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ORIGINAL RESEARCH

Dodd–Frank and risk in the financial services industry

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Abstract We present evidence that discretionary risk taking by financial institutions has declined following the passage of Dodd–Frank. The largest institutions experience the greatest reduction in risk consistent with the legislation's objective of reducing systemic risk and an ultimate goal of ending the too-big-to-fail doctrine. Analysis of a sample of banks, the most highly regulated financial institutions, reveals that banks exhibiting characteristics consistent with riskier business strategies prior to Dodd–Frank experience the greatest risk reduction. Further, banks that alter their business practices by increasing their capital ratios and reducing their level of non-performing loans following the law's passage are shown to experience the greatest reduction in risk. Our results point to the efficacy of Dodd–Frank in reducing risk in the financial system.

Keywords Dodd–Frank Regulation · Bank risk · Wall Street Reform · Wall Street Reform and Consumer Protection Act

JEL Classification G14 · G21 · G23 · G28

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1 Introduction

The United States (US) financial system was fundamentally shaken by the events that began in 2008. Few could have imagined that such dramatic changes could occur within such a short time: the rescue of Bear Stearns and American Insurance Group (AIG), the collapse of Lehman Brothers, the failure of Washington Mutual, then the nation's largest thrift institution, and government takeovers of Fannie Mae and Freddie Mac. Although short-term measures were implemented by both the Bush and Obama administrations to stabilize the financial system, policy makers undertook more comprehensive reform efforts to promote long-term financial stability and prevent future crises. The Dodd–Frank Wall Street Reform and Consumer Protection Act of 2010 (hereafter Dodd–Frank) was signed into law by President Obama on July 21, 2010. Dodd–Frank has been described as the most comprehensive overhaul of the financial regulatory system since the Great depression. The sixteen titles comprising the Act address a variety of issues ranging from financial stability to corporate governance.

The events precipitating the passage of Dodd–Frank were largely the result of excessive risk taking. Dodd–Frank is designed, in part, to alter the incentives for risk taking in the financial sector. In this study, we examine whether the passage of the legislation has achieved this objective by examining changes in capital market measures of risk surrounding Dodd–Frank's passage. After establishing an across the board decline in variance and institution-specific risk following the legislation, we identify the institutional characteristics influencing the extent of the risk reduction.

Our empirical evidence confirms that total and unsystematic risk measures have significantly declined following the passage of Dodd–Frank. The reductions are magnified as we increase the horizon over which we measure the risk shifts. For example, we find that the average institution experiences a decline in return variance that is approximately six times greater in a longer-term horizon than a shorter-term horizon. Additionally, the variance of equity returns of institutions with more than $50 billion in assets, a key threshold identified in Dodd–Frank declines dramatically following Dodd–Frank's passage. The magnitude of decline in the unsystematic risk measures is also profound confirming the decline in risk factors such as credit and liquidity risks that are within the institution's control.

When we examine our full sample of financial institutions in a cross-sectional framework, we again find that the larger institutions experience the greatest reduction in risk, consistent with the legislation's emphasis on curbing risk taking and the ultimate goal of ending the too-big-to-fail doctrine. This finding emphasizes that passage of the law with the intent to remove the implied protection for the largest institutions has not influenced the market to assign higher levels of risk to the largest financial institutions. Across various measures, we show that institutions engaged in more risk taking prior to Dodd–Frank curtail risk to a greater extent following the law's passage. These findings hold in models based on both the levels of the financial characteristics prior to Dodd–Frank and the changes in those characteristics following Dodd–Frank.

We also separately examine a subset of banks given the unique role of these depository institutions. In the post-Dodd–Frank era, we find that internal governance measures are not significant determinants of bank risk-taking, possibly because banks are highly regulated and supervised externally. This finding is consistent with the substitution effect between internal and external monitoring documented by Booth et al. (2002). Banks exhibiting characteristics consistent with riskier business strategies prior to Dodd–Frank (including large banks and those with higher levels of non-performing loans) experience the greatest risk reduction. Further, banks that alter their business practices by reducing their level of

nonperforming loans and increasing their capital ratios following the law's passage experience the greatest reduction in risk. Our results point to the efficacy of Dodd–Frank in reducing risk in the financial system.

The remaining sections of the paper are organized as follows. Section 2 outlines key provisions of the Dodd–Frank Act. Section 3 discusses previous studies related to regulation and bank risk. Section 4 presents the hypotheses. Section 5 outlines the data and methods. Section 6 presents the risk shift results, Sect. 7 presents the regression results, and Sect. 8 summarizes the study.

2 Major provisions of the Dodd–Frank Act

The stated purpose of Dodd–Frank is to "promote the financial stability of the US by improving accountability and transparency in the financial system, to end 'too-big-to-fail,' to protect the American taxpayer by ending bailouts, to protect consumers from abusive financial services practices, and for other purposes."[1] The 16 titles address virtually all aspects of the financial system.

Title I establishes two new agencies: the Financial Stability Oversight Council (FSOC) and the Office of Financial Research, both under the auspices of the Treasury Department. The FSOC is expected "to identify risks to the financial system, promote market discipline, and devise strategies for addressing emerging threats to the financial system. It also provides for enhanced supervision and prudential standards for nonbank financial firms regulated by the board of governors and large, inter-connected bank holding companies (BHCs)."[2] Section 171 requires the establishment of minimum leverage and risk-based capital standards on a consolidated basis for insured depository institutions, depository institution holding companies, and nonbank financial companies supervised by the Board of Governors.

Title II provides for the orderly liquidation of troubled institutions. Prior to Dodd–Frank, troubled depositories and securities firms were liquidated by the Federal Deposit Insurance Corporation (FDIC) or the Securities Investor Protection Corporation (SIPC). Dodd–Frank broadens the list of covered financial institutions to include insurance companies and other nonbank financial companies. To that end, the Act creates an orderly liquidation fund managed by the FDIC. The fund will be capitalized with assessments on BHCs with assets $\geq$\$50 billion and nonbank financial companies supervised by the Board of Governors.

Title III eliminates the Office of Thrift Supervision (OTS). Institutions formerly regulated by the OTS will be now be regulated by the Federal Reserve, FDIC, and the Office of the Comptroller of the Currency (OCC). The ceiling on FDIC deposit insurance has been permanently increased to \$250,000.

Title IV regulates hedge funds and other private fund investment advisers for the first time. It increases their reporting requirements although there are some exemptions, including an exemption for some advisors with assets under \$150 million.

Subtitle A of Title V defines the Federal Insurance Office Act of 2010. It requires the establishment of the Federal Insurance Office whose primary responsibilities include monitoring the insurance industry, making recommendations to the FSOC regarding insurers who may threaten the financial system, and working with state insurance regulators on issues related to the industry.

[1] Source: http://www.stlouisfed.org/regtimeline/pdf/BILLS-111hr4173ENR.pdf.

[2] Source: http://www.stlouisfed.org/regtimeline/pdf/BILLS-111hr4173ENR.pdf.

Title VI defines the Volcker rule which effectively bans proprietary trading at institutions that have access to Federal Reserve funds and have federally insured deposits. Titles VII–XVI address other aspects of the financial system including regulating credit default swaps, requiring greater accountability on executive compensation, strengthening corporate governance and instituting mortgage reform.

In sum, Dodd–Frank represents a significant increase in regulation for the financial services industry, and is likely to alter the incentives for risk-taking. The literature provides an abundance of evidence that regulatory changes affect risk. We explore these findings in the next section.

3 Impact of regulation on bank risk

Well before the development of the Dodd–Frank legislation, studies acknowledged the need for regulatory reform and ending the too-big-to-fail doctrine. For example, Stern (2001) argues that government policies must reduce their protections of the large, too-big-to-fail institutions before regulatory changes can be implemented that incorporate market discipline and data to a greater extent. Furthermore, there are studies that criticize the effectiveness of the Dodd–Frank legislation and argue that it will not prevent failures and bailouts (e.g., Allen 2010; Fama and Litterman 2012; Kane 2012; Prasch 2012).

Boyd and De Nicolo (2005) summarize two alternative views regarding the impact of competition on bank risk-taking. One view suggests that increased competition leads to greater risk taking. They argue that this view has fundamentally influenced bank regulation.[3] The alternate view suggests that banks become more risky as their markets become more concentrated. Boyd and De Nicolo find support for this latter view in their theoretical model. Thus, to the extent that Dodd–Frank alters the competitive balance within the industry, it may alter risk taking.

Numerous studies have examined the impact of new regulations on the risk of financial institutions. Broadly speaking, changes in regulation fall into the deregulation or re-regulation categories. Dodd–Frank falls into the latter category. In this section, we provide a brief review of existing studies on risk and regulation, based on whether the legislation significantly deregulated or re-regulated the financial services industry.

3.1 Deregulation

The recent work by Semaan and Drake (2011) examines the relation between deregulation and risk across several regulated industries. Their findings for the financial sector are particularly relevant to our study. They find a significant decline in systematic risk and a significant increase in idiosyncratic risk following deregulation in the short-term. An important insight of their analysis is that the increase in idiosyncratic risk is transient; the risk actually decreases over a longer post-deregulation period. Zhao and He (2014) and Akhigbe and Whyte (2004) examine the impact of the passage of Gramm–Leach–Bliley Act of 1999 (GLBA) on financial institutions. Zhao and He (2014) conclude that the expansion into non-traditional market-sensitive business activities following GLBA contributed to increased market, operating and accounting risks of US BHCs. Akhigbe and

[3] With a limited number of bank charters (i.e., less competition), banks avoid risks that may increase bankruptcy likelihood as this would erode the value of their charter and their ability to earn monopoly rents. With more charters (i.e., more competition), banks are less inclined to avoid risk. Thus, regulators may desire to constrain the number of competitors in order to preserve the stability of the banking system.

Whyte (2004) document significant increases in total and unsystematic risks for banks and insurance companies following the passage of the GLBA. In contrast, they find that securities firms generally experienced significant declines in risk and all institutions experienced a significant decline in systematic risk.

Earlier studies have also shown a relation between deregulation and risk. Aharony et al. (1988) find that the passage of the Depository Institutions Deregulation and Monetary Control Act (DIDMCA) of 1980 resulted in an increase in total risk for both money center and regional banks and a significant decrease for thrifts. Bundt et al. (1992) find that large BHCs experience significant increases in both systematic and unsystematic measures of bank risk following DIDMCA's passage. Bhargava and Fraser (1998) document significant increases in both unsystematic and total risks in response to Fed actions permitting limited entry by BHCs into investment banking.

3.2 Re-regulation

Laeven and Levine (2009) examine how the interaction of ownership structure and regulatory environment influences bank risk taking of the largest 279 banks across 48 countries. They find that the impact of the regulatory environment on risk taking may be positive or negative depending on the bank's ownership/governance structure. As an example, they find that deposit insurance is associated with an increase in risk only when the bank has a large equity holder who can capitalize on the risk-taking incentives. Their results show that a more stringent regulatory environment (higher capital requirements, greater degree of capital stringency, greater restrictions on activities, and the existence of deposit insurance) is associated with greater risk when the bank has a large equity holder, but a stringent regulatory environment has the opposite effect when ownership is diverse. They argue that this may occur due to large equity holders seeking to compensate for the utility loss from a stringent regulatory environment.

Gonzalez (2005) finds that regulatory restrictions increase the incentives for risk-taking by reducing bank charter value. Banks in countries with stricter regulation have a lower charter value, which increases their incentives to follow risky policies. In effect, stricter regulation may have the unintended consequence of destabilizing the banking system. Konishi and Yasuda (2004) find that risk-taking by Japanese banks was reduced by the implementation of capital adequacy requirements. Akhigbe and Whyte (2001) find that the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 resulted in a significant decline in bank risk, although the degree of risk reduction is dependent on the capitalization, size and credit risk of the institutions.

These studies provide ample evidence that changes in the regulatory environment impact risk-taking. We develop specific hypotheses in the following section.

4 Hypotheses

Dodd–Frank dramatically re-regulates many aspects of the financial system with the ultimate objective of reducing risk. Whether the legislation achieves this objective is an empirical question.

We begin with our null hypothesis that Dodd–Frank has no significant impact on risk in the financial services industry. This hypothesis likely holds for institutions that are largely already compliant with the broad provisions of Dodd–Frank. Banks that are already well-capitalized, well-governed, relatively small, and with limited exposure to risky investments may not experience significant changes in risk. It is also possible that given the protracted

legislative process, the market fully anticipated the changes resulting in the inability to detect significant changes in risk. Another scenario that could result in an insignificant reaction is that it will take time for the provisions of Dodd–Frank to be fully implemented causing the market to take a "wait and see" attitude. In effect, there is a period of time in which firms adjust to the changed environment and investors adjust their expectations regarding the firms' ability to adapt to the new environment (Semaan and Drake 2011).

The more likely outcome, however, is that Dodd–Frank affects risk. We expect that Dodd–Frank's passage materially reduces risk in the industry. The law requires the establishment of minimum leverage and risk-based capital requirements on a consolidated basis for insured depository institutions, depository institution holding companies, and nonbank financial companies supervised by the Board of Governors. The newly mandated Oversight Council also has the discretion to change asset thresholds for the application of any of these standards. Other key provisions, including say-on-pay and increased deposit insurance limits, the Volcker rule, and the regulation of credit default swaps, should all contribute to reducing risk. Recently, Balasubramnian and Cyree (2014) provide some evidence that Dodd–Frank has been effective in reducing the size and too-big-to-fail discounts on yield spreads.

Nonetheless, it is possible that some institutions may experience an increase in risk. For example, since Dodd–Frank aims to remove the implied protection of the too-big-to-fail doctrine, large institutions may be perceived as more risky following Dodd–Frank since, in theory, bailouts are no longer an option.[4] Furthermore, it is possible that the restrictions within the legislation incentivize banks to increase risk. For example, Gonzalez (2005) finds that regulatory restrictions increase the incentives for risk-taking by reducing bank charter value and may have the unintended consequence of destabilizing the banking system.

5 Data and methods

We begin by identifying depository and non-depository institutions using the Standard Industry Classification (SIC) codes provided in the Compustat database.[5] We require that firms have continuous return data available from the Center for Research in Security Prices (CRSP) for at least 300 trading days prior to the first event leading up to Dodd Frank's passage (the introduction of the financial reform bill (HR 4173) in the House of Representatives on December 2, 2009) and 300 days after the last event date (the signing of the legislation into law by President Obama on July 21, 2010).[6] This criterion results in an initial sample of 694 institutions, of which 520 are depository institutions and 174 are non-depository institutions.

5.1 Estimating changes in risk measures

We estimate changes in four capital market-based measures of risk: variance, beta, and two estimates of unsystematic risk. We estimate the changes using four horizons within the pre-Dodd Frank and post-Dodd Frank event periods. The pre- and post-event horizons include

[4] Allen (2010) and Fama and Litterman (2012) argue that Dodd–Frank will not prevent failures and bailouts.

[5] We use the following two-digit Standard Industry Classification (SIC) codes: 60 for depository institutions, 63 for insurance companies and 62 for securities firms/brokers.

[6] We identify key legislative events leading up the Dodd–Frank's passage as reported in the Library of Congress (see http://thomas.loc.gov/home/LegislativeData.php?&n=BSS&c=111).

300, 200, 100 and 50 days before the first event on December 2, 2009 and 300, 200, 100 and 50 days after the passage of the law on July 21, 2010. For robustness, we also shift the event window forward 30 days (between January 2, 2010 and August 21, 2010) and back 30 days (between November 2, 2009 and June 21, 2010).

The first risk measure is the variance of daily stock returns [$Var(R_i)$] for each institution i. We calculate the change in total risk [$\Delta Var(R_i)$] from the pre- to the post-event periods as follows:

$$\Delta Var(R_i) = Var(R_i)Post - Var(R_i)Pre \tag{1}$$

The second risk and third risk measures are the change in systematic risk, $\Delta\beta_{1i}$, and the change in unsystematic risk measured as the change in the variance of the residuals [$Var(e_i)$], both estimated using the single factor model as follows:

$$R_{it} = \beta_{0i} + \beta_{1i}R_{mt} + e_{it} \tag{2}$$

Each risk measure is estimated during the pre-Dodd–Frank period and separately in the post-period. The change in beta for each institution i is given as:

$$\Delta\beta_{1i} = \beta_{1i}Post - \beta_{1i}Pre \tag{3}$$

The change in the variance of the residuals [$Var(e_i)$] is given as:

$$\Delta Var(e_i) = Var(e_i)Post - Var(e_i)Pre \tag{4}$$

An alternative measure of the conditional error variance, ε_{it}, is calculated as follows:

$$R_{it} = \bar{R}_{it} + \sqrt{h_{it}}\varepsilon_{it} \tag{5}$$

This estimation uses a GARCH (1, 1) model to estimate the variance of returns, h_{it}, conditional on past information as follows:

$$\begin{aligned} h_{it} &= \omega_i + \theta_i\left(R_{i,t-1} - \bar{R}_{i,t-1}\right)^2 + \varphi_i h_{i,t-1} \\ &= \omega_i + \theta_i h_{i,t-1}\varepsilon^2_{i,t-1} + \varphi_i h_{i,t-1} \end{aligned} \tag{6}$$

where the parameters ω, θ, and φ are estimated using maximum likelihood. We calculate the average GARCH conditional error variance (ε_i) over both the pre- and post-event periods and then calculate the change in the conditional error variance as follows:

$$\Delta\varepsilon_i = \varepsilon_i(Post) - \varepsilon_i(Pre) \tag{7}$$

We estimate the risk measures for all institutions then separately for depository and non-depository institutions. Since Dodd–Frank requires enhanced supervision for institutions with an asset threshold in excess of $50 billion, we also examine separately the risk shift for institutions with total assets $\geq$$50 billion and institutions with assets $<$$50 billion.

5.2 Explaining changes in risk for all financial institutions

We evaluate governance and operating characteristics of the institutions directly addressed by Dodd–Frank to explain changes in measures of institution-level risk. A key objective of Dodd–Frank is to improve accountability and transparency in the financial system. Dodd–Frank strengthens corporate governance by authorizing the SEC to issue rules allowing

shareholders to use proxy materials to nominate potential board members and requires that firms explain CEO duality. Given these new mandates, we identify governance measures that are likely to promote these objectives. We use three governance measures: The Corporate Library (TCL) governance rating, institutional ownership, and insider ownership.

The TCL rating is an overall governance risk assessment metric provided by TCL which assigns a rating based on the level of concern associated with the firm's governance structure. We convert these qualitative ratings to a governance score ranging from 1 to 5 with 5 being the best governance score. On the one hand, institutions with strong (weak) governance may see less (more) pronounced reductions in risk, to the extent that well-governed firms have risk-taking under control and weakly-governed firms do not. Alternatively, institutions with strong governance mechanisms may more effectively incorporate the new legislative requirements, thus experiencing more pronounced reductions in risk.

Insider ownership has also been positively linked to risk taking (e.g., Saunders et al. 1990). To the extent that Dodd–Frank provides incentives to curb risk taking, institutions with relatively high levels of inside ownership should experience a more pronounced risk shift. Institutional owners perform an important monitoring function and the new rules on proxy access will likely increase their power. We expect this measure to be inversely related to the risk shift, if the power of institutional owners prior to Dodd–Frank was insufficient to control risk. Institutional ownership is measured as the percentage of total shares outstanding held by institutional investors and insider ownership is the percentage of shares held by insiders. Both measures are obtained from TCL database.

We control for the size of the institution using two alternate proxies: (1) the natural log of total assets and (2) a dummy variable equal to 1 for institutions with total assets $\geq$\$50 billion and 0 otherwise. This latter measure more specifically hones in on institutions that are likely to be considered too-big-to-fail. We expect the largest institutions to experience a greater change in risk. We control for financial characteristics using Tobin's Q (the market value of equity divided by the book value of equity), cash flow (EBIT plus depreciation)/total assets, the capital ratio (equity/assets ratio), the cumulative percent change in the institution's stock price run-up in the 100-day period prior to the first key event leading up to Dodd–Frank's passage, and the type of institution (1 for depository institutions and 0 otherwise). Financial ratios are computed using end of year 2009 *Compustat* data.

We assess the relation between the risk changes and the explanatory variables for our full sample of financial institutions using the following model estimated using ordinary least squares:

$$\text{Risk} = f(\text{Capital ratio, TCL rating, institutional ownership, insider ownership, size, stock price run-up, Tobin's Q, cash flow, type of institution}) \tag{8}$$

where Risk $\in$ {Change in variance, change in unsystematic risk}.

5.3 Explaining changes in risk for banks

Given the unique role of depository institutions, we conduct a separate cross-sectional analysis for this subsample. This allows us to highlight bank-specific balance sheet measures that influence risk taking such as loan quality and volatility of funding sources.[7] We

[7] We thank an anonymous referee for suggesting this important set of characteristics.

include four bank-specific measures: non-performing loans (non-performing loans/total assets), deposit volatility (standard deviation of quarterly deposits for 40 quarters prior to first event date (12/02/2009) leading to the passage of the Dodd–Frank legislation), the deposit ratio (total deposits/total liabilities), and non-interest income (non-interest income divided by total assets). These measures are calculated using data from end of year 2009 Federal Reserve Y-9C reports.

The following expanded model for a subset of banks is also estimated using ordinary least squares:

$$\begin{aligned}\text{Risk} = f(&\text{Non-performing loans, deposit volatility, deposit ratio, non-interest income,}\\ &\text{capital ratio, TCL rating, institutional ownership, insider ownership, size,}\\ &\text{Tobin's Q, stock price run-up, cash flow, type of institution})\end{aligned} \tag{9}$$

where Risk $\in$ {Change in variance, change in unsystematic risk}.

6 Changes in risk

6.1 Changes in risk for all institutions

Table 1 shows the changes in the four risk measures over the three event windows and four horizons for the full sample of financial institutions. The three event windows are defined by shifting the definition of the Dodd–Frank legislative period from the base period of 12/2/2009–7/21/2010 forward 30 days, to 1/2/2010–8/21/2010, and back 30 days to 11/2/2009–6/21/2010 to capture any uncertainty regarding the event date.

Across the four horizons, we consistently detect significant reductions in both the total variance and the institution-specific variability, and the reductions are increasing as the horizon increases. Focusing on the base event period, the variance of equity returns declines by 0.0455 over the shortest horizon (−50, +50) and declines by 0.2732 over the longest horizon (−300, +300). Thus, the average institution experiences a decline in variance that is approximately six times greater in the long term than in the short term.

Table 1 shows a significant reduction in unsystematic risk using both the market model and GARCH risk measures. This is consistent with the expectation that institution-specific risk, including credit and liquidity risks which are determined by management, are expected to decline significantly with the Dodd–Frank legislation.

The average beta increases significantly over the two shortest horizons (−50, +50) and (−100, +100), reflecting increased sensitivity to market forces. It appears that uncertainties in the macro economy as a whole and the heightened sensitivity of the financial sector, in particular, initially overwhelm the potential risk reducing benefits of the legislation from the market's perspective. However, as we increase the horizon over which we estimate the risk shifts, we find that the increased market risk dissipates and significant reductions occur over the longer horizons. Overall, our results provide strong evidence of a significant reduction in all the risk measures across our sample of financial institutions.

To establish that the risk reduction observed among US banks is attributable to Dodd–Frank's passage, we estimate the change in variance for a sample of 20 non-US systematically important financial institutions for which data are available from Bloomberg. Although these banks also experience a reduction in variance (from 0.1990 to 0.0431, a difference of −0.1516 that is statistically significant at the 1 % level), the magnitude of the

Table 1 Changes in risk measures surrounding the passage of the Dodd–Frank Act of 2010

Windows	$\Delta\sigma_r^2$		$\Delta\beta$		$\Delta\sigma_e^2$		Δ GARCH (1, 1)	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Base period: 12/2/2009–7/21/2010 (N = 694)								
(−300, +300)	−0.2732***	−0.1840***	−0.0470***	−0.0369**	−0.0234***	−0.0205***	−0.0020***	−0.0014***
(−200, +200)	−0.2075***	−0.1184***	−0.1436***	−0.1195***	−0.0182***	−0.0149***	−0.0014***	−0.0008***
(−100, +100)	−0.0598***	−0.0277***	0.0981***	0.1165***	−0.0082***	−0.0063***	−0.0006***	−0.0003***
(−50, +50)	−0.0455***	−0.0144***	0.2008***	0.2258***	−0.0066***	−0.0048***	−0.0004***	−0.0003***
Shift forward period: 1/2/2010–8/21/2010 (N = 694)								
(−300, +300)	−0.2142***	−0.1395***	−0.0874***	−0.0497***	−0.0195***	−0.0170***	−0.0016***	−0.0011***
(−200, +200)	−0.2246***	−0.1376***	−0.1682***	−0.1407***	−0.0187***	−0.0156***	−0.0012***	−0.0007***
(−100, +100)	−0.0601***	−0.0290***	0.1204***	0.1270***	−0.0082***	−0.0069***	−0.0005***	−0.0003***
(−50, +50)	−0.0097	−0.0033***	0.1550***	0.1782***	−0.0031***	−0.0032***	−0.0008***	−0.0003***
Shift back period: 11/2/2009–6/21/2010 (N = 694)								
(−300, +300)	−0.2852***	−0.1970***	−0.0556***	−0.0391***	−0.0239***	−0.0217***	−0.0020***	−0.0015***
(−200, +200)	−0.2358***	−0.1404***	−0.1637***	−0.1388***	−0.0193***	−0.0157***	−0.0015***	−0.0010***
(−100, +100)	−0.0716***	−0.0298***	0.1235***	0.1357***	−0.0087***	−0.0069***	−0.0005***	−0.0004***
(−50, +50)	−0.0114	−0.0034***	0.1586***	0.1796***	−0.0032***	−0.0032***	−0.0001	−0.0001***

This table reports the mean and median changes in total risk ($\Delta\sigma_r^2$), market risk ($\Delta\beta$), unsystematic market model risk ($\Delta\sigma_e^2$), and unsystematic GARCH risk [ΔGARCH(1, 1)] surrounding the passage of Dodd–Frank. The pre- and post-Dodd–Frank periods include 300, 200, 100, and 50 days prior to 12/2/2009 and following 7/21/2010, respectively. We also shift the windows forward 30 days (between 1/21/2010 and 8/21/2010) and back 30 days (between 11/2/2009 and 6/21/2010). The change in total risk is defined as the difference in the post- and pre-Dodd–Frank variance of raw, daily returns. The change in beta is estimated as the difference in the post- and pre-Dodd–Frank market beta, where betas are estimated using OLS with daily returns. The change in idiosyncratic market model risk is defined as the difference in the post- and pre-Dodd–Frank error variance, where error variances are calculated using the error terms from the OLS estimation of the single factor market model with daily returns in the pre- and post-Dodd–Frank period. The change in GARCH risk is estimated using a GARCH (1, 1) model. The *t* test and Wilcoxon signed-rank test evaluate the null hypothesis that the mean and median change in each respective risk measure equals zero

***, ** Statistical significance at the 1 and 5 % levels, respectively

decline is significantly lower than that experienced by US banks. Since other countries were also implementing measures designed to stabilize their banking systems, it is not surprising that we observe a reduction in risk for these banks. However, the more dramatic reduction among US banks suggests that the risk reduction is attributable to the passage of Dodd–Frank. In the interest of brevity, we do not tabulate the results.

To further corroborate that our results are more likely attributable to Dodd–Frank than to market wide forces in general, we run simple correlations between the average error variance obtained from the GARCH model and the volatility index (VIX) in both the pre- and post-Dodd–Frank periods. In the period prior to the passage of Dodd–Frank, the correlation is 0.7429. Following the passage of the law, the correlation falls to 0.5373. Since we find that the correlation actually decreases, we are more confident that the increase in risk that we capture is not simply due to changes in the overall volatility of the market.

6.2 Changes in risk for subsets

We further examine the risk shifts for subsets of institutions in Table 2. We separately examine depository and non-depository institutions as well as size-based groups based on the $50 billion asset threshold. The table reports the four risk shift measures estimated using the base event period for the (−300, +300) horizon. Both depository and non-depository institutions experience significant reductions in risk. Although the reduction in risk appears to be smaller for depository institutions compared to the non-depository

Table 2 Changes in risk measures for subsets of financial institutions

	All institutions (N = 694)	Depository institutions (N = 520)	Non-depository institutions (N = 174)	Assets <$50 billion (N = 628)	Assets ≥$50 billion (N = 66)
Variance					
Pre	0.3927	0.3958	0.3837	0.3802	0.5119
Post	0.1195	0.1353	0.0725	0.1249	0.0682
Δ Variance	−0.2732***	−0.2605***	−0.3111***	−0.2553***	−0.4437***
Beta					
Pre	0.9587	0.8190	1.3761	0.8639	1.8606
Post	0.9117	0.8332	1.1464	0.8569	1.4332
Δ Beta	−0.0469**	0.0142	−0.2297***	−0.0070	−0.4274***
Error variance: market model					
Pre	0.0498	0.0517	0.0439	0.0497	0.0504
Post	0.0264	0.0289	0.0190	0.0274	0.0173
Δ Error variance	−0.0234***	−0.0228***	−0.0249***	−0.0223***	−0.0331***
Error variance: GARCH model					
Pre	0.0029	0.0031	0.0024	0.0029	0.0029
Post	0.0009	0.0010	0.0005	0.0009	0.0004
Δ Error variance	−0.0020***	−0.0020***	−0.0020***	−0.0020***	−0.0025***

This table reports the mean risk measures over the pre- and post-Dodd–Frank periods for subsets of financial services firms. The pre- and post-Dodd–Frank periods are measured using the (−300, +300) horizon around the 12/2/2009–7/21/2010 event window. We use *t* tests to capture the significance of the changes

***, ** Significance at the 1 and 5 % levels respectively

institutions, the shifts in total risk and shifts in error variance measures are not significantly different between these two groups.[8]

Institutions with assets <$50 billion threshold have a variance of returns of 0.3802 in the pre-Dodd–Frank-period and significantly lower variance (0.1249) in the post-Dodd–Frank period. The risk reduction is most impressive for institutions with assets exceeding $50 billion. In the pre-Dodd–Frank-period, the variance of equity returns for these largest institutions is 0.5119, falling to 0.0682 in the post period. For all four risk measures, the declines are significantly different between the size subsets at the 1 and 5 % levels based on unreported t-statistics. Thus, it is clear that risk reductions are amplified for the largest institutions.

Notably, the largest institutions are consistently more risky compared to smaller institutions prior to Dodd–Frank's passage. For example, prior to Dodd–Frank, the average variance of the largest institutions is 0.5119 compared to 0.3802 for the smaller institutions. However, following the law's passage the picture is reversed, i.e., large institutions have a lower variance (0.0682) compared to smaller institutions (0.1249). A similar pattern is evident for the two error variance measures. In contrast, the largest institutions have consistently higher betas than smaller institutions in both the pre- and post-Dodd–Frank periods.

7 Explaining changes in risk: cross-sectional regression analyses

In this section, we report the results of our regression analyses for all institutions and for various subsets. We first report the summary statistics for the explanatory variables used in the regressions.

7.1 Summary statistics

Table 3 shows the mean and standard deviation for the full sample and various subsets based on the type of institution and asset size.[9] Panel A shows summary statistics for governance measures and other control variables that are available across all institutions and subsets. Data constraints reduce our overall sample to 167 institutions, of which 81 are non-depository and 86 are depository institutions. There are 131 institutions with total assets <$50 billion, and 36 institutions with total assets ≥$50 billion.

In terms of the governance measures, the average TCL rating for all institutions is 3.03 with the largest institutions have an average TCL rating of 2.75, the lowest of all portfolios. As expected, institutional ownership is highest among the largest institutions (71 %). Insider ownership is almost 8 %, on average, across all institutions. On average, non-depositories manage more assets than depositories, and depositories have a lower capital-to-asset ratio (10.08 %) compared to non-depositories (26.02 %). The largest institutions have lower capitalization and a more pronounced increase in their stock prices in the 100-days leading up to Dodd–Frank's passage. Tobin's Q is comparable across the institutions, but is lowest for the largest institutions. Cash flow as a percentage of total assets is

[8] The magnitude of decline in the risk measures is not significantly different between the depository and non-depository institutions at least at the 5 % level, except for the average change in beta. Depository institutions do not have a significant change in beta but non-depository institutions have a significant decline in beta. The difference between the two portfolios is significant at the 1 % level.

[9] Our sample size is reduced considerably because of data constraints.

Table 3 Summary Statistics

	All institutions			Non-depository institutions			Depository institutions			Total assets <$50 billion			Total assets ≥$50 billion		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Panel A: Governance and other measures															
Governance measures															
TCL rating	167	3.030	0.867	81	3.111	0.822	86	2.954	0.906	131	3.107	0.879	36	2.750	0.770
Institutional ownership	167	0.630	0.253	81	0.686	0.292	86	0.576	0.196	131	0.608	0.265	36	0.710	0.180
Insider ownership	167	0.080	0.106	81	0.095	0.134	86	0.065	0.068	131	0.094	0.112	36	0.030	0.059
Other measures															
Size	167	0.216	0.412	81	0.235	0.426	86	0.198	0.401	131	0.000	0.000	36	1.000	0.000
Capital ratio	167	17.808	13.305	81	26.019	15.023	86	10.076	2.926	131	19.180	13.836	36	12.819	9.792
Stock price run-up	167	0.135	0.192	81	0.164	0.18	86	0.108	0.200	131	0.115	0.199	36	0.210	0.147
Tobin's Q	167	1.154	0.721	81	1.175	0.904	86	1.134	0.495	131	1.185	0.779	36	1.040	0.436
Cash flow	167	3.001	4.691	81	4.795	6.143	86	1.311	1.224	131	3.226	5.058	36	2.182	2.905
Type of institution	167	0.515	0.501		–	–		–	–	131	0.527	0.501	36	0.472	0.506
Panel B: Bank-specific measures															
Risk taking measures															
Non-performing loans	–	–	–	–	–	–	75	1.731	1.247	57	1.560	1.22	18	2.272	1.207
Deposit volatility	–	–	–	–	–	–	75	0.443	1.133	57	0.521	1.289	18	0.196	0.155
Deposit ratio	–	–	–	–	–	–	75	62.218	16.431	57	66.972	10.996	18	47.163	21.474
Non-interest income	–	–	–	–	–	–	75	1.823	1.121	57	1.532	0.993	18	2.743	1.019

This table shows summary statistics for all institutions and. TCL rating is the overall governance score (ranging from 1 to 5, with 5 being the best); institutional ownership is the percentage of shares held by institutions; insider ownership is the percentage of shares held by insiders; size >$50B is equal to 1 if assets exceed $50B and 0 otherwise; capital ratio is the equity/assets ratio; stock price run-up is the cumulative percent change in the institutions stock price in the 100 trading day-period prior to first event date (12/02/2009); Tobin's Q is the market value of equity/book value of equity; cash flow is (EBIT + depreciation)/total assets; type of institution is equal to 1 for banks and savings institutions and 0 otherwise; non-performing loans is non-performing loans/total assets; deposit volatility is standard deviation of quarterly deposits for 40 quarters prior to first event date (12/02/2009); deposit ratio is total deposits/total liabilities; non-interest income is non-interest income/total assets

3.0 % on average, but the level for non-depositories is more than twice the level for depositories. Depository institutions represent approximately 52 % of our sample.

Panel B reports summary statistics for key variables related to bank risk taking. Our original sample of 86 depository institutions in Panel A is reduced to 75 depository institutions (hereafter banks) for which data are available. The average amount of non-performing loans is 1.73 %, and the largest banks (N = 18) have a higher level of non-performing loans (2.27 %) compared to smaller banks (1.56 %, N = 57). The variability of deposits is highest among smaller institutions that are also more reliant on deposits as a funding source (67 % compared to 47 % for large institutions). As expected, non-interest income as a percentage of total assets is higher for the largest banks (2.74 %) compared to smaller banks (1.53 %).

7.2 Regression results: changes in variance and levels of explanatory variables

Table 4 shows the regression results for all institutions combined (models 1, 2, and 3) and separately for banks (models 4, 5, and 6). We focus on the changes in risk measures that are of primary concern to regulators, variance and unsystematic risk, since they are influenced by institution-specific characteristics. As noted by Saunders et al. (1990) discretionary risk taking is reflected in unsystematic risk rather than systematic risk. Models 1, 2, and 3 (4, 5, and 6) differ with respect to the dependent variable used to capture the risk shifts and are estimated using ordinary least squares.[10] In all instances, the explanatory variables are measured at their 2009 levels.

Focusing on all institutions, the TCL rating has a negative coefficient that is statistically significant across all three models. This shows that institutions with relatively strong governance prior to the legislation are expected to effectively incorporate the new legislative requirements such that they curb discretionary risk taking to a greater extent than institutions with weak governance. This interpretation is corroborated by the fact that institutional ownership is also inversely related to the risk reduction, suggesting that the monitoring function of institutional investors will be effective in motivating institutions to reduce risk. Insider ownership is not significantly related to the risk changes. Together these results point to the effectiveness of external monitors in influencing the business practices of financial institutions.

The largest institutions experience greater risk reduction. This result is consistent with Table 2, and the intuition that larger institutions are perceived to be a greater systemic threat to the financial system, and as such, Dodd–Frank incentivizes these firms to reduce risk. This is especially important, given the stated intent to end the too-big-to-fail doctrine. Interestingly, our analyses do not show that the removal of the implied protection for the largest institutions influenced the market to assess higher levels of risk for these firms. Other control variables are also significantly related to the risk shifts.

Models 4, 5, and 6 show the results for banks exclusively, allowing us to incorporate balance sheet and income statement measures of risk that are directly relevant to banks. Consistent with our expectation, banks with a higher level of non-performing loans prior to

[10] The models include the size proxy that is defined to be a dummy variable equal to 1 for institutions with total assets ≥$50 billion and 0 otherwise, because this measure more specifically hones in on institutions that are likely to be considered too-big-to-fail. Nevertheless, when we run the models using the continuous form of the size variable, our results are mainly consistent.

Table 4 Regression results: change in risk and levels of explanatory variables

Variables	All institutions			Banks		
	Model 1: Δ variance	Model 2: Δ error variance (market model)	Model 3: Δ error variance [GARCH (1, 1)]	Model 4: Δ variance	Model 5: Δ error variance (market model)	Model 6: Δ error variance [GARCH (1, 1)]
Risk-taking measures						
Non-performing loans	–	–	–	−0.0464**	−0.0034***	−0.0003***
Deposit volatility	–	–	–	−0.0168	−0.0016	−0.0001
Deposit ratio	–	–	–	−0.0018*	−0.0002**	−0.0000
Non-interest income	–	–	–	−0.0413***	−0.0025***	−0.0002**
Capital ratio	−0.0000	−0.0000	−0.0000	0.0023	−0.0002	−0.0000
Governance measures						
TCL rating	−0.0576**	−0.0033***	−0.0004***	−0.0104	−0.0000	−0.0001
Institutional ownership	−0.1270**	−0.0094***	−0.0006**	−0.0850	−0.0053	−0.0005
Insider ownership	−0.0535	−0.0048	−0.0006	0.0204	−0.0037	−0.0010
Other measures						
Size	−0.2338***	−0.0156***	−0.0010***	−0.1988***	−0.0155***	−0.0005**
Stock price run-up	−0.3588***	−0.0259***	−0.0020***	−0.0664	−0.0086*	−0.0006*
Tobin's Q	0.0102	0.0008	−0.0000	0.0658*	0.0027	0.0003
Cash flow	0.0229***	0.0010***	0.0002***	0.0334*	0.0023*	0.0003***
Type of institution	0.0361	−0.0041**	0.0003	–	–	–
N	167	167	167	75	75	75

Table 4 continued

Variables	All institutions			Banks		
	Model 1: Δ variance	Model 2: Δ error variance (market model)	Model 3: Δ error variance [GARCH (1, 1)]	Model 4: Δ variance	Model 5: Δ error variance (market model)	Model 6: Δ error variance [GARCH (1, 1)]
Adjusted R^2	0.7351	0.8370	0.7260	0.9046	0.9348	0.9194
F-value	52.49***	96.29***	50.16***	60.29***	90.62***	72.27***

This table shows the relation between change in risk and the levels of institution-specific characteristics in 2009. The models differ by the risk measure used as the dependent variable and are estimated using OLS. The risk measures are estimated during the base period using the (−300, +300) window. Non-performing loans is non-performing loans/total assets; Deposit volatility is standard deviation of quarterly deposits for 40 quarters prior to first event date (12/02/2009); deposit ratio is total deposits/total liabilities; non-interest income is non-interest income/total assets; capital ratio is the equity/assets ratio; TCL rating is the overall governance score (ranging from 1 to 5, with 5 being the best) obtained from the Board Analyst database; institutional ownership is the percentage of shares held by institutions; insider ownership is the percentage of shares held by insiders; size is a dummy variable equal to 1 for institutions with total assets ≥$50 billion, 0 otherwise; stock price run-up is the cumulative percent change in the institutions stock price in the 120 trading day-period prior to first event date (12/02/2009); Tobin's Q is the market value of equity/book value of equity; cash flow is (EBIT + depreciation)/total assets; type of institution is equal to 1 for banks and savings institutions, and 0 otherwise

***, **, * Significance at the 1, 5, and 10 % levels respectively

Dodd–Frank experience the greatest risk reduction. This finding suggests that the market believes that these banks will reduce or eliminate toxic assets from their balance sheets. Banks that are more reliant on deposits as a funding source also experience the greatest reduction, potentially indicating that the market rewards those banks that utilize safe funding sources. Notably, banks with a higher level of non-interest income experience a greater reduction in risk, consistent with the idea that riskier sources of income may be curbed via the additional oversight of the Oversight Council that is established within the law. The governance measures are not significant for the sample of banks. Since banks are already highly regulated, it is not surprising that internal governance measures are not significant given the substitution effect between internal and external governance (regulation). The coefficient on size is negative and significant, reaffirming that the largest banks have greater incentives to reduce risk, in line with a key objective of the Dodd–Frank legislation to eliminate the too-big-to-fail doctrine. As our earlier results show, these results do not indicate that the removal of the implied protection for the largest institutions is associated with higher levels of risk assigned to these firms by the market.

Together these results suggest that the largest banks and those engaged in riskier business practices prior to the legislation experience the greatest reduction in risk. These are the very institutions primarily targeted by Dodd–Frank pointing to the efficacy of the legislation.

7.3 Regression results: change in risk and change in explanatory variables

Our regression results thus far focus on the relation between the changes in risk and the levels of the explanatory variables in 2009 prior to the passage of Dodd–Frank. Arguably, the change in risk over the long-term period (−300, +300) may be more likely related to the change in firm characteristics following the passage of the legislation. Indeed, Dodd–Frank is designed to encourage institutions to alter their business practices, including reducing their level of non-performing loans and increasing their capital ratios. Presumably, the market identifies which institutions will actually follow through in the expected direction and are assigned the greatest reduction in risk.

We investigate this possibility by re-estimating the models using the changes in the characteristics as explanatory variables. We measure the change in each explanatory variable as the difference between the level of the variable in 2011 relative to 2009. The additional data constraints reduce our sample to 110 institutions, of which 49 are banks.

Table 5 shows the mean and median change in the variables. The sample that includes all institutions has a significant increase in institutional ownership but a significant decrease in insider ownership. Performance measured in terms of Tobin's Q also deteriorates over the 2 year period. Using the sample of only banks, we find that non-performing loans falls significantly, reflecting the emphasis on improving balance sheets follow Dodd–Frank. Non-interest income also declines significantly, perhaps reflecting a move toward more traditional banking activities. As expected, banks have significantly improved their capitalization. Governance measures point to increased institutional ownership and reduced insider ownership. Performance measures paint a mixed picture with significant declines in Tobin's Q and significant improvement in cash flow.

The regression results are shown in Table 6. Institutions that increased their capital ratios following the passage of the legislation show a greater reduction in risk, consistent

Table 5 Changes in institution-specific measures following Dodd–Frank

	All institutions			Banks		
	N	Mean	Median	N	Mean	Median
Risk-taking measures						
Δ Non-performing loans	–	–	–	49	−0.7965***	−0.6100
Δ Deposit volatility	–	–	–	49	0.0545	0.0000
Δ Deposit ratio	–	–	–	49	−1.3190	−0.8400
Δ Non-interest income	–	–	–	49	−0.1884**	−0.1700
Δ Capital ratio	110	0.3436	0.6404	49	1.2144***	1.0309
Governance measures						
Δ TCL rating	110	−0.1182*	0.0000	49	−0.1224	0.0000
Δ Institutional ownership	110	0.0510***	0.0270	49	0.0900***	0.0790
Δ Insider ownership	110	−0.0088***	−0.0018	49	−0.0137***	−0.0083
Other measures						
Δ Size	110	−0.0350	−0.0452	49	0.0252	−0.0104
Δ Tobin's Q	110	−0.1987***	−0.1632	49	−0.2271***	−0.2337
Δ Cash flow	110	−0.0314	0.3472	49	0.9323***	0.6495

This table reports the mean and median changes in risk taking, governance and other measures from 2009 to 2011. Δ Non-performing loans is the change in non-performing loans/total assets; Δ deposit volatility is the change in the standard deviation of deposit volatility; Δ deposit ratio is the change in total deposits/total liabilities; Δ non-interest income is the change in non-interest income/total assets; Δ capital ratio is the change in equity/assets ratio; Δ TCL rating is the change in the overall governance score (ranging from 1 to 5, with 5 being the best) obtained from the Board Analyst database; Δ institutional ownership is the change in percentage of shares held by institutions; Δ insider ownership is the change in the percentage of shares held by insiders; Δ size is the change in the natural log of total assets; Δ Tobin's Q is the change in the market value of equity/book value of equity; Δ cash flow is the change in (EBIT + depreciation)/total assets

***, **, * Significance at the 1, 5, and 10 % levels respectively

with the predictions of capital adequacy theory. With respect to the governance measures, the TCL rating is only marginally significant.[11] However, increased institutional ownership is associated with greater risk reduction, supporting the importance of the monitoring function of these investors. Institutions that reduced their level of assets, presumably by shedding toxic assets, experienced the greatest reduction in variance of returns. Depository institutions show greater risk reduction in these models.

The results for the bank sample (Models 4, 5, and 6) provide interesting insights. The coefficient on the change in non-performing loans is positive and statistically significant, suggesting that banks that reduced their level of non-performing assets experience the largest decline in risk. Changes in the volatility of deposits and funding sources are not significantly related to risk changes. Additionally, banks that increased their capital ratio experienced the greatest reduction in risk. Unlike the full sample of institutions, changes in governance measures are generally not significant in explaining the change in risk. This confirms our earlier conclusion that, since banks are more heavily regulated than other institutions, the impact of other monitoring mechanisms is reduced. Banks with higher cash flow following Dodd–Frank also experienced the greatest risk reduction.

[11] The TCL rating is "sticky" and does not change significantly even over a 2 year period (2009–2011). Thus, it is not surprising that this measure is only marginally significant.

Table 6 Regression results: change in risk and changes in explanatory variables

Variables	All institutions			Banks		
	Model 1: Δ variance	Model 2: Δ error variance (market model)	Model 3: Δ error variance [GARCH (1, 1)]	Model 4: Δ variance	Model 5: Δ error variance (market model)	Model 6: Δ error variance [GARCH (1, 1)]
Risk-taking measures						
Δ Non-performing loans	–	–	–	0.0925**	0.0065**	0.0004**
Δ Deposit volatility	–	–	–	0.0300	0.0031	0.0000
Δ Deposit ratio	–	–	–	0.0051	0.0003	0.0000
Δ Non-interest income	–	–	–	0.0802	0.0043	0.0002
Δ Capital ratio	−0.0205**	−0.0012*	−0.0001	−0.0485**	−0.0038*	−0.0002**
Governance measures						
Δ TCL rating	0.0780*	0.0052*	0.0004	0.0313	0.0022	0.0001
Δ Institutional ownership	−0.9699***	−0.0632***	−0.0068***	0.2290	0.0163	−0.0011
Δ Insider ownership	0.1668	0.0102	0.0012	0.8554	0.0821	0.0063**
Other measures						
Δ Size	0.2471**	0.0077	0.0013*	0.1115	−0.0006	0.0005
Δ Tobin's Q	0.0537	0.0067	0.0003	0.0808	0.0192*	0.0006
Δ Cash flow	−0.0008	0.0001	−0.0000	−0.0675**	−0.0069**	−0.0005***
Type of institution	−0.1097**	−0.0148***	−0.0007**	–	–	–
N	110	110	110	49	49	49
Adjusted R^2	0.2948	0.4122	0.3091	0.7670	0.7974	0.8647
F-value	6.75	10.64	7.15	15.66	18.53	29.47

This table reports the regression results for the 1-year changes in variance measures on risk taking and governance measures. The models differ by the risk measure used as the dependent variable and are estimated using OLS. The changes in the risk measures are estimated during the base period using the (−300, +300) window. Changes in the explanatory variables are measured as the change from 2009 to 2011. Δ Non-performing loans is the change in non-performing loans/total assets; Δ deposit volatility is the change in the standard deviation of deposit volatility; Δ deposit ratio is the change in total deposits/total liabilities; Δ non-interest income is the change in non-interest income/total assets; Δ capital ratio is the change in equity/assets ratio; Δ TCL rating is the change in the overall governance score (ranging from 1 to 5, with 5 being the best) obtained from the Board Analyst database; Δ institutional ownership is the change in percentage of shares held by institutions; Δ insider ownership is the change in the percentage of shares held by insiders; Δ size is the change in the natural log of total assets; Δ Tobin's Q is the change in the market value of equity/book value of equity; Δ cash flow is the change in (EBIT + depreciation)/total assets; Type of institution is equal to 1 for banks and savings institutions, and 0 otherwise

***, **, * Significance at the 1, 5, and 10 % levels respectively

8 Conclusions

We present evidence that discretionary risk taking by financial institutions has declined following the passage of Dodd–Frank. The effect is not transient and is magnified over longer horizons. The average institution experiences a decline in return variance that is six times greater in a longer-term horizon than in a shorter-term horizon, and the decline is most pronounced for the largest institutions. A similar pattern is observed for other risk measures as well.

When we examine our full sample of financial institutions in a cross-sectional framework, we show that institutions with stronger governance experience the greatest reduction. The cross-sectional evidence again shows that the largest institutions experience the greatest reduction in risk. This finding is especially important, given the stated intent to end the too-big-to-fail doctrine. Our results emphasize that passage of the law with the intent to remove the implied protection for the largest institutions has not influence the market to assess higher levels of risk for the largest financial institutions. Furthermore, in general, institutions with the highest risk profile in the era prior to Dodd–Frank curtail risk to a greater extent following the passage of the law.

Our analyses on a sample of banks, the most highly regulated financial institutions, reveal that banks exhibiting characteristics consistent with riskier business strategies prior to Dodd–Frank experienced the greatest risk reductions. Additionally, banks that alter their business practices by increasing their capital ratios and reducing their level of non-performing loans following the law's passage experienced the greatest reduction in risk. We also document a substitution effect between internal and external governance mechanisms among banks in the post Dodd–Frank period. Our results point to the efficacy of Dodd–Frank in reducing risk in the financial system.

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