IMPACT OF DODD-FRANK ON CEO PAY AND BANK RISK

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Abstract

We examine how bank equity risk is impacted by changes in the structure of bank CEO compensation from the enactment of the Dodd-Frank Act (DFA). We use the generalized diff-in-diff methodology of Djourelova (2023) to *isolate* the impact of DFA-related changes in bank CEO compensation on bank risk. We categorize banks according to their pay-risk relationship in the pre-DFA period and find significant differences in CEO compensation between high- and low-pay-risk banks. Specifically, we find differences in performance-vesting restricted stock awards, LTIPs, and anti-hedging provisions increased after DFA, and time-vesting options grants decreased. Instrumenting for these differences in compensation structure, we find that idiosyncratic risk and systemic risk went down in the post-DFA period, and this reduction is driven by high pay-risk banks. No significant effect is found for differences in bank equity performance.

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Introduction

The financial crisis (2007-2009) represents a watershed in the regulation and supervision of financial institutions. Following the crisis, the Dodd-Frank Act (DFA) of 2010 was passed which included provisions in bank regulations and supervision which were intended to mitigate bank risk taking and enhance the stability of the financial sector. While many of the regulatory changes have focused on measuring risk exposures and ensuring that capital and loss absorption capacity vary with bank risk, regulatory oversight has also focused on the structure of senior bank management compensation.[1]

There are three reasons why the DFA might have changed the structure of bank CEO compensation.[2] First, Section 956 explicitly directed financial regulators to adopt rules to make CEO compensation more performance-oriented, less convex and tied to long-term performance measures. Second, the much larger DFA subsumed the specifically targeted bank compensation rules proposed by US Treasury earlier in response to the financial crisis. Third, there are many accounts in the press that that these compensation rules were being followed by both regulators and bankers.

This paper empirically examines the impact of DFA-related changes in CEO compensation on a bank's equity risk and systemic (tail) risk. We make a reasonable expectation that regulators are more likely to have a higher level of supervisory focus on the compensation of bank CEOs who had a higher pay-risk relationship before DFA, than the compensation of banks who had a lower pay-risk relationship before DFA. But DFA also prescribed rules that did not address the

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[1] Wall (2020) explains that these provisions provide the framework used by bank regulators in their oversight of bank executive compensation in the post-DFA era. Additionally, the paper provides an excellent literature survey of studies that examine the relationship between bank CEO compensation and bank risk taking.

[2] See Section III for a detailed discussion of these reasons.

executive compensation structures such as regulations for credit agencies, private fund advisers, OTC derivatives, etc. To isolate the impact of bank executive compensation structure on bank equity risk, we use the generalized difference-in-difference (diff-in-diff) methodology of Djourelova (2023).[3]

Studies of management compensation structure typically define pay-risk sensitivity as the change in the dollar value of CEO wealth for a .01 change in stock return volatility (*vega*). In this paper we examine the changes in the structure of CEO compensation around the passage of DFA and whether these changes reduce a bank's equity risk and systemic risk. The basic idea for the first-stage regression is that greater regulatory scrutiny of bank CEO compensation in the post-DFA era is likely to vary with a bank's pre-DFA sensitivity of pay to risk (*prevega)*. We classify banks into two groups -- a high-*prevega* (low-*prevega*) group, which is defined as a dummy variable set to unity (zero) when pay-risk sensitivities in the pre-DFA period is greater than (less than or equal to) the median *prevega* value in our sample, respectively. We expect that reliance on risk sensitive compensation to decrease more for high-*prevega* banks than low-*prevega* banks. We examine several components of the compensation package that are likely to influence pay-risk sensitivities such as bonus, long term incentive plans, performance and time vesting stock grants, time and performance vesting option grants, and anti-hedging provisions.

Given that DFA changed several regulations other than bank CEO compensation, consistent with Djourelova (2023), the first-stage regression helps us to isolate the impact of DFA

[3] Such a methodology has also been used by Pierce and Schott (2016) who uses binary treatment, in contrast to Djourelova (2023) who uses continuous treatment. In the paper, we present results using binary treatment, but all our results are robust to continuous treatment. These results are not reported but are available from the authors. This methodology is similar in spirit to Bartik instruments in which identification is based on heterogeneous exposure to a common shock.

on differences in bank CEO compensation between high- and low-*prevega* banks. If DFA did change bank CEO compensation, then the first-stage results would show statistical significance -- which it does. Note that all other regulatory changes due to DFA are not used in the second-stage regression. We then use the predicted values of changes in compensation due to DFA between high- and low-*prevega* banks from the first-stage regression to examine changes in the bank's equity risk and systemic risk in the second-stage regression.

By way of background, Djourelova develops a generalized diff-in-diff model to examine the persuasiveness of "slanted" language. She exploits the April 2013 Associate Press's (AP's) ban on use of the term "illegal immigrant" in its dispatches as an exogenous shock to slanted language. Because media outlets differ in the extent they rely on AP copy, pre-ban differences in AP reliance across outlets generates differences in exposure to the shock. Her methodology consists of two stages. In the first stage, she regresses, at the county level, the circulation-weighted share of articles that use the term "illegal immigrant" relative to the term "immigrant" on AP intensity (i.e., number of pre-ban AP-sourced articles per 1,000 articles) times the post-ban period. In the second-stage, she estimates the effect of the ban on views on immigration by comparing survey responses before and after the ban and in counties with different AP intensities. She finds that individuals exposed more intensively to the AP ban through local media have lower support for retrictive immigration policies.

There is a significant divergence between the generalized diff-in-diff model and the standard diff-in-diff model. In the standard diff-in-diff model there is a treated group, and a control or untreated group. In the generalized diff-in-diff model, there is a group that is more likely to being affected by the treatment, and a group less likely to be affected by the treatment. A simple example might help to highlight the difference. Let's say one is trying to estimate the impact of a certain drug on the likelihood of contracting a desease. In the standard diff-in-diff model, the treatment group and control group are chosen by certain charcteristics. Then in a random manner, one patient is given a drug, and the other patient, a placebo. The researcher hence examines for signficant differences in incedence of desease. In a generalized diff-in-diff model, the two groups are differentiated by their a priori exposire to desease (i.e. severiety of how they might react to the drug). Both groups get the drug. One examines if there are differences between pre- and post-drug delivery on the incidence of desease in the two groups of patients who are differentiated by their a priori sevierity reaction to the drug.

We examine 216 unique banks over the sample period 2000 through 2019. Overall, we find significant differences in the change in the structure of CEO compensation between high- and low-*prevega* banks. Specifically, we find that performance-vesting restricted stock awards, use of long-term incentive plans (LTIP) and anti-hedging provisions increased more at high-*prevega* banks than at low-*prevega* banks. Conversely, we find greater decreases in the use of time-vesting options at high pre-*prevega* banks than at low-*prevega* banks.

We hence examine the relation between changes in risk taking and changes in compensation structure for the two sets of banks. Instrumenting for the differences in compensation structure we find that differences between the two groups of banks' post-DFA in terms of risk taking (i.e., stock return volatility) decreased in the post-DFA era with the risk reduction driven by high pay-*prevega* banks. We then examine if this result is driven by a bank's idiosyncratic risk or beta, and we find that that it is a bank's idiosyncratic bank risk that went down in the post-DFA period. Additionally, we find a similar result for systemic or tail risk. We find no change in the performance of the two sets of banks as measured by Tobin's Q.[4]

An important empirical challenge in examining the relationship between bank risk and compensation is that compensation policies are likely to be endogenous due to confounding factors. For example, the optimal CEO compensation structure is likely to vary with the bank's business model, bank size and capital, whether it received TARP funds, whether it faced regulatory stress tests, bank culture and future growth opportunities.[5] Thus, the relationship between risk and compensation in the cross-section may reflect these confounding factors rather than reflecting any causal link between risk taking and compensation.

We address these endogeneity concerns in four ways. First, we include bank fixed effects, which controls for cross-sectional differences in time-invariant bank characteristics like bank size. Using bank fixed effects allows us to focus only on 'within bank variation.' Second, we also include time-varying variables factors such as bank size, capital, whether the bank received TARP funds, and the distance between stress capital and regulatory capital that a bank faced in regulatory stress tests. Third Fahlenbrach *et al.* (2012) find that banks that did poorly in the 1998 Russia crisis also did poorly in 2007-2009 crisis, which they attribute to a bank's risk culture. Accordingly, we conduct additional tests to ensure that *prevega* is not capturing a bank's risk culture. We find no correlation between a bank's 1998 buy-and-hold returns and *prevega*. We also repeated our generalized diff-in-diff model using the bank's 1998 buy-and-hold returns instead of *prevega* and

[4] We also find similar results when we use stock returns and excess stock returns. Excess stock returns using the 4-factor model of Demsetz and Strahan (1999), wherein the 4-factors consist of: market returns, the change in the yield on the 3-month Treasury bill rate, the change in the spread between the 10-year Treasury note and the 3-month Treasury bill rate, and the change in the spread between Moody's Baa-rated corporate bonds and 30-year Treasury bonds. These results are not reported but are available from the authors.

[5] See, for example, Hubbard and Palia (1995), Fahlenbrach *et al.* (2012), and DeYoung *et al*. (2013).

found no significant results. Fourth, we calculate the sensitivity of wealth to equity risk due to options by using the yearly mean of the annualized standard deviation of stock returns in all Black-Scholes computations, instead of using the equity risk specific to each bank (Guay 1999; Coles *et al.* 2006; Hayes *et al.* 2012).

We conduct three additional robustness tests. First, to minimize the impact of the crisis years (2008-09) on *prevega*¸ we redefine the pre-Dodd-Frank period as 2000-2007 instead of 2000-2009, and find similar results. Second, we examine a shorter six-year window before and after DFA, and find similar results.[6] Third, it is possible that the reduction in risk is due to changes in pay-performance sensitivities (*delta*) rather than pay-risk sensitivities (*vega*). We find no significant difference in the impact on bank risk and performance between the two groups of *predelta* banks which suggests that the primary channel is through the effect of compensation structure on *vega*.

This paper proceeds as follows. Section II describes our methodology. Section III provides an overview of the literature relating bank risk to compensation policy and provides a conceptual framework for our empirical analysis. Section IV explains the Dodd-Frank Act and its potential impact on CEO's compensation structure and bank risk. Section V describes our data and the empirical variables constructed for our tests. We present our empirical findings in Section VI. Section VII provides a summary and conclusions.

[6] Note that we are estimating a fixed effects model and therefore need time variation in our variables. Therefore we picked six years rather than three or four years.

II. Empirical Methodology

To isolate the impact of bank executive compensation structure on bank equity risk, we use the generalized difference-in-difference (diff-in-diff) methodology of Djourelova (2023). An attractive feature of this approach is its ability to isolate the role of the policy changes by using differences in the exposure of firms to the impact of the policy change.

In the context of the Dodd-Frank Act (DFA) policy change, we classify banks into two groups based on their pay-risk sensitivities in the pre-DFA period. We define pay-risk sensitivity in the pre-DFA era as *prevega*. The first group, high-*prevega*, are those banks whose average pay-risk sensitivities are greater than the median pay-risk sensitivities of all banks in the pre-DFA period. This is effectively the treated group of banks -- whose CEO compensation structure regulators are concerned about. The second group of banks are the control group wherein banks have pay-risk sensitivities that are equal to or less than the median pay-risk sensitivities of all banks in the pre-DFA period. We then examine if the difference between the high and low pay-risk groups changed following the enactment of DFA. For ease of convenience, we summarize our empirical strategy in Figure 1.

Figure 1

We build our empirical model in two stages. In the first-stage we examine which elements of the compensation structure changed after DFA. In doing so, we use the guidance of DFA and relate it to testable hypotheses to the various compensation structures described in detail in Section IV. The first-stage regression model is given by equation (1) below.

$$Comp_{it} = \beta \times high\_prevega_{i} * D\mathrm{F} + \gamma' \; X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t} \qquad (1)$$

where subscript *i* indicates the bank and subscript *t* indicates the year, respectively. $Comp_{it}$ are the different compensation variables that we examine. $high\_prevega_i$ is a dummy equal to one when the pay-risk sensitivities before DFA (*prevega*) of banks is greater than median of our sample, and otherwise equal to zero. *DF* is a dummy variable indicating the post Dodd-Frank period (2010 to 2019). Our interest is the coefficient β, which is the average treatment effect which is based on comparing the difference in the impact of the DFA policy changes between banks in the high-*prevega* group and banks in the low-*prevega* group. The vector *X* representing time-varying control variables are bank size and capital, whether the bank received TARP funds, and whether the bank faced regulatory stress tests. α is the bank fixed effect, which absorbs unobserved and time-invariant confounding factors, and δ are year dummies which control for any macro time trend. All standard errors are robust and are clustered at the bank-level.

Our specification is designed to address two potential concerns regarding confounding factors. The first concern is regulators in the post-DFA period might focus their attention on compensation policies of the largest banks. Using bank-level fixed effects and including the control variable *size* in our regression mitigates this concern. The second concern is that other factors affecting bank risk can determine the change of compensation structure. Such factors might include risk reduction due to a bank receiving TARP funds and/or facing regulatory stress testing. Accordingly, we control for these effects by using as independent variables, proxies for a bank receiving TARP funds and facing regulatory stress testing.

In the second-stage regression we use the fitted values from the above equation to examine the impact of the changes in compensation structure on bank risk and performance. The second-stage is given by equation (2) below.

$$Bank\ risk\ or\ peformance_{it} = \mu \times \widehat{compensation\ structure}_{it} + \gamma' X_{it} + \alpha_i + \delta_t + \epsilon_{it} \qquad (2)$$

where compensation structure is instrumented by high_$prevega_i * D$F. Bank risk is proxied by the annualized standard deviation of equity returns, or beta or idiosyncratic risk, whereas bank performance is proxied by Tobin's Q. We cluster robust standard errors at the bank-level.

III. Conceptual Framework and Related Literature on Bank Compensation and Risk Taking

The relationship between bank risk-taking incentives and compensation is ambiguous. Focusing first on the relationship between risk-taking incentives and incentive pay; higher incentive pay should serve to align the interests of management and shareholders by linking CEO compensation to shareholder wealth. However, the effects of increasing incentive pay on risk taking are ambiguous. On the one hand, high incentive pay may lead to a concentration of wealth in the shares of the banks leading to greater managerial risk aversion. This effect is likely to increase if share grants are required to be held after vesting and are subject to claw backs. On the other hand, as John and John (1993) and Bolton *et al.* (2015) point out, a higher incentive pay may incentivize bank CEOs to shift risk to depositors and debt holders. Edmans and Liu (2011) show that managers with debt-based incentives manage their firms more conservatively, evidence for which has been found by Sundaram and Yermack (2007) in the general firm literature and by Bennett *et al.* (2015) and van Bekkum (2016) for banks.

At first glance, option pricing theory (and the pricing of performance-based stock grants) suggests that increases in *vega* should provide greater incentives for risk taking. However, Core and Guay (1999), Guay (1999), Lambert *et al.* (1991), Carpenter (2000), Ross (2004), and

Lewellen (2006) point out that undiversified risk averse executives are unlikely to value their options according to Black-Scholes. If for example, CEOs value options in terms of certainty equivalence then the relationship between risk taking and *vega* is ambiguous. To see why, the CEO's certainty equivalent wealth can be written as:

$$CE = E(W) - risk\ premium \qquad (3)$$

Differentiating (1) with respect to volatility (σ) yields

$$\frac{\partial CE}{\partial \sigma} = \frac{\partial E(W)}{\partial \sigma} - \frac{\partial risk\ premium}{\partial \sigma} \qquad (4)$$

As shown, the effect of an increase in CE consists of two components, the effect of volatility on expected wealth and the effect of volatility on the risk premium required to take on additional risk. In the context of Black-Scholes, and more generally for compensation structures with convex payoffs, the effect of volatility on the value of CEO option holdings is unambiguous since $\frac{\partial\ E(W)}{\partial \sigma} > 0$. The second term will also be positive if managers are risk averse and are unable to totally hedge the components of the compensation package with convex payoffs. The net effect on equation (4) and the CEO's preference for volatility will therefore depend on the relative magnitude of wealth and their risk aversion. In other words, the convexity of the compensation plan (e.g., from options) can be offset by the concavity of the utility function of the risk-averse CEO. The magnitude of the risk aversion effect is expected to vary with the diversification of the manager's portfolio of wealth, hedging opportunities and the availability of claw back provisions.

Given the ambiguity concerning the effect of incentive pay and *vega* on risk taking, it is perhaps not surprising that the empirical evidence concerning the relationship between bank risk taking and incentive compensation is mixed. For example, Houston and James (1995) find a negative relation between bank CEO stock and option holdings measured as a percentage of ownership and stock return volatility. In addition, Fahlenbrach and Stulz (2011) find no consistent evidence of a relationship between *vega* and other incentive-based compensation measures and bank performance during the financial crisis. In contrast, Chen *et al.* (2006) finds a positive relation between value of manager's stock options and stock return volatility. DeYoung *et al.* (2013) also find a positive relationship between *vega* and various risk measures and conclude that prior to the financial crisis the structure of CEO compensation promoted bank risk taking.

There are several potential reasons for the conflicting findings concerning the incentive effects of CEO compensation. First, the sample period used in these studies are different and geographic and activity restrictions on banks have changed dramatically over the past three decades. The changes are likely to affect risk taking opportunities and the market for corporate control in banking, which in turn will affect the optimal compensation contract for bank CEO's (see, for example, Hubbard and Palia (1995)). Second, as Fahlenbrach *et al.* (2012) argue, compensation policies are likely to vary with bank culture and growth opportunities which leads to cross-sectional variation in both compensation policies and the relationship between compensation and risk taking. As a result, studies in which identification is based on cross-sectional variation in risk taking and compensation structure are likely to suffer from omitted variable bias. Third, most prior studies focus on only two measures of the incentive effects of compensation on bank risk taking (stock and option grants). However, as Edmans and Liu (2011) point out a significant portion of CEO compensation is in the form of inside debt (i.e., sum of pensions and deferred cash compensation). Bennett *et al.* (2015) and van Bekkum (2016) find a significant negative relation between bank risk taking and the amount of inside debt held by bank

CEOs during the pre-crisis period.[7] Finally, *vega* is not likely to be exogenous. A bank's compensation committee and the board of directors have an incentive to use compensation to influence risk taking and more generally their investment and lending policies of the bank. As a result, Guay (1999) and Coles *et al.* (2006) argue that there are likely to be feedback effects through which the level of bank risk influences the choice of compensation policies. Failure to control for these feedback effects is likely to result in biased estimates of the true relationship between risk taking and compensation structure.

In all regression specifications we include bank-level fixed effects so that identification is through within bank variation in risk and compensation structure. Including bank-level fixed effects allows us to control for time invariant differences between banks in culture, investment opportunities and strategic focus.[8] We further address endogeneity concerns using an alternative methodology. We use the approach employed by Guay (1999) and Core and Guay (1999) to calculate the sensitivity of wealth to performance and risk by using the yearly mean of annualized stock return volatility in all Black–Scholes computations, instead of using the equity risk specific to each firm.

IV. The Impact of Dodd-Frank on the Relationship between CEO Compensation Structure and Risk Taking

In response to the financial crisis of 2007 to 2009, Congress enacted the comprehensive Dodd-Frank Wall Street Reform and Consumer Protection Act (commonly referred to as Dodd-Frank) in 2010. The Dodd-Frank Act (DFA) impacted almost every part of US financial industry

[7] van Bekkum (2016) finds that a bank's CEO inside debt holdings is positively correlated with *vega*.

[8] We report statistical significance based on robust standard errors clustered at the bank level (Petersen (2009)).

by creating rules and regulations (such as the orderly liquidation authority of insurance companies and broker dealers to different regulatory agencies like the SEC, the Fed, and the Federal Insurance Office) as well as creating new agencies such as Financial Stability Oversight Council and the Office of Financial Research.

There are three reasons why the DFA might have changed the structure of bank CEO compensation. First, in late 2009, the Federal Reserve began a review of incentive compensation practices at the largest banks to assess their compliance with incentive compensation guidance promulgated by bank regulatory agencies. The regulatory focus on CEO compensation was motivated by the belief that compensation affects CEO risk taking incentives which, in turn, affects the bank's risk-taking strategy. On July 16, 2009, the US Treasury proposed the Corporate and Financial Institution Compensation and Fairness Act (CFICA), which was subsumed by the larger DFA and passed by the House on December 11, 2009. On May 5, the Senate passed the larger DFA (with the CFICA provisions), which President Obama signs into law on July 21, 2010. Figure 2 presents a summary of the timeline associated with the DFA.

Figure 2

Second, while rules concerning bank CEO compensation were first proposed in 2010 and have yet to be fully formalized, it is well understood by practitioners that regulatory guidelines concerning compensation policies under DFA have changed the structure of bank compensation. This sentiment is reflected in two *Wall Street Journal* articles[9] which state "Portions of the Dodd-Frank mandate—including making pay more sensitive to risk and long-term results—have made

[9] "Trump's Move on Wall Street Pay Too Late for Bankers", *Wall Street Journal*, July 23, 2017; "Limits on Wall Street Pay Are Back on Regulators' Agenda", *Wall Street Journal,* March 5, 2019.

it into guidelines adopted by the Federal Reserve and other agencies. Banking groups have said their members follow the guidelines, but Washington and Wall Street have wrangled for years over whether they need to be locked in with formal rules"; and "The Dodd-Frank law, passed a year later, mandated new rules to limit payouts and more closely align them to firms' long-term financial health … Alan Johnson, a consultant who helps banks design their pay plans, said much of what regulators had hoped to accomplish with the pay rules is already a reality. … "I think the regulators are going to refight a war they've already won," Mr. Johnson said."

Third, Section 956 of DFA[10] specifically mandated six agencies (Fed, FDIC, OCC, SEC, NCUA, FHFA) draft rules regarding incentive compensation for financial institutions. These rules explicitly directed financial regulators_to adopt rules discouraging incentive compensation arrangements that misalign manager's incentives with long-term firm value and assisted executives from taking inappropriate risks. In doing so, regulators focused on making CEO compensation more performance-oriented, less convex and tied to long-term performance measures.

The rules prohibit, for covered persons at covered institutions, incentive compensation that encourages inappropriate risks by providing excessive compensation or that could lead to material financial loss. Covered persons include senior executive officers (we study CEOs) and significant risk-takers (deemed to be any person who can put the bank at risk of a material financial loss). Covered institutions are based on a three-tiered approach with requirements increasing in stringency with asset size. Level 1 institutions are banks with assets over $250 billion, level 2 institutions are banks with assets between $50 and $250 billion, and level 3 institutions are banks

[10] https://www.federalreserve.gov/publications/other-reports/files/incentive-compensation-practices-report-201110.pdf.

with assets under $50 billion.[11] Accordingly, we examine if DFA is associated with reduced risk taking.

One way to reduce risk taking is by substituting restricted stock awards for option grants. Restricted stock is stock that is nontransferable and generally becomes available to the recipient under a graded vesting schedule that lasts for several years. Given that options granted to the executive have convex payoffs, the substitution of restricted stock for options is expected to reduce *vega*.

Hypothesis 1: We expect a higher dollar value of restricted stock awards after DFA, and a lower dollar value of time vesting options granted post-DFA.

Another potential way to reduce risk taking incentives is to substitute performance-vesting requirements for time-based vesting. Performance-vesting provisions either initiate or accelerate vesting of stock and option grants to executives when they achieve accounting, stock-price, and/or some other target thresholds.[12] However, unlike time vesting stock and option grants, performance-based grants are contingent on performance metrics (such as firm profitability and stock price performance). As a result, we expect the use of performance-vesting to reduce the pay-risk relationship.

[11] See Maag (2018) for a description of the proposed compensation rules under DFA. When we split our sample into level 1, level 2, and level 3 banks, respectively, we find no significant differences in the results between the three groups. These results are not reported but are available from the authors.

[12] Recent empirical work by Bettis *et al.* (2018) finds that the trend towards a greater reliance on performance-vesting provisions has resulted in an increase in *vega* for non-financial firms.

Hypothesis 2: We expect the dollar amount in performance-based vesting for stocks and options to increase after DFA, and the dollar amount in time-based vesting for stocks and options to decrease after DFA, respectively.

As explained before, DFA focused on tying compensation to long term performance. Accordingly, we examine if pay became more long-term oriented after DFA.

Hypothesis 3: We expect the dollar amount in long-term incentive plans (LTIPs) to increase after DFA.

DFA mandated for large banks[13] a four-year deferral of 60% of short-term CEO incentive compensation (less than three years), and a two-year deferral of 60% of long-term CEO incentive compensation (at least three years). Accordingly, we examine if the dollar amount of deferred incentive compensation increased after DFA.

Hypothesis 4: We expect the dollar amount of deferred incentive compensation to increase after DFA.

The SEC has sometimes forced executives to disgorge bonuses that were inflated based on financial misstatements.[14] However, less extreme forms of misreporting often go unpunished because of the 'grey boundaries' between good-faith reporting and misreporting. Fried (2010) finds that no-fault excess-pay claw backs do not deter executives from financial misreporting before DFA was enacted. They find that nearly 50% of S&P 500 firms had no excess-pay claw

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[13] For banks whose asset size is greater than or equal to $250 billion. For level 2 banks, the deferral amount is 50%, and the deferral period is two years (one year) for short-term (long-term) incentive compensation, respectively.

[14] See SEC Report Pursuant to Section 308(c) of SOX that reviews enforcement actions over the five years preceding the enactment of SOX available at https://www.sec.gov/news/studies/sox308creport.pdf, and SEC v. Razmilovic, 738 F.3d 14,32 (C.A.2, 2013) that held that it was not an abuse of discretion for the district court to order disgorgement of a culpable CEO's bonuses earned in relation to an accounting fraud.

back policies. Of those firms with clear policies, 81% did not require directors to recoup excess pay but gave directors discretion to allow executives to keep excess pay. Of the remaining firms, 86% did not permit directors to recoup excess pay without a finding of misconduct. As a result, less than 2% of S&P 500 firms required directors to recover excess pay from executives whether or not there was misconduct. Accordingly, we examine if CEO bonus declined after DFA because of enhanced implementation of no-fault excess pay claw backs.

Hypothesis 5: We expect cash bonuses to decrease after DFA.

DFA aimed to minimize the adverse impact of any hedging activities by the CEO in purchasing any hedge or similar instrument to offset any decrease in the value of the executive's incentive compensation. CEOs were prohibited to purchase directly or through a third-party any such hedging instrument in order that CEOs do not take excessive risks. Accordingly, we examine if such anti-hedging provisions increased after DFA.

Hypothesis 6: We expect anti-hedging provisions to increase after DFA.

IV. Data and Variable Construction

IV.A Data

We obtained information on the structure of bank CEO compensation from ExecuComp. We restrict our sample to bank holding companies (BHCs) by selecting firms with SIC codes between 6000 and 6199. Our data is from 2000 to 2019, which results in an initial sample of 249 unique BHCs comprising of 2,843 bank-year observations. We obtain stock return data from CRSP and the bank's financial statement data from Compustat. After excluding observations with missing values for bank size, bank capital, and the CEO's *vega*, we have 216 unique BHCs comprising of 2,367 bank-year observations. In July 2006, the SEC required companies to disclose information on executive deferred compensation and pensions from fiscal year 2006 onwards. Accordingly, our second sample covers the period 2006-2019 for which we have 172 unique BHCs comprising of 1,709 bank-year observations. A summary of our data collection methodology is given in Table 1.

Table 1

IV.B Variable Construction

Our main variables of interest are bank risk and bank performance. We define the variable *total risk* as the annualized standard deviation of bank daily equity stock returns, *beta* as the regression coefficient of banks' stock returns on the market portfolio, *idiosyncratic risk* as the bank's idiosyncratic risk from the one-factor model. We proxy for bank performance with Tobin's Q. We define the variable *Tobin's Q* as the ratio of book value of debt plus the market value of equity to total assets. As in Core and Guay (2002), we define the pay-risk variable *vega* as the change in the dollar value of CEO wealth for a 0.01 unit change in stock return volatility. Specifically, *vega* is defined as $e^{-dT}\,\mathrm{N(Z)\,ST^{(1/2)}} \times 0.01$ where *d* is the natural logarithm of dividend yield, *T* is time to maturity, *N* is the density function of the normal distribution, *S* is stock price, *X* is the exercise price of the option, *r* is the natural logarithm of the risk-free interest rate, *σ* is annualized stock return volatility and $Z = [\mathrm{In(S/X)} - T(\mathrm{r} - \mathrm{d} + \sigma^2/2)]/\sigma \mathrm{T}^{(1/2)}$. We calculate *prevega,* as the average CEO *vega* between 2000 and 2009 for each bank. If regulatory scrutiny in the post-DFA era is focused on banks with the greatest pre-crisis pay-risk relationship, we expect the changes to impact these banks more. Accordingly, *high_prevega* is a dummy equal to one when the pay-risk sensitivities before the DFA (*prevega*) of banks is greater than median *prevega* of our sample, and otherwise equal to zero. To examine changes in regulatory scrutiny of bank CEO compensation in the post-DFA era, we define a dummy variable, *DF*, which equals one for years 2010 to 2019, and zero otherwise.

We create and include four control variables in our model. The first control variable is bank size (*size*), defined as the natural logarithm of a bank's total assets. The second control variable is bank capital (*capital*), defined as the ratio of market value of equity to total assets. The third control variable captures whether a bank receives capital infusions from the federal government under the Troubles Asset Relief Program (TARP). We define a dummy variable, *TARP*, that is set to unity when the bank signed the agreement to receive TARP funds and remains unity until they repaid the TARP money, and zero otherwise. The fourth control variable captures the effect of stress tests on bank risk taking. As in Cortes, et al. (2020), we use the banks' stressed capital ratio distance from their regulatory thresholds (*stress*). We use their preferred measure and update it for time-varying regulatory thresholds. Specifically, *stress* is defined as the minimum stress-test distance, which is equal to the minimum of (stressed Tier 1 capital less their regulatory Tier 1 capital ratio, stressed total risk-based capital less their regulatory total risk-based capital ratio, stressed leverage ratio less their regulatory leverage ratio). Table 2 summarizes the definitions of our variables and presents the data source.

Table 2

We also examine how each component of a CEO's pay changes around the passage of the DFA.[15] We do so by examining how four components of the CEO package changes following

[15] We also examined if there are changes in CEO turnover before and after the DFA and find no significant differences. These results are not reported but are available from the authors.

2009. Specifically, we examine the changes in cash bonus (*bonus*), restricted stock awards (*stock*), options (o*ptions*), and long-term performance-based compensation (*LTIP*).

As discussed earlier, if regulatory scrutiny of compensation structures designed to promote risk taking increased following the financial crisis, we expect the components of equity-based compensation to change; with a decrease in reliance on time-based option grants and an increase in performance-based restricted stock grants. To examine changes in the components of equity-based compensation, we decompose equity-based compensation into four components based on the type of vesting provisions: (1) the dollar value of performance-vesting restricted stock (*pv stock),* defined as the dollar value of newly awarded performance-vesting restricted stocks; (2) the dollar value of performance-vesting options (*pv option),* defined as the dollar value of newly granted performance-vesting options; (3) the dollar value of time-vesting restricted stock (*tv stock),* defined as the dollar value of newly awarded time-vesting restricted stocks; and (4) time-vesting options (*tv option),* defined as the dollar value of newly granted time-vesting options. In the sub-sample of banks where data is available from 2006-2019, we create two variables; the first is *deferred comp,* defined as the present value of deferred compensation, and the second is *pensions,* defined as the present value of accumulated pensions. We also manually collect from a bank's proxy statements, annual or quarterly reports when anti-hedging provisions were introduced during the sample period.

Table 3 presents descriptive statistics for the variables of interest. The average *prevega* is 0.50, with a median value of 1. These estimates are similar to those reported for non-financial firms reported in other studies (for example, Coles, Daniel and Naveen (2006)). The average bank size is $14.50 billion, with a corresponding median value of $10.63 billion. The average (median) bank capital ratio is 12% (10%), suggesting that these banks are well capitalized. On average, the number of banks who receive TARP funds is 11%, with a median value of 0. This suggests that banks that received TARP money were few and they attempted to leave the program as soon as possible due to the compensation limits in the TARP agreement. In Figure 3, we find that the fraction of banks that received TARP funds started to be positive in 2007, peaked in 2009, after which it declined substantially till 2013. Our results are consistent with those in Bayatzitova and Shivdasani (2011) and Wilson and Wu (2012). We find that the average (median) minimum stress-test distance to be 0.14 (0), respectively. Every year, the Fed discloses names of banks participated in the stress test program under the Dodd-frank act. In Figure 4, we find that the fraction of banks that participated in the Fed's annual stress test program started to be positive in 2013, peaked in 2017, after which it declined.

Table 3

***Figures 3 and 4 ***

The mean (median) average annualized standard deviation of daily equity returns (*total risk*) is 35.5% (27.4%), which is consistent with studies in the general firm literature. The mean (median) beta of a bank is 1.25 (1.22), which suggests that banks have high systematic risk. Additionally, we find that the mean (median) of a bank's idiosyncratic risk is 28.83% (22.04%), and a bank's tail risk is 2.85 (2.24). Finally, the average Tobin's Q is 1.13, with median values of 1.05, respectively.

V. Empirical Results

VA. Compensation Structure Changes in the Post Dodd-Frank Era

We begin our empirical analysis by examining how compensation structure changed around the passage of the DFA using the generalized diff-in-diff framework of equation (1). The coefficient of interest is β, which is the average treatment effect that compares the difference between banks in the high-*prevega* group, and banks in the low-*prevega* group during the post-DFA period. Specifically, we examine changes in the various incentive-based components of CEO pay (namely, bonus, restricted stock awards, option grants, and LTIPs) and whether there is a difference in how these components changed for high versus low *prevega* banks. Estimates of equation (1) are presented in Table 4.

Table 4

The findings in Table 4 are generally consistent with the predictions of hypotheses 1 through 5. For example, in column (1), we examine if the value of bonuses changes around the DFA. As shown, the coefficient estimate of high-*prevega* is negative and significant at the obe-percent level indicating that banks in the high-*prevega* group decreased bonuses by $0.323 million more than banks in the low-*prevega* group in the post-DFA period. The difference between high- and low-*prevega* banks is equal to 27.1% of the sample standard deviation of bonuses. These findings are consistent with the predictions of Hypothesis 5.

Next, we examine changes in the reliance on restricted stock awards after the passage of the DFA. As shown in column (2) we find a strong positive relation between stock-based compensation and high-*prevega* indicating the high-*prevega* banks increased stock-based compensation more than other banks in our sample. The average restricted stock value for banks in the high-*prevega* group is $1.139 million dollars higher than those in the low-*prevega* group (roughly equal to half sample standard deviation of restricted stock awards).

As shown in column 3 of Table 4, we find a significantly greater decrease in the use of option grants among high-*prevega* group in the post-DFA era. The economic magnitude is equal to 63.5% of the standard deviation in option grants. These findings are consistent with the predictions of hypothesis 1. Similarly, in column (4), we find an increase in long-term incentive plans (LTIP).[16] This estimate suggests that banks of high-*prevega* group raise their CEO's long-term incentive plans by $0.878 million compared with banks of low-*prevega* group. The estimate is equal to 40.6% of the standard deviation of LTIP. These findings are consistent with the predictions of Hypothesis 3.

In summary, the above findings indicate that LTIP and restricted stock awards increased, and options granted and bonus decreased, after DFA. We next examine if the changes in restricted stock and options were driven by DFA's emphasis of structuring bank CEO pay towards incentive compensation that does not promote risk taking. The results of this analysis are presented in Table 5. As shown in columns (1) and (4), we find a positive relationship for performance-vesting restricted stock awards and a negative relationship for time-vesting option grants. This suggests a substitution of time-vesting option grants with performance-vesting restricted stock awards. The coefficient of column (1) shows that banks in the high-*prevega* group increase performance-vesting stocks by $1.378 million more than banks in the low-*prevega* group. The coefficient of column (4) suggests that banks in the high-*prevega* group reduce time-vesting options by $1.286 million compared with banks in the low-*prevega* group; and the estimate's economic magnitude

[16] LTIP is defined in the reporting requirements as performance-based stock awards plus performance-based option grants.

is equal to half of one standard deviation of time-vesting options. We find no statistically significant changes in the use of performance-vesting option grants (column (2)), or time-vesting restricted stock awards (column (3)). These findings are consistent with hypothesis 2.

Table 5

Finally, we examine how other compensation structures[17] might have changed after DFA, the results of which are given in Table 6. In column (1), we find a statistically insignificant difference in deferred compensation between the high-*prevega* group and the low-*prevega* group in the post-DFA era. This is evidence against hypothesis 4. In column (2), we find a statistically insignificant difference in the present value of pensions between the high-*prevega* group and the low-*prevega* group in the post-DFA era. Given that both deferred compensation and pensions did not change, we find that inside debt (which is the sum of deferred compensation and pensions) did not change in the post-DFA era. In column (3) we find anti-hedging provisions to significantly increase, which is evidence in support of hypothesis 6. The coefficient of column (3) indicates that banks in the high-*prevega* group increase the probability of creating anti-hedging provisions by 16.1% than banks in the low-*prevega* group. This estimate is equal to 41.3% of the standard deviation of anti-hedging provisions.

Table 6

In summary, we find that performance-vesting restricted stock awards went up, as did long-term incentive plans (LTIPs) and anti-hedging provisions. Conversely, we find decreases in the use of time-vesting options and bonuses.

[17] We also examined the vesting periods of restricted stock, options, and LTIPs and found no significant changes after DFA. These results are not reported but are available from the authors.

VB. Characteristics of High and Low Pay-Risk Sensitivities Banks in the Pre-DFA Period

While the findings in Tables 4 and 5 suggest differences in the impact of post-DFA regulatory scrutiny on the compensation structure for high- and low-*prevega* banks, the observed differences may arise from differences in the characteristics of the two sets of banks that is related to the intensity of regulatory scrutiny along some dimension other than *prevega*. To address this question, we compare the characteristics of high pay-risk sensitivities and low pay-risk sensitivity banks in the pre-DFA era. For this analysis we use data on bank characteristics *for the last year* prior to the implementation of DFA. As a result, we have only one observation for each bank, and this is a cross-sectional regression. We examine for differences between high- and low-*prevega* banks along a number of pre-DFA dimensions including bank size, capital, ratio of mortgage-backed securities (MBS) to assets, ratio of real estate loans to assets, and ratio of non-interest income to asset. We include MBS and real estate variables given that the financial crisis originated in the subprime sector which was securitized in the originate-to-distribute model of banking.[18] Additionally, we include non-interest income as a regressor given that Brunnermeier, Dong and Palia (2020) found it to be related to bank risk. We examine the relationship between these *prevega* and these bank characteristics by estimating a Probit regression where the dependent variable is one if the bank is in the high-*prevega* group, and zero otherwise. As shown in Table 6, we find only bank size to be significantly related to high-*prevega*. Panel B of Table 7 provides the names of banks ranked by *prevega.* As shown in the first column, high *prevega* banks are among the largest systemically important financial institutions (for example, JPMorgan Chase, Bank of

[18] We also included commercial and industrial loans and found it to be statistically insignificant. These results are not reported but are available from the authors.

America, Wells Fargo) and have high *prevega*. These results show that only bank size is correlated to *prevega* in a cross-sectional regression.

Table 7

In Panel B we list the top-15 banks in each group of high and low pay-risk sensitivity banks. Consistent with the findings reported in Panel A, the top-15 high pay-risk sensitivity banks include large banks like Wells Fargo, JPMorgan Chase, and Bank of America. Conversely, the top-15 low pay-risk sensitivity banks include small banks like Pacwest Corp, MUFG Holdings Corp., and Signature Bank.

<u>Is *prevega* a proxy for bank size?</u> Given the above results, we examine if partitioning the pre-DFA sample by *prevega* is equivalent to partitioning it by bank size? In short, the answer is NO! These three reasons why our results are due to *prevega* and not bank size. One, we include bank-level fixed effects which capture time-invariant cross-sectional differences between banks (which includes cross-sectional differences in variables such as bank size). Two, to capture time-varying 'within bank differences' in bank size, we have included *ln(bank assets*) as an independent variable. For robustness, we also included $ln(bankassets)^2$, and none of our results changed significantly.[19] Three, instead of partitioning the pre-DFA sample into two groups based on *prevega* and using $DF* high\text{-}prevega_i$ as our instrumental variable in the first-stage regression, we partition our pre-DFA sample into two groups based on bank size. In Robustness Test 1 (Table 13) we find that our results are not driven by the size of the bank.

[19] These results are not reported but are available from the authors.

VC. Impact of Changes in Compensation Structures on Bank Risk and Performance

In this section we examine how the endogenously chosen compensation structures changes are related to bank equity risk and performance in the post-Dodd-Frank period. Note that we cannot include all the endogenously determined compensation variables in one regression specification, because each of them has the same instrumental variable $\text{high\_}p\text{revega}_i * D\text{F}$. We also do not examine compensation components that did not significantly change due to DFA, because they would be weak instruments for the second-stage regressions.

Table 8 presents the 2SLS regression findings for total bank equity risk. We find that the differences between the two groups of banks' post-DFA stock return volatility is lower when time-vesting options grants decreased more for high-*prevega* banks. Conversely, the differences between the two groups of banks' post-DFA stock return volatility is lower when performance-vesting restricted stock, LTIPs and anti-hedging provisions increased. There is no impact of differences in bonuses due to DFA, probably because the TARP program specifically targeted bonuses. The coefficient of LTIP is -4.58, which indicates that a one standard deviation increase in LTIP is associated with a 9.9% decrease in total bank equity volatility. The coefficient of performance-vesting stock is -3.73 which implies a one standard deviation increase in performance-vesting stock is associated with a 9.5% decrease in bank equity risk. The coefficient of time-vesting options is 4, which for a one standard deviation decrease in time-vesting options suggests a 12.28% decrease in total bank equity risk. The coefficient of anti-hedging provisions is 28.01, which for a one standard deviation increase in anti-hedging provisions suggests an 11% decrease in total bank equity risk. Therefore, the decreases in total bank equity risk range from

9.5% (from changes in performance-vesting stock) to 12.28% (from changes in time-vesting options).[20]

***Table 8 ***

We now examine if the decreases in total bank equity risk after DFA were due to changes in a bank's systematic risk (beta) or idiosyncratic risk. We estimate the CAPM to get a bank's beta and idiosyncratic risk and repeat the analysis wherein the dependent variable in 2SLS is a bank's beta or idiosyncratic risk. In Panel A of Table 9, we present the second-stage results when the dependent variable is a bank's beta, and in Panel B of Table 9, we present the second-stage results when the dependent variable is a bank's idiosyncratic risk. We find that a bank's beta is generally insignificantly related to the changes in a CEO's compensation due to DFA. In contrast, we find that a bank's idiosyncratic risk is significantly related to the changes in a CEO's compensation due to DFA. Once again, the coefficient on bonus is not statistically significant. The coefficient of LTIP is -4.55, which indicates that a one standard deviation increase in LTIP is associated with a 9.83% decrease in a bank's residual risk. The coefficient of performance-vesting stock is -3.35 which implies a one standard deviation increase in performance-vesting stock is associated with a 8.51% decrease in a bank's residual risk. The coefficient of time-vesting options is 3.6, which for a one standard deviation decrease in time-vesting options suggests a 11.05% decrease in a bank's residual risk. The coefficient of anti-hedging provisions is -26.0 which for a one standard deviation increase in anti-hedging provisions suggests a 10.14% decrease in in a bank's residual risk. Therefore, the decreases in total bank equity risk range from 8.51% (from changes in performance-vesting stock) to 11.5% (from changes in time-vesting options).

[20] We are unable to calculate the *relative* importance of each component of compensation on bank risk because the compensation components are highly correlated with each other.

***Table 9 ***

Table 10 presents the 2SLS regression results for bank performance. We do not find any statistically significant relationship between bank performance and the compensation variables. The above results suggest that DFA reduced excessive equity pay-risk in the banking industry, without adversely impacting bank equity performance.[21] The lack of association between risk and performance is not surprising because according to asset pricing theory, a firm's returns are only impacted by non-diversifiable market risk *beta* and not by diversifiable idiosyncratic risk.

Table 10

The above results show that bank risk differences between the two groups of banks' post-DFA idiosyncratic risk (namely, idiosyncratic return volatility) decreased over the sample period. We hence examine which group of banks reduced their idiosyncratic risk after DFA. In other words, did the low-*vega* banks increase their idiosyncratic risk, and/or did the high-*vega* banks decrease their idiosyncratic risk?

$$idiosyncratic\ risk_{it} = \gamma' X + \alpha_i + \delta_t + u_{it} \qquad (5)$$

Using equation (5) above, we calculate the average excess idiosyncratic risk, i.e., the variance of u_{it} across four groups: low-*vega* banks in the pre-DFA period, high-*vega* banks in the pre-DFA period, low-*vega* banks in the post-DFA period, and high-*vega* banks in the post-DFA period, respectively. For ease of analysis, we net out the excess idiosyncratic risk of the first group (i.e., low-*vega* banks in the pre-DFA period) from the idiosyncratic risks of the other three groups. The results of this analysis are given in Table 11. As shown in row (1) there was no significant difference in the average idiosyncratic risks between the low- and high-*prevega* groups in the pre-

[21] We also examine the impact of the level of pay (ln(TDC1)). Consistent with the results on the pay components, we find the level of pay to go down. These results are not reported but are available from the authors.

DFA period. This suggests that there is no time trend in idiosyncratic equity risks in the pre-DFA period. However, we find that idiosyncratic risk is significantly lower for high-*prevega* banks in the post-DFA period. These results suggest that the risk reduction that we found in Panel B of Table 9 is due to the lower idiosyncratic risks of high pay-risk banks in the post-DFA period.

Table 11

In Figure 5, we plot the excess idiosyncratic risk of both high- and low-*prevega* banks by year. For ease of interpretation, we normalize each year's excess idiosyncratic risk by excess idiosyncratic risk of the year 2000. Each red dot depicts the excess idiosyncratic risk of the high-*prevega* banks, and each blue triangle depicts the excess idiosyncratic risk of the low-*prevega* banks. We observe that before the financial crisis of 2007-09, the high-*prevega* banks have a similar trend to the low-*prevega* banks. But in the financial crisis, the excess idiosyncratic risk of the high-*prevega* banks increased substantially. Importantly, we find that the excess idiosyncratic risk of the high-*prevega* banks decreased significantly after DFA, whereas the excess idiosyncratic risk of the low-*prevega* banks did not change significantly.

Figure 5

VE. Impact of Changes in Compensation Structures on Bank Systemic (Tail) Risk

The above results have shown that the idiosyncratic risks of the high-pay risk banks fell post-DFA, with no change in their bank performance. But regulators are concerned by a bank's systemic risk. Accordingly, we use a widely used measure of systemic risk, namely, the Marginal Expected Shortfall (MES) measure of Acharya, et al (2017). MES measures the impact of the tail risk of a bank and is defined as the expected loss on a bank's equity conditional on the worst 5% of daily market returns. This translates into equity return of bank *i* conditional on the worst 5% of daily market returns. In Table 12, we repeat our analysis with our dependent variable being the systemic risk measure MES.

Table 12

In Panel A, we once again find that the coefficient on bonus is statistically insignificant. The coefficient of LTIP is -0.32, which indicates that a one standard deviation increase in LTIP is associated with a 0.69% decrease in systemic risk. The coefficient of performance-vesting stock is -0.47 which implies a one standard deviation increase in performance-vesting stock is associated with a 1.2% decrease in systemic risk. The coefficient of time-vesting options is 0.45, which for a one standard deviation decrease in time-vesting options suggests a 1.38% decrease in systemic risk. Therefore, the decreases in systemic risk range from 0.69% (from changes in LTIP) to 1.38% (from changes in time-vesting options).

In Panel B we examine which set of banks lowered their systemic risk. Consistent with the results for idiosyncratic risk, we find that the low-*vega* banks did not change their systemic risk, but the high-*vega* banks decreased their systemic risk.

VF. Robustness Tests

We conduct six sets of robustness tests. The first robustness test examines if the above results are due to bank size and not by *prevega.* To test if bank size is driving our results, we create a large size variable, $prelarge_i$, defined as a dummy equal to one when the size of the bank before DFA is greater than median size of pre-DFA banks, and zero otherwise. Then instead of using *DF** high-$prevega_i$ as our instrumental variable in the first-stage regression, we use *DF** high- $prelarge_i$ as our instrumental variable in the first-stage regression. In Table 13, the second stage results of using high-$prelarge_i$ shows that total risk, idiosyncratic risk, and Tobin's Q is not statistically significant. This is not surprising given that our results using high-$prevega_i$ controlled for differences in bank size cross-sectionally (via bank-level fixed effects) and in time-series (using bank size as a control variable). Therefore, our results are not driven by the size of the bank, but by *prevega*.

Table 13

It is possible that changes in bank CEO compensation occurred not because of DFA but rather due to investor risk preference changing after the financial crisis. In order to examine this alternative mechanism, namely, changes in investor risk preferences, we use the variance risk premium (VAP) of Rosenberg and Engle (2002) and Bollerslev, Gibson and Zhou (2012)). VAP is defined as the difference between the implied volatility from S&P500 options and realized volatility from S&P500 intraday returns. In our second robustness test we use as our instrumental variable *prevega**VAP instaed of *prevega**DF. If it is indeed changing investor preferences driving our results we should find the new iv to be significantly related to changes in compensation in the first-stage and a lowering of idiosyncratic risk in the second-stage. In Table 14, we find insignificant results in both the first- and second-stage, indicating that it is not changes in investor risk preferences that is driving our results.[22]

Table 14

The third robustness test uses the average sample volatility to calculate *prevega* instead of using an individual bank's stock return volatility (Guay 1999; Coles *et al.* 2006; Hayes *et al.* 2012). By doing so, we control for reverse causality from an individual bank's risk to compensation. We run six regression models, the results of which are given in Table 15. In the first-stage regressions we find consistent results with the results in Tables 4-7. Specifically, we once again find

[22] We observe that VAP fell substantially in 2008 and recovered in 2009 well before the DFA. These results are not reported but are available from the authors.

differences in performance-vesting restricted stock awards, LTIPs and anti-hedging provisions to go up after DFA, and differences in time-vesting options grants go down. When we examine the second-stage regression results, we find once again that bank idiosyncratic risk goes down with changes in compensation. There are no corresponding changes in bank performance.

Table 15

In the fourth robustness test, we redefine the pre-DFA period as 2000-2007 to calculate *prevega* instead of 2000-2009. We run six regression models, the results of which are given in Panel A of Table 16. In the first-stage regressions we find consistent results with the results in Tables 4-7. Additionally, the second-stage regression results show that bank idiosyncratic risk goes down with changes in compensation, but there is no corresponding change in bank performance.[23] In Panel B, we examine a shorter 6-year window around DFA. Once again, we find consistent results.

Table 16

In the fifth robustness test, we repeat our analysis on the two groups of banks by classifying them by pay-performance sensitivities *(predelta*) instead of pay-risk sensitivities (*prevega*). In Table 17, we find that bank idiosyncratic risk generally does not statistically significantly decrease (except LTIP). Consistent with our previous results bank performance does not change.

Table 17

[23] We also examined bank performance defined as stock returns, and excess returns using the 4-factor model of Demsetz and Strahan (1999). The 4-factors consist of total market returns, the change in the yield on the 3-month Treasury Bill (short-term interest rate), the change in the spread between the 10-year and 3-month Treasury rates (term structure), and the change in the spread between rates on Moody's Baa-rated corporate bonds and 30-year Treasury Bonds (credit spread). We find stock returns and excess returns to be generally statistically insignificant and consistent with the results on Tobin's Q. We also examined a sample of manufacturing firms (SIC codes between 2000 and 3999) to analyze if DFA impacted these firms differently than banks. We find volatility to increase after DFA, in stark contrast to banks where we find volatility declines. These results are not reported but are available from the authors.

In the sixth robustness test, we examine if *prevega* is not capturing a bank's risk culture as in Fahlenbrach *et al.* (2012). They find that bank's that did poorly in the 1998 Russia crisis also did poorly in the 2007-2009 crisis, which they attribute to a bank's risk culture. In Figure 6, we find no correlation between a bank's 1998 buy-and-hold returns and *prevega*. In Table 18, we repeat our generalized diff-in-diff model using the bank's 1998 buy-and-hold returns instead of *prevega* and find no significant results. These results suggest that our results are driven by changes in the sensitivity of CEO pay to risk and not to a bank's general risk culture.

Figure 6

Table 18

VI. Conclusions

In this paper we examine changes in the relationship between bank risk and the structure of CEO compensation following the enactment of the Dodd-Frank Act (DFA) of 2010. The basic idea is that effect of greater regulatory scrutiny of compensation in the post-DFA era is likely to vary with a bank's pre-DFA pay-risk sensitivity. Using a generalized diff-in-diff methodology, we find significant differences between high and low pay-risk sensitivity banks. We find significant increases in performance-vesting restricted stock awards, LTIPs and anti-hedging provisions after DFA. We also find significant decreases in time-vesting options grants. Instrumenting for these significant differences in compensation structure, we find that bank idiosyncratic equity risk and systemic tail risk goes down in the post-DFA period. This is driven by reductions in the idiosyncratic risk and systemic tail risk of high pay-risk banks after the DFA. Finally, we find no significant differences in bank equity performance.

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Figure 1: Impact of Changes in CEO Compensation Structure Due to More Severe Regulatory Scrutiny (i.e., Dodd-Frank) on Bank Risk and Performance

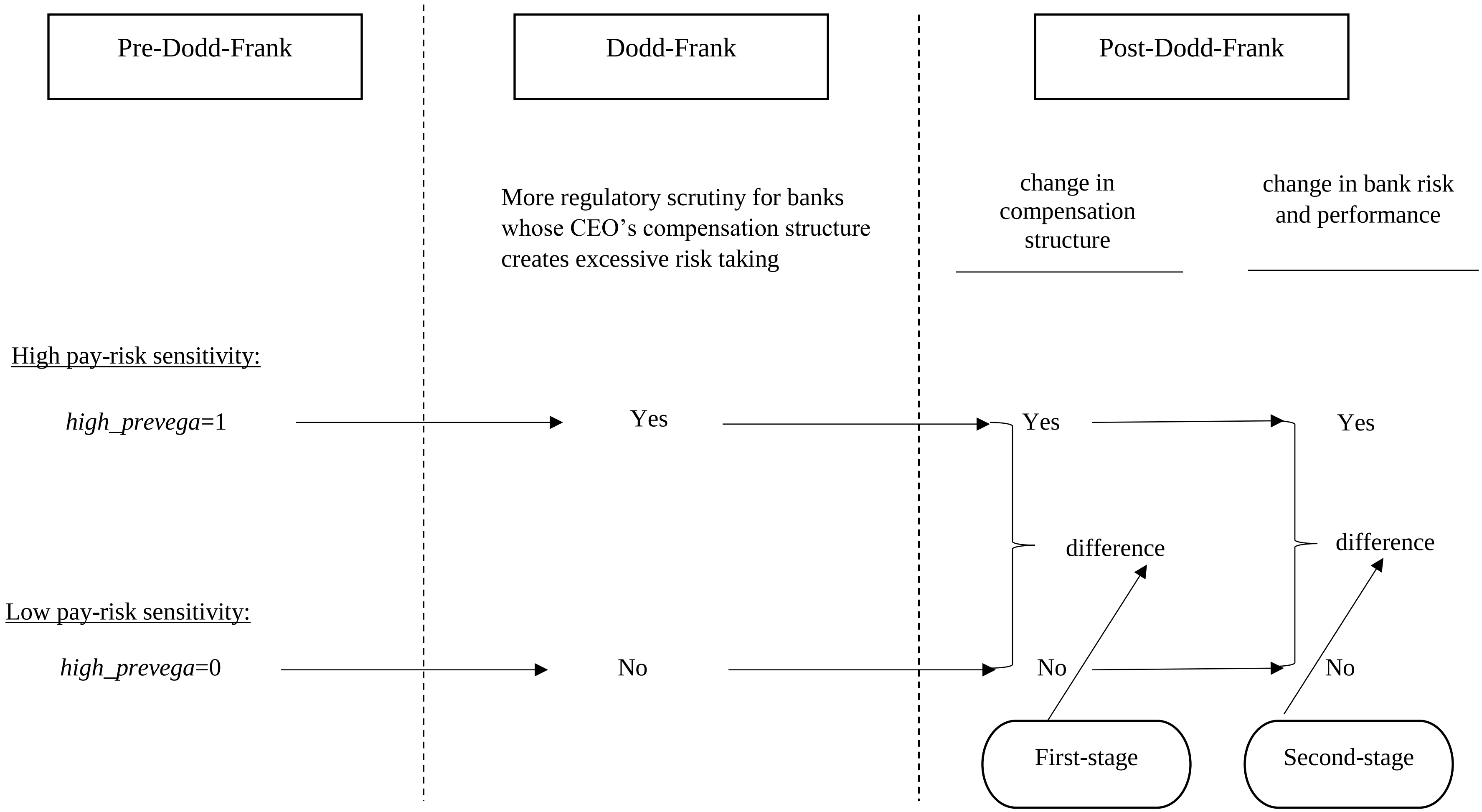

Figure 2: Timeline for the Passage of Dodd-Frank Act in US Congress

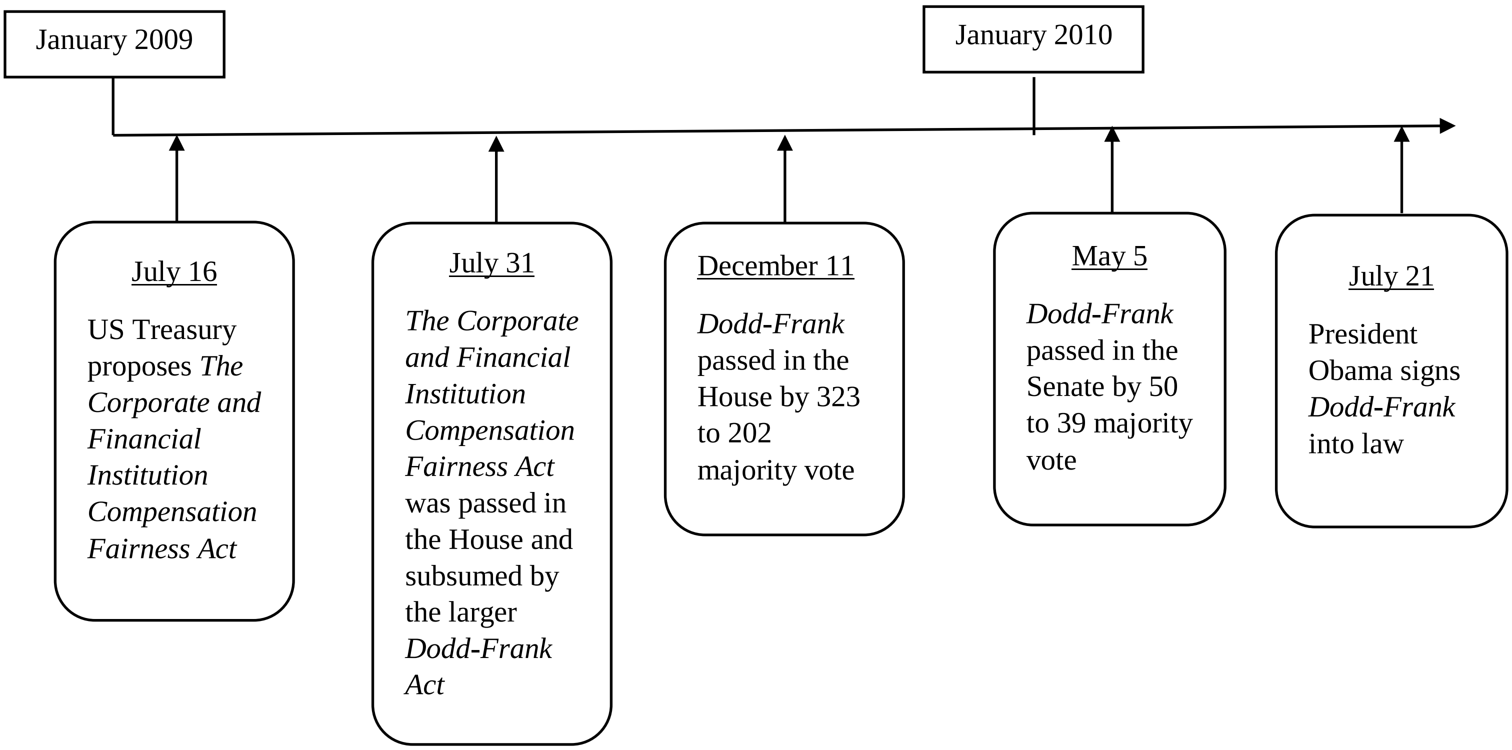

Figure 3: Fraction of Banks in the TARP Program

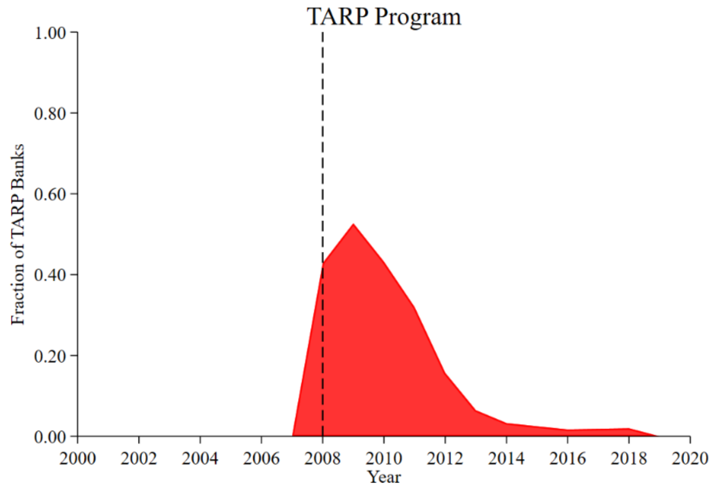

Figure 4: Fraction of Banks in the Stress Test Program

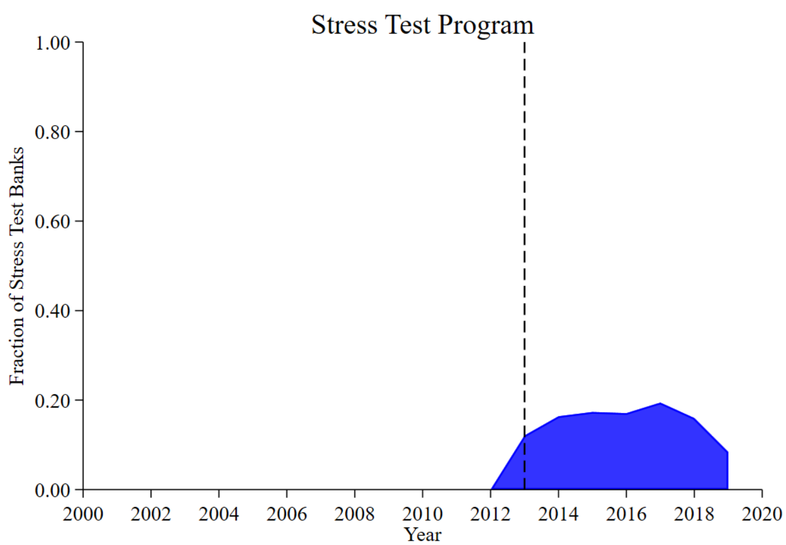

Figure 5: Time Series of Excess Idiosyncratic Risk Between High-*prevega* and Low-*prevega* Groups

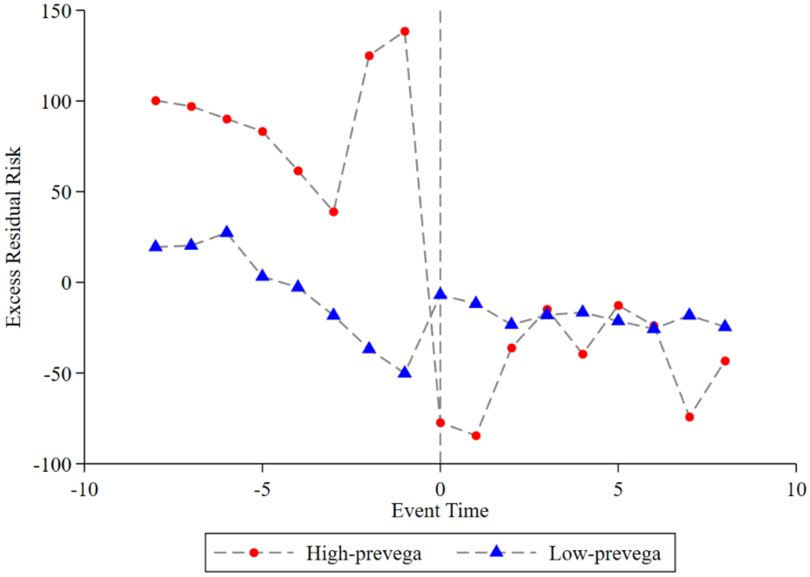

Figure 6: Scatterplot of *Prevega* against Buy and Hold Returns in 1998 Russia Crisis

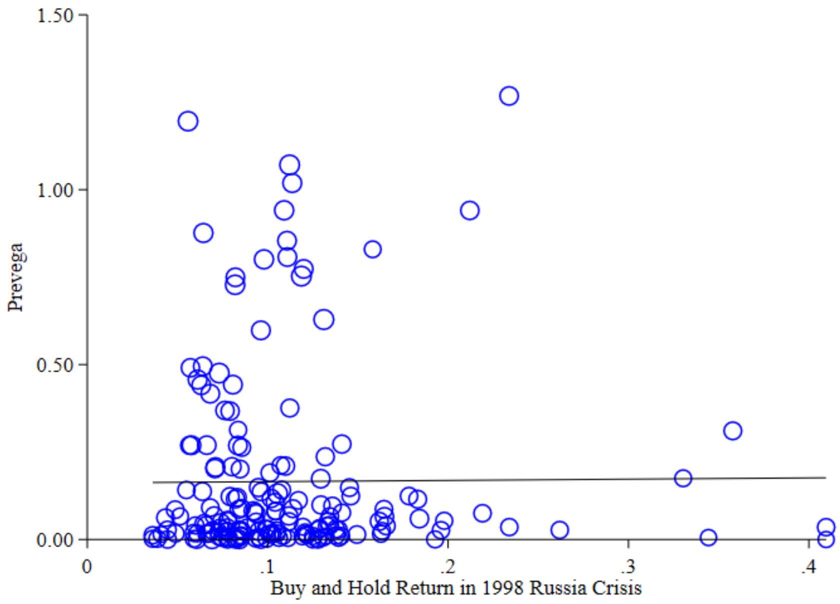

Table 1: Sample Creation

Sample Selection Criteria	# of Unique Bank-Holding Companies	# of Observations
SIC between 6000 and 6199 in ExecuComp (2000-2019)	249	2,823
Delete missing values for *size*, *capital*, and *vega*	216	2,367
Sub-sample from 2006 to 2019 (when deferred compensation and anti-hedging data is available)	172	1,709

Table 2: Variable Definitions and Sources

Variable Names	Definition (Units)	Source
Sample: 2000-2019		
$high\_prevega_i$	Dummy equal to 1 if average *vega* of bank *i* from 2000 to 2009 is greater than median value of *vega* from 2000 to 2009, otherwise equal to 0	ExecuComp
DF	Dummy equal to 1 if year is from 2010 to 2019, otherwise equal to 0	Compustat
size	Natural logarithm of total assets	Compustat
capital	Ratio of market value of equity to total assets	Compustat
TARP	Dummy equal to1 when the bank signed the agreement to receive TARP funds and remains unity until they repaid the TARP money	Manually collected from the website of the treasury department
stress	the banks' stressed capital ratio distance from their regulatory thresholds	Compustat & manually collected from the Fed reserve
bonus	$ bonus (million)	ExecuComp
stock	$ newly granted restricted stock (million)	ExecuComp
options	$ newly granted options (million)	ExecuComp
LTIP	$ long-term incentive plan payouts (million)	ExecuComp
pv stock	$ newly granted performance-vesting restricted stock (million)	Incentive Lab
pv option	$ newly granted performance-vesting options (million)	Incentive Lab
tv stock	$ newly granted time-vesting stocks (million)	Incentive Lab
tv option	$ newly granted time-vesting options (million)	Incentive Lab
deferred comp[24]	Present value of deferred compensation (million)	ExecuComp
pensions	Present value of accumulated pensions (million)	ExecuComp

[24] Sample period is 2006 to 2019 because proxy statements disclosed deferred compensation and pension information after 2005, and banks generally adopted anti-hedging provisions after 2010.

anti-hedging	Dummy equal to 1 if bank adopts an anti-hedging provision with respect to compensation, otherwise equal to 0	Manually collected from proxy statement, annual report or quarterly report
total risk	Annualized standard deviation of daily stock returns (percent)	CRSP
beta	The coefficient of market stock return on bank stock return, estimated from the CAPM model	CRSP
idiosyncratic risk	Annualized standard deviation of residual stock returns(percent), estimated from the CAPM[25]	CRSP
Systemic (tail) risk	Marginal Expected Shortfall (MES); Acharya, et al (2017)	CRSP
Tobin's Q	Book value of debt plus market value of equity divided by total assets	Compustat

[25] We estimated the beta and idiosyncratic risk from the CAPM model : $bank\ stock\ return_{byt} = \alpha_{by} + \beta_{by} \times market\ stock\ return_t + v_{byt}$ by using the daily stock return for each bank b at each fiscal year y.

Table 3: Summary Statistics

Variable	N	Mean	S.D	Min	25%	50%	75%	Max
high_prevega	2,367	0.50	0.50	0.00	0.00	1.00	1.00	1.00
DF	2,505	0.52	0.50	0.00	0.00	1.00	1.00	1.00
size	2,505	16.49	1.63	13.06	15.42	16.18	17.33	21.36
capital	2,505	0.12	0.09	0.02	0.08	0.10	0.12	0.62
TARP	2,367	0.11	0.31	0.00	0.00	0.00	0.00	1.00
stress	2,367	0.14	0.67	-0.80	0.00	0.00	0.00	7.80
bonus	2,505	0.47	1.19	0.00	0.00	0.00	0.38	7.40
stock	2,505	1.48	2.79	0.00	0.00	0.30	1.57	14.67
options	2,494	0.94	2.55	0.00	0.00	0.00	0.53	17.00
LTIP	2,505	0.85	2.16	0.00	0.00	0.00	0.51	12.41
pv stock	1,157	1.37	2.54	0.00	0.00	0.00	1.81	12.81
pv option	1,157	0.02	0.17	0.00	0.00	0.00	0.00	1.50
tv stock	1,157	1.16	2.39	0.00	0.00	0.00	1.34	14.20
tv option	1,157	1.25	3.07	0.00	0.00	0.00	0.96	20.41
deferred comp	847	3.84	6.90	0.00	0.29	1.09	4.31	36.54
pensions	1,076	4.94	7.20	0.00	0.40	1.93	6.65	35.76
anti-hedging	1,845	0.19	0.39	0.00	0.00	0.00	0.00	1.00
total risk	2,505	35.47	22.21	14.21	22.43	27.59	40.14	130.26
beta	2,505	1.25	0.44	0.23	0.98	1.22	1.50	2.6
idiosyncratic risk	2,505	28.83	19.07	11.88	17.80	22.04	32.65	118.68
systemic (tail) risk	2,352	2.85	2.05	0.33	1.57	2.24	3.37	11.18
Tobin's Q	2,505	1.13	0.35	0.94	1.01	1.05	1.11	3.64

Table 4: Impact of Dodd-Frank on Components of CEO Compensation

$$Comp_{i,t} = \beta \times high_p revega_i * DF + \gamma' X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}$$

where *high_prevega*$_i$ is a dummy equal to unity if average *vega* of bank *i* from 2000 to 2009 is greater than median value of *vega* from 2000 to 2009, otherwise equal to 0, *DF* is a dummy variable equal to unity from 2010 onwards, α_i indicates the dummy variables for each individual bank i, δ_t indicates year dummies, ϵ_{it} are the error terms, and the model specification follows Djourelova (2023). Column headings show the relevant compensation variables examined. The sample period is from 2000 to 2019 and the control variables in X_{it} are *size*, *capital*, *TARP*, and *stress*. Robust standard errors are given in parentheses and are clustered at the bank-level. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively All variables are defined in Table 2.

Compensation variable=	*bonus*	*stock*	*options*	*LTIP*
	(1)	(2)	(3)	(4)
*high_prevega**DF	-0.323**	1.139***	-1.618***	0.878***
	(0.156)	(0.350)	(0.306)	(0.291)
Observations	2,367	2,367	2,356	2,367
Adj.R2	0.58	0.57	0.52	0.46
Control Variables	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes

Table 5: Impact of Dodd-Frank on Performance-Vesting v. Time-Vesting for Stock and Options

$$Comp_{i,t} = \beta \times high\_prevega_i * DF + \gamma' X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}$$

where *high_prevega_i* is a dummy equal to unity if average *vega* of bank *i* from 2000 to 2009 is greater than median value of *vega* from 2000 to 2009, and otherwise equal to 0; *DF* is a dummy variable equal to unity from 2010 onwards; α_i indicates the dummy variables for each individual bank i; δ_t indicates year dummies; ϵ_{it} are the error terms; and the model specification follows Djourelova (2023). Column headings show the relevant compensation variables examined. The sample period is from 2000 to 2019 and the control variables in X_{it} are *size, capital, TARP,* and *stress*. Robust standard errors are given in parentheses and are clustered at the bank-level. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively All variables are defined in Table 2.

Compensation variable =	*performance-vesting*		*time-vesting*	
	stock	*options*	*stock*	*options*
	(1)	(2)	(3)	(4)
*high_prevega_i*DF*	1.378***	-0.023	-0.120	-1.286***
	(0.401)	(0.018)	(0.318)	(0.429)
Observations	1,134	1,134	1,134	1,134
Adj.R^2	0.55	0.27	0.33	0.41
Control variables	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes

Table 6: Impact of Dodd-Frank on Other Compensation Structures

$$Comp_{i,t} = \beta \times high\_prevega_i * DF + \gamma' X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}$$

where *high_prevega*$_i$ is a dummy equal to unity if average *vega* of bank *i* from 2000 to 2009 is greater than median value of *vega* from 2000 to 2009, and otherwise equal to 0; *DF* is a dummy variable equal to unity from 2010 onwards; α_i indicates the dummy variables for each individual bank i; δ_t indicates year dummies; ϵ_{it} are the error terms; and the model specification follows Djourelova (2023). Column headings show the relevant compensation variables examined. The control variables in X_{it} are *size*, *capital*, *TARP*, and *stress*. Robust standard errors are given in parentheses and are clustered at the bank-level. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively All variables are defined in Table 2.

Compensation variable =	*deferred comp* (1)	*pensions* (2)	*anti-hedging* (3)
high_prevega$_i$**DF*	-1.610	-1.257	0.161***
	(1.430)	(1.101)	(0.057)
Observations	826	1055	1,708
Sample period	2006-2019	2006-2019	2006-2019
Adj.R^2	0.58	0.60	0.54
Control Variables	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes

Table 7: Cross-sectional Probit Regression to Examine Differences in Banks with High Pay-Risk Sensitivities and Banks with Low Pay-Risk Sensitivities before Dodd-Frank

For Panel A, we estimate a Probit regression where the dependent variable is unity if the bank is in the high-*prevega* group before the DFA, and zero otherwise. The independent variables are as follows: *size*, *capital*, ratio of mortgage-backed securities to assets (*MBS*), ratio of real estate loans to assets (*RE*), and ratio of non-interest income to assets (*NII*). Data is for the one-year just before the DFA, where the year is defined by the year data is available for each bank. Robust standard errors are given in parentheses. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively

Panel A: Probit regression

Variable	*constant*	*size*	*capital*	*MBS*	*RE*	*NII*
Coefficient	-20.715***	1.212***	6.609	0.975	0.328	18.559
S.e	(3.382)	(0.214)	(5.970)	(1.647)	(1.180)	(16.148)

Panel B: Top-15 banks ranked by *prevega*

	Ranked highest to lowest		Ranked lowest to highest	
Rank	Name	*size*	Name	*size*
1	Capital One Financial	18.063	Pacwest Bancorp.	15.449
2	Wells Fargo	20.038	Popular Inc.	17.456
3	JPMorgan Chase & Co.	20.834	MUFG Americas	17.542
4	American Express Co.	18.795	AMRESCO Comm. Finl.	13.48
5	Washington Mutual Inc.	19.463	Signature Bank	15.685
6	MBNA	17.744	Legacy Tex Financial	14.538
7	US Bancorp	19.079	Intl. Bancshares Corp.	16.28
8	HSBC Finance Corp.	18.286	Southside Bancshares	14.706
9	Concord EFS Inc.	14.606	Columbia Banking Sys.	14.912
10	US Bancorp DE/old	18.285	PRA Group Inc.	13.279
11	Bank One Corp.	19.467	Bancfirst Corp-OK	15.152
12	Countrywide Financial	18.324	Park National	15.742
13	Bank of America	20.81	First Republic Bank	16.269
14	Navient Corp.	18.255	Capitol Federal Finl.	15.9
15	Wachovia Corp.	19.921	Finova Group Inc.	15.998

Table 8: 2SLS Impact of Changes in Compensation Due to Dodd-Frank on Bank Equity Risk

$$total\ risk_{i,t} = \mu \times \widehat{compensation\ structure}_{i,t} + \gamma' X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}$$

where compensation structure is instrumented by high_$prevega_i * D$F. *high_prevega*$_i$ is a dummy equal to unity if average *vega* of bank *i* from 2000 to 2009 is greater than median value of *vega* from 2000 to 2009, and otherwise equal to 0; *DF* is a dummy variable equal to unity from 2010 onwards; α_i indicates the dummy variables for each individual bank *i*; δ_t indicates year dummies; ϵ_{it} are the error terms; and the model specification follows Djourelova (2023). *total risk* is the annualized standard deviation of stock returns. The control variables in X_{it} are *size*, *capital*, *TARP*, and *stress*. Robust standard errors are given in parentheses and are clustered at the bank-level. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively. All variables are defined in Table 2.

	(1)	(2)	(3)	(4)	(5)
bonus	12.468				
	(7.844)				
LTIP		-4.584**			
		(2.303)			
performance-vesting stock			-3.732**		
			(1.810)		
time-vesting options				3.999*	
				(2.093)	
anti-hedging					-28.008*
					(15.476)
Observations	2,367	2,367	1,134	1,134	1,708
Adj.R^2	0.54	0.68	0.73	0.58	0.70
Control Variables	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes

Table 9: 2SLS Impact of Changes in Compensation Due to Dodd-Frank on Bank Beta or Idiosyncratic Risk

$$beta\ or\ idiosyncratic\ risk_{i,t} = \mu \times \widehat{compensation\ structure}_{i,t} + \gamma' X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}$$

where compensation structure is instrumented by $high\_prevega_i * DF$. *high_prevega*$_i$ is a dummy equal to unity if average *vega* of bank *i* from 2000 to 2009 is greater than median value of *vega* from 2000 to 2009, and otherwise equal to 0; *DF* is a dummy variable equal to unity from 2010 onwards; α_i indicates the dummy variables for each individual bank *i*; δ_t indicates year dummies; ϵ_{it} are the error terms; and the model specification follows Djourelova (2023). In Panel A, the dependent variable is *beta* estimated from the CAPM model, and in Panel B the dependent variable is *idiosyncratic risk*, the standard deviation of the residual value, estimated from the CAPM model, respectively. The control variables in X_{it} are *size*, *capital*, *TARP*, and *stress*. Robust standard errors are given in parentheses and are clustered at bank level. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively. All variables are defined in Table 2.

Panel A: Beta	(1)	(2)	(3)	(4)	(5)
bonus	-0.089				
	(0.142)				
LTIP		0.033			
		(0.054)			
performance-vesting stock			-0.060		
			(0.046)		
time-vesting options				0.064	
				(0.049)	
anti-hedging					0.100
					(0.272)
Observations	2,367	2,367	1,134	1,134	1,708
Adj. R^2	0.54	0.53	0.61	0.52	0.46
Control Variables	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes

Panel B: Idiosyncratic Risk	(1)	(2)	(3)	(4)	(5)
bonus	12.377				
	(7.602)				
LTIP		-4.551**			
		(2.255)			
performance-vesting stock			-3.355**		
			(1.604)		
time-vesting options				3.595*	
				(1.844)	
anti-hedging					-26.004*
					(14.559)
Observations	2,367	2,367	1,134	1,134	1,708
Adj. R^2	0.43	0.59	0.67	0.50	0.63
Control Variables	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes

Table 10: 2SLS Impact of Changes in Compensation Due to Dodd-Frank on Bank Equity Performance

$$\text{Performance}_{i,t} = \mu \times \widehat{compensation\,structure}_{i,t} + \gamma' X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}$$

where compensation structure is instrumented by $\text{high\_prevega}_i * D\text{F}$. *high_prevega*$_i$ is a dummy equal to unity if average *vega* of bank *i* from 2000 to 2009 is greater than median value of *vega* from 2000 to 2009, and otherwise equal to 0; *DF* is a dummy variable equal to unity from 2010 onwards; α_i indicates the dummy variables for each individual bank *i*; δ_t indicates year dummies; ϵ_{it} are the error terms; and the model specification follows Djourelova (2023).The dependent variable is Tobin's Q. The control variables in X_{it} are *size*, *capital*, *TARP*, and *stress*. Robust standard errors are given in parentheses and are clustered at bank level. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively. All variables are defined in Table 2.

	(1)	(2)	(3)	(4)	(5)
bonus	0.088 (0.098)				
LTIP		-0.032 (0.034)			
performance-vesting stock			-0.021 (0.028)		
time-vesting options				0.023 (0.030)	
anti-hedging					-0.168 (0.225)
Observations	2,367	2,367	1,134	1,134	1,708
Adj.R^2	0.78	0.79	0.90	0.89	0.81
Control Variables	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes

Table 11: Average Excess Idiosyncratic Risk

This table presents bank excess risk for four groups, high- and low-*prevega*, and pre- and post-Dodd-Frank, respectively. We estimate bank excess risk $u_{i,t}$ by estimating the equation idiosyncratic $\text{risk}_{it} = \gamma' X_{i,t} + \alpha_i + \delta_t + u_{i,t}$ from 2000 to 2019. X_{it} are *size*, *capital*, *TARP*, and *stress*, α_i indicates dummy variables for each individual bank i, and δ_t indicates year dummies. Each cell shows the average of bank excess risk, normalized by subtracting the average of bank excess risk in the low-*prevega* group in the pre-Dodd-Frank period. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively. All variables are defined in Table 2.

Period	low-*prevega*	high-*prevega*	*t*-statistic for differences in means
Pre-DFA (2000-2009)	0.000%	2.778%	(-2.919)***
Post-DFA (2010-2019)	-1.644%	-1.004%	(-1.032)
t-statistic for differences in means	(1.797)*	(5.619)***	

Table 12:

Panel A: 2SLS Impact of Changes in Compensation Due to Dodd-Frank on Bank Systemic (Tail) Risk

$$tail\ risk_{i,t} = \mu \times \widehat{compensation\ structure}_{i,t} + \gamma' X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}$$

where compensation structure is instrumented by high_$prevega_i * D$F. *high_prevega*$_i$ is a dummy equal to unity if average *vega* of bank *i* from 2000 to 2009 is greater than median value of *vega* from 2000 to 2009, and otherwise equal to 0; *DF* is a dummy variable equal to unity from 2010 onwards; α_i indicates the dummy variables for each individual bank *i*; δ_t indicates year dummies; ϵ_{it} are the error terms; and the model specification follows Djourelova (2023). *tail risk* is the marginal expected shortfall (MES) measure of Acharya, et al (2017). The control variables in X_{it} are *size*, *capital*, *TARP*, and *stress*. Robust standard errors are given in parentheses and are clustered at the bank-level. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively. All variables are defined in Table 2.

	(1)	(2)	(3)	(4)	(5)
bonus	0.831 (0.638)				
LTIP		-0.322* (0.193)			
performance-vesting stock			-0.467** (0.204)		
time-vesting options				0.451** (0.208)	
anti-hedging					-2.324 (1.431)
Observations	2,352	2,352	1,120	1,120	1,694
Adj.R^2	0.63	0.71	0.68	0.53	0.71
Control Variables	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes

Panel B: Average Excess Systemic Risk (Tail Risk)

This table presents bank excess risk for four groups, high- and low-*prevega*, and pre- and post-Dodd-Frank, respectively. We estimate bank excess risk $u_{i,t}$ by estimating the equation tail $\text{risk}_{it} = \gamma' X_{i,t} + \alpha_i + \delta_t + u_{i,t}$ from 2000 to 2019. X_{it} are *size*, *capital*, *TARP*, and *stress*, α_i indicates dummy variables for each individual bank *i*, and δ_t indicates year dummies. Each cell shows the average of bank excess risk, normalized by subtracting the average of bank excess risk in the low-*prevega* group in the pre-Dodd-Frank period. *** denotes statistical significance at the 1% level; ** denotes statistical significance at the 5% level; and * denotes statistical significance at the 10% level, respectively. All variables are defined in Table 2.

Period	low-*prevega*	high-*prevega*	*t*-statistic for differences in means
Pre-DFA (2000-2009)	0.000%	-0.652%	(7.357)***
Post-DFA (2010-2019)	-0.069%	-0.772%	(-13.598)***
t-statistic for differences in means	(0.865)	(1.869)*	

Table 13 (Robustness Test 1): Placebo Results by Partitioning the Pre-DFA Sample into Two Groups Based on Bank Size

	Bonus	*LTIP*	*performance-vesting stock*	*time-vesting options*	*anti-hedging*
	(1)	(2)	(3)	(4)	(5)
Total risk	7.971	-3.008	-5.220	2.288	-60.298
	(7.958)	(2.618)	(9.665)	(2.903)	(69.312)
Idiosyncratic risk	7.033	-2.654	-2.670	1.170	-49.667
	(7.343)	(2.509)	(6.664)	(2.521)	(59.328)
Systemic risk	0.807	-0.290	-0.542	0.383	-5.976
	(0.811)	(0.225)	(0.800)	(0.447)	(6.229)
Tobin's Q	-0.029	0.011	0.121	-0.053	0.358
	(0.102)	(0.039)	(0.369)	(0.126)	(0.714)

Table 14 (Robustness Test 2): Placebo Results by Using the Investor Risk Preferences

		First-Stage	Second-Stage			
Regression	Compensation	Compensation	Total risk	Idiosyncratic risk	Systemic risk	Tobin'Q
(1)	*Bonus*	0.001	-2.302	-3.431	-0.089	-0.060
		(0.002)	(75.230)	(71.091)	(0.298)	(0.698)
(2)	*LTIP*	-0.000	6.621	9.869	0.148	0.174
		(0.007)	(256.957)	(300.072)	(2.713)	(4.279)
(3)	*performance-vesting stock*	-0.012	-7.472	-9.531	-0.001	0.035
		(0.011)	(11.499)	(11.223)	(0.008)	(0.078)
(4)	*time-vesting options*	0.005	16.438	20.966	0.002	-0.077
		(0.013)	(44.050)	(50.758)	(0.017)	(0.243)
(5)	*anti-hedging*	0.000	332.266	641.585	-0.554	-5.393
		(0.001)	(6060.101)	(1.1e+04)	(2.674)	(96.502)

Table 15 (Robustness Test 3):

Panel A: Redefining the Pre-DFA Period as 2000-2007 instead of 2000-2009

		First-Stage	Second-Stage			
Regression	Compensation	Compensation	Total risk	Idiosyncratic risk	Systemic risk	Tobin'Q
(1)	*bonus*	-0.342**	14.643*	14.188*	0.999	0.084
		(0.168)	(8.625)	(8.269)	(0.694)	(0.085)
(2)	*LTIP*	0.800***	-6.254**	-6.059**	-0.409*	-0.036
		(0.306)	(3.023)	(2.952)	(0.211)	(0.033)
(3)	*performance-vesting stock*	1.238***	-4.149**	-3.564*	-0.491**	-0.053*
		(0.426)	(2.076)	(1.824)	(0.205)	(0.032)
(4)	*time-vesting options*	-1.430***	3.591**	3.086**	0.491**	0.046*
		(0.443)	(1.753)	(1.541)	(0.221)	(0.027)
(5)	*anti-hedging*	0.130**	-41.147*	-37.741*	-3.097*	-0.208
		(0.059)	(23.545)	(21.966)	(1.833)	(0.271)

Panel B: Using a Shorter (6-year) Window for both Pre- and Post-Dodd-Frank

		First-stage	Second-stage			
Regression	Compensation	Compensation	Total risk	Idiosyncratic risk	Systemic risk	Tobin'Q
(1)	*Bonus*	-0.324***	13.830*	14.543**	0.548	0.068
		(0.122)	(7.152)	(7.195)	(0.540)	(0.098)
(2)	*LTIP*	0.787**	-5.697*	-5.991*	-0.240	-0.028
		(0.333)	(3.155)	(3.245)	(0.226)	(0.040)
(3)	*performance-vesting stock*	1.249***	-5.428**	-4.773**	-0.606**	-0.022
		(0.466)	(2.339)	(2.103)	(0.278)	(0.035)
(4)	*time-vesting options*	-1.602**	4.231**	3.721**	0.431**	0.017
		(0.633)	(2.006)	(1.773)	(0.197)	(0.028)
(5)	*anti-hedging*	0.157***	-28.945*	-27.568*	-2.105	-0.168
		(0.051)	(15.337)	(14.628)	(1.408)	(0.228)

Table 16 (Robustness Test 4): Using Sample Mean Volatility Rather than Individual Bank Volatility in Defining *prevega*

		First-stage	Second-stage			
Regression	Compensation	Compensation	Total risk	Idiosyncratic risk	Systemic risk	Tobin'Q
(1)	*bonus*	-0.315*	13.139	13.208	0.920	0.094
		(0.162)	(8.429)	(8.253)	(0.693)	(0.105)
(2)	*LTIP*	0.864***	-4.785**	-4.810**	-0.355*	-0.034
		(0.296)	(2.398)	(2.367)	(0.201)	(0.035)
(3)	*performance-vesting stock*	1.313***	-3.861**	-3.582**	-0.452**	-0.021
		(0.382)	(1.693)	(1.516)	(0.193)	(0.029)
(4)	*time-vesting options*	-1.368***	3.706**	3.438**	0.395**	0.020
		(0.426)	(1.762)	(1.565)	(0.178)	(0.028)
(5)	*anti-hedging*	0.159***	-29.192*	-27.903*	-2.567*	-0.180
		(0.058)	(15.915)	(15.223)	(1.519)	(0.237)

Table 17 (Robustness Test 5): Using *predelta* Rather Than *prevega* to Classify Banks Before Dodd-Frank

	Bonus	*LTIP*	*performance-vesting stock*	*time-vesting options*	*anti-hedging*
	(1)	(2)	(3)	(4)	(5)
Total risk	16.941	-4.433*	-3.697	3.792	-28.061
	(13.366)	(2.414)	(2.729)	(3.396)	(18.434)
Idiosyncratic risk	17.084	-4.471*	-3.525	3.616	-26.284
	(13.054)	(2.348)	(2.557)	(3.181)	(17.176)
Systemic risk	0.977	-0.272	-0.244	0.215	-2.460
	(0.983)	(0.199)	(0.194)	(0.189)	(1.837)
Tobin's Q	0.157	-0.041	-0.019	0.019	-0.239
	(0.169)	(0.037)	(0.028)	(0.029)	(0.280)

Table 18 (Robustness Test 6): Placebo Test Using Bank Performance in 1998 Russia Crisis as the Treatment

		First-stage	Second-stage			
Regression	compensation	Compensation	Total risk	Idiosyncratic risk	Systemic risk	Tobin'Q
(1)	*bonus*	0.087	0.181	-2.377	0.321	0.251
		(0.210)	(18.330)	(18.295)	(1.982)	(0.575)
(2)	*LTIP*	0.250	0.063	-0.826	0.112	0.087
		(0.385)	(6.374)	(6.185)	(0.665)	(0.135)
(3)	*performance-vesting stock*	0.581	1.031	1.362	0.123	0.045
		(0.697)	(3.471)	(3.273)	(0.357)	(0.056)
(4)	*time-vesting options*	-0.485	-1.235	-1.631	-0.148	-0.054
		(0.799)	(4.335)	(4.249)	(0.452)	(0.091)
(5)	*anti-hedging*	-0.010	62.219	101.716	-2.896	-1.141
		(0.067)	(441.145)	(656.245)	(25.436)	(6.775)