# Causal Impact of Risk Oversight Functions on Bank Risk: Evidence from the Dodd-Frank Act

Lakshmi Balasubramanyan[a]
Naveen D. Daniel[b]
Joseph G Haubrich[c]
Lalitha Naveen[d]

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## Abstract

We document the causal impact of having a risk committee (RC) and a chief risk officer (CRO) on bank risk using the passage of the Dodd Frank Act as a natural experiment. The Act requires bank holding companies with over $10B of assets to have an RC to oversee risk management, while those with over $50B of assets are additionally required to have a CRO. We use difference-in-difference and regression discontinuity approaches to estimate the change in risk following RC and CRO adoption. Overall, we find no evidence that the RC or CRO have a causal impact on bank risk.

*Keywords:* Bank Holding Companies, Risk, Chief Risk Officer, Risk Committee, Dodd Frank Act, Bank Risk

[a]*Weatherhead School of Management, Case Western Reserve University, Cleveland, OH 44106, USA; lxb249@case.edu*
[b]*LeBow College of Business, Drexel University, Philadelphia, PA 19104, USA; nav@drexel.edu*
[c]*The Federal Reserve Bank of Cleveland, Cleveland, OH 44101,USA; joseph.g.haubrich@clev.frb.org*
[d]*Fox School of Business, Temple University, Philadelphia, PA 19122, USA; lnaveen@temple.edu*

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Lakshmi Balasubramanyan

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Naveen Daniel

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Joseph Haubrich

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Lalitha Naveen

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**Causal Impact of Risk Oversight Functions on Bank Risk:**
**Evidence from a Natural Experiment**

Does the presence of a board-level risk committee (RC) and a chief risk officer (CRO) improve bank risk management? We address this question using the passage of the Dodd-Frank Wall Street Reform and Consumer Protection Act (DFA, hereafter) that required banks, based on their size, to adopt an RC and a CRO. We take advantage of this legislative change to assess the causal impact of the RC and CRO on bank risk using difference-in-difference and regression discontinuity methodologies. Our main takeaway is that the presence of an RC or CRO has no causal impact on bank risk.

The DFA regulation was signed into law in July 2010 with the purpose of promoting financial stability in the US banking sector. Two aspects of the DFA are relevant to our study. All publicly traded bank holding companies (hereafter, simply banks) with at least $10 billion of consolidated assets are required to have a risk committee consisting of members from the board of directors[1]. Additionally, those with at least $50 billion in assets are required to designate an executive specifically as chief risk officer. The stated purpose of these two institutions—RC and CRO—is to oversee the risk management function at the board level and the management level. The key requirements of the RC are that: (i) it should be a stand-alone risk committee; (ii) its chair should be an independent director; (iii) it should meet at least once a quarter; (iv) all of its members should understand risk management; and (v) it should have at least one expert with experience in risk management. For the CRO, the requirements are that: (i) the technical expertise of the CRO should include experience in evaluating the bank's risk profile, and (ii) the CRO should report

[1] The Economic Growth, Regulatory Relief, and Consumer Protection Act passed in May 2018 raised the mandatory threshold for risk committees to $50 billion.

directly to the CEO and the RC. The CRO provides all the reports necessary for the RC to oversee the risk management policies of the bank.

It is possible that the RC and CRO have no real impact on risk for two reasons. First, banks might comply with the DFA but treat the regulatory requirements for RC and CRO as nothing more than a nuisance. This possibility is similar to the argument in Ellul and Yerramilli (2013), in which the authors hypothesize that the risk management function may have no impact because "banks appoint risk managers, without giving them any real powers, merely to satisfy bank supervisors." Second, even if banks take these mandates seriously, the risk committee members and the CRO may not be qualified enough to catch serious problems.

Alternatively, it is possible that, by putting the spotlight on risk, the DFA forced banks to take a closer look at risk. The word "risk" is mentioned, on average, 170 times in banks' 10K statement in 2005. This number nearly doubled to 322 in 2015 (see Figure 1). The increased focus on risk could mean that some banks might realize that they were taking on more risk than was optimal and they might have scaled it back.

Finally, it is possible that some banks will realize that they were not taking enough risks and, given the increased confidence that they have because of the oversight of the RC and CRO, they might actually have increased their risk following the passage of the law.

The aggregate impact could be a mix of these cases. The overall effect of the RC and CRO on risk, therefore, is an empirical issue.

As noted above, the DFA required all publicly traded banks with assets ≥ $50 billion to install an RC and designate an executive as CRO while banks with assets ≥ $10 billion (but less than $50 billion) were only required to install an RC. The deadline for compliance with the law for firms with assets ≥ $50 billion was January 1, 2015, while banks with assets ≥ $10 billion (but

less than $50 billion) had to comply by July 1, 2015. The relevant asset size was that as of June 30, 2014.

To identify the causal impact of the CRO and RC, we start by employing a difference-in-difference methodology (hereafter "diff-in-diff"). We modify the diff-in-diff research design to allow for the fact that (i) banks were given almost 5 years to comply with the law after its passage, (ii) some banks that were affected by the law were compliant even before the law was passed, (iii) some banks not affected by the law were compliant before the law was passed and, (iv) some banks became compliant after the law was passed.

Thus, our treated sample consists of only those banks that were shocked by the law to adopt risk oversight functions, rather than those that were simply affected by the law because they were above the size threshold. That is, the treated firms are those that were subject to the law but were not compliant as of the signing of the law ("treated" firms). It is reasonable to assume that the treated firms forced to comply did so only because of the law and would not have an RC and a CRO had it not been for the law. Of course, it is possible that even without the law, other trends in the industry might have induced these banks to add an RC or a CRO.

To account for banks being given 5 years to comply with the law, we exclude the years between the passage of the law and banks' compliance with the law. For example, for a treated bank that installed an RC only in 2012, we exclude the year 2011 from the analysis. Thus, for this hypothetical treated bank, the years 2010 and earlier constitute the pretreatment period and the years 2013 and onwards constitute the post-treatment period.

As far as the control sample is considered, there are several different ways to form the control group; each has its pros and cons. The ideal control group would be one that is similar in characteristics to the treated group but is not shocked by the law. Thus, our baseline control group

is the set of banks that were subject to the law but were already compliant as of the passage of DFA as of June 2010. One advantage of this control group is that banks could have changed their risk, not directly in response to the addition of the RC or CRO, but in response to other regulations contained in the DFA (such as the Volcker rule provisions or the DFA stress tests, for example[2]). As long as the degree of compliance with respect to these additional regulations was distributed equally across our treatment and control groups, changes in risk due to these other regulations are netted out using our diff-in-diff analysis, and we are able to isolate changes in risk due to the RC and CRO. Of course, it remains a possibility that these changes are swamped by the effect of other aspects of the DFA and regulatory changes. In this sense, our experiment is similar to studies of how firm performance changed because of changes in board independence mandated by the Sarbanes Oxley Act. There too, Sarbanes Oxley had several other requirements in addition to changes in board independence (such as certification requirement by the CEO and CFO, changes in audit committee independence, nominating committee independence etc.). The studies that used SOX as an exogenous shock to board independence focused on firms that were compliant in terms of the board independence versus firms that were not, a research design very similar in spirit to what we adopt here.

We use several alternative control groups, which we discuss in Section I. For the firms in the control group, the years 2010 and earlier constitute the pre-period and the years 2011 and onward constitute the post-period.

A second innovation in research design we employ is the regression-discontinuity approach, which exploits precise knowledge of the rules determining treatment to move closer to the experimental ideal. This tackles the potential endogeneity of the intervention itself, which in

[2] For a summary of regulations based on size thresholds in DFA, see Labonte and Perkins, (2017).

our case is the passage of the DFA and its size thresholds (Imbens and Lemieux, 2008). The idea behind regression discontinuity is that banks that are just below the threshold ($10 billion for the RC and $50 billion for the CRO) are similar to those that are just above the threshold. However, those above the threshold are subject to regulations regarding the RC and CRO while those below are not. Thus, this analysis limits our sample to firm-years after the passage of the law, that is, from 2011 onward.

As with the diff-in-diff, we modify the regression discontinuity design to account for the lag between the passage of the law and its implementation. Our treated sample of firms is exactly the same as with the diff-in-diff. That is, these are firms that were subject to the law but were not compliant as of the signing of the law. As with the diff-in-diff, we exclude the years between the passage of the law and the banks' compliance with the law. The control firms are those that were below the asset threshold and were not compliant. (In a typical regression discontinuity design, we would include all firms under the threshold because none of these firms would be compliant with the law). We also exclude the years for these control firms once they choose to voluntarily comply with the law. To study the impact of the RC, we pick a bandwidth of $7 billion because the tier of banks that the Federal Reserve monitors starts at $3 billion. Thus, to be included in our regression discontinuity sample, firms must have assets between $3 billion and $17 billion. To study the impact of the CRO, we pick a bandwidth of $30 billion, so firms must have assets between $20 billion and $80 billion to be included in our sample.

We use data on bank holding companies and financial holding companies from 2005 to 2015. We consider all years for a given bank as long as its assets are greater than $3 billion in any of the 11 years of our sample period. Our main proxy for bank risk is *Aggregate Risk*, which is

the standard deviation of daily returns. We also use three other proxies for risk: tail risk (as in Ellul and Yeramilli, 2013), the expected default frequency, and a measure of derivative usage.

Using the diff-in-diff approach, we find that that the presence of an RC has no causal impact on risk. There is weak evidence that the CRO has an impact, but contrary to the spirit of the legislation, the CRO leads to an increase in risk. With the regression discontinuity approach, we find no evidence of either the RC or CRO affecting risk.

Overall, we conclude that the presence of a risk committee and chief risk officer has no significant causal impact on risk. Our results contribute to two broad areas of the corporate finance and banking literatures, specifically the impact of corporate governance and the determinants of bank risk-taking.

Our paper is closest to Ellul and Yerramilli (2013), who find that a "strong and independent risk management function can curtail risk exposures at banks." Our paper differs from theirs, however, in two important ways. First, while Ellul and Yerramilli examine the impact of the *strength* of the risk management function, *broadly defined*, on risk, we examine the specific impact of the presence of an RC and a CRO on risk. Ellul and Yerramilli construct a risk management index (RMI) for each firm-year observation, which is the first principal component of six variables formed based on RC and CRO characteristics. Their definitions of RC and CRO, however, are much broader than the strict definition of the DFA. For example, they assume that the bank has a CRO if the bank has a chief lending officer, chief compliance officer, or a chief credit officer with enterprise-wide responsibility. Because of this broad definition, 100% of the firms in Ellul and Yerramilli's sample had a CRO by 2008 even though the DFA was passed only in 2010 and banks were given until 2015 to comply with the regulation. Similarly, the authors characterize the strength of the board committee designated with overseeing risk in terms of directors' financial

expertise and the frequency of board meetings. This committee could be the risk management committee or the audit and risk management committee. Thus, as per their broad definition, all firms have an RC in every year of their sample (1994–2009) even though the DFA was passed only in 2010.

The second key difference is that the authors examine the 15-year period ending in 2009 while the law was passed only in 2010. Thus, our research design (difference-in-difference and regression discontinuity) provides a cleaner test of causation. Ellul and Yerramilli address the endogeneity of the RMI using the average change in the RMI of peer firms as the instrument in a two-stage least squares setting. They also consider a dynamic GMM by including lagged values of risk to control for the possibility that the bank's prior risk somehow determines both the current RMI and current risk.

The main takeaway of Ellul and Yerramilli (2013) is that a better risk management function, broadly defined, lowers risk. Our paper finds that the presence of an RC and a CRO, specifically defined under DFA, has no impact on risk. Thus our findings complement theirs and suggest that other aspects of risk management may be more important than having an RC or a CRO.[3]

## I. Data

We start with the set of firms in the Federal Reserve National Information Center (NIC) database with the following entity types: BHC (bank holding companies), FHD (financial holding company/BHC), and DEO (domestic entity other). We limit ourselves to publicly traded

[3] A few papers have looked at the impact of a CRO and RC on returns and risk with mixed results (Aebi, Sabato, and Schmid, 2012; Pernell, Jung, and Dobbin, 2017a, 2017b; and Hines and Peters, 2015). None of these papers focus on causation.

institutions because we need stock returns to estimate risk. We obtain data from 2005 (5 years before the DFA was passed) to 2015. We also limit the sample to firms whose book value of assets is greater than or equal to $3 billion in any of our sample years. That is, even if a bank grows in size to cross the $3 billion threshold in, say, 2008, we include all the years of this bank from 2005 to 2015. We choose the $3 billion threshold so as to limit our sample size and thus ensure that hand collecting data from proxy statements is not too onerous. The starting sample is 114 banks. We drop Santander Holdings USA because our focus is on domestic banking organizations. CIT Group and Goldman Sachs Incorporated are in the sample, as they were listed as DEO from 2005 to 2008 before acquiring FHD and BHC status, respectively. We drop all firm-years of firms that failed or were acquired. Our final sample consists of 94 banks and 980 bank-years.

We obtain financial information on the banks from the FR Y-9C reports filed with the Federal Reserve System. The FR Y-9C provides a detailed breakdown of the BHC portfolio, security holdings, regulatory risk capital, and derivative usage information. The financial information is presented on a calendar-year basis.

### *A. RC and CRO*

The information on RC, CRO, and other relevant data were collected by hand from the 10-K and proxy statements filed by the banks with the SEC. As mentioned in the introduction, the key requirements of the RC are that: (i) it should be a stand-alone risk committee; (ii) its chair should be an independent director; (iii) it should meet at least once a quarter; (iv) all of its members should understand risk management; and (v) it should have at least one expert with experience in risk management. Several papers (e.g., Güner, Malmendier, and Tate, 2008, Minton, Taillard, and

Williamson, 2014) argue that the financial experience of directors matters for bank risk-taking, so we feel it is important to make a distinction between RC presence and compliance. We collect the names of the RC members, the experience and independence of the members of the RC, the details about the chair of the RC, and the frequency of the RC meetings. We collect the experience of risk committee members using the biographical information supplied by the company. While it is possible to code the first three requirements of the RC objectively, we found it impossible to objectively decide whether all of its members understand risk management and whether it has at least one expert in risk management. Thus, we form two indicator variables:

*RC Present* = 1 if the firm has an RC
= 0 if the firm has no RC

*RC Compliant* = 1 if the firm has an RC that meets the first 3 requirements
= 0 if the firm has no RC or the RC does not meet the first 3 requirements

We also collect data on the presence of a chief risk officer (CRO) and the position of the CRO in the executive hierarchy.

For the purposes of this paper, a bank is considered to have a CRO if there is an executive whose title contains the word "risk." Examples includes "chief risk officer," "executive risk management officer," and "chief credit risk officer." Officers whose positions may include some risk management, but whose focus is not sufficiently risk-oriented to warrant such a title (e.g., "chief credit officer," "chief compliance officer," etc.) are not considered CROs and thus are not coded as such.

For a CRO to be compliant with the DFA, the requirements are that: (i) the technical expertise of the CRO should include experience in evaluating the bank's risk profile, and (ii) the CRO should report directly to the CEO and the RC. Again, it is impossible to figure out from the

biographical information whether the CRO has the technical experience to evaluate the bank's risk profile and whether the CRO reports directly to the CEO and RC. Thus, we only have one indicator variable:

*CRO Present* = 1 if the firm has a CRO
= 0 if the firm has no CRO

That is, we do not have *CRO Compliant* dummy. Figure 2 plots the time series of the risk-oversight measure for firms above and below the size thresholds requiring compliance. As expected, all three measures increase over time.

### *B. Risk Measures*

We use two main proxies for bank risk: *Aggregate Risk* and *Tail Risk*. Ellul and Yeramilli (2013) use *Tail Risk* as the main proxy. Their logic for this is as follows: "As banks are in the business of taking risks, the main purpose of the risk management function is to mitigate the risk of large losses, that is, to mitigate tail risk. Accordingly, our main risk measure of interest is *Tail Risk*." Kashyap, Rajan, and Stein (2008) and Acharya et al. (2010) argue that tail risk is a significant measure of risk for financial institutions. As in their paper, we define *Tail Risk* as the negative of the mean return on the 5% worst-return days in the year.

It is likely that tail risk does not capture all of the risks that firms care about. For example, in JP Morgan's 2014 Annual Report, the firm provides a table of the various risks that are inherent in the firm's business and they are: principal risk, credit risk, capital risk, market risk, liquidity risk, structural interest rate risk, model risk, legal risk, country risk, compliance risk, operational risk, fiduciary risk, and reputational risk. While some of these risks are systematic in nature (example: interest rate risk), some are idiosyncratic (example: compliance risk), while others could

be considered a mix between the two (example: credit risk). Thus, our main proxy for risk is *Aggregate Risk*, which is given by the (annual) volatility of daily returns.

### *C. Control Variables*

We follow Ellul and Yeramilli (2013) for the control variables. We include return on assets, the buy-and-hold return on the BHC's stock over the calendar year, the ratio of deposits to assets, the ratio of short-term borrowing to assets, the ratio of tier-1 capital to assets, the ratio of loans to assets, the ratio of bad loans to assets, the ratio of noninterest income to total income, the ratio of derivative trading to assets, and the ratio of derivatives hedging to assets (as in Purnanandam, 2007). We provide all variable definitions in Table 1. We also include an indicator variable for whether the bank had a large M&A and an indicator variable for CEO turnover. Finally, we include the CEO incentive measures *CEO Delta* and *CEO Vega*. These variables are constructed as in Core and Guay (2002) and Guay (1999). Coles, Daniel, and Naveen (2006) examine the effect of incentives on firm risk for a broad sample of firms, while Fahlenbrach and Stulz (2011) examine the effect of bank CEO incentives on bank performance during the financial crisis. We also include the Gompers, Ishii, and Metrick (2003) governance index as well as the percentage ownership by institutions. We winsorize all our variables at the 1$^{st}$ and 99$^{th}$ percentile levels. All functional transformations (example: logs) are made on the winsorized variables. Table 1 reports the summary statistics for the risk measures, governance measures, and firm controls.

As a preliminary description of the data before seeking to identify causal impact, Table 2 reports the results of the OLS regression on *Aggregate Risk* against the three measures of risk oversight (*RC Present*, *RC Compliant*, and *CRO Present*). Both with and without firm fixed effects, only the *CRO Present* variable is significant among the risk oversight factors. Overall the fit is reasonable, with an $R^2$ of 84 percent.

## II. Causal Impact of the RC and CRO on Risk

We use two methods—difference-in-difference and regression discontinuity—to estimate the causal impact of an RC and a CRO on bank risk.

We first describe how we form the treatment group and the control group. The law was passed on July 21, 2010, and the final regulation was issued on March 27, 2014. It required firms whose asset size, as of June 30, 2014, was above $10 billion to comply with the RC requirements by July 1, 2015[4]. The table below provides the breakdown of the 94 firms in our sample based on asset size.[5]

| | | Assets ≥ $10B as of 2014:Q2 | | |
|---|---|---|---|---|
| | | Yes | No | Total |
| Assets ≥ $10B as of 2010:Q2 | Yes | 52 | 1 | 53 |
| | No | 8 | 33 | 41 |
| | Total | 60 | 34 | 94 |

Of the 60 firms that had assets ≥ $10B as of 2014:Q2, 8 firms had assets < $10B as of the signing of the law. Thus, it is unlikely these 8 firms had plans to comply with the law at the time (unless they had a strategic plan that showed that they would cross the $10B threshold before 2014:Q2. Thus, for our base case, only 52 firms form the sample group. Of the 52 firms, only 14 were noncompliant as of the signing of the law, and these firms constitute the treatment group. The remaining 38 firms with an RC already in place when the law was passed serve as our control

[4] *Federal Register*, 79 (59): 17317, subpart C sec 252.21(c), March 27, 2014.

[5] While the sample size looks relatively small, recall that we start with the full sample of publicly-listed BHCs

group.[6]

For the CRO requirement, the relevant size threshold was $50 billion[7]. The table below provides the breakdown of the 94 firms in our sample based on the $50 billion threshold.

| | | Assets ≥ $50B as of 2014 Q2 | | |
|---|---|---|---|---|
| | | Yes | No | Total |
| Assets ≥ $50B as of 2010 Q2 | Yes | 23 | 1 | 24 |
| | No | 0 | 70 | 70 |
| | Total | 23 | 71 | 94 |

Our base-case sample for the CRO analysis consists of the 23 firms that had the relevant asset size at the date of signing of the law and as of the date the law became effective. Of these, 19 firms already had a CRO; this is our control group. The remaining 4 firms, which did not have a CRO, are the treatment group.

Figure 3 provides a graphical representation of the taxonomy we used to define the treatment and control groups.

*A. Difference-in-Difference*

We use the standard research design for the diff-in-diff specification.

$$Risk = \beta_0 + \beta_1\, Treated \text{ dummy} + \beta_2\, After \text{ dummy} + \beta_3\, Treated \text{ dummy} \times After \text{ dummy} + Controls + Firm\ FE + \varepsilon$$

We define the *Treated* dummy and the *After* dummy as described earlier. Specifically,

*Treated* dummy = 1 if assets ≥ $10 billion and firm is not compliant
= 0 otherwise

[6] For robustness, we include the 8 firms who had to comply with the law by 2015 but were not affected by the law at the time it was passed. 4 of these firms already had an RC in place. Our results remain unaltered. This also suggests that the possible endogeneity of bank size is not a major issue.

[7] Unlike the RC requirement, the CRO requirement, although part of the Basel principles (BCBS 2010), was not explicitly specified in the Dodd-Frank Act. It was proposed as one of the set of rules implementing the enhanced prudential standards mandated in section 165 of the DFA by the Board of Governors on December 11, 2011, and finalized on March 27, 2014, effective January 1, 2015.

*After* dummy = 1 if year > 2010
= 0 otherwise

The key variable of interest is the interaction term, which captures the change in risk of the treated group relative to the change in risk of the control group. The coefficient on the interaction term (=$\beta_3$) could be negative, zero, or positive as per our hypotheses, but if the point of the law was to reduce risk, and if the law was effective in reducing the risk, then the $\beta_3$ should be negative. A negative coefficient implies that the RC or CRO, on average, caused a reduction in risk.

Table 3 reports the univariate DID results for aggregate risk. Panels A–C show the results for *RC Present*, *RC Compliant*, and *CRO Present*, respectively. In all cases, we see that passage of the DFA reduced aggregate risk for both treated and control firms. The change in risk (after minus before) is always negative and economically large, about the order of magnitude of one standard deviation of aggregate risk. The difference-in-differences is much smaller, however, and insignificant. In fact, the risk of the control group drops by more than that of the treated group, indicating that banks with an RC or CRO already in place reduced risk more than those forced to comply with the law.

Table 4 presents the multivariate regression results. Consistent with the univariate results, the *After* dummy is negative and significant, but the crucial parameter for causality, *Treated x After* is small and insignificant for both RC cases. Risk oversight appears to be significant only for the *CRO Present* case. The coefficient on the interaction term in Column 3 = 0.004, and this is significant at the 1% level. The coefficient is economically significant as well, and represents a 23% increase in risk relative to the median of 0.017. Perhaps disconcertingly, this coefficient is positive, suggesting that if anything, the appointment of a CRO subsequently *increased* risk at the treated firms.

A key part of the diff-in-diff identification is the assumption that without the intervention the two groups would show similar changes over time ("parallel trends" assumption). Figure 4 plots the mean level of aggregate risk for the control and treatment groups—which show little difference before the financial crisis but definitely show larger increases in risk during the crisis for firms that already had an RC or CRO (the control group).

*B. Regression Discontinuity*

The implementation of the DFA allows an additional means of identification, as it created strict cut-offs based on total assets for which firms were subject to the risk oversight rules. We use the standard research design for the regression discontinuity specification.

$$Risk = \lambda_0 + \lambda_1\, Above\ Threshold \text{ dummy} + \lambda_2\, Size + Controls + Firm\ FE + \varsigma$$

where *RC Treatment* dummy = 1 if \$10 billion ≤ assets ≤ \$17 billion
= 0 if \$3 billion ≤ assets < \$10 billion

*CRO Treatment* dummy = 1 if \$50 billion ≤ assets ≤ \$70 billion
= 0 if \$30 billion ≤ assets < \$50 billion

We choose a \$3 billion as the cutoff at the lower end because, in the Fed database of banks, the next-tier below the \$10 billion threshold starts at \$3 billion. To keep the bandwidth the same across the threshold, we choose \$17 billion as the upper end. Unfortunately, there were few usable observations around the \$50 billion threshold for chief risk officer, with only two banks between \$30 billion and \$50 billion and 1 between \$50 billion and \$70 billion meeting the criteria, so we limit the discussion to the RC case.

Figure 5 plots the mean of *Aggregate Risk* around the threshold of \$10 billion. Although means can be deceptive, there does not appear to be a sharp discontinuity at that level. Table 5 reports the regression discontinuity results where the dependent variable is *Aggregate Risk*. The

key variable of interest is the *Above Threshold* indicator variable, the coefficient on which ($=\lambda_1$) captures the difference in risk between the treated and control groups. If $\lambda_1$ is negative, it implies that the RC caused a reduction in risk. Consistent with figure 5, the regression discontinuity results show no significant impact of *Above Threshold* on *Aggregate Risk*, although the coefficients do have a negative sign. One reason for the lack of significance could be lack of power due to the small number of observations.

A central concern with regression discontinuity designs is the possibility that nonlinearity is mistaken for discontinuity. Although the pattern in Figure 5 suggests that is not an issue, Table 5 reports specifications including a squared size term ($Size^2$) and the corresponding interaction terms (=*Above Threshold* × *Size* and *Above Threshold* × $Size^2$). We find that only the coefficients on *Size* and $Size^2$ are significant.

## III. Robustness

This section discusses the validity of the diff-in-diff results. The primary concerns are (i) the degree to which the results depend on the particular choice of risk, and (ii) possible confounding effects from the market turmoil in 2008–2009. We address the first by using three additional measures of risk: *Tail Risk*; the expected default frequency over the next year, *EDF*; and a measure of derivative usage, *Deriv. Trading/Asset.* Ellul and Yerramilli (2013) use *Tail Risk* in their analysis. As in their paper, we define this as the negative of the mean return on the 5% worst-return days in the year. The EDF measure–which corresponds to the variable *EDF1* in Moody's KMV (now Moody's Analytics CreditEdge®)–takes a forward-looking approach to risk, and the derivative ratio aims to capture a direct portfolio shift toward increasing risk (as in Pernell, Jung, and Dobbins 2017a,b).

Table 6 presents the results. In the first panel, we report the results with *Tail Risk* as the measure of risk-taking. The second panel of Table 6 reports the results with *EDF* as the measure of risk-taking. The third panel reports the results using *Deriv. Trading/Asset* as the measure of risk-taking. The inferences are very similar when we use *Tail Risk* rather than *Aggregate Risk*. As before, we find that risk is lower after the DFA. The coefficient on the *After* variable is negative and statistically significant for all three risk-oversight measures that we consider. Importantly, the coefficient on the interaction term, *Treated* × *After*, is small and insignificant for both *RC* variables. The coefficient is larger and statistically significant for *CRO Present*, but once again is of the opposite sign than might be expected from the intent of the law.

The EDF and derivative measures show a few variations, however. There are mixed results on the overall impact of the DFA, with only *RC Present* showing a decrease, and none of the coefficients being significant. The coefficient on the interaction term, *Treated* × *After* is insignificant in most of the EDF and derivative cases but is significant for the EDF measures in the case of *RC Compliant*. The coefficient on *CRO Present* remained positive, suggesting an increase in risk, but this is not significant in either case. Internet Appendix Tables A1-A6 present the results of OLS specifications and regression discontinuity specifications using the three alternative measures of risk.

To address the second concern—that our results are somehow driven by the financial crisis—we exclude the crisis years 2008 and 2009 from the sample and re-estimate the results. Table 7 reports the results. For aggregate risk, we find that the coefficient on the *After* variable is negative in all three risk-oversight measures, but it is statistically significant for only the two *RC* variables. This suggests that some of the risk reduction associated with the *After* variable was possibly because the risk went up during the crisis years and then came down. We find that the

coefficient on the interaction term *Treated* × *After is* not significant for any of the risk-oversight measures. For EDF, the *After* variable is positive, but insignificant. The coefficient on the *Treated* × *After* is negative in all three specifications, but statistically significant only in one specification (for *RC Present*). For derivative risk, as before, the coefficient on *After* is positive and marginally significant in one case. The coefficient on *Treated* × *After* is positive and insignificant. The appendix reports the results of using EDF and the derivative measure in the regression discontinuity design, where neither risk-oversight measure was significant in any of the specifications. In general, the results in Table 7 confirm our earlier finding that the adoption of the RC or CRO mandated by the law had no effect on risk for banking institutions.

Finally, in Table 8, we use the number of times the word "risk" is mentioned in proxy statements as our measure of risk. It is clear from Figure 1 that firms significantly increased—almost doubled—the use of the word "risk" in their proxy statements since the crisis period. This discussion could just be window dressing, where banks tried to convince shareholders that the banks' risk-taking was well supervised, or it could actually reflect the importance placed by the bank on its risk oversight. To examine this, we use the number of times the word "risk" is mentioned as a measure of risk-taking instead of *Aggregate Risk* or *Tail Risk*. Table 8 presents the univariate analysis of diff-in-diff. Panels A, B, and C present the results for *RC Present*, *RC Compliant*, and *CRO Present*. In all three cases, we find no significant effect of the regulation on the mention of risk.

Overall, the results in this section support our main conclusion that the adoption of the RC or CRO mandated by the Dodd-Frank Act had no subsequent impact on bank risk.

## IV. Conclusions

Regulations pursuant to the Dodd-Frank Act mandated that bank holding companies with assets over $10 billion have a board risk committee and those with assets over $50 billion have a chief risk officer in place by January 1, 2015. We exploit this regulation and use difference-in-difference and regression discontinuity techniques to assess the causal impact of risk committee and chief risk officer on bank risk.

While we cannot speak to the issue of whether a bank holding company that freely chooses a risk committee becomes safer, our results strongly indicate that forcing such a committee on a BHC through regulatory intervention does not make the firm less risky. This conclusion is robust across several specifications and identification techniques. Only the EDF measure shows a significant impact on risk, and that disappears when the years between 2008 and 2009 are dropped, and it disappears again in the regression discontinuity design. The impact of the chief risk officer mandated by the Dodd-Frank Act is more ambiguous. The results from the difference-in-difference specification suggest that the appointment of a CRO pursuant to the Dodd-Frank Act resulted in an economically and statistically significant increase in aggregate and tail risk, but not in expected default frequency or derivative usage.

One possible explanation is that the RC and CRO requirements did have an impact, forcing firms to monitor risk more closely, but that in optimizing their risk profiles, some firms chose more risk, and others chose less, so that there was no monotonic relationship between increased risk focus and aggregate risk. The identification may be further confounded by similar disparate reactions to other regulatory changes. A different explanation is that firms simply implemented a committee or an officer without giving them any power, though the increases in aggregate and tail risk with the appointment of a CRO argue against this. Neither explanation says much for the

effectiveness of mandating a risk committee or a chief risk officer in reducing overall bank risk. Taken together, our results suggest that these aspects of the regulation (Dodd-Frank Act), had little direct impact on reducing bank risk.

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**Figure 1**
**Frequency of the Word "Risk" in Proxies**

The figure plots the mean and median number of times the word "risk" is mentioned in the proxy statements.

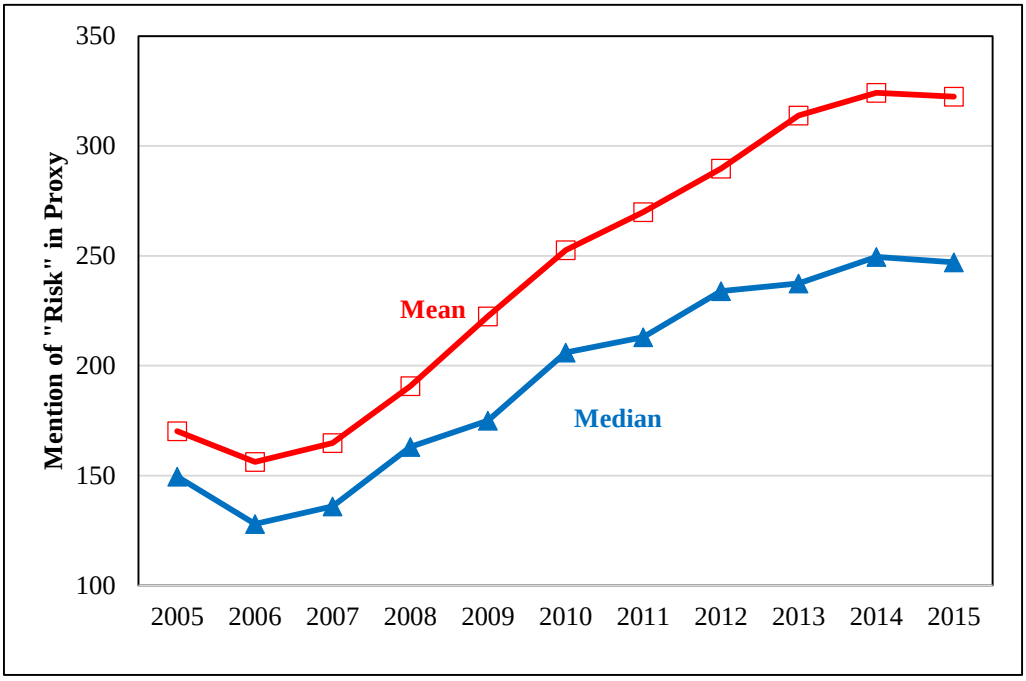
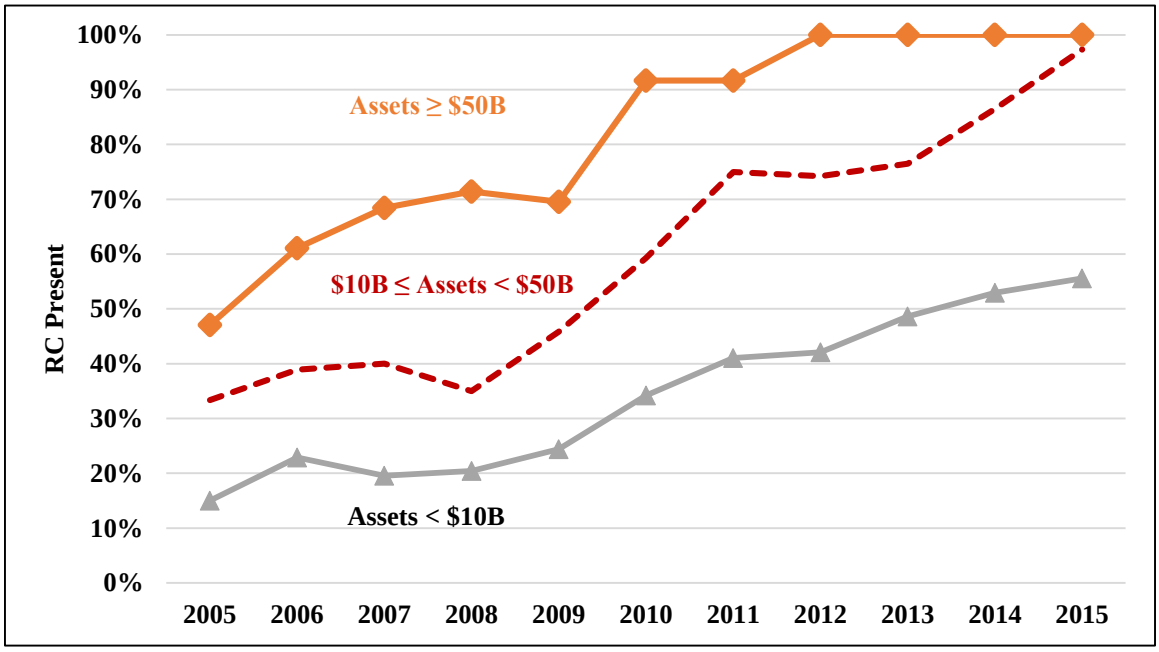


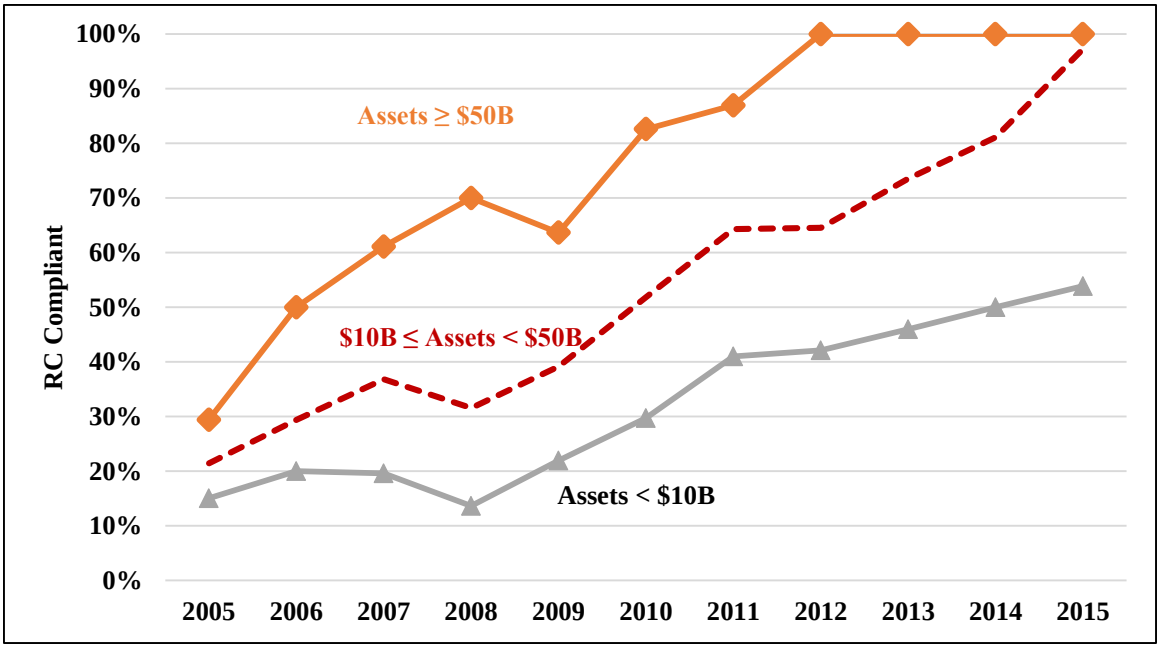
**Figure 2**
**RC and CRO Time Series**

The figures plot the mean of three indicator variables: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise; (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise.

**Panel A: *RC Present***



**Panel B: *RC Compliant***




**Panel C: *CRO Present***

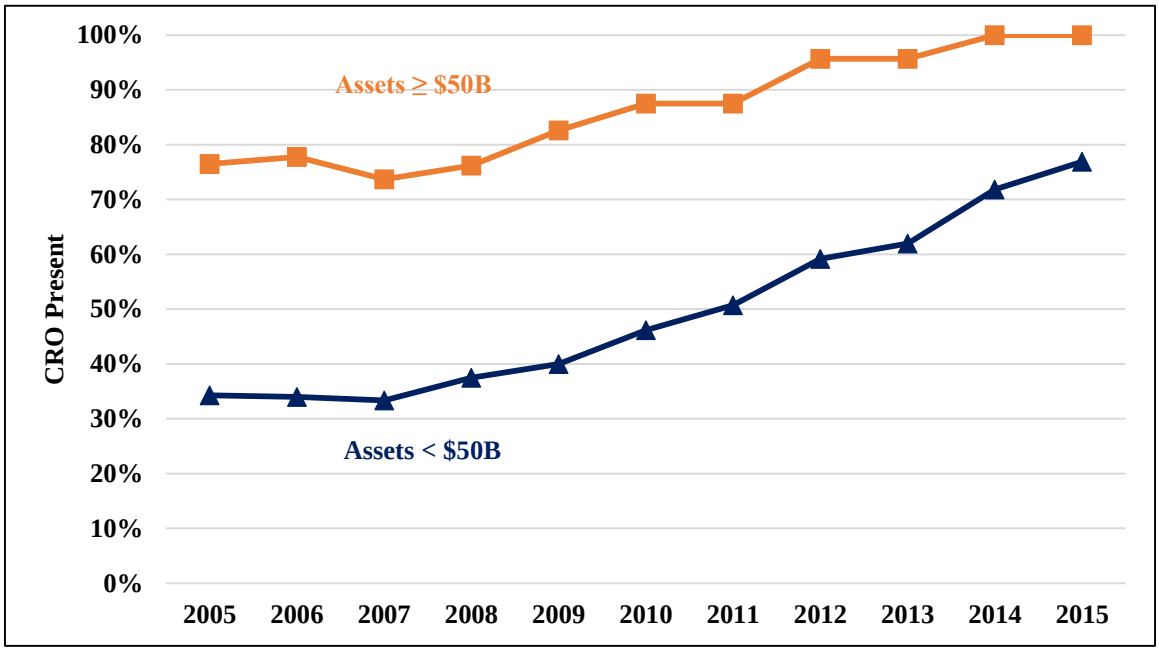


**Figure 3**
**DID: Treated and Control Groups**
The figure illustrates the treated group and the various possible control groups.

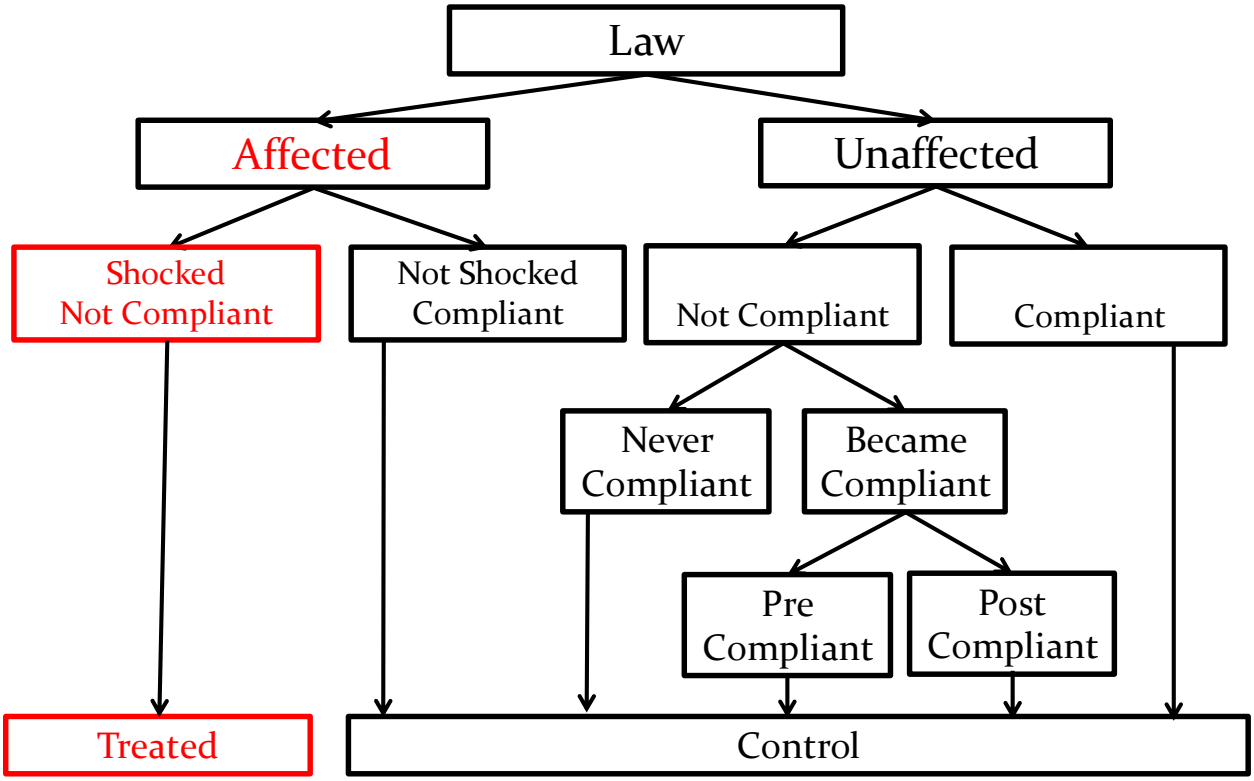
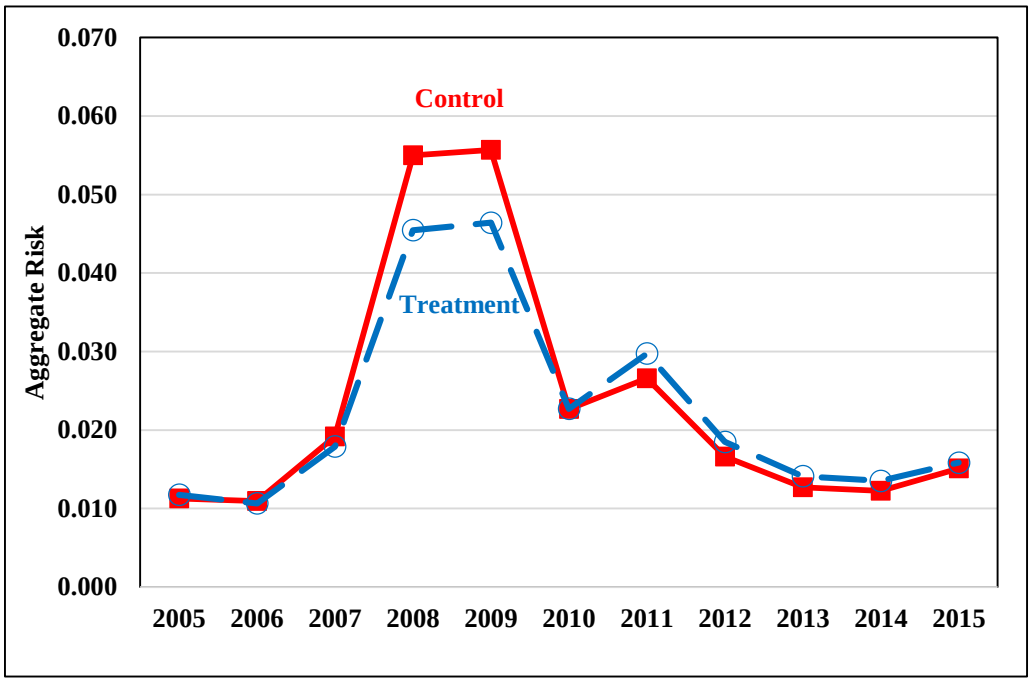


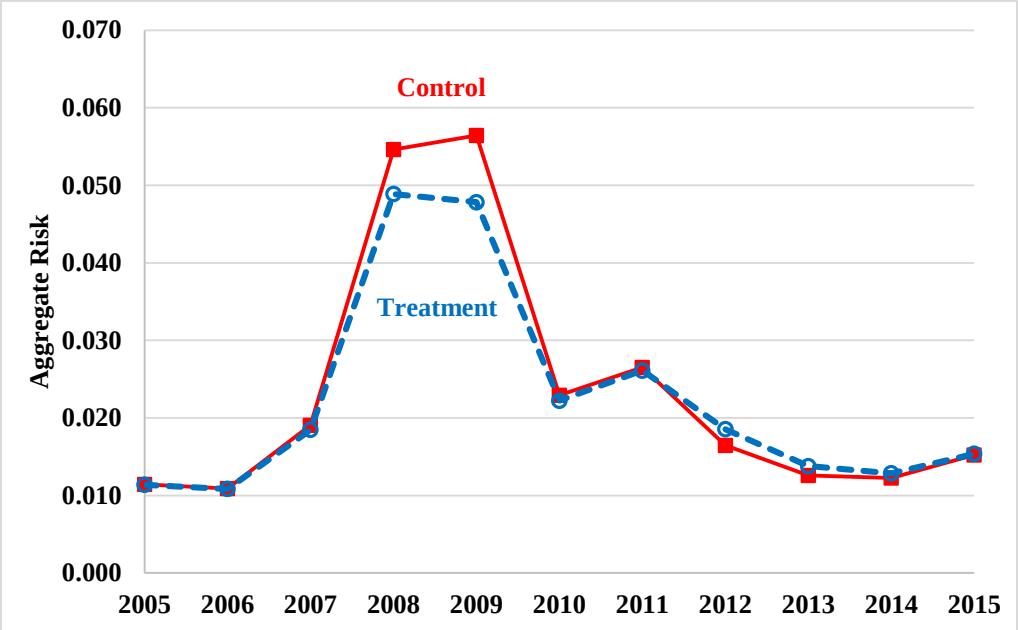
**Figure 4**
**DID: Parallel Trends**

The figure plots the means of *Aggregate Risk* of the treatment and control groups. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. The control group is the set of firms that were affected by the law but were already compliant as of the passage of the law.

**Panel A: *RC Present***



**Panel B:** ***RC Compliant***




**Panel C:** ***CRO Present***

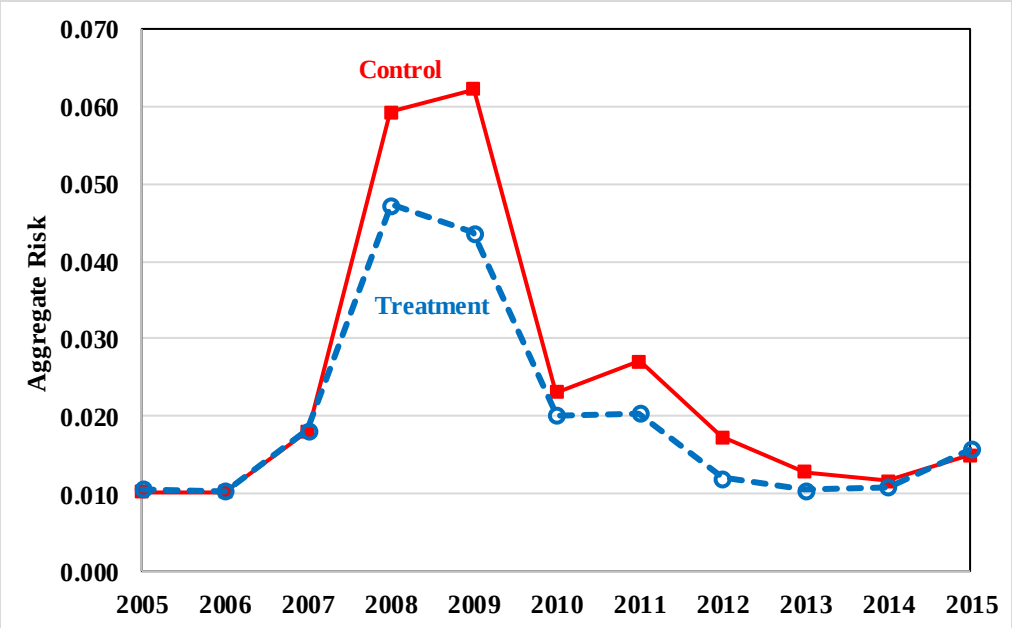
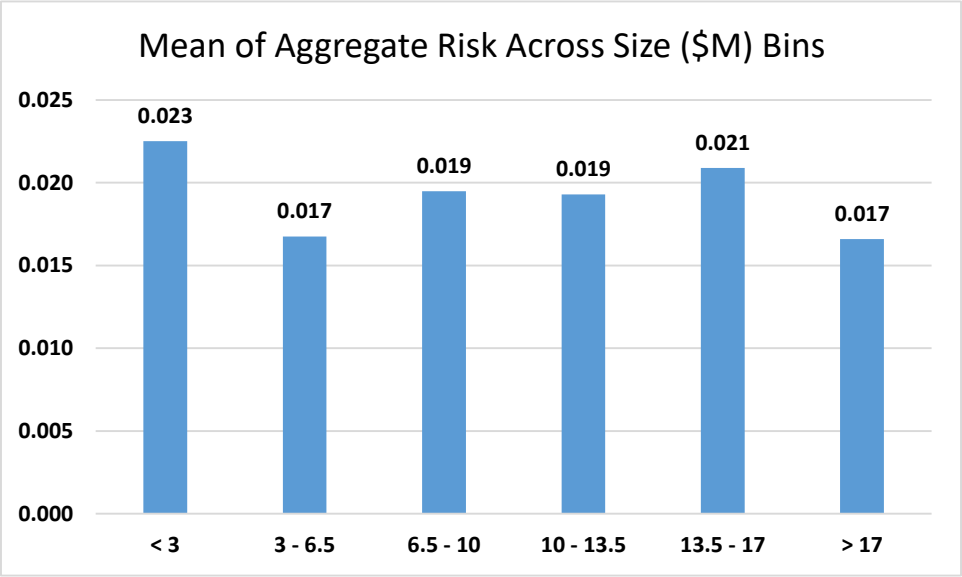


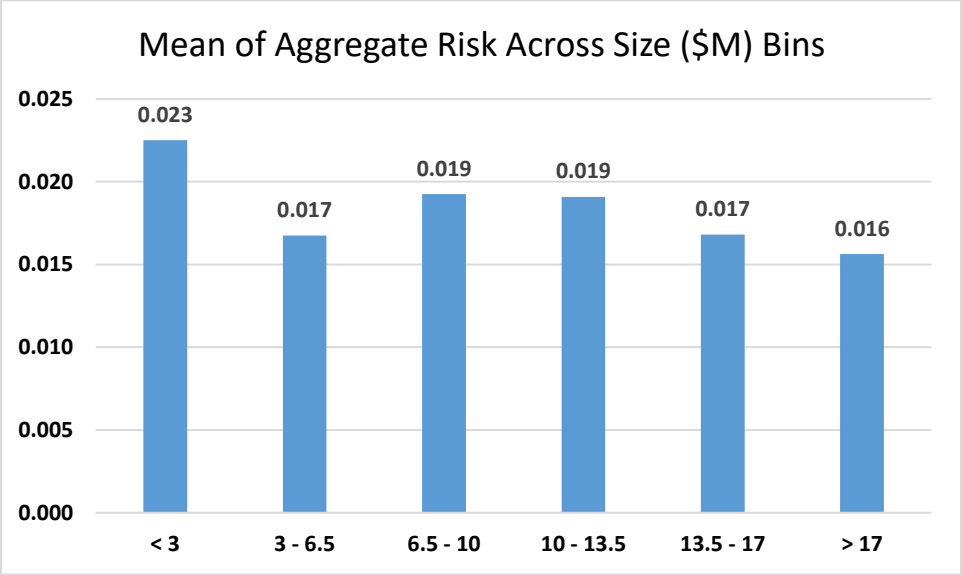
**Figure 5**
**Regression Discontinuity: Univariate (Risk around the Threshold)**

The figure plots the mean of *Aggregate Risk* of banks around the $10 billion threshold for *RC Present* and *RC Compliant*. We do not present the figure for *CRO Present* because there are very few relevant observations around the $50 billion threshold (2 between $30 and $50 billion and 1 between $50 and $70 billion).

**Panel A: *RC Present***




**Panel B: *RC Compliant***



## Table 1
## Summary Statistics

The table provides the summary statistics (mean, standard deviation, median, and interquartile range (IQR)) for the key variables. We have three risk measures. (i) *Aggregate Risk*, (ii) *Tail Risk*, and (iii) *EDF*. *Aggregate Risk* is the standard deviation of daily returns during the year. *Tail Risk* is the negative of the mean return on the 5% worst-return days during the year. *EDF* is the expected default frequency (EDFTM) credit measure under the 9th generation of Moody's Analytics Public Firm EDF model" (formerly KMV) EDF9 model based on information available as of the EDF date. It is expressed as an annualized probability of default over an X year horizon (where X = 1 to 10 in one-year increments) and is represented as a percentage, so that *EDF* is the calculated one-year expected default probability. We have three risk oversight measures. (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise; (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The control variables used in our risk regressions are as described in Ellul and Yeramilli (2013) and are defined almost verbatim below. *Assets* is the book value of total assets (BHCK2170). *ROA* is the ratio of income before extraordinary items (BHCK4300) to assets. *Annual Return* is the buy-and-hold return on the BHC's stock over the calendar year. *Deposits/Assets* is the ratio of total deposits (BHDM6631+BHDM6636+ BHFN6631+BHFN6636) to assets. *ST Borrowing/*Assets is the ratio of assets financed by commercial paper and other short-term nondeposit borrowing to assets. *Tier-1 Capital/Assets* is the ratio of Tier-1 capital (BHCK8274) to assets. *Loans/Assets* is the ratio of total loans (BHCK2122) to assets. *Bad Loans/Assets* is the ratio of the sum of loans past due 90 days or more (BHCK5525) and nonaccrual loans (BHCK5526) to assets. *Noninterest Income/Income* is the ratio of noninterest income (BHCK4079) to the sum of interest income (BHCK4107) and noninterest income (BHCK4079). *Deriv. Trading/Assets* is the ratio of the total gross notional amount of derivative contracts held for trading, obtained by adding amounts on interest rate contracts (BHCKA126), foreign exchange contracts (BHCKA127), equity derivative contracts (BHCK8723), and commodity and other contracts (BHCK8724) to assets. *Deriv. Hedging/Assets* is the ratio of the value of derivatives used for hedging purposes (obtained by adding the following variables: BHCK8725, BHCK8726, BHCK8727, and BHCK8728) to assets. *Large M&A* equals 1 if book assets grew more than 20% and equals 0 otherwise. *CEO Turnover* equals 1 if there is a change in the CEO and equals 0 otherwise. *CEO Delta* is the dollar change in CEO wealth for a 1% change in stock price, computed as in Core and Guay (2002). *CEO Vega* is the dollar change in CEO wealth for a 1-point change in stock return volatility, computed as in Guay (1999). *G-Index* is as described in Gompers, Ishii, and Metrick (2003). *Institutional Ownership* is the ownership by institutions.

| | Mean | Std. Dev. | Median | IQR |
|---|---|---|---|---|
| **Risk Measures** | | | | |
| Aggregate Risk | 0.023 | 0.015 | 0.017 | 0.013 |
| Tail Risk | 0.049 | 0.031 | 0.036 | 0.031 |
| EDF | 0.603 | 1.361 | 0.408 | 0.328 |
| **Risk Oversight Measures** | | | | |
| RC Present | 0.567 | | | |
| RC Compliant | 0.525 | | | |
| CRO Present | 0.603 | | | |
| **Firm Measures** | | | | |
| Assets ($ Billion) | 127 | 370 | 1,210 | 4,230 |
| ROA | 0.005 | 0.005 | 0.005 | 0.003 |
| Annual Return | 0.070 | 0.290 | 0.061 | 0.319 |
| Deposits/Assets | 0.704 | 0.137 | 0.733 | 0.118 |
| ST Borrowing/Assets | 0.033 | 0.034 | 0.022 | 0.045 |
| Tier-1 Capital/Assets | 0.090 | 0.021 | 0.086 | 0.025 |
| Loans/Assets | 0.626 | 0.157 | 0.667 | 0.160 |
| Bad Loans/Assets | 0.011 | 0.011 | 0.007 | 0.013 |
| Noninterest Income/Income | 0.275 | 0.168 | 0.241 | 0.173 |
| Deriv. Trading/Assets | 1.852 | 7.696 | 0.002 | 0.149 |
| Deriv. Hedging/Assets | 0.085 | 0.147 | 0.030 | 0.105 |
| Large M&A | 0.136 | | | |
| **Governance Measures** | | | | |
| Institutional Ownership | 0.598 | 0.189 | 0.629 | 0.273 |
| G-Index | 10 | 3 | 9 | 4 |
| CEO Delta ($000) | 477 | 921 | 130 | 393 |
| CEO Vega ($000) | 162 | 340 | 30 | 111 |
| CEO Turnover | 0.089 | | | |
| CEO Tenure | 9.0 | 7.4 | 6.6 | 9.6 |

## Table 2
## OLS Regressions of Risk

The table presents the OLS regression results where the dependent variable is *Aggregate Risk* and the key independent variable is one of three risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise; (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; And (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The first three columns do not have firm fixed effects (FE) while the last three columns include firm FE. Table 1 defines the control variables.

| | Dependent Variable = Aggregate Risk | | | | | |
|---|---|---|---|---|---|---|
| | Risk Oversight = | | | | | |
| Variables | *RC Present* | *RC Compliant* | *CRO Present* | *RC Present* | *RC Compliant* | *CRO Present* |
| ***Risk Oversight*** | **-0.000** | **-0.000** | **0.002*** ** | **-0.000** | **-0.000** | **0.002*** |
| | **(-0.5)** | **(-0.6)** | **(3.7)** | **(-0.1)** | **(-0.3)** | **(1.8)** |
| *Size* | 0.004 | 0.004 | 0.002 | 0.032*** | 0.033*** | 0.031*** |
| | (0.8) | (0.8) | (0.4) | (3.5) | (3.6) | (3.4) |
| *Size²* | -0.000 | -0.000 | -0.000 | -0.001*** | -0.001*** | -0.001*** |
| | (-0.7) | (-0.7) | (-0.3) | (-3.3) | (-3.3) | (-3.1) |
| *ROA* | -0.371*** | -0.363*** | -0.337*** | -0.174* | -0.168* | -0.174* |
| | (-4.2) | (-4.2) | (-3.8) | (-1.9) | (-1.9) | (-1.9) |
| *Annual Return* | -0.010*** | -0.010*** | -0.010*** | -0.010*** | -0.010*** | -0.010*** |
| | (-8.6) | (-8.6) | (-8.7) | (-8.4) | (-8.3) | (-8.4) |
| *Deposits/Assets* | 0.001 | 0.001 | 0.001 | -0.007 | -0.007 | -0.007 |
| | (0.3) | (0.3) | (0.3) | (-0.8) | (-0.8) | (-0.8) |
| *ST Borrowing/Assets* | 0.016 | 0.015 | 0.018* | -0.003 | -0.003 | -0.002 |
| | (1.4) | (1.3) | (1.7) | (-0.2) | (-0.3) | (-0.1) |
| *Tier1 Capital/Assets* | 0.033** | 0.033** | 0.033** | -0.066** | -0.064** | -0.066** |
| | (2.0) | (2.0) | (2.1) | (-2.5) | (-2.4) | (-2.5) |
| *Loans/Assets* | 0.002 | 0.002 | 0.000 | -0.002 | -0.002 | -0.004 |
| | (0.5) | (0.5) | (0.1) | (-0.4) | (-0.3) | (-0.6) |
| *Bad Loans/Assets* | 0.092*** | 0.089*** | 0.085*** | 0.065 | 0.060 | 0.059 |
| | (3.1) | (2.9) | (2.7) | (1.6) | (1.5) | (1.5) |
| *Non-Interest Income/Income* | -0.003 | -0.003 | -0.004 | -0.003 | -0.003 | -0.004 |
| | (-1.1) | (-1.1) | (-1.6) | (-0.6) | (-0.6) | (-0.7) |
| *Deriv. Trading/Assets* | 0.000 | 0.000 | 0.000 | -0.000 | -0.000 | -0.000 |
| | (1.1) | (1.0) | (1.0) | (-0.5) | (-0.5) | (-0.6) |
| *Deriv. Hedging/Assets* | 0.002 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 |
| | (0.6) | (0.6) | (0.5) | (0.4) | (0.4) | (0.5) |
| *Large M&A* | 0.001** | 0.001** | 0.001* | -0.000 | -0.000 | -0.000 |
| | (2.1) | (2.2) | (2.0) | (-0.4) | (-0.3) | (-0.4) |
| Year FE | Y | Y | Y | Y | Y | Y |
| Firm FE | N | N | N | Y | Y | Y |
| Observations | 769 | 758 | 770 | 769 | 758 | 770 |
| $R^2$ | 0.842 | 0.842 | 0.846 | 0.877 | 0.877 | 0.878 |

**Table 3**
**Diff-in-Diff (Univariate): Aggregate Risk**

This table examines the diff-in-diff results in a univariate setting. The table presents the mean of *Aggregate Risk*, which is the standard deviation of daily returns during the year. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. Control firms are those that were affected by the law but were already compliant as of the passage of the law.

**Panel A: *RC Present***

| | Control | Treated | Treated – Control |
|---|---|---|---|
| Before | 0.029 | 0.026 | -0.003* |
| After | 0.016 | 0.017 | 0.001 |
| After–Before | -0.013*** | -0.009*** | |
| Diff-in-Diff | | | 0.004 |

**Panel B*: RC Compliant***

| | Control | Treated | Treated – Control |
|---|---|---|---|
| Before | 0.029 | 0.027 | -0.002 |
| After | 0.016 | 0.016 | 0.000 |
| After–Before | -0.013*** | -0.011*** | |
| Diff-in-Diff | | | 0.002 |

**Panel C: *CRO Present***

| | Control | Treated | Treated – Control |
|---|---|---|---|
| Before | 0.032 | 0.025 | -0.007 |
| After | 0.017 | 0.013 | -0.004 |
| After–Before | -0.015*** | -0.012* | |
| Diff-in-Diff | | | 0.003 |

## Table 4
## Diff-in-Diff: Multivariate

The table presents the diff-in-diff regression results where the dependent variable is *Aggregate Risk* and the key independent variables (*Treated*, *After*, and *Treated × After*) are based on one of three risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise; (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. Control firms are those that were affected by the law but were already compliant as of the passage of the law. Table I defines the control variables.

| | Dependent Variable = Aggregate Risk | | |
|---|---|---|---|
| | Risk Oversight = | | |
| | *RC Present* | *RC Compliant* | *CRO Present* |
| *Treated* | -0.001 | 0.001 | -0.006* |
| | (-0.3) | (0.3) | (-2.0) |
| *After* | -0.011*** | -0.011*** | -0.009*** |
| | (-7.7) | (-7.6) | (-3.9) |
| ***Treated × After*** | **0.001** | **-0.001** | **0.004*** ** |
| | **(0.8)** | **(-0.8)** | **(3.5)** |
| *Size* | 0.016 | 0.018* | 0.010 |
| | (1.6) | (1.9) | (0.3) |
| *Size²* | -0.000 | -0.000* | -0.000 |
| | (-1.5) | (-1.8) | (-0.4) |
| *ROA* | -0.229 | -0.175 | -0.095 |
| | (-1.3) | (-0.9) | (-0.3) |
| *Annual Return* | -0.019*** | -0.020*** | -0.026*** |
| | (-7.3) | (-7.7) | (-10.6) |
| *Deposits/Assets* | -0.008 | -0.006 | -0.015 |
| | (-1.0) | (-0.8) | (-1.4) |
| *ST Borrowing/Assets* | 0.001 | 0.002 | 0.044 |
| | (0.0) | (0.1) | (0.8) |
| *Tier1 Capital/Assets* | -0.026 | -0.020 | -0.076 |
| | (-0.8) | (-0.6) | (-1.1) |
| *Loans/Assets* | 0.002 | 0.002 | -0.011 |
| | (0.3) | (0.4) | (-1.7) |
| *Bad Loans/Assets* | 0.077 | 0.075 | 0.146 |
| | (1.4) | (1.3) | (1.2) |
| *Non-Interest Income/Income* | -0.013** | -0.013** | -0.027*** |
| | (-2.2) | (-2.3) | (-2.8) |
| *Deriv. Trading/Assets* | 0.000 | 0.000 | 0.000 |
| | (0.7) | (0.9) | (0.0) |
| *Deriv. Hedging/Assets* | -0.001 | -0.001 | -0.002 |
| | (-0.3) | (-0.3) | (-0.4) |
| *Large M&A* | 0.001 | 0.001 | -0.000 |
| | (0.2) | (0.3) | (-0.0) |
| Observations | 414 | 407 | 200 |
| $R^2$ | 0.38 | 0.39 | 0.46 |

## Table 5
## Regression Discontinuity: Multivariate

The table presents the regression discontinuity regression results where the dependent variable is *Aggregate Risk* and the key independent variable is *Above Threshold*. Only firm-years since 2011 are included because the law was passed in 2010. *Aggregate Risk* is the standard deviation of daily returns during the year. *Above Threshold* is an indicator variable which equals 1 if the size is above the threshold ($10 billion for RC) and equals 0 otherwise. We consider two risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise, and (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. Control firms are those that were not affected by the law and had not voluntarily complied with the law even though they were not subject to the law. For the treated firms, only the firm-years post compliance are included. For the control firms, we exclude the firm-years after they chose to voluntarily comply. Table I defines the control variables.

| | Dependent Variable = Aggregate Risk | | | |
|---|---|---|---|---|
| | Risk Oversight = | | | |
| | *RC Present* | *RC Compliant* | *RC Present* | *RC Compliant* |
| ***Above Threshold*** | **-0.000** | **-0.002** | **-1.157** | **1.616** |
| | **(-0.1)** | **(-0.5)** | **(-0.4)** | **(0.5)** |
| *Size* | 0.001 | 0.001 | -0.293 | -0.290 |
| | (0.4) | (0.2) | (-1.0) | (-1.0) |
| *Size*$^2$ | | | 0.010 | 0.009 |
| | | | (1.0) | (1.0) |
| *Above Threshold × Size* | | | 0.163 | -0.169 |
| | | | (0.4) | (-0.5) |
| *Above Threshold × Size*$^2$ | | | -0.006 | 0.004 |
| | | | (-0.4) | (0.4) |
| Observations | 69 | 75 | 69 | 75 |
| $R^2$ | 0.004 | 0.004 | 0.018 | 0.027 |

## Table 6
## DID: Multivariate (Robustness)

The table presents the diff-in-diff regression results for alternative risk measures. The first panel estimates the same specification as Table 4 but with *Tail Risk* as the dependent variable. The second panel estimates the same specification but with *EDF* as the dependent variable. The third panel again estimates the same specification but with *Deriv. Trading/Assets* as the dependent variable, dropping the two derivative variables from the set of independent variables. Control variables in all 3 panels are included as in Table 2 but are not tabulated for ease of exposition. The key independent variable is one of three risk oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise. (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. Control firms are those that were affected by the law but were already compliant as of the passage of the law. Controls variables as in Table 4 are included in the regression, but not shown here for ease of presentation. Table 1 defines the control variables.

| | Risk Oversight = | | |
|---|---|---|---|
| | *RC Present* | *RC Compliant* | *CRO Present* |
| | | Tail Risk | |
| Treated | -0.002 | 0.001 | -0.012* |
| | (-0.5) | (0.2) | (-1.9) |
| After | -0.024*** | -0.023*** | -0.019*** |
| | (-7.6) | (-7.4) | (-3.7) |
| **Treated × After** | **0.004** | **-0.003** | **0.010*** ** |
| | **(1.0)** | **(-0.7)** | **(3.5)** |
| Obs | 414 | 407 | 200 |
| $R^2$ | 0.35 | 0.36 | 0.43 |
| | | EDF | |
| Treated | 0.110 | 0.198** | -0.007 |
| | (1.4) | (2.3) | (-0.1) |
| After | -0.015 | 0.018 | 0.092 |
| | (-0.3) | (0.3) | (1.0) |
| **Treated × After** | **-0.119** | **-0.220** ** | **0.111** |
| | **(-1.9)** | **(-2.2)** | **(0.8)** |
| Obs | 415 | 408 | 200 |
| $R^2$ | 0.47 | 0.48 | 0.53 |
| | | Deriv. Trading/Assets | |
| Treated | -1.415 | -2.870* | 2.712* |
| | (-1.0) | (-1.8) | (2.0) |
| After | 1.899 | 1.252 | 0.849 |
| | (1.5) | (1.0) | (0.5) |
| **Treated × After** | **0.186** | **2.575** | **1.427** |
| | **(0.1)** | **(1.3)** | **(0.6)** |
| Obs | 415 | 408 | 200 |
| $R^2$ | 0.79 | 0.79 | 0.88 |

## Table 7
## DID: Multivariate (Excluding 2008-2009)

The table presents the diff-in-diff regression results. The panels estimated the same specification as Tables 6 and 8 but with the years of the credit crisis (2008–2009) excluded. Panel 1 uses *Aggregate Risk*, panel 2 uses *EDF*, and panel 3 uses *Deriv. Trading/Assets* as the risk measure. Control variables in all 3 panels are included as in Tables 4 and 6 but are not tabulated for ease of exposition. The key independent variable is one of three risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise; (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. Control firms are those that were affected by the law but were already compliant as of the passage of the law. Controls variables as in Table 4 are included in the regression, but not shown here for ease of presentation. Table I defines the control variables.

| | Risk Oversight = | | |
|---|---|---|---|
| | *RC Present* | *RC Compliant* | *CRO Present* |
| | *Aggregate Risk*, excluding 2008-2009 | | |
| Treated | 0.000 | 0.000 | -0.000 |
| | (0.4) | (0.5) | (-0.5) |
| After | -0.002*** | -0.002*** | -0.001 |
| | (-3.0) | (-3.2) | (-1.4) |
| **Treated × After** | **-0.000** | **-0.001** | **-0.001** |
| | **(-0.2)** | **(-0.8)** | **(-0.5)** |
| Obs | 332 | 325 | 164 |
| $R^2$ | 0.38 | 0.38 | 0.47 |
| | EDF Risk, excluding 2008-2009 | | |
| Treated | 0.228*** | 0.207** | -0.015 |
| | (2.3) | (2.3) | (-0.2) |
| After | 0.006 | 0.005 | 0.074 |
| | (0.1) | (0.1) | (1.5) |
| **Treated × After** | **-0.235*** ** | **-0.205** | **-0.050** |
| | **(-3.2)** | **(-2.6)** | **(-0.9)** |
| Obs | 333 | 326 | 164 |
| $R^2$ | 0.55 | 0.55 | 0.66 |
| | Derivative risk, Excluding 2008-2009 | | |
| Treated | -1.352 | -2.735* | 2.602* |
| | (-1.0) | (-1.8) | (1.9) |
| After | 2.213* | 1.640 | 1.628 |
| | (2.0) | (1.5) | (1.0) |
| **Treated × After** | **0.152** | **2.428** | **1.916** |
| | **(0.1)** | **(1.3)** | **(0.9)** |
| Obs | 333 | 326 | 164 |
| $R^2$ | 0.81 | 0.81 | 0.91 |

**Table 8**
**DID (Univariate): Mention of "Risk" In Proxies**

The table presents mean of the number of times the word "risk" is mentioned in the proxy statements. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. Control firms are those that were affected by the law but were already compliant as of the passage of the law.

**Panel A: *RC Present***

| | Control | Treated | (T) – (C) |
|---|---|---|---|
| Before | 261 | 173 | -88*** |
| After | 426 | 306 | -120** |
| (A) – (B) | 165*** | 133*** | |
| Diff-in-Diff | | | -32 |

**Panel B: *RC Compliant***

| | Control | Treated | (T) – (C) |
|---|---|---|---|
| Before | 258 | 202 | -56** |
| After | 427 | 357 | -70** |
| (A) – (B) | 169*** | 155*** | |
| Diff-in-Diff | | | -14 |

**Panel C*: CRO Present***

| | Control | Treated | (T) – (C) |
|---|---|---|---|
| Before | 360 | 107 | -252*** |
| After | 564 | 338 | -225** |
| (A) – (B) | 204*** | 231*** | |
| Diff-in-Diff | | | 27 |

## Internet Appendix: Additional Results

This section reports additional results using the EDF default probabilities from CreditEdge, the *EDF*, defined as the calculated one-year expected default probability (we refer to this as *EDF*) and *Deriv. Trading/Assets*, the ratio of the total gross notional amount of derivative contracts held for trading, as a more direct measure of shifts in bank portfolios The expected default frequency (EDFTM) credit measure under the EDF9 model is based on information available as of the EDF date. It is expressed as an annualized probability of default over an X-year horizon (where X = 1 to 10 in one-year increments) and is represented as a percentage.

## Table A1
## OLS Regressions with Risk Measure = Tail Risk

The table presents the OLS regression results where the dependent variable is *Tail Risk* and the key independent variable is one of three risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise. (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The first three columns do not have firm FE while the last three columns include firm FE. Table 1 defines the control variables.

| | Dependent Variable = *Tail Risk* | | | | | |
|---|---|---|---|---|---|---|
| | Risk Oversight = | | | | | |
| Variables | *RC Present* | *RC Compliant* | *CRO Present* | *RC Present* | *RC Compliant* | *CRO Present* |
| ***Risk Oversight*** | **-0.001** | **-0.001** | **0.005$^{***}$** | **-0.000** | **-0.000** | **0.002** |
| | **(-0.5)** | **(-0.6)** | **(3.4)** | **(-0.1)** | **(-0.2)** | **(1.2)** |
| *Size* | 0.010 | 0.010 | 0.005 | 0.060$^{***}$ | 0.062$^{***}$ | 0.058$^{***}$ |
| | (0.9) | (0.9) | (0.5) | (2.9) | (2.9) | (2.8) |
| *Size$^2$* | -0.000 | -0.000 | -0.000 | -0.002$^{***}$ | -0.002$^{***}$ | -0.002$^{**}$ |
| | (-0.7) | (-0.8) | (-0.4) | (-2.6) | (-2.7) | (-2.6) |
| *ROA* | -0.802$^{***}$ | -0.787$^{***}$ | -0.733$^{***}$ | -0.398$^{*}$ | -0.393$^{*}$ | -0.399$^{*}$ |
| | (-4.1) | (-4.0) | (-3.6) | (-1.9) | (-1.8) | (-1.9) |
| *Annual Return* | -0.020$^{***}$ | -0.019$^{***}$ | -0.019$^{***}$ | -0.018$^{***}$ | -0.017$^{***}$ | -0.017$^{***}$ |
| | (-7.5) | (-7.4) | (-7.5) | (-6.9) | (-6.8) | (-6.9) |
| *Deposits/Assets* | 0.003 | 0.004 | 0.003 | -0.012 | -0.012 | -0.012 |
| | (0.3) | (0.4) | (0.4) | (-0.7) | (-0.7) | (-0.7) |
| *ST Borrowing/Assets* | 0.031 | 0.030 | 0.036$^{*}$ | -0.008 | -0.008 | -0.006 |
| | (1.4) | (1.4) | (1.7) | (-0.3) | (-0.3) | (-0.2) |
| *Tier1 Capital/Assets* | 0.068$^{*}$ | 0.068$^{*}$ | 0.068$^{**}$ | -0.141$^{**}$ | -0.132$^{*}$ | -0.140$^{**}$ |
| | (2.0) | (2.0) | (2.0) | (-2.0) | (-1.9) | (-2.1) |
| *Loans/Assets* | 0.005 | 0.005 | 0.002 | 0.001 | 0.001 | -0.001 |
| | (0.8) | (0.7) | (0.4) | (0.1) | (0.1) | (-0.1) |
| *Bad Loans/Assets* | 0.169$^{***}$ | 0.158$^{**}$ | 0.156$^{**}$ | 0.089 | 0.069 | 0.081 |
| | (2.8) | (2.5) | (2.4) | (1.2) | (0.9) | (1.0) |
| *Noninterest Income/Income* | -0.004 | -0.004 | -0.006 | -0.001 | -0.001 | -0.002 |
| | (-0.8) | (-0.8) | (-1.2) | (-0.1) | (-0.1) | (-0.1) |
| *Deriv. Trading/Assets* | 0.000 | 0.000 | 0.000 | -0.000 | -0.000 | -0.000 |
| | (1.0) | (0.9) | (0.9) | (-0.8) | (-0.8) | (-0.9) |
| *Deriv. Hedging/Assets* | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 |
| | (0.5) | (0.5) | (0.4) | (0.4) | (0.5) | (0.5) |
| *Large M&A* | 0.003$^{**}$ | 0.003$^{**}$ | 0.003$^{**}$ | -0.000 | -0.000 | -0.000 |
| | (2.2) | (2.2) | (2.1) | (-0.2) | (-0.2) | (-0.2) |
| Year FE | Y | Y | Y | Y | Y | Y |
| Firm FE | N | N | N | Y | Y | Y |
| Observations | 769 | 758 | 770 | 769 | 758 | 770 |
| $R^2$ | 0.83 | 0.83 | 0.83 | 0.86 | 0.86 | 0.86 |

## Table A2
## Regression Discontinuity Regressions with Risk Measure = Tail Risk

The table presents the regression discontinuity regression results where the dependent variable is *Tail Risk* and the key independent variable is *Above Threshold*. Only firm-years 2011 are included because the law was passed in 2010. *Aggregate Risk* is the standard deviation of daily returns during the year. *Above Threshold* is an indicator variable which equals 1 if the size is above the threshold ($10 billion for RC and $50 billion for CRO) and equals 0 otherwise. We consider three risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise; (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. Control firms are those that were not affected by the law and had not voluntarily complied with the law even though they were not subject to the law. For the treated firms, only the firm-years post compliance are included. For the control firms, we exclude the firm-years after they chose to voluntarily comply. Table I defines the control variables.

| | Dependent Variable = *Tail Risk* | | | |
|---|---|---|---|---|
| | Risk Oversight= | | | |
| | *RC Present* | *RC Compliant* | *RC Present* | *RC Compliant* |
| ***Above Threshold*** | **0.000** | **-0.003** | **5.814** | **6.457** |
| | **(0.0)** | **(-0.5)** | **(0.8)** | **(1.1)** |
| *Size* | 0.002 | 0.001 | -0.481 | -0.471 |
| | (0.4) | (0.2) | (-0.7) | (-0.7) |
| *Size*$^2$ | | | 0.016 | 0.015 |
| | | | (0.7) | (0.7) |
| *Above Threshold × Size* | | | -0.645 | -0.730 |
| | | | (-0.7) | (-1.0) |
| *Above Threshold × Size*$^2$ | | | 0.018 | 0.020 |
| | | | (0.6) | (0.9) |
| Observations | 69 | 75 | 69 | 75 |
| $R^2$ | 0.00 | 0.02 | 0.02 | 0.02 |

## Table A3
## OLS Regressions with Risk Measure = EDF

The table presents the OLS regression results where the dependent variable is *EDF* and the key independent variable is one of three risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise. (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The first three columns do not have firm FE while the last three columns include firm FE. Table I defines the control variables.

| | Dependent Variable = *EDF* | | | | | |
|---|---|---|---|---|---|---|
| | Risk Oversight = | | | | | |
| Variables | *RC Present* | *RC Compliant* | *CRO Present* | *RC Present* | *RC Compliant* | *CRO Present* |
| ***Risk Oversight*** | **-0.196** | **-0.188** | **-0.121** | **0.084** | **0.092** | **-0.461** |
| | **(-1.0)** | **(-1.1)** | **(-0.5)** | **(0.8)** | **(0.9)** | **(-1.0)** |
| *Size* | -0.869 | -0.836 | -1.066 | 0.220 | 0.109 | 0.550 |
| | (-1.3) | (-1.3) | (-1.6) | (0.2) | (0.1) | (0.5) |
| *Size*$^2$ | 0.021 | 0.021 | 0.027 | -0.019 | -0.015 | -0.028 |
| | (-0.7) | (1.2) | (1.5) | (-0.7) | (-0.6) | (-0.9) |
| *ROA* | --59.759$^*$ | -60.277$^*$ | -60.189$^*$ | -46.688 | -50.209$^*$ | -47.105 |
| | (-1.8) | (-1.8) | (-1.7) | (-1.6) | (-1.7) | (-1.6) |
| *Annual Return* | -0.955$^{***}$ | -0.876$^{***}$ | -0.955$^{***}$ | -0.789$^{***}$ | -0.718$^{***}$ | -0.803$^{***}$ |
| | (-5.6) | (-5.0) | (-5.4) | (-6.6) | (-6.3) | (-6.7) |
| *Deposits/Assets* | -0.780 | -0.816 | -0.766 | -2.323 | -2.423 | -2.339 |
| | (-0.8) | (-0.9) | (-0.8) | (-0.8) | (-0.8) | (-0.8) |
| *ST Borrowing/Assets* | 1.834 | 1.917* | 1.638 | -0.028 | 0.004 | -0.381 |
| | (1.6) | (1.7) | (1.7) | (-0.0) | (0.0) | (-0.2) |
| *Tier1 Capital/Assets* | -6.948 | -6.495 | -7.076 | -27.134 | -25.112 | -27.082 |
| | (-1.0) | (-1.0) | (-1.0) | (-1.3) | (-1.2) | (-1.3) |
| *Loans/Assets* | -0.476 | -0.537 | -0.490 | 1.062 | 0.917 | 1.442 |
| | (-1.0) | (-1.1) | (-1.1) | (0.8) | (0.7) | (0.8) |
| *Bad Loans/Assets* | 34.052 | 30.939 | 33.905 | 42.739$^*$ | 37.065 | 44.484$^*$ |
| | (1.6) | (1.4) | (1.5) | (1.9) | (1.6) | (1.9) |
| *Noninterest Income/Income* | 0.257 | 0.171 | 0.254 | 0.875 | 0.661 | 1.307 |
| | (0.6) | (0.4) | (0.6) | (0.5) | (0.4) | (0.6) |
| *Deriv. Trading/Assets* | -0.007 | -0.008 | -0.007 | -0.002 | -0.003 | -0.002 |
| | (-0.6) | (-0.7) | (-0.6) | (-0.2) | (-0.2) | (-0.1) |
| *Deriv. Hedging/Assets* | -0.058 | -0.010 | 0.035 | 0.356 | 0.391 | 0.243 |
| | (-0.2) | (-0.0) | (0.1) | (1.0) | (1.1) | (0.8) |
| *Large M&A* | -0.060 | -0.047 | -0.065 | -0.160 | -0.152 | -0.154 |
| | (-0.8) | (-0.7) | (-0.9) | (-1.5) | (-1.3) | (-1.5) |
| Year FE | Y | Y | Y | Y | Y | Y |
| Firm FE | N | N | N | Y | Y | Y |
| Observations | 752 | 741 | 753 | 752 | 741 | 753 |
| $R^2$ | 0.21 | 0.19 | 0.20 | 0.23 | 0.21 | 0.24 |

## Table A4
## Regression Discontinuity Regressions with Risk Measure = EDF

The table presents the regression discontinuity regression results where the dependent variable is *EDF* and the key independent variable is *Above Threshold*. Only firm-years 2011 are included because the law was passed in 2010. *Aggregate Risk* is the standard deviation of daily returns during the year. *Above Threshold* is an indicator variable which equals 1 if the size is above the threshold ($10 billion for RC and $50 billion for CRO) and equals 0 otherwise. We consider three risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise; (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. Control firms are those that were not affected by the law and had not voluntarily complied with the law even though they were not subject to the law. For the treated firms, only the firm-years post compliance are included. For the control firms, we exclude the firm-years after they chose to voluntarily comply. Table I defines the control variables.

| | Dependent Variable = *EDF* | | | |
|---|---|---|---|---|
| | Risk Oversight= | | | |
| | *RC Present* | *RC Compliant* | *RC Present* | *RC Compliant* |
| ***Above Threshold*** | **-0.032** | **-0.037** | **739.88** | **724.57** |
| | **(-0.1)** | **(-0.1)** | **(1.0)** | **(0.9)** |
| *Size* | -0.340 | -0.352 | 85.39 | 85.492 |
| | (-0.6) | (-0.7) | (0.8) | (0.9) |
| *Size*$^2$ | | | -2.787 | -2.790 |
| | | | (-0.8) | (-0.9) |
| *Above Threshold × Size* | | | -93.34 | -93.567 |
| | | | (-0.9) | (-0.0) |
| *Above Threshold × Size*$^2$ | | | 3.072 | 3.021 |
| | | | (0.9) | (0.9) |
| Observations | 70 | 76 | 70 | 76 |
| $R^2$ | 0.00 | 0.01 | 0.01 | 0.01 |

## Table A5
## OLS Regressions with Risk Measure = Deriv. Trading/Assets

The table presents the OLS regression results where the dependent variable is *Deriv. Trading/Assets* and the key independent variable is one of three risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise; (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The first three columns do not have firm FE while the last three columns include firm FE. Table I defines the control variables.

| | Dependent Variable = *Deriv. Trading/Assets* | | | | | |
|---|---|---|---|---|---|---|
| | Risk Oversight = | | | | | |
| Variables | *RC Present* | *RC Compliant* | *CRO Present* | *RC Present* | *RC Compliant* | *CRO Present* |
| ***Risk Oversight*** | **0.788** | **0.872** | **0.262** | **0.421** | **0.433** | **-0.025** |
| | **(1.4)** | **(1.6)** | **(0.6)** | **(0.9)** | **(1.1)** | **(-0.1)** |
| *Size* | -33.962*** | -33.718*** | -33.080*** | 0.977 | 0.476 | 0.845 |
| | (-6.1) | (-6.1) | (-6.1) | (0.1) | (0.0) | (0.1) |
| *Size²* | 0.996*** | 0.990*** | 0.973*** | -0.037 | -0.022 | -0.032 |
| | (6.0) | (6.1) | (6.0) | (-0.1) | (-0.1) | (-0.1) |
| *ROA* | -212.985*** | -209.328*** | -216.670*** | -13.965 | -17.561* | -15.893 |
| | (-3.0) | (-3.0) | (-3.0) | (-1.5) | (-1.8) | (-1.5) |
| *Annual Return* | 0.329 | 0.213 | 0.330 | 0.003 | 0.018 | 0.000 |
| | (0.6) | (0.4) | (0.6) | (0.0) | (0.2) | (0.0) |
| *Deposits/Assets* | -23.360*** | -22.095*** | -23.511*** | -1.068 | -1.215 | -1.156 |
| | (-2.8) | (-2.7) | (-2.8) | (-0.3) | (-0.3) | (-0.3) |
| *ST Borrowing/Assets* | -24.003** | -21.838** | -23.493** | -5.163 | -4.999 | -4.974 |
| | (-2.4) | (-2.3) | (-2.3) | (-1.2) | (-1.3) | (-1.2) |
| *Tier1 Capital/Assets* | -49.926** | -47.166** | -49.817** | 4.493 | 3.884 | 5.923 |
| | (-2.1) | (-2.1) | (-2.1) | (0.7) | (0.6) | (0.9) |
| *Loans/Assets* | -8.928*** | -8.968*** | -8.857*** | -0.744 | -0.860 | -0.873 |
| | (-3.2) | (-3.2) | (-3.1) | (-0.9) | (-1.1) | (-0.8) |
| *Bad Loans/Assets* | -40.493 | -45.565 | -40.026 | -1.762 | -3.302 | -1.939 |
| | (-1.5) | (-1.6) | (-1.5) | (-0.2) | (-0.3) | (-0.2) |
| *Non-Interest Income/Income* | -3.652 | -3.864 | -3.617 | -0.022 | 0.064 | -0.050 |
| | (-1.1) | (-1.2) | (-1.1) | (-0.0) | (0.0) | (-0.0) |
| *Large M&A* | -0.532 | -0.520 | -0.519 | 0.199 | 0.189 | 0.216 |
| | (-1.0) | (-1.0) | (-1.0) | (1.1) | (1.1) | (1.1) |
| Year FE | Y | Y | Y | Y | Y | Y |
| Firm FE | N | N | N | Y | Y | Y |
| Observations | 769 | 758 | 770 | 769 | 758 | 770 |
| $R^2$ | 0.74 | 0.74 | 0.74 | 0.0.03 | 0.03 | 0.02 |

## Table A6
## Regression Discontinuity Regressions with Risk Measure = Deriv. Trading/Assets

The table presents the RD regression results where the dependent variable is *Deriv. Trading/Assets* and the key independent variable is Above Threshold. Only firm-years 2011 are included because the law was passed in 2010. *Aggregate Risk* is the standard deviation of daily returns during the year. *Above Threshold* is an indicator variable which equals 1 if the size is above the threshold ($10 billion for RC and $50 billion for CRO), and equals 0 otherwise. We consider three risk-oversight measures: (i) *RC Present*, which equals 1 if the firm has an RC and equals 0 otherwise; (ii) *RC Compliant*, which equals 1 if the firm has an RC that satisfies 3 requirements imposed by the DFA and equals 0 otherwise; and (iii) *CRO Present*, which equals 1 if the firm has a CRO and equals 0 otherwise. The treated firms are those that that were shocked by the law. That is, they were noncompliant as of the passage of the law. Control firms are those that were not affected by the law and had not voluntarily complied with the law even though they were not subject to the law. For the treated firms, only the firm-years post compliance are included. For the control firms, we exclude the firm-years after they chose to voluntarily comply. Table I defines the control variables.

| | Dependent variable = *Deriv. Trading/Assets* | | | |
|---|---|---|---|---|
| | *Risk Oversight =* | | | |
| | *RC Present* | *RC Compliant* | *RC Present* | *RC Compliant* |
| ***Above Threshold*** | **-0.014** | **-0.019** | **-7.406** | **1.402** |
| | **(-0.4)** | **(-0.5)** | **(-0.2)** | **(0.1)** |
| *Size* | 0.021 | 0.021 | 2.979 | 2.998 |
| | (1.0) | (1.1) | (1.0) | (1.0) |
| *Size*$^2$ | | | -0.096 | -0.097 |
| | | | (-1.0) | (-1.0) |
| *Above Threshold × Size* | | | 0.619 | -0.420 |
| | | | (0.2) | (-0.1) |
| *Above Threshold × Size*$^2$ | | | -0.010 | 0.021 |
| | | | (-0.1) | (0.2) |
| Observations | 70 | 76 | 70 | 76 |
| $R^2$ | 0.02 | 0.02 | 0.07 | 0.07 |