection. We use two proxies: the property rights index (*Rights*) and the anti-self-dealing index (*Anti-self-dealing*). *Intervention* is a dummy bank variable that takes value one for banks with government intervention on executive compensation, and 0 otherwise. All the control variables are defined in Appendix A1. Standard errors are clustered by country in all the regressions, and ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	HIGH Shareholder protection				LOW Shareholder protection			
	Rights		Anti-self-dealing		Rights		Anti-self-dealing	
	Fixed effects (1)	Tobit (2)	Fixed effects (3)	Tobit (4)	Fixed effects (5)	Tobit (6)	Fixed effects (7)	Tobit (8)
Crisys		-0.7431		1.9322		-1.7361		1.0720
		(-0.42)		(1.26)		(-0.91)		(0.69)
Post	-1.1475	-0.6119	-0.6739	-3.0589	-0.2802	-4.5040	-1.1599	-1.0779
	(-1.12)	(-0.31)	(-0.88)	(-1.58)	(-1.13)	(-1.57)	(-1.38)	(-0.47)
Crisys*Post	-1.4531**	-3.9141**	-2.2064**	-5.2525***	1.0447**	2.2241	-0.3601	-0.8949
	(-2.59)	(-2.43)	(-2.64)	(-2.78)	(2.38)	(0.84)	(-0.55)	(-0.37)
Crisys*Post*Intervention	0.4289	3.9899**	1.1915	6.7343***			-2.1117*	-8.6348
	(0.66)	(2.33)	(1.54)	(2.99)			(-1.86)	(-0.98)
Post*Bankdevelop	0.0055	-0.0069	0.0004	0.0194	-0.0105**	-0.0100	0.0009	-0.0497**
	(0.66)	(-0.33)	(-0.06)	(0.92)	(-2.78)	(-0.37)	(0.11)	(-2.11)
Post*GDP growth contraction	0.0782**	0.1413	0.0202	0.4935***	-0.0251	-0.0124	0.0072*	0.0167
	(2.74)	(0.83)	(0.50)	(2.67)	(-0.30)	(-0.03)	(1.79)	(0.06)
Ln(Returnvolatility)	-0.5383**	-0.1804	-0.1074	-2.3310**	0.0876	0.7308	-0.3872	2.8035**
	(-2.33)	(-0.15)	(-0.47)	(-2.08)	(0.20)	(0.84)	(-1.47)	(2.38)
Ln(Performance)	-0.1321	0.9869	0.3097	0.3419	0.6083**	-0.0075	-0.0938	1.2350
	(-0.64)	(1.49)	(1.46)	(0.69)	(2.42)	(-0.01)	(-0.47)	(0.79)
Size	0.4559	0.2552	0.3624*	0.1944	0.5709*	1.5725**	0.4982	0.2581
	(1.58)	(0.40)	(1.97)	(0.43)	(1.93)	(2.35)	(1.04)	(0.19)
Equity	0.0922	5.0774	-0.7008	-0.1596	-3.7903**	23.4808***	-1.3975	9.7328
	(0.03)	(0.73)	(-0.20)	(-0.03)	(2.39)	(5.74)	(-0.70)	(1.11)
Intercept	1.4036	-8.9317	-2.4168	4.0026	-9.8327**	-25.2548***	-1.1624	-25.2677***
	(0.42)	(-1.38)	(-0.66)	(0.82)	(-2.59)	(-5.29)	(-0.28)	(-3.27)
Bank-fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Cluster country-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.1441	0.0863	0.1466	0.0618	0.1237	0.0694	0.1499	0.0989
# Obs	766	766	562	562	228	228	432	432
# Banks	99	99	77	77	36	36	58	58

We only find a statistically significant reduction in vega for banks in countries with stronger shareholder protection because the coefficients of *Crisys*Post* are only negative and significant in columns (1) - (4). The coefficients of *Crisys*Post* for banks in countries with weaker shareholder protection are non-significant in columns (6) - (8), and even positive in column (5). Therefore, the results are similar using both *Rights* and *Anti-self-dealing* as proxies for shareholder protection, and using both fixed-effects and Tobit estimators.

We include the interaction *Crisys*Post*Intervention* to control for the impact of government intervention on the change in vega. The coefficients of this triple interaction term are not significant at conventional levels in columns (1) and (3), suggesting that government intervention does not contribute to additional reductions in vega in countries with stronger shareholder protection. They are even positive in columns (2) and (4) when we apply Tobit estimators in countries with stronger shareholder protection. There are several reasons why government intervention may be associated with a smaller decrease in pay-risk sensitivity in countries with stronger shareholder protection. Government intervention usually limits cash compensation, counteracting managerial incentives to increase their short-term compensation. Moreover, shareholders and managers in distressed banks have more risk-taking incentives, and distressed banks are the ones that are most affected by government intervention.[12] A lower reduction in the investment opportunity set during the crisis in banks subject to government intervention might also lead to a lower reduction in vega in them.

We do not obtain a clear effect for government intervention in countries with weaker shareholder protection. The coefficient of *Crisys*Post*Intervention* is negative in column (7) using the fixed-effects estimator, and non-significant in column (8) using the Tobit estimator and the Anti-self-dealing index as a proxy for shareholder protection. There are no banks suffering government intervention on executive compensation when we focus on countries with an index of property rights below the median. There are therefore no coefficients for *Crisys*Post*Intervention* in columns (5) and (6).

Although not reported, we perform additional robustness tests. We check that the results do not change when *Intervention* takes the value of 1, not for the whole period after the onset of the crisis, but only for the specific years that government financial support is received. Several countries also changed their regulation to impose long-term restrictions on executive compensation. Most of these changes fall outside our analysis period. The UK, being the first, implemented its Remuneration Code in January 2010, which required the deferral of bonus compensation, introduced risk-adjusted incentive-based pay, and reduced cash-based compensation. The EU imposed bonus caps for all banks in the European Union in February 2013. Reforms in the US aimed to tie pay to long-term performance and increase the say of shareholders in approving compensation and electing directors on compensation committees (Kleymenova and Tuna, 2016). We check that our results remain when we exclude UK banks in 2010 and 2011.

Table 7 reports the results for the influence of shareholder protection on the change in total and cash pay-risk sensitivities for

[12] In the next section we analyze if bank solvency affects the change in pay-risk sensitivity.

Table 7

Shareholder protection, government intervention, and the change in total and cash pay-risk sensitivities. This table reports the results of analyzing the impact of shareholder protection and government intervention on total and cash pay-risk sensitivities. *Ln(total compensation)* is the natural logarithm of total bank executive compensation. *Ln(salary + cash bonus)* is the natural logarithm of salary plus cash bonus. *Post* is a dummy variable that takes value one after the onset of the global financial crisis and zero otherwise. *Ln(Returnvolatility)* is the natural logarithm of the standard deviation of weekly stock returns. *Shareholder protection* refers to the particular country variable used in the regressions as a proxy for shareholder protection. We use two proxies for shareholder protection: the property rights index (*Rights*) and the anti-self-dealing index (*Anti-self-dealing*). We use two placebo variables: *Insurer power* and *Official supervision*. *Intervention* is a dummy bank variable that takes value one for banks with government intervention on executive compensation, and 0 otherwise. Control variables are defined in Appendix A1. All regressions include bank fixed effects, and standard errors are clustered by country. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	Banks in countries with systemic crises							
	Shareholder protection				Placebo variables			
	Rights		Anti-self-dealing		Insurer Power		Official supervision	
	Ln(total compensation)	Ln (salary+cash bonus)	Ln (Total compensation)	Ln (salary+cash bonus)	Ln(total compensation)	Ln (salary+cash bonus)	Ln(total compensation)	Ln (salary+cash bonus)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	0.8230*	0.5929***	-0.4257	-0.0477	-0.3738	0.2454	0.7788	0.6959**
	(1.89)	(3.37)	(-0.87)	(-0.10)	(-0.60)	(0.47)	(1.61)	(3.27)
Post* Ln(Returnvolatility)	-0.0554	-0.0041	0.0895	0.1267	0.1062	-0.0164	-0.0875	-0.0357
	(-0.66)	(-0.18)	(0.49)	(0.79)	(0.46)	(-0.10)	(-0.91)	(-1.10)
Post *Ln(Returnvolatility)*Shareholder protection	-0.0010	-0.0016**	-0.5360**	-0.5416*	-0.2505	-0.1079	-0.0057	-0.0084
	(-1.47)	(-3.02)	(-3.07)	(-2.18)	(-1.60)	(-0.70)	(-0.83)	(-1.43)
Post *Ln(Returnvolatility)*Intervention	-0.0528	0.0576	0.0393	0.1166**	-0.0878	-0.0140	0.0835	0.0582
	(-0.45)	(1.21)	(0.35)	(2.46)	(-0.35)	(-0.12)	(0.37)	(0.98)
Post*Shareholder protection	-0.0056	0.0021	2.0897**	1.5264	0.9668	0.5187	-0.0355	-0.0139
	(-0.86)	(0.42)	(3.07)	(1.77)	(1.69)	(0.85)	(-0.85)	(-0.45)
Post* Intervention	-0.0136	-0.4832**	-0.5366	-0.6599**	-0.0526	-0.0977	-0.5573	-0.2880
	(-0.04)	(-2.79)	(-1.79)	(-3.17)	(-0.06)	(-0.24)	(-0.65)	(-1.31)
Post*Bankdevelop	0.0017	-0.0017	0.0008	-0.0012	-0.0001	-0.0022	0.0007	-0.0010
	(1.56)	(-1.12)	(0.61)	(-1.32)	(-0.04)	(-1.40)	(1.19)	(-1.47)
Post*GDP growth contraction	-0.0104	-0.0009	-0.0057	0.0006	-0.0049	0.0032	-0.0081	0.0001
	(-0.64)	(-0.11)	(-0.38)	(0.07)	(-0.34)	(0.41)	(-0.51)	(0.01)
Ln(Returnvolatility)	-0.0113	0.0415	0.0263	0.0697	-0.0239	0.0135	0.0017	0.0354
	(-0.12)	(0.66)	(0.33)	(1.14)	(-0.19)	(0.17)	(0.02)	(0.51)
Ln(Performance)	0.1058	0.0502*	0.0952	0.0416	0.1143	0.0379	0.0923	0.0387***
	(1.75)	(2.17))	(1.71)	(1.63)	(1.55)	(1.59)	(1.43)	(1.91)
Size	0.2972***	0.4187***	0.3132***	0.4152***	0.2645**	0.4106***	0.910***	0.4096***
	(3.83)	(7.14)	(4.38)	(6.80)	(2.96)	(6.45)	(3.33)	(6.50)
Equity	0.5433*	2.6473***	0.6306*	2.48222***	0.5451**	2.7276***	0.5401*	2.5600***
	(1.99)	(4.35)	(2.20)	(3.95)	(2.29)	(5.20)	(2.24)	(4.41)
Intercept	11.57059***	9.3731***	11.4390***	9.4571***	11.8863***	9.6440***	11.7186***	9.5995***
	(14.84)	(13.28)	(15.20)	(12.66)	(12.52)	(12.91)	(13.13)	(12.34)
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster country-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.1729	0.1589	0.1853	0.1765	0.1381	0.1417	0.1656	0.1611
# Obs	593	593	561	561	593	593	593	593
# Banks	71	71	67	67	71	71	71	71

banks in countries with systemic banking crises. We extend model (2) to analyze whether the reduction in total and cash pay-risk sensitivities found in these countries varies depending on country shareholder protection. We simultaneously include interactions with the proxies for country shareholder protection (*Shareholder protection*) and for government intervention (*Intervention*).

Columns (1) - (4) report the results for the effect of shareholder protection using *Rights* and *Anti-self-dealing* as proxies. The non-significant coefficients of *Post*Ln(Returnvolatility)* and the significant and negative coefficients of *Post*Ln(Returnvolatility)*Shareholder protection* in columns (2) - (4) suggest that the reduction in total and cash pay-risk sensitivities in banks in countries suffering systemic banking crises is only significant in countries with stronger shareholder protection. Although negative, only the coefficient of *Post*Ln(Returnvolatility)*Shareholder protection* is non-significant at conventional levels in column (1). However, shareholder protection is not clearly associated with a change in the level of executive compensation because the coefficients of *Post*Shareholder protection* are mostly non-significant in columns (1) - (4). We only find a significant and positive coefficient for *Post*Shareholder protection* in column (3).

The results for government intervention are different to those found for shareholder protection because government intervention is more associated with changes in the level of executive compensation than with changes in pay-risk sensitivity. The significant and negative coefficients of *Post*Intervention* in columns (2) and (4) suggest that government intervention reduced executive cash compensation after the onset of systemic crises. The non-significant coefficients of *Post*Ln(Returnvolatility)*Intervention* in columns (1) - (3) and its positive and significant coefficient in column (4) suggest that government intervention on executive compensation is not associated with the reduction in pay-risk sensitivity after the onset of systemic banking crises. The coefficients of the variables controlling for differences across countries in bank development and in the intensity of the crisis are non-significant. The positive coefficient of *Post*Ln(Returnvolatility)*Intervention* in column (4) even suggests that government intervention is associated with a smaller decrease in cash pay-risk sensitivity. This finding is consistent with the smaller reduction in vega found in Table 6 for banks affected by government intervention in countries with stronger shareholder protection.

As a robustness test for the influence of shareholder protection, we replicate the same methodology using alternative country variables as placebo variables. In particular, we use two variables measuring the extent to which the deposit insurance authority (*Insurer power*) and authorities in general (*Official supervision*) have the power to take specific actions to prevent and correct problems in banks.[13] The results in columns (5) - (8) of Table 7 show non-significant coefficients for *Post*Shareholder protection* or *Post*Ln(Returnvolatility)*Shareholder protection*. The lack of significance for these coefficients suggests that the effect attributed to shareholder protection of reducing the sensitivity of executive compensation to bank risk is not ultimately caused by strong power of national authorities to intervene in banks.

The results in this section show a reduction in pay-risk sensitivity after the onset of systemic crises only in banks in countries with stronger shareholder protection. This finding remains after controlling for government intervention on executive compensation after the onset of the crisis. Therefore, the results are consistent with stronger shareholder protection in a country improving the ability of bank shareholders to introduce changes in executive compensation, and support the contracting hypothesis versus the managerial entrenchment hypothesis or the government intervention hypothesis.

[13] Barth et al. (2004) have previously used these variables and they are defined in detail in Table A1 in the Appendix.

4.4. Changes in delta after the onset of systemic banking crises

Although we focus on changes in pay-risk sensitivity to analyze risk-taking incentives, we now analyze the change in delta after the onset of the crisis because delta has traditionally been used together with vega as a proxy for the incentives embedded in compensation packages. Delta is a useful measure to proxy the convergence of interest between shareholders and managers because it is related to the amount of stock grants in executive compensation packages. However, its influence on manager risk-taking incentives is not clear because a higher delta increases the benefits for managers of undertaking risky projects with positive NPV but also reinforces managerial risk aversion (Knopf et al., 2002; Coles et al., 2006; Low, 2009; DeYoung et al., 2013).

We apply model (1) using *Ln(delta)* as the dependent variable. The results reported in Table 8 indicate a reduction in delta after the onset of systemic crises only in countries with a shareholder protection above the median in the sample, i.e., only in countries with higher shareholder protection. The coefficients of *Crisys*Post* are non-significant when we analyze all the banks in our sample in columns (1) and (2). Only the negative and significant coefficient of *Post* in column (1) suggests an average reduction in delta after the onset of the crisis, but the non-significant coefficients of *Crisys*Post* indicate that there are no differences between countries with and without systemic banking crises. These results change when we split the sample according to shareholder protection. The coefficients of *Crisys*Post* are negative and significant in columns (3) - (6) in banks in countries with higher shareholder protection, but the coefficients of *Crisys* and *Crisys*Post* are always non-significant in columns (7) - (10) in banks in countries with lower shareholder protection.

The reduction in delta in banks in countries with higher shareholder protection is in line with the reduction in total and cash pay-performance sensitivity shown in Table 5. These results are consistent with findings by DeYoung et al. (2013), suggesting 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. Additionally, a potential greater convergence of interests between shareholders and managers during crisis periods to avoid bank failure may make stock grants less necessary in executive compensation packages and may explain the reduction in delta.

4.5. Bank-level characteristics and the change in pay-risk sensitivity

In this section we analyze whether the reduction in pay-risk sensitivity in countries with stronger shareholder protection varies across banks following the predictions of the contracting hypothesis. Differences across banks may emerge in countries with stronger shareholder protection because the ability of bank shareholders to transfer their risk-taking incentives to bank executive compensation also depends on bank-specific governance arrangements, such as ownership concentration and board independence. Moreover, differences in bank solvency and in the specific change in investment opportunities also change shareholders' risk-taking incentives after the onset of the crisis across banks. We test these aspects in the following two sub-sections.

4.5.1. Ownership concentration and board independence

We use the proportion of shares owned by the main shareholder and the proportion of independent directors at the end of 2006 as proxies for bank ownership concentration and board structure.

Table 8

Changes in delta after the onset of the global financial crisis. This table reports the change in delta using both fixed-effects and tobit estimators. The dependent variable is *Ln(delta)* defined as the natural logarithm of the change in the dollar value of executive wealth for a 0.01 change in stock price. *Crisys* is a dummy variable identifying banks in countries suffering a systemic banking crisis after 2007. *Post* is a dummy variable that takes value one after the onset of the global financial crisis, and zero otherwise. *Ln(Returnvolatility)* is the natural logarithm of the standard deviation of weekly stock returns. *Ln(Performance)* is measured as total shareholders' value, that is, the initial total value of the firm in the first sample period capitalized year by year using the total gross returns of holding the stock during the relevant period. We use its natural logarithm. *Size* is the natural logarithm of total bank assets. *Equity* is the ratio of equity to total bank assets. Columns (3) - (10) report the results for sub-samples according to shareholder protection. We use two proxies for shareholder protection: the property rights index (*Rights*), and the anti-self-dealing index (*Anti-self-dealing*). *Intervention* is a dummy bank variable that takes value one for banks with government intervention on executive compensation, and 0 otherwise. All the control variables are defined in Appendix A1. Standard errors are clustered by country in all the regressions, and ***, **, * indicate significance at 1%, 5%, and 10% respectively.

			HIGH Shareholder protection				LOW Shareholder protection			
	All Banks		Rights		Anti-self-dealing		Rights		Anti-self-dealing	
	Fixed effects (1)	Tobit (2)	Fixed effects (3)	Tobit (4)	Fixed effects (5)	Tobit (6)	Fixed effects (7)	Tobit (8)	Fixed effects (9)	Tobit (10)
Crisys		0.3110		-0.1277		1.5857**		-0.8667		0.2550
		(0.37)		(-0.14)		(2.27)		(1.05)		(0.31)
Post	-0.4364**	-1.0265	-0.5519	-0.0681	-0.3742	-1.2108	-0.0579	-2.0111	-0.3974	-0.1562
	(-2.74)	(-1.55)	(-1.40)	(-0.06)	(-1.60)	(-1.45)	(-0.75)	(-1.60)	(-0.88)	(-0.12)
Crisys*Post	-0.4559	-0.8073	-0.5035*	-1.9469**	-0.7846*	-2.5538***	0.3815	0.7139	0.0368	-0.0564
	(-1.65)	(-1.19)	(-2.01)	(-2.14)	(-2.05)	(-2.57)	(1.29)	(0.69)	(0.10)	(-0.04)
Crisys*Post*Intervention			-0.3633**	1.6489	0.0096	2.9899**			-0.5289	-4.7484
			(-2.32)	(1.49)	(0.04)	(2.41)			(-1.06)	(-1.01)
Post*Bankdevelop			0.0008	-0.0056	-0.0016	0.0091	-0.0068***	-0.0040	-0.0022	-0.0313**
			(0.23)	(-0.48)	(-0.60)	(0.87)	(-3.08)	(-0.42)	(-0.45)	(-2.17)
Post*GDP growth contraction			0.0306*	-0.0241	0.0481**	0.0530	0.0342	0.1093	0.0261	-0.0280
			(1.81)	(-0.25)	(2.22)	(0.45)	(1.19)	(0.60)	(1.59)	(-0.20)
Ln(Returnvolatility)	0.0017	0.2371	0.0078	0.3709	0.0655	-0.7015	-0.0581	0.0187	-0.0675	1.5750***
	(0.02)	(0.55)	(0.08)	(0.69)	(0.65)	(-1.50)	(-0.49)	(0.06)	(-0.68)	(2.61)
Ln(Performance)	0.1124	0.4387	0.1039	0.3496	0.2625	0.0047	0.1836**	0.0886	-0.0076	0.5299
	(1.04)	(1.32)	(1.00)	(0.97)	(1.68)	(0.02)	(2.98)	(0.20)	(-0.06)	(0.62)
Size	0.2519**	0.0448	0.2976*	0.0846	0.2713**	0.0176	0.1084	0.5106*	0.3051	0.0912
	(2.28)	(0.16)	(1.97)	(0.25)	(2.26)	(0.07)	(1.12)	(1.96)	(1.17)	(0.12)
Equity	-0.1610	3.5996	0.3062	1.5611	0.3036	-1.7291	-0.0438	10.6041***	-0.3707	5.7423
	(-0.15)	(1.13)	(0.17)	(0.37)	(0.14)	(-0.52)	(-0.11)	(4.73)	(-0.33)	(1.15)
Intercept	-2.3392	-5.3742*	-2.5880	-4.5740	-3.9967*	2.4075	-1.9526	-8.7693***	-1.8980	-12.1197***
	(-1.47)	(-1.67)	(-1.25)	(-1.33)	(-1.78)	(0.96)	(-1.65)	(-2.87)	(-0.80)	(-3.38)
Bank-fixed effect	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Cluster country-level	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
R^2	0.1214	0.2264	0.1317	0.0670	0.1508	0.0528	0.1636	0.0935	0.1309	0.1052
# Obs	994	483	766	766	562	562	228	228	432	432
# Banks	135	130	99	99	77	77	36	36	58	58

Table 9
Ownership concentration, board independence, and the change in vega. This table reports the results for the change in vega across different sub-samples of banks in countries with shareholder protection above the median. We use two proxies for shareholder protection: the property rights index (Rights) in Panel A, and the anti-self-dealing index (Anti-self-dealing) in Panel B. The dependent variable is Ln(vega). Crisys is a dummy variable identifying banks in countries suffering a systemic banking crisis after 2007. Post is a dummy variable that takes value one after the onset of the global financial crisis, and zero otherwise. % main shareholder is the proportion of shares owned by the main shareholder at the end of 2006. % independent directors is the proportion of independent directors at the end of 2006. Although not reported to save space, all the regressions include the same control variables as in Table 4. All the control variables are defined in Appendix A1. Standard errors are clustered by country in all the regressions, and ***, **, * indicate significance at 1%, 5%, and 10% respectively.

Panel A: HIGH Rights	Governance above the median				Governance below the median			
	% main shareholder		% independent directors		% main shareholder		% independent directors	
	Fixed effects (1)	Tobit (2)	Fixed effects (3)	Tobit (4)	Fixed effects (5)	Tobit (6)	Fixed effects (7)	Tobit (8)
Crisys		-2.8667		-2.1638		1.7408		0.1803
		(-1.54)		(-1.10)		(0.88)		(0.09)
Post	-0.7311*	-1.0866	-0.5238	-1.8492*	-0.5592	-1.3349	-0.6235	-0.7902
	(-1.84)	(-0.77)	(-1.63)	(-1.68)	(-0.70)	(-1.02)	(-0.90)	(-0.46)
Crisys*Post	-1.1706	-4.6249**	-0.9017	-1.9484	-0.9883	-0.4722	-1.1657	-2.1490
	(-1.20)	(-4.69)	(-1.67)	(-1.26)	(-1.49)	(-0.31)	(-1.63)	(-1.21)
Bank-fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Cluster country-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.1457	0.1335	0.1092	0.0859	0.1393	0.0750	0.1903	0.0765
# Obs	356	356	358	358	410	410	408	408
# Banks	49	49	47	47	50	50	52	52

Panel B: High Anti-self-dealing	Governance above the median				Governance below the median			
	% main shareholder		% independent directors		% main shareholder		% independent directors	
	Fixed effects (1)	Tobit (2)	Fixed effects (3)	Tobit (4)	Fixed effects (5)	Tobit (6)	Fixed effects (7)	Tobit (8)
Crisys		0.8781		2.5264		2.9802		1.1371
		(0.59)		(1.32)		(1.51)		(0.78)
Post	-0.3772**	-0.5083	-0.7637**	-0.8993	-1.0229	-2.2754**	-0.7028	-1.1837
	(-2.26)	(-0.42)	(-2.73)	(-1.14)	(-1.56)	(-2.41)	(-0.94)	(-0.64)
Crisys*Post	-3.7524***	-5.7095***	-1.9413***	-1.6873	-0.4432	1.7596	-0.9286	0.8594
	(-6.71)	(-6.93)	(-3.05)	(-0.98)	(-0.75)	(1.53)	(-1.16)	(0.48)
Bank-fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Cluster country-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.2396	0.0519	0.1429	0.0337	0.1307	0.0751	0.1576	0.0609
# Obs	235	235	268	268	327	327	294	294
# Banks	36	36	37	37	41	41	40	40

Table 9 reports the results for the change in vega separately for the two sub-samples around the median of each proxy in a particular country. We only use banks in countries with stronger shareholder protection because results from previous tables suggest that the contracting hypothesis explains bank executive pay to a greater extent in these countries.[14] We report both fixed-effects and tobit estimates using *Rights* (Panel A) and *Anti-self-dealing* (Panel B) as proxies for country shareholder protection. We only report results for the main variables capturing differences in the change in vega (*Crisys*, *Post*, and *Crisys*Post*), although regressions include the same control variables as in Table 4.

We only find significant reductions in vega in the sub-sample of banks with a higher proportion of shares owned by the main shareholder or a higher proportion of independent directors (*Governance above the median*). The results in Panel A, using *Rights* as the proxy for shareholder protection, do not suggest a clear greater reduction in vega in countries suffering systemic crises. The negative and significant coefficients of *Post* and the non-significant coefficients of *Crisys*Post* in columns (1) and (4) suggest that banks in countries without systemic crises reduced vega after the onset of the crisis to a similar extent as banks in countries with systemic crises. We only find a greater reduction in vega in countries with systemic crises in column (2) when we use the tobit estimator and focus on banks with a higher proportion of shares owned by the main shareholder. The reduction in vega in countries without systemic crises is consistent with the reduction in the investment opportunity set reported in Table 2 that is also experienced by banks in countries without systemic crises, although to a lesser extent than in countries with such crises. The results reported in Panel B, using *Anti-self-dealing* as the proxy for shareholder protection, clearly suggest a greater reduction in vega in countries with systemic crises for the sub-sample of banks with a higher proportion of shares owned by the main shareholders or a higher proportion of independent directors (*Governance above the median*). The coefficients of *Crisys*Post* are negative and significant at the one percent level in three of the four estimations. Only the coefficient in column (4) is non-significant at conventional levels.[15]

However, we do not find a significant reduction in vega in the sub-sample of banks in countries suffering systemic crises when we focus on banks with a proportion of shares owned by the main shareholder or a proportion of independent directors below the median in the particular country (*Governance below the median*). The coefficients of *Crisys*Post* are always non-significant in columns (5) - (8), in both Panel A and Panel B. Moreover, the coefficients of *Crisys* are mostly non-significant, and only in column (6) in Panel B is it significant at conventional levels. The non-significant coef-

[14] We also expect a lower variation in these variables among firms in countries with weak shareholder protection. The higher agency costs between managers or controlling shareholders and minority shareholders in these countries are usually associated with higher ownership concentration and less-developed internal governance mechanisms, such as the board of directors (La Porta et al., 2000).

[15] Although not reported to save space, we obtain similar results to those reported for *Anti-self-dealing* when we use *Investor protection* as the proxy for shareholder protection.

Table 10
Bank solvency, bank-specific changes in the investment opportunity set, and vega. This table reports the results for the change in vega across different sub-samples of banks in countries with shareholder protection above the median. We use two proxies for shareholder protection: the property rights index (*Rights*) in Panel A, and the anti-self-dealing index (*Anti-self-dealing*) in Panel B. The dependent variable is *Ln(vega)*. *Crisys* is a dummy variable identifying banks in countries suffering a systemic banking crisis after 2007. *Post* is a dummy variable that takes value one after the onset of the global financial crisis, and zero otherwise. *ZscorePre* is the Z-score index in the pre-crisis period. *ZscorePost* is the Z-score index in the post-crisis period. *DiffQ* is the difference in the average annual market-to-book equity ratio between the periods after the onset of the crisis and before it. *Mortgage* is the ratio of commercial real estate and family mortgage loans to total assets at the end of 2006. Panels A.1. and B.1. report the results for banks with higher solvency or for banks experiencing a greater reduction in investment opportunities after the onset of the crisis. Panels A.2. and B.2. report the results for the alternative sub-samples to those in Panels A.1. and B.1. Although not reported to save space, all the regressions include the same control variables as in Table 4. All the control variables are defined in Appendix A1. Standard errors are clustered by country in all the regressions, and ***, **, * indicate significance at 1%, 5%, and 10% respectively.

Panel A: HIGH Rights
Panel A.1.: HIGH solvency or HIGH reduction in investment opportunities

	ZscorePre		ZscorePost		DiffQ		Mortgage	
	Fixed effects (1)	Tobit (2)	Fixed effects (3)	Tobit (4)	Fixed effects (5)	Tobit (6)	Fixed effects (7)	Tobit (8)
Crisys		0.1568		-0.6460		-3.2536***		1.5744
		(0.08)		(-0.32)		(-2.73)		(0.75)
Post	0.2384	-1.7872*	-0.6823	-2.4460**	-0.3916	-1.2848	-0.4259	1.0245
	(0.73)	(-1.86)	(-1.35)	(-2.24)	(-0.71)	(-0.92)	(-0.62)	(0.75)
Crisys*Post	-0.7953*	-1.819	-1.0914**	-2.0843*	-0.9562	-2.3635*	-1.9591**	-4.0671***
	(-1.80)	(-1.20)	(-2.46)	(-1.78)	(-1.49)	(-1.71)	(-2.74)	(-2.72)
Bank-fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Cluster country-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.1846	0.1400	0.1556	0.0965	0.1552	0.1356	0.2037	0.078
# Obs	321	321	330	330	325	325	339	339
# Banks	40	40	41	41	40	40	43	43

Panel A.2.: LOW solvency or LOW reduction in investment opportunities

	ZscorePre		ZscorePost		DiffQ		Mortgage	
	Fixed effects (1)	Tobit (2)	Fixed effects (3)	Tobit (4)	Fixed effects (5)	Tobit (6)	Fixed effects (7)	Tobit (8)
Crisys		-1.2819		-1.3041		1.4232		-2.0648
		(-0.70)		(-0.74)		(0.70)		(-1.25)
Post	-0.9921	-0.6943	-0.4926	-0.5324	-0.6333	-1.0998	-0.8797	-2.4485*
	(-1.64)	(-0.46)	(-0.80)	(-0.32)	(-1.34)	(-0.71)	(-1.50)	(-1.90)
Crisys*Post	-1.2995	-2.5207	-1.2404	-2.4478	-1.0473	-2.4227	-0.3018	-0.6048
	(-1.64)	(-1.48)	(-1.39)	(-1.40)	(-1.44)	(-1.46)	(-0.48)	(-0.44)
Bank-fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Cluster country-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.1417	0.0557	0.1276	0.0715	0.1532	0.0629	0.1362	0.1012
# Obs	445	445	436	436	441	441	427	427
# Banks	59	59	58	58	59	59	56	56

Panel B: HIGH Anti-self-dealing
Panel B.1.: HIGH solvency or HIGH reduction in investment opportunities

	ZscorePre		ZscorePost		DiffQ		Mortgage	
	Fixed effects (1)	Tobit (2)	Fixed effects (3)	Tobit (4)	Fixed effects (5)	Tobit (6)	Fixed effects (7)	Tobit (8)
Crisys		2.1870		-0.9134		-0.9102		4.0076**
		(1.04)		(0.31)		(-0.62)		(2.18)
Post	0.3246	-1.6389*	-0.3632	-1.8159	-0.4694	-1.1124	-0.9057	-0.2316
	(0.89)	(-1.87)	(-0.67)	(-1.53)	(-0.82)	(-0.85)	(-1.40)	(-0.23)
Crisys*Post	-0.9229*	-0.3901	-0.8176*	-0.3138	-0.7332	-0.2245	-2.5829***	-2.5287*
	(-1.98)	(-0.34)	(-2.01)	(-0.26)	(-1.11)	(-0.15)	(-3.78)	(-1.70)
Bank-fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Cluster country-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.2344	0.0845	0.1927	0.0502	0.1149	0.0464	0.2100	0.0430
# Obs	232	232	229	229	229	229	246	246
# Banks	31	31	30	30	31	31	33	33

Panel B.2.: LOW solvency or LOW reduction in investment opportunities

	ZscorePre		ZscorePost		DiffQ		Mortgage	
	Fixed effects (1)	Tobit (2)	Fixed effects (3)	Tobit (4)	Fixed effects (5)	Tobit (6)	Fixed effects (7)	Tobit (8)
Crisys		1.4231		2.2452		4.2875**		-0.1830
		(0.78)		(1.46)		(2.01)		(-0.10)
Post	-1.0205	-0.7383	-0.7247	-0.8635	-0.6569	-1.0982	-0.6624	-1.6218
	(-1.74)	(-0.51)	(-1.41)	(-0.54)	(-1.37)	(-0.81)	(-1.01)	(-1.27)
Crisys*Post	-1.5746	-0.3243	-1.6002	-0.6174	-1.7840	-1.1596	-0.6965	0.9260
	(-1.38)	(-0.13)	(-1.25)	(-0.27)	(-1.72)	(-0.55)	(-0.90)	(0.54)
Bank-fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Cluster country-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.1339	0.0289	0.1304	0.0715	0.1741	0.0578	0.1362	0.0639
# Obs	330	330	333	333	333	333	316	316
# Banks	46	46	47	46	46	47	44	44

ficients of *Crisys* and *Crisys*Post* in columns (5) - (8) suggest that, whether in countries with or without systemic crises, banks did not experience a reduction in vega when the proportion of shares owned by the main shareholder or a proportion of independent directors was below the median.

These results are consistent with the predictions of the contracting hypothesis because shareholders in banks with higher ownership concentration or more independent directors are more able to induce changes in executive compensation following changes in shareholders' risk-taking incentives.

4.5.2. Bank solvency and the change in the investment opportunity set

Shareholders of more solvent banks have more incentives to behave prudently after the onset of a crisis to reduce the probability of losing their charter value in case of bankruptcy (Keeley, 1990). However, shareholders of distressed banks may even have incentives to "gamble for resurrection" and may be expected to encourage more risky behavior by managers. For this reason, under the contracting hypothesis, if shareholder incentives are the drivers of the change in bank executive compensation, we predict that the reduction in pay-risk sensitivity would be higher in more solvent banks. Distressed banks might even increase their pay-risk sensitivity. Moreover, the change in the investment opportunity set after the onset of the systemic crisis may be different across banks. Therefore, if the contracting hypothesis is relevant, we should find a higher reduction in pay-risk sensitivity in banks with a greater decline in their bank-specific investment opportunities.

We now test these predictions by analyzing differences in the change in pay-risk sensitivity across banks depending on their solvency and in the change in the specific investment opportunity set. Table 10 reports the results for the change in vega separately for the two sub-samples around the median of the particular proxy for bank solvency and the change in a bank's investment opportunities. We again only use banks in countries with stronger shareholder protection because the contracting hypothesis applies to them to a greater extent. We report results using *Rights* (Panel A) and *Anti-self-dealing* (Panel B) as the proxies for shareholder protection. Panels A.1 and B.1 report the results for more solvent banks and banks with a greater reduction in investment opportunities after the onset of the crisis. Panels A.2 and B.2 report the results for banks with lower solvency or a smaller change in the specific investment opportunity set.

We find that the reduction in vega after the onset of systemic banking crises basically arises in more solvent banks and in banks with a greater reduction in their investment opportunities. The results reported in Panel A.1, using *Rights* to identify banks in countries with stronger shareholder protection, show that the coefficients of *Post* are non-significant in columns (1) and (3), and negative and significant when we use tobit estimators in columns (2) and (4). These two negative coefficients indicate a reduction in pay-risk sensitivity after the onset of the crisis in more solvent banks in countries without systemic crises. The negative and significant coefficients of *Crisys*Post* in columns (1), (3), and (4) suggest that more solvent banks in countries suffering systemic crises reduced vega to a greater extent. The negative and significant coefficients of *Crisys*Post* in columns (6), (7), and (8) indicate a reduction in vega of stock options granted to bank executives after the onset of systemic banking crises in banks with a greater reduction in investment opportunities. The non-significant coefficients of *Post* indicate that this reduction is not observed in countries without systemic crises.

The results reported in Panel B.1, using *Anti-self-dealing* to identify countries with stronger shareholder protection, are similar although slightly less significant. We only find a greater reduction in vega when we use a fixed-effects estimator in columns (1) and (3). We also find that banks experiencing a greater reduction in their investment opportunity set, because they had a higher ratio of commercial real estate and family mortgage loans immediately before the onset of the crisis, experienced a greater reduction in vega. However, we do not find a greater reduction in countries with systemic crises when we use *DiffQ* as a proxy for the change in the investment opportunity set after the onset of the crisis.

However, the results in Panels A.2 and B.2 do not show a reduction in vega in less solvent banks or in banks that suffered a smaller reduction in their investment opportunity set, even in countries with stronger shareholder protection. The coefficients of *Post* and *Crisys*Post* are non-significant at conventional levels in all of the estimations. Only the coefficient of *Post* is negative and significant in column (8) of Panel A.2 when we use the ratio of commercial real estate and family mortgage loans to total assets at the end of 2006 as a proxy for the change in a bank's investment opportunity set after the onset of the crisis and when we apply the Tobit estimator.

These results are consistent with the prediction of the contracting hypothesis because the shareholders of more solvent banks and/or of banks suffering a greater reduction in the specific investment opportunity set are those with most incentives to reduce the risk-taking incentives embedded in bank executive compensation after the onset of the crisis.

5. Conclusions

This paper uses a hand-collected database to analyze the change in bank executive pay-risk sensitivity after the onset of the global financial crisis in an international sample of publicly-traded banks across 34 countries. We exploit differences in shareholder protection across countries to test the relevance of the contracting hypothesis versus the managerial entrenchment hypothesis and the government intervention hypothesis for explaining changes in bank executive compensation.

Our results indicate a reduction after the onset of the crisis in both the vega of stock option packages granted to bank executives, and in the sensitivity of total and cash compensation to bank risk in countries suffering systemic crises. We find that the above reduction in pay-risk sensitivity is greater in countries with stronger shareholder protection. In fact, we do not find a significant reduction in pay-risk sensitivity in the sub-sample of banks in countries suffering systemic crises but with weaker shareholder protection. Moreover, the reduction in pay-risk sensitivity in countries with stronger shareholder protection is greater in banks with higher ownership concentration and more independent directors, in banks experiencing a greater reduction in investment opportunities, and in more solvent banks. Government intervention reduces the level of compensation but does not change the risk-taking incentives embedded in bank executive compensation.

These results are consistent with the contracting hypothesis versus the managerial entrenchment hypothesis: stronger shareholder protection allows shareholders to transfer their risk-taking incentives to bank executive compensation. The average reduction in the risk-return opportunity set after the onset of the crisis diminishes shareholders' risk-taking incentives, especially in more solvent banks, and strong shareholder protection and better bank governance allow shareholders to introduce changes in executive compensation packages and to reduce the sensitivity of executive compensation to bank risk.

In terms of policy implications, the unchanged risk-taking incentives embedded in executive compensation in banks in countries with worse shareholder protection reveal that, in the absence of shareholder protection, government interventions did not curb risk-taking incentives in management compensation packages. Our results provide support for measures improving shareholder rights in the approval of bank executive compensation as a more effective tool for reducing misaligned pay packages. Recent reforms increas-

ing the say of shareholders ("say on pay" policies) in approving compensation and electing directors to compensation committees seem to be a step in the right direction.

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Appendix A

Table A1
Variable definitions and data sources. This table shows the definition of all the variables and their sources.

NAME	DEFINITION	SOURCE
	Bank executive compensation	
Ln(vega)	The natural logarithm of the 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 the delta . Delta 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(TotalCompensation)	The natural logarithm of the sum of salary, bonus, total value of restricted stock granted, total value of stock options granted, long-term incentive payouts, and other annual payments.	Hand-collected data and Capital IQ Database
Ln(salary + cashbonus)	The natural logarithm of the sum of salary and cash bonus.	Hand-collected data and Capital IQ Database
	Bank performance and risk	
Ln(Returnvolatility)	The annual standard deviation of weekly stock returns as the main proxy for bank risk.	Capital IQ Database
Ln(Performance)	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
	Bank solvency and investment opportunities	
ZscorePre	Estimated as (ROA+(equity/assets))/sd(ROA). sd(ROA) is the standard deviation of ROA and is computed using annual ROA data for the pre-crisis period. The numerator is computed using data at the end of 2006. A higher Zscore indicates that a bank has a lower probability of insolvency.	Capital IQ Database
ZscorePost	Estimated as (ROA+(equity/assets))/sd(ROA). sd(ROA) is the standard deviation of ROA and is computed using annual ROA data for the post-crisis period. The numerator is computed using data at the end of 2011. A higher Zscore indicates that a bank has a lower probability of insolvency.	Capital IQ Database
DiffQ	The difference in the average annual market-to-book equity ratio between the periods after the onset of the crisis and before it.	Capital IQ Database
Mortgage	The ratio of commercial real estate and family mortgage loans to total assets at the end of 2006.	Capital IQ and Bankscope Databases
	Banking crises	
Crisys	A dummy variable that takes value zero for banks in the control group, i.e., banks in countries without systemic banking crises, and value one for banks in countries with systemic crises.	Laeven and Valencia (2012)
Post	A dummy variable that takes value one for the period after the onset of the crisis. Otherwise, it takes value 0. We consider 2007 as the starting year of the crisis for the US and UK, and 2008 for the remaining countries.	Laeven and Valencia (2012)
	Shareholder protection and government intervention variables	
Rights	The property rights component assesses the extent to which a country's legal framework allows individuals to freely accumulate private property, secured by clear laws that are enforced effectively by the government. It provides a quantifiable measure of the degree to which a country's laws protect private property rights and the extent to which such laws are respected. It also assesses the likelihood that private property will be expropriated by the state in 2006. Scale from 0 to 100.	Heritage Foundation
Anti-self-dealing	The degree to which minority shareholders are protected from large shareholders at the expense of small ones. It combines an ex ante anti-self-dealing index, which captures the strength of anti-self-dealing laws, and an ex post anti-self-dealing index, which captures the enforcement of these laws in 2006. Scale from 0 to 1.	Djankov et al. (2007)
Intervention	A dummy variable that takes value 1 for banks that were affected by government limitations on executive compensation after the onset of the global financial crisis. Otherwise, it takes value 0.	Web sites of central Banks and government authorities providing financial support to banks
Other bank-level variables		
Size	The natural logarithm of the bank's annual total assets.	Bankscope Database
Equity	The natural logarithm of the equity to total assets ratio.	Bankscope Database
% main shareholder	Proportion of shares owned by the main shareholder at the end of 2006	Bankscope Database and banks' annual reports
% independent directors	Proportion of independent directors on the board at the end of 2006	Bankscope Database and banks' annual reports
	Other country-level variables	
Bankdevelop	The ratio of private credit of deposit money banks to GDP at the end of 2006.	Global Financial Development Database (GFDD). World Bank
GDP growth contraction	The difference between the country's average GDP growth in the pre-crisis period and after its onset.	Global Financial Development Database (GFDD). World Bank
Insurer power	Variable based on the assignment of 1 (yes) or 0 (no) values to three questions assessing whether the deposit insurance authority has authority (1) to make the decision to intervene in a bank, (2) to take legal action against bank directors or officials, or (3) has ever taken any legal action against bank directors or officers. This variable ranges from 0 to 3, with higher values indicating more power.	World Bank's Regulation and Supervision Database
Official supervision	Official supervisory power, ranging from 0 to 14, captures the power of supervisors to take prompt corrective action, to restructure and reorganize troubled banks, and to declare a troubled bank insolvent. Higher values indicate greater power of supervisors.	World Bank's Regulation and Supervision Database

Table A2
Mean values per country. The table shows by country the mean value of each variable. The definition and source of each variable is indicated in Table A1.

	Ln (vega)	Ln (delta)	Ln (total compensation)	Ln (salary+ cashbonus)	Ln (Returnvo-latility)	Ln (Perfor-mance)	ZscorePre	ZscorePost	DiffQ	Mortgage	Crisys	Post	Rights	Anti- self-dealing	Intervention	Size	Equity	% main shareholder	% independent directors
Australia	2.9184	1.4351	15.8443	14.8243	3.3115	7.4143	9.9258	5.7428	-0.2902	0.3810	0	0.4528	90	0.76	0	9.2544	0.1006	0.1113	0.6581
Austria	3.7596	1.4562	15.4840	14.9992	3.0505	8.2545	0.2093	1.0457	0.0684	0.1336	1	0.5926	90	0.21	0	11.0227	0.0684	0.4137	0.9464
Bahrain			16.4010	16.2675	3.5271	8.0440	0.2135	0.6705	0.7053	0.1074	0	0.6667	70		0	10.0932	0.1052	0.2025	0.1818
Bangladesh			10.9647	10.7252	3.7372	5.3403	0.1111	0.2156	3.5450	0.0016	0	0.6956	30		0	6.9010	0.7669	0.3454	
Belgium	2.6824	1.2260	15.8933	15.2685	3.5775	9.9842	0.2785	-0.2122	10.0674	0.0275	1	0.5	90	0.54	0.1667	12.0035	0.0987	0.1587	0.3639
Bosnia-Herzegovina	0	0	15.0370	14.8774	3.9091	9.1569	0.0291	0.1790	-0.3271	0.1453	0	0.6667	10		0	11.7184	0.0825		
Canada	5.0223	2.4609	16.1292	14.9379	3.2015	8.3528	6.0608	5.2208	-0.4129	0.3336	0	0.5	90	0.64	0	10.7056	0.0600	0.0253	0.8596
China	0	0	14.5568	13.6845	3.5845	11.4316	0.0687	0.5854	1.1492	0.0666	0	0.6896	30	0.76	0	13.4372	0.0590	0.5281	0.2707
Croatia			15.3420	15.0012	3.6122	7.6164	0.8726	0.7957	-0.6033	0.0562	0	0.4762	30	0.25	0	9.4222	0.1193	0.9042	0.0588
Cyprus	2.1456	3.7899	14.9320	14.6014	3.8305	3.4314	0.0225	0.0279	-0.0010	0.1576	0	0.6667	90		0	10.7784	0.0623	0.081	0.3333
Czech Republic			14.7462	13.7514	3.5208	8.8135	0.5399	0.3495	0.0100	0.0952	0	0.5	70	0.33	0	10.3500	0.0952	0.6035	0.4000
Denmark	0.1261	1.8812	13.7371	13.6635	3.1819	5.7748	0.3166	0.4538	-0.6839	0.0683	1	0.4914	90	0.46	0	8.2200	0.0937	0.1833	0.8775
Finland	0	0	14.6298	14.6298	2.9307	5.8240	0.7348	0.0992	-0.4784	0.5395	0	0.4444	90	0.46	0	8.1447	0.0522		0.5178
France	1.6588	3.1217	14.5925	14.0984	3.4042	8.2976	0.5677	0.3084	-0.3626	0.0747	0	0.4706	70	0.38	0	10.8577	0.1262	0.52	0.2845
Germany	0.8603	1.8236	15.6017	14.7688	3.3861	7.9938	0.2698	0.4132	-0.7342	0.1205	1	0.4615	90	0.28	0.1154	10.6934	0.0722	0.5699	0.5889
Hong Kong	0.9328	1.3323	14.8317	14.2935	3.3676	8.2041	0.6580	0.4133	-0.3363	0.1002	0	0.4872	90	0.96	0	10.1632	0.1050	0.5568	0.3684
India	2.9069	-1.0015	13.5090	12.9485	3.6713	8.9121	4.0561	11.8603	0.0208	0.1416	0	0.48	50	0.58	0	13.2821	0.0590	0.2435	0.5694
Indonesia	0.4177	-0.2105	14.9566	14.3579	3.7807	8.5832	0.0598	0.2431	1.1543	0.0769	0	0.5714	30	0.65	0	9.9891	0.1147	0.6786	0.4592
Ireland	2.0981	0.6916	15.4883	14.6983	3.8005	8.5126	4.2028	0.1710	-1.8668	0.2592	1	0.4231	90	0.79	0	11.8826	0.0476		0.4218
Italy	1.8954	2.5503	15.2313	14.5450	3.2639	7.8415	0.8580	0.5893	-0.4421	0.1457	0	0.5789	50	0.42	0	10.2569	0.1010	0.25	0.7986
Malaysia	0.4816	-2.3150	13.8771	13.0547	3.0448	8.7952	11.0357	3.0480	0.1436	0.1187	0	0.4444	50	0.95	0	10.6199	0.0814	0.3623	0.5707
Netherlands	2.3354	2.4323	14.7452	14.2014	3.3102	6.4451	0.3340	0.3696	-1.0461	0.1454	1	0.4444	90	0.20	0	8.8886	0.0823	0.1921	0.5000
Norway	0	0	14.2474	13.6636	3.4001	6.3657	0.0853	0.1390	-0.3120	0.0754	0	0.5185	90	0.42	0	10.6154	0.0763	0.2036	0.6467
Oman			15.0250	14.6386	3.2708	6.9118	0.0497	0.2110	1.2828	0.0675	0	0.6666	50		0	8.2454	0.1371	0.3242	0.4545
Pakistan			15.3563	15.0502	3.6534	5.9288	0.0879	0.4386	-0.2722	0.0179	0	0.5333	30	0.41	0	8.2525	0.7998	0.2935	0.8222
Philippines			16.3961	16.0166	3.5033	7.6491	0.1594	0.2522	1.2143	0.0730	0	0.6666	30	0.22	0	9.8003	0.0857		0.1667
Poland	0.5035	-1.4646	14.4457	14.2966	3.5715	7.6362	0.1209	0.2447	0.0326	0.1193	0	0.54	50	0.29	0	10.2633	0.0550	0.7481	0.6696
Portugal			15.8178	15.5517	3.5869	8.6180	0.0924	0.1093	-0.0543	0.3121	0	0.6666	70	0.44	0	11.7395	0.0604	0.05	0.4667
Singapore	4.5297	0.1299	15.9335	15.1796	3.0872	9.7521	0.2902	0.8597	0.1182	0.1722	0	0.5333	90	1	0	11.728	0.1014	0.1715	0.7343
Spain	1.3992	1.6364	16.2984	15.5948	3.3409	9.7229	0.3969	0.3134	-0.7522	0.3464	1	0.5106	70	0.37	0	12.3587	0.0548	0.2426	0.4971
Sweden	0.9897	1.7899	14.6080	14.3541	3.3829	8.9516	0.3243	0.3762	-1.0799	0.2151	0	0.4444	90	0.33	0	11.5448	0.0477	0.2016	0.8034
Switzerland	1.8593	4.1429	16.3309	15.6568	3.5991	7.1582	0.1291	0.3536	0.0493	0.2080	0	0.5128	90	0.27	0.1026	9.1031	0.1239	0.2942	0.9178
UK	2.2759	-0.8213	15.8205	15.0021	3.4795	8.7227	0.7170	0.7966	-0.8589	0.1791	1	0.5607	90	0.95	0.0467	10.7372	0.1273	0.1198	0.5423
US	6.0264	2.7904	17.2669	15.0808	3.4356	10.5985	0.9523	0.1794	-1.5282	0.2194	1	0.5532	90	0.65	0.5177	12.8702	0.0879		0.8139

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