THE DODD-FRANK ACT AND BASEL III: RISK IMPLICATIONS FOR GLOBAL BANKS

ABSTRACT

We examine the impact of the Dodd-Frank Act (DFA) and Basel III on market risk-taking behavior of global banks. Specifically, we measure the change in risk of global systemically important banks (G-SIBs) from the pre- global financial crisis (GFC) period to the post-European debt crisis period. Our results show a significant increase in each type of risk (total, market, and idiosyncratic) for G –SIBs from the pre-GFC period to the post-GFC period. While the risk of G-SIBs on average declined from the post-GFC period to the post-European debt crisis period, the risk level of G-SIBs on average, contrary to our expectations, is significantly higher during the post-European debt crisis period relative to the pre-GFC period. In addition, European global banks contributed significantly to the shift in risk from the pre-GFC period to the post- GFC period, as well as from the pre-GFC period to the post-European debt crisis period.

Key Words: *Dodd-Frank Act, Basel III, Bank Risk, and G-SIBs*

INTRODUCTION

During the 2007–2009 global financial crisis (GFC, *hereafter*), the impairment of a number of large U.S. financial institutions, including AIG, Bear Stearns, Citigroup, and Bank of America, the government takeovers of Fannie Mae and Freddie Mac and the collapse of Lehman Brothers sent shocks through the global financial system. The depth and severity of the crisis were exacerbated by weaknesses in the banking sector, such as excessive leverage, insufficient and low-quality capital, inadequate liquidity buffers, and the complexity and interconnectedness of large banks. In particular, large systemically important financial institutions (SIFIs)[1] in the United States were at the center of the crisis. U.S. regulators and supervisory authorities had limited options to prevent failures of these institutions as a means to maintain the safety and soundness of the global financial system during the crisis. As a consequence, public sector intervention to restore the global financial stability during the crisis was called for and was conducted on a massive scale. For example, G-20 world leaders initially responded to the GFC by establishing a banking sector reform program in their September 2009 Pittsburgh summit.

In July 2010, the U.S. Congress responded to the GFC by enacting the *Dodd-Frank Wall Street Reform and Consumer Protection Act* (hereafter, DFA), which is considered the most comprehensive overhaul of the U.S. financial regulatory system since the Great Depression.

[1] A typical definition of a SIFI has been provided by Federal Reserve Governor, Daniel Tarullo as follows: "*A financial institution is systemically important if the failure of the firm to meet its obligations to creditors and customers would have significant adverse consequences for the financial system and the broader economy*."

DFA is a major reform effort designed to confront many of the structural issues faced by large domestic as well as global banks and to limit the risk-taking behavior of those banks. Five days after the DFA was signed into law, the Basel Committee on international banking supervision (Basel Committee, *hereafter*) announced new international regulatory capital standards (hereafter, Basel III) on July 26, 2010. On September 12, 2010, global regulators, central bank governors, and the Basel Committee announced that they would fully endorse Basel III. Both DFA and international regulatory requirements are based on the global standards set by the Financial Stability Board (FSB, *hereafter*) and Basel Committee. Since then international regulatory authorities have developed new regulations comprising enhanced monitoring and supervision, establishments of resolution mechanisms in case of bank failure especially for those banks that would pose significant cost and risk to financial system. This has led to the emergence of "Globally Systemically Important Bank" (hereafter, G-SIB) [2]. G-SIBs are subject to additional capital surcharge and regulations. An official list of 29 G-SIBs deemed to be "*too-systemically-relevant to fail*" (e.g., Moenninghoff et al., 2015) was released at the end of November 2011. Regulators introduced capital reforms including a new leverage ratio, global liquidity standards together with systemic capital surcharge for G-SIBs.

The above regulations are likely to have significantly reduced the insolvency risk of G-SIBs, thereby reducing market-based risks such as total, systematic, and unsystematic risks of global banks. Basel III further emphasizes the improvement of the quality of core capital (common equity Tier 1 capital ratio) with the overriding goal of strengthening bank equity capital cushions and the safety and soundness of global banking system following the GFC. Again, these measures are likely to lead to reduction of market-based risks of global banks.

While GFC ended in 2009 in the US, the European sovereign debt crisis (European debt crisis, *hereafter*) erupted in late 2009. As concerns regarding the European debt crisis intensified in early 2010 and thereafter, the world financial markets remained very volatile during 2010-2012 period.[3] European debt crisis was ultimately contained by the financial guarantees of leading European countries. In order to identify the pre-crisis, crisis, and post-crisis periods surrounding GFC and European sovereign debt crisis, we divide our sample period (06/03/2006 -12/13/2015) into different time windows chosen at well specified events. More specifically, we divide our sample period into 5 different sub-periods. First subperiod (June 3, 2006 until July 31, 2007) is defined as the pre-global financial crisis (GFC) period (e.g., Ivashina and Scharfstein, 2010). Second subperiod (August 1, 2007 until December 31, 2009) is identified as the GFC period (e.g., McNulty and Akhigbe, 2017). The third subperiod (January 1, 2010 until the end of our sample period (December 13, 2015) is defined as the post-GFC period. The fourth subperiod (October 4, 2009 until December 14, 2012) is defined as the European debt crisis period. The European sovereign debt crisis started on October 4, 2009 when the government of Greece announced that 2009 budget deficit was expected to reach 6% of its GDP. The European debt

[2]G-SIBs are deemed systemically important to the global economy in the sense that the failure of one could trigger a global financial crisis. The prevention of their collapse and the limitation of the consequences of a collapse are important means of protecting these financial institutions. Please see the list of 29 G-SIBs (Appendix A) compiled in November 2014.

[3] During this period, European countries experienced collapse of financial institutions, defaults of sovereign bonds, and rapidly rising yield spreads on government bonds. The European debt crisis led to a loss of confidence in European banking system.

crisis apparently ended on December 14, 2012 when the European Council in Brussel announced the adoption of a Single Supervisory Mechanism (SSM) and a Single Resolution Mechanism (SRM) for EU banks. The final and the fifth subperiod which is defined as the post-European debt crisis spans from December 15, 2012 until the December 13, 2015 (the end of our sample period). Table 1(Panel A) reports pre-crisis, crisis, post-crisis periods surrounding GFC and European debt crisis.

TABLE 1(PANEL A): EVENT WINDOWS SURROUNDING GLOBAL FINANCIAL CRISIS AND EUROPEAN DEBT CRISIS

Event Description	Event Period
Pre- Global Financial Crisis (GFC)	06/03/2006 – 07/31/ 2007
Global Financial Crisis (GFC)	08/01/2007 – 12/31/ 2009
Post- Global Financial Crisis (GFC)	01/01/2010 – 12/13/ 2015
European Debt Crisis	10/04/2009 – 12/14/2012
Post-GFC plus European debt crisis	12/15/ 2012 –12/13/2015

As with most regulations, the passage of the DFA and Basel III agreements related to capital adequacy and liquidity requirements for internationally active banks were complex and involved negotiations, and political compromise that led up to the final passage of the DFA and announcements of Basel III. Table 1(Panel B) shows major event dates and a brief description of each event leading up to and including the passage of the Dodd-Frank Act and Basel III.

TABLE 1 (PANEL B): EVENTS SURROUNDING THE PASSAGE OF THE DODD-FRANK ACT OF 2010 AND BASEL III

Date	Event Description
12/2/2009	Congressman Frank introduced initial version of the proposed legislation in the House
12/11/2009	The House passed the Frank Bill
1/20/2010	President Obama endorsed the "Volcker Rule"
3/22/2010	The Senate Banking Committee passed the financial regulation bill.
4/13/2010	Lincoln proposed the derivative legislation to mandate sweeping changes in derivative market
5/20/2010	The Senate passed the Dodd Bill.
6/20/2010	Final bill was passed by the House.
7/15/2010	Final bill was passed in the Senate.
7/21/2010	President Obama signed the Dodd-Frank Act
7/26/2010	Basel III Agreements were reached by Basel Committee
9/12/2010	Central bank regulators and Basel Committee officially endorsed Basel III

After the end of GFC, the debate whether the global financial system has become more or less risky from the perspective of market-based risk still continues today. On the one side, new regulations including Dodd-Frank and Basel III require banks to lower insolvency risk by holding higher amount of capital, meeting global liquidity standards, and engaging in risk-reducing activities. On the other hand, critics argue that ''*the fundamental risks remained and the efforts of regulators and politicians were simply rearranging the deckchairs on the Titanic*.'' (Baily and Elliott, 2013). During GFC and European debt crisis periods, global financial system became fragile and vulnerable to systemic contagion. Following GFC, a number of studies related to bank risk and GFC have analyzed financial contagion and systemic risk in the banking sector (e.g. Caluuzo and Dong, 2015; Allen et al., 2012; and Huang et al., 2012). Based on measures of market risk, Calluzzo and Dong (2015) find that financial institutions have become less risky individually but that the financial system as a whole has become more vulnerable to systemic or contagion risk after the crisis.

Peltzman (1976) argues that regulation alters the riskiness of the regulated firm by lowering the variability of earnings, which should reduce total risk (variability of stock returns) of the firm. Previous studies also document significant market-based risk implications for banks following major regulatory reforms (e.g., Aharony, Saunders, and Swary, 1988; Bundt, Cosimano, and Halloran, 1992; Bhargava and Fraser, 1998; Akhigbe and Whyte, 2001a, 2001b, 2003, and 2004; Yildirim et al., 2006; and Geyfman and Yeager, 2009). Bhattacharya and Purnanandam (2012) provide empirical evidence that systematic risks (measured by the market beta) associated with banking stocks doubled over the 2000- 2006 period, while the measures of idiosyncratic (unsystematic) risk approximately halved over the same period. They also document that the excessive risk taking by banks was closely linked to the residential mortgage lending and securitization activities over the 2000-2006 period. Few studies also evaluate capital markets' assessment of risk of U.S. financial institutions following the passage of the DFA (e.g., Gao et al., 2018; and Akhibe et al., 2015). These studies in general find evidence that largest financial institutions in U.S. experience greatest reduction in total risk as well as idiosyncratic risk during the post-DFA era.

Following the passage of DFA and Basel III, we anticipate that internationally active banks are likely to have less incentive to increase either their total risk or idiosyncratic risk due to increased capital requirements, supervision, market disclosure, and implicit bank closure. In this study, we measure market-based risk of global banks (e.g., total risk, systematic risk, and idiosyncratic risk) following GFC and European debt crisis. We then compute changes in *total*, *systematic* and *idiosyncratic* risks (market-based risks) of global banks from the pre-crisis period to the post-crisis period. Total risk is of greatest concern to bank regulators because of the regulators' undiversified exposure to insolvency risk. An increase in bank's credit or liquidity risk can lead to an increase in idiosyncratic risk which can ultimately lead to a failure of a bank. On the other hand, an increase in equity capital ratio (lower leverage ratio) can lead to a decrease in default risk. Shareholders of banks are mostly concerned with market risk (market beta or equity beta), because rational investors are likely to diversify their idiosyncratic risk. However, the market beta (equity beta) of a typical firm is likely to be higher (lower) with more (less)

leverage.[4] Thus, increased capital ratio (lower leverage) requirements by Basel III capital standards are more likely to help reduce systematic risk. Since total risk is the sum of systematic risk and idiosyncratic risk, it is useful for regulators, managers and analysts to analyze the change of total risk which can either be attributed to idiosyncratic risk or to market risk or both.

In this paper, we focus on the impact of DFA and Basel III on market-based risks of large cross-border banks in general and on G-SIBs in particular. Specifically, the paper highlights the changing nature of risk of global banks from the pre- GFC period (June 3, 2006- July 31, 2007) to the post-GFC period (January 1, 2010- December 13, 2015). We also test the robustness of our results by measuring change in risk from the pre-GFC period (June 3, 2006- July 31, 2007) to the European crisis period (December 15, 2012- December 13, 2015). We argue that several provisions in the DFA and Basel III, such as systemic regulation, orderly liquidation authority, regulatory capital, minimum leverage ratio requirement and derivatives regulations, are likely to have a significant impact on the competitive environment in global banking as well as on risk and return profiles of stockholders of global banks. We examine whether G-SIBs have become less risky by reducing their risk-taking behavior (total risk) during the post-crisis period relative to the pre-GFC period. We further test whether changes in market assessment of risk of global banks are associated with bank-specific characteristics, such as bank size, capital ratios, non-performing loans, type of global bank (G-SIBs versus non- G-SIBs) and the type of home-country regulators. Finally, given the pivotal role that G-SIBs play in the global economy, findings of our study are likely to be of interest to bank managers, shareholders, regulators and policymakers.

The remainder of this paper is structured as follows. Section 2 outlines the major provisions of the DFA and Basel III. Section 3 provides a brief review of the related literature and develops a number of hypotheses. Section 4 outlines the data and sample statistics followed by a brief presentation of the empirical regression methodology. Empirical results are discussed in Section 5. Section 6 concludes.

MAJOR PROVISIONS OF THE DFA AND BASEL III

Major Provisions of the DFA

The DFA was proposed in 2009. After a lengthy legislative process, it was approved in July 2010. It is considered a hallmark banking legislation and it is likely to be one of the most influential piece of legislation in the history of the United States. President Obama called it "*a sweeping overhaul of the financial regulatory system, a transformation on a scale not seen since the reforms that followed the Great Depression.*"[5] The goals of this legislation, as proclaimed by its proponents, are "to promote the financial stability of the United States 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." In particular, this legislation forces stricter regulations on

[4] Equity Beta = Asset Beta + [1+(1-T)*D/E], where T= Marginal corporate tax rate; D= Total Debt; E= Total Equity; D/E = leverage ratio. Equity beta is also known as market beta,

[5]Available at http://www.whitehouse/gov/the_press-office/Remarks-of-the-President-on-Regulagory-Reform/

those financial institutions that are large and systemically important. Further, the proposed regulations require SIFIs to have a Recovery and Resolution Plan (RRP), such as "living wills," and to hold additional risk-based capital for loss absorption.

DFA provisions are likely to have extra-territorial consequences as well (e.g., Skeel and Cohan, 2011). For example, foreign banking organizations (FBOs) including several global European banks with at least US $50 billion in assets (worldwide test) that directly or indirectly own a US bank (US subsidiary), or that maintain a US branch or agency are subject to Dodd-Frank regulations. The reason is that the failure of such FBOs could jeopardize the stability of the US financial system due to their scope, size, and interconnectedness. Therefore, under the DFA, regulators are required to address systemic risk to US financial system posed by US operation of systemically important FBOs. DFA regulations also require the Financial Oversight Stability Council (FOSC, hereafter) to establish prudential standards in terms of capital ratio, liquidity ratio, and stress testing, and resolution plan (or "living wills") requirements not only for US-based SIFIs, but also for those systemically important FBOs that operate in the US. Thus, DFA provisions described above are designed to limit the risk of insolvency of systemically important FBOs that operate as US subsidiaries or US branches or agencies of foreign banks. As indicated earlier, total risk of a large cross-border bank operating in the US is of greatest concern to US regulators because they are concerned about the undiversified exposure to insolvency risk. By limiting the total risk, regulators aim to limit the exposure of taxpayers' bailout fund (insurance funds). Other DFA provisions such as Volcker Rules and regulations related to trading of derivatives are aimed at increasing the restrictions on trading and investment banking activities to reduce idiosyncratic risk of individual bank. Such regulations are also likely to have adverse impact on systemically important cross-border banks. Our study predicts that the proposed regulations under the DFA are likely to reduce the total risk and idiosyncratic risk of global banks in general, and of G-SIBs in particular.

Major Provisions of Basel III related to G-SIBs

Basel III emphasizes on the quality and quantity of core capital with an overriding goal of strengthening bank capital cushion on a global basis. Although the Basel Committee believes that increased capital and liquidity requirements will strengthen banks across-the-board, these efforts are designed to limit idiosyncratic risk as well as risk of insolvency. The BCBS with the Financial Stability Board (FSB, *hereafter*), a body established by the G20, suggested that systemically important banks should have loss absorbing capacity beyond the Basel III standards. Consequently, similar to DFA provisions, the Basel Committee along with FSB have developed a series of proposals addressing issues surrounding G-SIBs such as capital and liquidity surcharges, mandatory recovery and resolution plans, and contingent capital and bail-in debt requirements. These requirements are aimed at reducing the insolvency risk and total risk of individual banks, thereby reducing the exposure to taxpayers' bailout funds. As pointed earlier, a capital surcharge required for G-SIBs may also help reduce their market risk exposures (equity beta).

RELATED LITERATURE AND DEVELOPMENT OF HYPOTHESES

Literature Review

Prior studies offer important insights into investors' responses to bank regulations or deregulations that may affect risk, competitiveness, and overall performance of banks. For instance, 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 but also resulted in a decrease in total risk for thrifts. In addition, Bundt et al. (1992) show that the passage of the DIDMCA resulted in increases in both systematic and unsystematic risks. Sundaram et al. (1992) provide evidence that the passage of the Financial Institutions Reform, Recovery, and Enforcement act (FIRREA) of 1989 led to an increase in risk of both banks and savings and loans (S&Ls). Bhargava and Fraser (1998) report that banks experience a significant increase in both idiosyncratic and total risk in response to decisions by the Fed that allow bank holding companies (BHCs) to participate in investment banking. Akhigbe and Whyte (2003) examine changes in market assessment of bank risk following the Riegle-Neal Act of 1994 and find that banks experience significant decline in both unsystematic and total risks but no significant change in systematic risk. Akhigbe and Whyte (2001a) find a reduction in total risk taking after the passage of the 1991 Federal Deposit Insurance Corporation Improvement Act (FDICIA). Akhigbe and Whyte (2004) analyze effects of the Gramm-Leach-Bliley Act (GLBA) of 1999 on changes in the risk of financial institutions and find a significant increase in total risk for commercial banks and insurance companies after the passage of GLBA. Geyfman and Yeager (2009) examine changes in market-based risk measures from pre-GLBA to post-GLBA for universal banks and document that an increased participation in investment banking is associated with higher total risk and unsystematic risk but no change in systematic risk. Recent work by Akhigbe, Martin and Whyte (2015) examines changes in market assessment of risk of U.S. depository and non-depository institutions after the passage of the DFA. They present evidence that both depository and non-depository institutions experience a significant reduction in total, unsystematic, and market risks following the passage of the DFA. Akhigbe et al. (2015) conclude that the largest financial institutions in the United States experience the greatest decline in total and unsystematic risks. Their findings also indicate that several bank-specific characteristics, including bank size, capital ratio, and non-performing loan ratios, are significant in explaining bank risk.

Development of Hypotheses

Nearly ten years after the collapse of large institutions, such as Bear Stearns and Lehman Brothers, and eight years after the passage of the DFA in July 21, 2010 coupled with the announcement of Basel III agreements by the Basel Committee in July 26, 2010, the debate about whether the global banking system has become safer after the GFC and European sovereign debt crisis continues. In this section, we present the arguments that support hypotheses that the passage of the DFA along with the announcement of Basel III may result in a decrease in total risk, idiosyncratic risk, and market risk of global banks from the pre- GFC period to post-GFC and post-European sovereign debt crisis periods.

Prior studies (e.g., Rajan, 2010; Gao et al., 2013; Balasubramanian and Cyree, 2014; Calluzzo and Dong, 2015; Akhigbe et al., 2015) provide evidence that the passage of the DFA has made large and complex financial institutions in the U.S. (SIFIs) have become safer by reducing their idiosyncratic risk and total risk by requiring banks to maintain higher capital ratios, to increase liquidity ratios, and to lower credit risk. Bank regulations underlying DFA and Basel III were designed to lower insolvency risk, thereby to decrease total risk by imposing market discipline, and taking appropriate regulatory actions to prevent excessive risk taking behavior of global banks. For example, anecdotal evidence suggests that large Wall Street firms shifted their core business from risky investment banking and trading to safer wealth and asset management business to lower idiosyncratic risk as well as and total risk of firms.[6] As indicated, several provisions in the DFA and Basel III, including much stricter regulations, such as systemic regulation, orderly liquidation authority, regulatory capital, and derivatives regulation, are aimed at reducing trading and investment banking activities of systemically important banks and lowering idiosyncratic (unsystematic) risk as well as total risk of global banks. Therefore, one would predict that G-SIBs would be less risky after the passage of the DFA and the announcement of Basel III agreements.

According to the "too-big-too- fail" (TBTF) hypothesis, regulators are reluctant to close or unwind the large and complex banks. This results in moral hazard behavior that leads large banks to take excessive risk. Total risk is of greatest concern to bank regulators because of the regulators' undiversified exposure to insolvency risk. The DFA, together with Basel III provisions have addressed this insolvency by requiring G-SIBs to have a greater oversight, and a resolution and recovery plan (RRP), such as a "living will," and to hold additional common equity Tier 1 capital for loss absorption (systemic capital surcharge). As a consequence, it is anticipated that additional capital surcharge, leverage ratio requirement, and liquidity provisions associated with DFA and Basel III could lead to a significant decline in both idiosyncratic risk and total risk of G-SIBs.

Thus, the issue of whether risk in G-SIBs decreases after the passage of the DFA and the announcement of Basel III agreements is an empirical question that we address in this study. We examine this issue by employing a control group that comprises a sample of non-systemically important global banks. Although it is difficult to identify control firms unaffected either by the DFA or Basel III given the interconnectedness of global banking system, we believe that, in response to the passage of the DFA and Basel III, G-SIBs are more likely to be affected than those that are non-systemically important global banks. Based on the discussion above, the following null hypotheses are tested for the sample of global banks that comprise G-SIBs and global non-systemically important banks (hereafter non-G-SIBs):

H1a: There is no significant shift in *total* risk associated with G-SIBs from the pre- GFC crisis period to the post-GFC period. Similarly, there is no significant shift in total risk associated with G-SIBs from the pre- GFC period to the post-European debt crisis period.

[6] "Life on Wall Street Grows Less Risky," by Aron a Lucchetti and Julie Steinberg, *Wall Street Journal*, September 9, 2013.

H1b: There is no significant shift in *total* risk associated with non-G-SIBs from the pre-GFC period to post-GFC period. Similarly, there is no significant shift in *total* risk associated with non-G-SIBs from the pre-GFC to the post-European debt crisis period.

H2a: There is no significant shift in unsystematic (*idiosyncratic*) risk associated with G-SIBs from the pre-GFC period to the post-GFC period. Similarly, there is no significant shift in unsystematic (*idiosyncratic*) risk associated with G-SIBs from the pre-GFC period to the post-European debt crisis period.

H2b: There is no significant shift in unsystematic (*idiosyncratic*) risk associated with non-G-SIBs from the pre-GFC period to the post-GFC. Similarly, there is no significant shift in unsystematic (*idiosyncratic*) risk associated with non-G-SIBs from the pre-GFC period to the post-European debt crisis period.

Akhigbe and Whyte (2001b) find that the capital adequacy requirements under the FDICIA resulted in a significant decline in market risk (market beta) of banks. Previous studies also show that expectations associated with bank stock returns were significantly different before and after the GFC (e.g., Beltratti and Stulz; 2012; and Bhimjee, Ramos, and Dias, 2016). Bhimjee, Ramos, and Dias (2016) find that shareholders of global banks favored diversification strategies including their involvements in non-traditional activities and financial innovation-related products before the GFC. They provide evidence that the global uncertainty regarding the soundness of bank balance sheets affected the valuation and market risk of the financial industry worldwide. Further, they argue that the outlook for future profitability of global banks during post-GFC period is likely to help shift market expectations in favor of more conservative banking business strategies that promote traditional banking activities. Both DFA and Basel III require global banks to hold more common equity capital leading to lower leverage ratio (i.e. higher capital ratio). As indicated earlier, everything else equal, a decrease in leverage ratio due to higher equity capital-to- asset ratio can lead to a lower systematic risk or lower market beta. Following GFC and European debt crisis, shareholders anticipate lower market beta and lower market returns relative to pre-GFC period. From the above discussion, we formulate following two hypotheses:

H3a: There is no significant shift in *systematic* risk (market beta) associated with G-SIBs from the pre- GFC period to the post-GFC period. Similarly, there is no significant shift in *systematic* risk associated with G-SIBs from the pre- GFC period to the post-European debt crisis period.

H3b: There is no significant shift in *systematic* risk associated with non-G-SIBs from the pre-GFC period to the post-GFC period. Similarly, there is no significant shift in *systematic* risk associated with non-G-SIBs from the pre- GFC period to the post-European debt crisis period.

Further, we hypothesize that the banking industry structure, its regulations, and its competitive environment in Europe (or EU) are significantly different from that of the United States and the rest of the world (e.g., Batten and Szilagyi, 2012). Therefore, it is possible that shift in risk associated with European global banks could be influenced by EU- specific regulations and market conditions during the pre-crisis and the post-crisis periods.

H4: There is no significant shift in risk (total risk, market risk, and idiosyncratic risk) for European global banks during the post-European debt crisis period relative to the pre-GFC period.

DATA AND METHODOLOGY

Data

We estimate bank risk using daily common stock returns for global banks. The initial official list of 29 G-SIBs was obtained from the FSB website at the end of November 2011, whereas that of non-G-SIBs was generated from the *Compustat Research Insight*. To be included in the sample, global banks are required to have balance sheet data and income statement data available from the Mergent Online database from June 6, 2006 through December 13, 2015. Global banks also are required to have market price data available from the DataStream database. The final sample consists of 21 G-SIBs and 26 Non- G-SIBs with a total sample of 47 global banks. Appendix-A includes name of all sample banks.

Table 2 provides the sample distribution of all global banks in terms of whether they are systemically important and by their geographic region. As seen in the Table 2, we separate the sample into two subsets according to their classification and for easy comparison. Column 3 shows that our sample includes 21 G-SIBs, and Column 4 indicates that our sample contains 26 global non-systemically important banks. Among the 21 G-SIBs, eight are headquartered in the United States, and ten of them are originated from Europe, and the remaining 3 G-SIBs are located in Asia.[7]

The primary goal of regulatory reform advanced by DFA and Basel III is to limit the ability of global banks to take excessive risk by requiring them to hold additional capital and liquid assets. In this study, the bank risk is assessed using standard market model. First, we estimate changes in three capital-market-based measures of risk: total risk (variance of stock returns), systematic risk (beta), and unsystematic risk (variance of errors) from the pre-GFC period (06/03/2006-07/31/2007) to the post- GFC period (01/01/2010- 12/13/2015). While the financial crisis in the

[7.] To address the systemic and moral hazard risk, the Financial Stability Board (FSB) identified a set of 29 G-SIBs in November 2011. FSB uses a methodology developed by the Basel Committee on Banking Supervision (BCBS). Beginning in November 2011, the list of G-SIBs is updated annually and published by the FSB each November.

TABLE 2: DISTRIBUTION OF SAMPLE OF ALL GLOBAL BANKS BY GEOGRAPHIC REGION

	All global financial institutions	Systemically Important global financial institutions	Non-systemically important global financial institutions
US	8	8	0
Europe	12	10	2
Asia	11	3	8
Others	16	0	16
Total	47	21	26

US ended in 2009, Europe continued to experience sovereign debt crisis during 2010-2012 period. During this period, world financial markets remained very volatile. In order to control for spill-over effects from the European debt crisis, we test the robustness of our results by estimating changes in risk from pre-GFC period (06/03/2006- 07/31/2007) to post-European debt crisis period (12/15/2012- 12/13/2015). Please note that all event periods including the pre-GFC period, the GFC period, the post-GFC period, the European debt crisis period, and the post – European sovereign crisis period are reported in Table 1.

Methodology

We estimate total risk (σ_r^2), using the variance of daily stock returns over the pre- GFC period and over the post-GFC period. We then estimate the change in total risk ($\Delta\sigma_r^2$) for each bank as follows:

$$\Delta\sigma_r^2 = \sigma^2 post\text{-criss} - \sigma^2 pre\text{-}crisis \quad \ldots\ldots \quad (1)$$

where pre-crisis is the pre-GFC defined as a period from 06/03/2006 to 07/31/2007; and post-crisis period is either the post-GFC period (01/01/2010 - 12/13/2015) or post-European sovereign debt crisis period (12/15/2012 - 12/13/2015).

We estimate the change in systematic risk (market risk) for each firm using standard market model:

$$R_t = \alpha + \beta R_{mt} + e_t, \quad \ldots\ldots \quad (2)$$

where R_t is the stock return on day *t*, R_{mt} is the return on the equally weighted market index on day, *t*. We use S&P 1200 global index as a proxy for the global stock market index. We estimate the model (2) using the OLS method. The intercept of the estimated model is α, and the estimated slope coefficient is the market beta (β), and the error term on day *t* is e_t. The change in market risk exposure (beta) is the difference between the market beta estimated over the post-crisis period and the market estimated over the pre-crisis period as follows:

$$\triangle \beta = Post\text{- crisis } (\beta) - Pre\text{-crisis}(\beta) \quad \ldots\ldots \quad (3)$$

Unsystematic or idiosyncratic risk (σ^2_e) is measured as the variance of the residuals of the OLS from the above model (2). The change in idiosyncratic risk ($\Delta\sigma^2_e$) for each bank is calculated as follows:

$$\Delta\sigma^2_e = \sigma^2_e \text{ post-crisis} - \sigma^2_e \text{ pre-crisis} \quad \ldots\ldots (4)$$

For each of risk measure, we compute the *t*-statistic. The *t*-statistic tests whether the change in risk is significantly different from zero.

We estimate each type of risk separately for global banks, G-SIBs, and non- G-SIBs. We then test the shift in risk from the pre- GFC period (06/03/2006 – 07/31/2007) to the post-GFC period (01/01/2010 -12/13/2015). In addition, we test the robustness of our results by estimating shift in risk from the pre-GFC period (06/03/2006- 07/31/2007) to post-European debt crisis period (12/15/2012- 12/13/2015) separately for the sample of global banks as well as for the sample of G-SIBs, and non G-SIBs.

Cross-Sectional Analysis of Risk Shifts of Global Banks

Although there is a substantial literature that examines the risk-taking behavior of U.S. financial institutions (Saunders, Strock and Travlos, 1990; Demsetz and Strahan, 1997; Stiroh, 2006; Laeven and Levine, 2009; Houston et al., 2010), global banks are likely to have been heterogeneously affected due to their distinct balance sheet exposure to GFC and European debt crisis shocks (e.g., Bruyckere et al., 2013; Bhimjee, Ramos, and Dias, 2016). In this section, we analyze the relationship between changes in market-based risk measures (total, systematic, unsystematic) and changes in bank-specific characteristics associated with global banks. We estimate the following cross-sectional regression model to evaluate whether changes in balance sheet and income statements ratios significantly explain the variation in three risk shift measures.

$$\Delta Risk = \gamma_0 + \gamma_1 \Delta LNSIZE + \gamma_2 \Delta CAPITAL + \gamma_3 \Delta TLNASS + \gamma_4 \Delta LLPTLN + \gamma_5 \Delta ROA + \gamma_6 \Delta NINTINC + \gamma_7 \Delta DEPLIAB + \gamma_5 GSIB + \gamma_5 EUROPE + e_i \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where the dependent variable ($\Delta Risk$) is change in total risk ($\Delta\sigma_r^2$), change in market beta ($\triangle\ \beta$), or change in idiosyncratic risk ($\Delta\sigma^2_e$) as defined in Equations (1), (3), and (4) respectively. The independent variables used in Equation (5) are defined below.

Our first explanatory variable is ΔLNSIZE, which is defined as the change in natural logarithm of a bank's total assets. Large cross-border banks are more likely to be well diversified and are less likely to be exposed to idiosyncratic risk. Nevertheless, large cross-border banks are more closely connected to and within the financial system through interbank liabilities and other exposures to the financial system, making them exposed to significant systemic risk. G-SIBs are deemed to be "too-big-to-fail" (TBTF) and they are more likely to receive implicit state guarantees. On the other hand, lack of market discipline coupled with moral hazard risk (Gropp et al., 2014; Kleinow and Horsch, 2014) can lead to an increase in total risk for large cross-border banks. We expect positive association between ΔRisk and ΔLNSIZE variables.

To measure the influence of a bank's equity capital on risk, we include the change in the *capital*-to-asset ratio (ΔCAPITAL) as a proxy for bank capital position. Specifically, Basel III and DFA

regulations call for an increase in common equity Tier 1 capital ratio.[8] We expect an inverse relationship between ΔCAPITAL and change in risk because banks with higher capital ratio are more likely to reduce their risk exposure during the post-GFC period. As discussed earlier, an increase in capital ratio (lower leverage) can lead to a lower insolvency risk and a lower market risk (beta). In order to assess the influence of credit risk on total risk and idiosyncratic risk, we use ΔLLPTLN, the change in ratio of loan-loss provisions to the total loans which is a proxy for credit risk in our regression. We expect a positive association between ΔLLPTLN and the change in total risk and idiosyncratic risk.

We use the change in ratio of deposit liabilities-to- asset (ΔDEPLIAB) as a proxy for a bank's business strategy. Traditional commercial banks with a focus on non-securitized loans, in general, are likely to have high deposit liabilities-to-asset ratios. In particular, banks with high deposit liabilities-to-asset ratios are more likely to have stable sources of funding and are less exposed to liquidity risk. These types of banks are less connected to other banks or other institutional investors, and they rely more on deposits as a stable source of funding. For these reasons, we expect an inverse relation between ΔDEPLIAB and change in total risk and change in unsystematic risk.

Higher ratios of change in total loans-to-total assets (ΔTLNASS) may suggest that a bank is more likely to be exposed to increased total risk and increased unsystematic risk. Thus, the change in total loan-to-asset ratio (ΔTLNASS) is expected to be positively related to the change in total risk and idiosyncratic risk. In contrast, a change in relatively high non-interest income-to-total income ratio (ΔNINTINC) indicates a bank's involvement in non-traditional banking activities such as investment banking or trading innovative financial products that are riskier than making traditional loans. Therefore, one would expect a positive relation between ΔNINTINC variable and the shift in idiosyncratic risk indicating that global banks with change in high non-interest income ratio will experience greater reduction in unsystematic risk (e.g., Morgan and Stiroh, 2005; Laeven and Levine, 2009).

We use ΔROA (change in net income to total assets) as a proxy for change in profitability of a bank. We expect a negative association between ΔROA and change in bank idiosyncratic risk because banks with an increase in profitability ratio will experience lower insolvency risk and lower total risk.

To differentiate a G-SIB from a non-G-SIB, we use G-SIB as an indicator variable which equals to 1 if the bank is a G-SIB, otherwise it equals to zero if it is a non-G-SIB. We anticipate a positive relation between risk shift and G-SIBs because G-SIBs relative to non-SIBs are more likely to experience greater risk reduction in total risk and unsystematic risk after the passage of DFA and after the implementation of Basel III.

[8] We use *Mergent Online* database to obtain balance sheet and income statement data for global banks. Due to lack of availability of data on Common Equity Tier 1 capital ratio, we use equity capital-to-asset ratio as a proxy for bank capital position.

We expect European global banks to behave differently than non-European global banks especially during the post-GFC period when European banks were directly exposed to European sovereign debt crisis (e.g., Batten and Szilagyi, 2012). Finally, the regulatory, monetary, and macroeconomic condition, and the regulatory environment in the European banking sector are distinctively different than that of the American or Asian global banks during the post-European debt crisis period. EUROPE is an indicator variable which is equal to 1 if the global bank has a home office in Europe, otherwise it is zero.

EMPIRICAL RESULTS

Changes in Risk from Pre-GCF period to Post-GCF period

Table 3A shows the changes in total, market, and unsystematic risks for all global banks, G-SIBs, and non-G-SIBs from the pre-GFC period (June 3, 2006 through July 31, 2007) to post-GFC period (January 1, 2010 through December, 13, 2015). Results reported in Table 3A (column 2). The total risk for all global banks, on average, has increased by 0.0223 from the pre-GFC period to post-GFC period. Similarly, for both G-SIBs and non-G-SIBs, the total risk also has increased by 0.0309 and 0.0153 respectively, over the same period. The results reported in Table 3A also indicate that the level of total risk of G-SIBs relative to non-G-SIBs is lower during both pre-GFC and post-GFC periods. It can be seen that increases in total risk for both G-SIBs and non-G-SIBs from the pre-GFC period to the post-GFC period are statistically significant at the 1% level and 5% level respectively. This result is not surprising. While the financial crisis in the US ended in 2009, the European debt crisis erupted in late 2009 and the crisis continued until the end of 2012. The *t*-test for difference in means associated with a change in variance reported in Table 3A (Column 5). These results indicate that total risk associated with G-SIBs, on average is significantly lower relative to non-G-SIBs during the pre-GFC period. However, the increase in total risk associated with G-SIBs from pre-GFC period to post-GFC period is more than that of non-G-SIBs over the same period and the difference in mean is statistically significant 10% level. As can be seen from Table 1 (panel A), the post-GFC period (01/01/2010- 12/13/2015) overlaps with the European sovereign debt crisis period (10/04/2009-12/14/2012) when global financial markets were very volatile.[9] Overall, these results suggest that global banking system was not safer at the end of GFC because of international financial contagion arising from the European debt crisis in the post-GFC period.

Changes in systematic risk (market beta) reported in Table 3A show that the average beta for all global banks and G-SIBs increases from the pre-GFC period to the post-GFC period. More importantly, the increase in market beta is significant only in the case of G-SIBs. Because the systematic risk is of primary concern to well-diversified shareholders, the above results suggest that market risk for shareholders of G-SIBs increased significantly from the pre-GFC period to the post-GFC period. Again, this result is not surprising because almost half of G-SIBs are European banks which were directly exposed to European debt crisis during the 2010-2012

[9] Due to absence of common European policy framework such as or bank resolutions mechanisms, several European governments were forced to rescue troubled banks with home office in Europe during European sovereign debt crisis.

TABLE 3A: CHANGES IN RISK MEASURES FOR SAMPLE OF GLOBAL BANKS FROM PRE-GFC PERIOD TO THE POST- GFC PERIOD

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	All global banks (N=47)	Global systemically important banks (N=21)	Global non-systemically important banks (N=26)	t-test for difference in means
Variance				
Pre-GFC	0.0273	0.0180	0.0348	3.52***
Post-GFC	0.0509	0.0489	0.0527	0.35
△Variance	0.0223***	0.0309***	0.0153**	-1.87*
Beta				
Pre-GFC	1.2500	1.2906	1.2171	-0.41
Post-GFC	1.3599	1.6573	1.1197	-3.66***
△Beta	0.1145	0.3631***	-0.0862	-3.26***
Error variance: market model				
Pre-GFC	0.0603	0.010	0.1004	1.13
Post-GFC	0.0584	0.023	0.0869	1.29
△Error variance	-0.0066**	0.0127***	-0.0017	-1.77*

Notes: $|p| \leq 0.01$, ***; $0.01 \leq |p| \leq 0.05$, **; $0.05 \leq |p| \leq 0.10$, *.

period which overlaps with the post-GFC period. In contrast, in the case of non-G-SIBs, the market risk during the post-GFC period relative to pre-GFC period declined, but the decrease in the market beta for the portfolio of non-G-SIBs is not statistically significant. Results reported in Table 3A show that market betas of the portfolio of G-SIBs during both pre-GFC and post-GFC periods are significantly greater than that of non-G-SIBs.

As can be seen from results reported in Table 3A, G-SIBs experience significant increase in idiosyncratic risk from pre-GFC period to post-GFC period. In the case of non-G-SIBs, the change in unsystematic (idiosyncratic) risk is not significant. Overall, these results suggest that the global financial system became riskier during the post-GFC period relative to pre-GFC period due to the persistence of European sovereign debt crisis.

Changes in Risk from Pre-GCF period to Post-European Debt Crisis

In this section, we control for the European debt crisis period and measure changes in risk from the pre-GCF period to the post-European debt crisis period. We are interested in finding whether the global banking sector became safer during the post-European debt crisis period relative to the pre-GFC crisis period. Table 3B shows the changes in total, market, and unsystematic risks for all global banks, G-SIBs, and non-G-SIBs from the pre-GFC period.

TABLE 3B: **CHANGES IN RISK MEASURES FOR SAMPLE OF GLOBAL BANKS FROM PRE-GFC PERIOD TO THE POST-EUROPEAN DEBT CRISIS PERIOD**

	All global banks (N=47)	Global systemically important banks (N=21)	Global non-systemically important banks (N=26)	t-test for difference in means
Variance				
Pre-GFC	0.0273	0.0180	0.0348	3.52**
Post-European Debt Crisis	0.0359	0.0245	0.0452	2.13**
△Variance	0.0075**	0.0065***	0.0084	0.27
Beta				
Pre-GFC	1.2500	1.2906	1.2172	-0.41
Post-European Debt Crisis	1.2693	1.4394	1.1319	-2.32**
△Beta	0.0127	0.1487***	-0.0972	-2.20**
Error variance: market model				
Pre-GFC	0.0603	0.010	0.1004	1.13
Post-European Debt Crisis	0.0469	0.0145	0.0730	1.67
△Error variance	-0.0028	0.0038***	-0.0020	-0.28

Notes: $|p| \leq 0.01$, ***; $0.01 \leq |p| \leq 0.05$, **; $0.05 \leq |p| \leq 0.10$, *.

31, 2007) to the post-European debt crisis period (December 15, 2012 through December 13, 2015). As can be seen from results reported in Table 3B, the total risk for G-SIBs, on average, increased by 0.0075 from the pre-GFC period to post-European debt crisis and this shift in risk is significant at 1% level. However, in the case of non-G-SIBs, the increase in total risk (0.0084) over the same period is not statistically significant. The results reported in Table 3B regarding the market beta reveals that the increase in market for G-SIBs from the pre-GFC period to the post-European debt crisis period is positive and significant at 1 % level. In contrast, the market risk shift in the case of non-G-SIBs is negative and it is not statistically significant. G-SIBs, on average, are likely to have higher market betas relative to non-G-SIBs during both the pre-GFC period as well as the post-European debt crisis period. The error variance results reveal that G-SIBs relative to non-G-SIBs, on average, are likely to have lower idiosyncratic risk during both pre-GFC and post- European debt crisis periods. During both pre-GFC period and post-European debt crisis period, mean differences in error variance between G-SIBs and non-G-SIBs are not statistically significant. In contrast, in the case of G-SIBs, the increase in idiosyncratic risk for from the pre-GFC period to post-European crisis period is positive and significant at 1 % level. Overall, these results suggest that G-SIBs have lower total risk and idiosyncratic risk, but higher market risk relative to non-G-SIBs for both pre-GFC and post-European debt crisis periods. The shift in total risk, market risk, and unsystematic risk from the pre-GFC period to the

post- European debt crisis period is positive and significant for G-SIBs. In the case of non-G-SIBs, the shift in risk for each of type of risk (total, market, or unsystematic) from the pre-GFC period to the post- European debt crisis period is insignificant.

Explaining Changes in Risk: Cross-sectional Regression Analysis

In this section, we report the results of our regression analysis for all global banks, G-SIBs, and non-G-SIBs. We first report the summary statistics for the explanatory variables used in the cross-sectional regression.

Summary statistics

Table 4 (Panel A) shows mean and median values for balance sheet and income statement variables related to bank risk taking for the sample of all global banks, G-SIBs, and non-G-SIBs. The average asset size of a global bank in our sample is US$786 billion. In contrast, the mean asset size of a G-SIB is US$1,481 billion, while the same for a non-GIB is only US$201.7 billion. As expected, our *t*-test results for difference in means reported in Column 8 of Table 4 (Panel A) indicate that, on average, the asset size of a typical G-SIB is significantly greater than that of a typical non-G-SIB. The average equity-to-asset ratio (CAPITAL) for G-SIBs is 6.12%, which is significantly lower than that of non-G-SIBs (8.1%). This result indicates that a typical G-SIB tends to hold less capital relative to its asset than does a non-G-SIB have. The mean TLNASS ratio for the sample of G-SIBs (23.44%) is significantly lower than that for the sample of non-G-SIBs (57.19%), indicating that, on average, the credit risk associated with a G-SIB is likely to be lower than that of a non-G-SIB. In contrast, the mean LLPTLN ratio for the sample of G-SIBs (4.68%) tends to be greater than that for non-G-SIBs indicating that the credit risk associated with loan portfolios of G-SIBs is greater than that of non-G-SIBs (1.55%). The mean ROA of the sample of G-SIBs (0.23%) is significantly lower than that of non-G-SIBs (1.20%). These results indicate that, on average, non-G-SIBs are significantly more profitable than are G-SIBs. In the case of G-SIBs, the NINTINC, on average, is 42.94%, which is significantly greater than that of non-G-SIBs (30.33%). This indicates that, G-SIBs relative to non-G-SIBs, are likely to have more diverse sources of revenue. The mean deposit liability-to- asset ratio (DEPLIAB) for the sample of G-SIB is not significantly different from that of non-G-SIBs. This result indicates that traditional sources of funding for both G-SIBs and non-G-SIBs are quite similar. Table 4 (Panel B) reports the correlation matrix among all explanatory variables. The correlation results reported in Table 4 (Panel B) indicates that the correlation coefficient between LNSIZE and G-SIB is 0.677 and it is highly significant. This result is not surprising because the average asset size of a G-SIB equals to seven times of the average asset of a non-G-SIB.

Regression results

This section presents the cross-sectional multivariate regression results. The results are based on estimates from the regression equation (5) described in Section 4.2.2. Table 5A shows that the dependent variable is the change in risk measures from the pre-GFC period (06/03/2006-07/31/2007) to the post-GFC period (01/01/2010- 12/13/ 2015). Explanatory variables in the regression include change in institutional specific characteristics for the sample of all global

TABLE 4 (PANEL A): SUMMARY STATISTICS FOR GLOBAL BANKS

	All global banks (N=47)		Global systemically important banks (N=21)		Global non-systemically important banks (N=26)		t-test for difference in means
	Mean	Median	Mean	Median	Mean	Median	
ASSET ($mil.)	785,787.3	478,726.9	1,481,149	1,592,017	201,683.1	126,167.8	-7.87***
LNSIZE	12.3710	12.9673	13.89	14.280	11.1684	11.6487	-6.17***
CAPITAL	0.072	0.0684	0.0612	0.0573	0.0807	0.0770	1.58
TLNASS	0.4211	0.2268	0.2344	0.2023	0.5719	0.3900	2.19**
LLPTLN	0.0295	0.0051	0.0468	0.0075	0.0155	0.0000	-2.18**
ROA	0.0076	0.0057	0.0023	0.0028	0.0120	0.0066	2.97***
NINTINC	0.3542	0.3650	0.4294	0.4174	0.30317	0.2585	-1.88*
DEPLIAB	0.4786	0.4832	0.4117	0.3993	0.5327	0.5164	1.29

TABLE 4 (PANEL B): CORRELATION MATRIX (EXPLANATORY VARIABLES) FOR ALL GLOBAL BANKS

	LNSIZE	CAPITAL	TLNASS	LLPTLN	ROA	NINTINC	DEPLIAB	GSIB	EUROPE
LNSIZE	1.00								
CAPITAL	-0.462 (0.001)	1.00							
TLNASS	-0.254 (0.084)	0.308 (0.035)	1.00						
LLPTLN	0.179 (0.226)	0.085 (.567)	-0.307 (0.036)	1.00					
ROA	-0.531 (0.0001)	0.624 (0.0001)	0.429 (0.003)	0.025 (0.867)	1.00				
NINTINC	0.068 (0.646)	-0.070 (0.639)	0.062 (0.675)	0.046 (0.757)	-0.025 (0.867)	1.00			
DEPLIAB	-0.081 (0.590)	0.078 (0.598)	0.402 (0.005)	-0.231 (0.117)	0.215 (0/146)	0.115 (0.438)	1.00		
G-SIB	0.677 (0.0001)	-0.229 (0.120	-0.310 (0.033)	0.309 (0.034)	-0.405 (0.004)	0.270 (0.066)	-0.188 (0.204)	1.00	
EUROPE	0.372 (0.010)	-0.299 (0.041)	-0.055 (0.710)	-0.136 (0.360)	-0.213 (0.150)	0.053 (0.724)	-0.024 (0.877)	0.455 (0.001)	1.00

Note: Pearson correlation coefficients are reported in panel B of Table 4B. Probability values are reported in parentheses.

banks (Models 1, 2, and 3). It is important to note that there were several recapitalization measures taken during the 2009-2010 period in Europe (e.g. consolidating the savings banks in Spain in 2010, the establishment of "a bad bank" in Germany in 2009, and nationalization of banks in several European countries, etc.). In addition, the regulatory environment for European banks differed from that of non-European banks during the 2009-2010 period. Therefore, we

include EUROPE as an indicator variable in all three models. If a global bank in our sample originated from continental Europe, then EUROPE is equal to 1, otherwise it equals to zero.

Cross-sectional results reported in Table 5A show the impact of the change in the size of bank asset (△LNSIZE), change in capital-to-asset ratio (△CAPITAL), change in loan-to-asset ratio (△TLNASS), change in loan-loss provision-to-total loan ratio (△LLPTLN), change in return on assets ratio (△ROA), change in non-interest income to total operating income ratio (△NINTINC), and change in deposit liabilities-to-asset ratio (△DEPLIAB) on change in total risk (Model 1), change in market risk (Model 2), and change in idiosyncratic risk (Model 3).
The results reported in Table 5A show that the regression coefficient associated with the △LNSIZE in Model 2 is negative and significant at 5% level. This indicates that there is an inverse relation between the asset size and the market risk (systematic risk). In contrast, coefficients associated with the △ROA (a measure of change in bank profitability) in Model (2) and Model (3) are both negative and significant at 1 % level indicating that more profitable global banks are likely to be exposed to lower market risk and lower idiosyncratic risk. As can be seen from results reported in Table 5A, the coefficient of G-SIBs in Model 1 is negative and statistically significant at 10 percent level. This indicates that G-SIBs relative to non-G-SIBs are likely to have significantly reduced total risk during the post-GFC period. Finally, regression coefficients associated with Europe variable in both Model 1 and Model 2 are positive and significant indicating that European global banks relative to non-European global banks contribute more to the shift in total risk and market risk during the post-GFC period when the European debt crisis was unfolding.

The correlation coefficient between the G-SIB and the size of the asset (LNSIZE) reported in Table 4 (Panel B) is 0.677 which is significant at 1% level. In order to avoid possible multi-collinearity issue among the explanatory variables in regression equation (5), we split the sample of global banks into two groups: (1) G-SIBs, and (2) non-G-SIBs. Then, we conduct separate regression for each group to check the robustness of our results. Results for G-SIBs reported in Table 5B show that the coefficient of the change in total loans-to- asset ratio (△TLNASS) in Model (1) is positive and significant at 5%. This indicates that an increase in shift of total risk of G-SIBs during post-GFC period is driven by an increase in credit risk associated with loan portfolios. As can be seen from the results reported in Table 5B, the shift in market beta in Model (2) is positively associated with change in equity-to-capital ratio (△CAPITAL) indicating that banks with higher equity-to-capital ratio are more likely to be exposed to an increased market risk. The regression coefficient associated with the △ROA (a measure of change in bank profitability) in Model (2) is negative and significant at 10 % level indicating that more profitable global banks are likely to have less exposure to market risk. The positive and significant coefficient associated with change in loan-loss provision-to-total loan ratio (△LLPTLN) in Model (3) suggests that an increase in idiosyncratic risk is related to increased credit risk associated with loan portfolio of G-SIBs.

Cross-sectional regression results for non-G-SIBs reported in Table 5C reveal that change equity-to-capital ratio (△CAPITAL) has an inverse relation with the shift in total risk. This result is consistent with Basel III capital regulations which require banks to maintain higher equity capital ratio while reducing the cost of bank bailout during the post-GFC period. The regression

Table 5A: Regression results for changes in risk measure of sample of global banks from the Pre- GFC period (06/03/2006- 07/31/2007) to the Post- GFC period (01/01/2010- 12/13/2015)

	Institutions		
	Model 1	Model 2	Model 3
	△variance	△beta	△error variance
Intercept	0.0217*** (0.0076)	-0.1061 (0.1122)	0.0426** (0.0185)
Δ LNSIZE	-0.0013 (0.0018)	-0.0676** (0.0272)	-0.0048 (0.0050)
Δ CAPITAL	-0.2272 (0.1607)	0.4874 (2.3723)	0.0778 (0.3908)
Δ TLNASS	-0.0122 (0.0242)	0.1050 (0.35734)	-0.0578 (0.0589)
Δ LLPTLN	0.0715 (0.0594)	0.1230 (0.8776)	0.2426 (0.1446)
Δ ROA	0.3810 (1.0638)	-46.4442*** (15.7020)	-7.0314*** (2.5865)
Δ NINTINC	0.0307 (0.0299)	-0.0462 (0.4411)	0.0780 (0.0727)
Δ DEPLIAB	-0.0079 (0.0142)	-0.0499 (0.2097)	-0.0123 (0.0346)
G-SIB	-0.0242* (0.0142)	0.1618 (0.2101)	-0.0794 (0.0346)
EUROPE	0.0605*** (0.0169)	0.4246* (0.2499)	0.0749 (0.0411)
N	47	47	47
Adjusted R^2	0.2538	0.2972	0.2209
F-Value	2.740**	3.16***	2.45**

Notes: $|p| \leq 0.01$, ***; $0.01 \leq |p| \leq 0.05$, **; $0.05 \leq |p| \leq 0.10$, *.

coefficient associated with the △ROA (a measure of change in bank profitability) in Model (3) is negative and significant at 5 % level indicating that more profitable global banks are likely to have less exposure to idiosyncratic risk.

Robustness Test of Regression results

Previous regression results estimate the relationship between the change in measure of risk (total, systematic, idiosyncratic) and the change in bank-specific characteristics that explain variation in each of the three types of risks. During the post-GFC period, financial markets world-wide were highly volatile due to the persistence of European sovereign debt crisis. In particular, European global banks were directly exposed to European debt crisis In order to check the robustness of our previous results, we control for European debt crisis period. We measure changes in risk from pre-GCF period to post-European debt crisis period instead of post-GFC period.

Table 5B: Regression results for changes in risk measure of sample of G-SIBs banks from the Pre- GFC period (06/03/2006- 07/31/2007) to the Post- GFC period (01/01/2010- 12/13/2015).

	Institutions		
	Model 1	Model 2	Model 3
	△variance	△beta	△error variance
Intercept	0.0323 (0.0163)	0.6049** (0.2469)	0.0122 (0.0415)
Δ LNSIZE	-0.0032 (0.0082)	0.0759 (0.0525)	-0.0061 (0.0208)
Δ CAPITAL	0.3377 (0.2875)	8.8676* (4.3448)	-0.0131 (0.7301)
Δ TLNASS	0.0701** (0.0316)	0.6706 (0.4781)	0.1203 (0.0803)
Δ LLPTLN	0.1523 (0.0520)	0.6720 (1.6846)	0.3838** (0.1320)
Δ ROA	-4.1454 (1.7038)	-54.6307* (25.7505)	-2.6917 (4.3270)
Δ NINTINC	0.0145 (0.0418)	-0.4835 (0.6317)	0.0361 (0.1061)
Δ DEPLIAB	0.0201 (0.0263)	0.3225 (0.3982)	-0.0268 (0.0670)
N	21	21	21
Adjusted R^2	0.4879	0.2487	0.3219
F-Value	2.91**	1.66	1.95

Notes: $|p| \leq 0.01$, ***; $0.01 \leq |p| \leq 0.05$, **; $0.05 \leq |p| \leq 0.10$, *.

Table 5C: Regression results for changes in risk measure of sample of Non-G-SIBs banks from the Pre- GFC period (06/03/2006- 07/31/2007) to the Post- GFC crisis period (01/01/2010- 12/13/2015)

	Institutions		
	Model 1	Model 2	Model 3
	△variance	△beta	△error variance
Intercept	0.0294** (0.0117)	0.0105 (0.1449)	0.0464 (0.0262)
Δ LNSIZE	-0.0022 (.0024)	-0.0607 (0.0408)	-0.0080 (0.0074)
Δ CAPITAL	-0.6553** (0.3176)	-6.0470 (3.9242)	-0.1509 (0.7093)
Δ TLNASS	-0.0189 (0.0536)	0.2516 (0.6623)	-0.1197 (0.1197)
Δ LLPTLN	0.2333 (0.2226)	1.7112 (2.7507)	0.3097 (0.4972)
Δ ROA	1.6300 (2.0230)	-33.6945 (24.9945)	-9.2854** (4.5181)
Δ NINTINC	-0.0118 (0.0825)	-1.1030 (1.0189)	0.1033 (0.1842)
Δ DEPLIAB	0.0164 (0.0396)	0.5006 (0.4888)	-0.0056 (0.0883)
N	26	26	26
Adjusted R^2	-0.0609	0.2376	0.1065
F-Value	0.79	2.11*	1.43

Notes: $|p| \leq 0.01$, ***; $0.01 \leq |p| \leq 0.05$, **; $0.05 \leq |p| \leq 0.10$, *.

As shown in the previous section, we follow the same regression model that focuses on the relationship between changes in market-based risk measures and changes in bank-specific characteristics for all global banks that explain variations in three risk measures. These results are reported in Table 6A. Results show that the coefficient of change in equity-to-capital ratio is negative and statistically significant at 1 % level in Model 1 indicating an inverse relation between △CAPITAL and the shift in total risk. This result is consistent with Basel III capital regulations which require banks to maintain higher equity capital ratio while reducing total risk. Regression coefficients associated with the △ROA (a measure of change in bank profitability) in Model (1) is positive and significant at 1% level indicating that profitable banks were taking more risk. On the other hand, the regression coefficient of △ROA in Model 2 is negative and significant at 10% level. This result suggests that profitable banks were less vulnerable to market risk. The coefficients of EUROPE in Model 1 and 2 are positive and statistically significant at 1 % and 5% level respectively. Again, these results suggest that European global banks compared with non-European global banks have had significant impact on the shift in total and unsystematic risks from the pre-GFC period to the post-European debt crisis period.

Table 6A: Regression results for changes in risk measure of sample of global banks from Pre- GFC period (06/03/2006- 07/31/2007) to the Post-European debt crisis period (12/15/2012- 12/13/2015).

	Institutions		
	Model 1	Model 2	Model 3
	△variance	△beta	△error variance
Intercept	0.0013 (0.0054)	-0.1322 (0.1025)	-0.0074 (0.0059)
Δ LNSIZE	0.0025* (0.0013)	-0.0430 (0.0249)	0.0022 (0.0014)
Δ CAPITAL	-0.3202*** (0.1147)	-0.7437 (2.1662)	0.1171 (0.1226)
Δ TLNASS	-0.0045 (0.0173)	-0.1077 (0.3263)	-0.0186 (0.0185)
Δ LLPTLN	0.0624 (0.0424)	0.8280 (0.8013)	0.0382 (0.0454)
Δ ROA	3.1771*** (0.760)	-27.5714* (14.3376)	1.0811 (0.8117)
Δ NINTINC	0.0030 (0.0213)	0.1303 (0.4028)	0.0138 (0.0228)
Δ DEPLIAB	-0.0080 (0.0101)	-0.0461 (0.1915)	-0.0095 (0.0108)
G-SIB	-0.0068 (0.0102)	0.1249 (0.1918)	-0.0016 (0.0109)
EUROPE	0.0357*** (0.0121)	0.1193 (0.2281)	0.0341** (0.0130)
N	47	47	47
Adjusted R^2	0.3651	0.1140	0.1910
F-Value	3.940***	1.660	2.210**

Notes: $|p| \leq 0.01$, ***; $0.01 \leq |p| \leq 0.05$, **; $0.05 \leq |p| \leq 0.10$, *.

Table 6B: Regression results for changes in risk measure of sample of G-SIBs from the Pre- GFC crisis period (06/03/2006- 07/31/2007) to the Post-European debt crisis period (12/15/2012- 12/13/2015).

	Institutions		
	Model 1	Model 2	Model 3
	△variance	△beta	△error variance
Intercept	0.0116 (0.0090)	0.3479** (0.1273)	0.0030 (0.0077)
Δ LNSIZE	-0.0034 (0.0045)	0.0115 (0.0640)	-0.0016 (0.0039)
Δ CAPITAL	0.0491 (0.1590)	5.1092** (2.240)	0.0376 (0.1353)
Δ TLNASS	0.0380** (0.0175)	0.1198 (0.2465)	0.0255* (0.0149)
Δ LLPTLN	0.1062*** (0.0287)	-0.2789 (0.4048)	0.0859*** (0.0245)
Δ ROA	-1.5374 (0.9425)	-18.2284 (13.2757)	-1.1924 (0.802)
Δ NINTINC	0.0025 (0.0231)	-0.3043 (0.3257)	0.0056 (0.0197)
Δ DEPLIAB	0.0039 (0.0146)	0.0188 (0.2053)	0.0022 (0.0124)
N	21	21	21
Adjusted R^2	0.5569	0.3647	0.4626
F-Value	3.51**	2.150	2.720*

Notes:
$|p| \leq 0.01$, ***; $0.01 \leq |p| \leq 0.05$, **; $0.05 \leq |p| \leq 0.10$, *.

Similar to previous analysis, we split the sample of global banks into two groups: (1) G-SIBs, and (2) non-G-SIBs. Regression results for G-SIBs reported in Table 6B show that the coefficient of the change in total loans-to- asset ratio (△TLNASS) in Model (1) is positive and significant at 5%. Consistent with results reported in Table 5B, we find that an increase in shift of total risk of G-SIBs during post-European crisis period is driven by an increase in credit risk associated with total loans-to-asset ratio. The shift in market beta (Model 2) is positively associated with the change in equity-to-capital ratio (△CAPITAL) which is consistent with our previous finding. The coefficients of △LLPTLN in Model 1 and Model 3 are positive and significant at 1% level, indicating that global banks with higher loan loss provision ratio are more likely to be exposed to higher loan default risk leading to to higher total risk as well as higher idiosyncratic risk.

Cross-sectional regression results for non-G-SIBs reported in Table 6C show that coefficients of (△LNSIZE) in Model (1) and Model (3) are positive and statistically significant at 5% level. These results indicate that larger non-G-SIBs are more likely to reduce the exposure to total risk and idiosyncratic risk than that of smaller non-G-SIBs during the post-European debt crisis. The results reported in Table 6C also reveals that the change in equity-to-capital ratio (△CAPITAL) in Model (1) has an inverse relation with the shift in total risk. This result is consistent with Basel III capital regulations which require banks to maintain higher equity capital

Table 6C: Regression results for changes in risk measure of sample of Non-G-SIBs from the Pre- GFC crisis period (06/03/2006- 07/31/2007) to the Post-European debt crisis period (12/15/2012- 12/13/2015)

	Institutions		
	Model 1	Model 2	Model 3
	△variance	△beta	△error variance
Intercept	0.0076 (0.0074)	-0.03579 (0.1346)	-0.0014 (0.0078)
Δ LNSIZE	0.0047** (0.0021)	-0.0314 (0.0379)	0.0050** (0.0022)
Δ CAPITAL	-0.6718*** (0.2016)	-5.6153 (3.6456)	0.0029 (0.2088)
Δ TLNASS	0.0127 (0.0340)	-0.2014 (0.6152)	-0.0645* (0.0352)
Δ LLPTLN	0.1657 (0.1413)	3.4648 (2.5554)	0.3918** (0.1463)
Δ ROA	4.9780*** (1.2841)	-14.5797 (23.2199)	2.6488* (1.3297)
Δ NINTINC	-0.0599 (0.0523)	-0.3330 (0.9465)	0.0256 (0.5420)
Δ DEPLIAB	0.0197 (0.0251)	0.2062 (0.4540)	-0.0399 (0.0260)
N	26	26	26
Adjusted R^2	0.3465	0.1255	0.2457
F-Value	2.89**	1.51	2.16*

Notes: $p| \leq 0.01$, ***; $0.01 \leq |p| \leq 0.05$, **; $0.05 \leq |p| \leq 0.10$, *.

ratio while reducing the cost of government bailout. The regression coefficient associated with △ROA in Model (1) is positive and significant at 5 % level, while the same coefficient is positive and significant at 10% in Model 3. These results suggest that less profitable non-G-SIBs are more likely to cut back the loan portfolio and reduce total risk and idiosyncratic risk. The coefficient of △LLPTLN in Model 3 is positive and significant at 5% level indicating that non-G-SIBs with higher loan loss provision ratio are more likely to be exposed to higher loan default risk which in turn, is likely lead to higher idiosyncratic and total risks. Consistent with policy goals of Basel III, these results suggest that global banks with high non-performing loan ratio experience a greater reduction in idiosyncratic risk during the post-European crisis period.

In order to avoid the potential multicollinearity issue among explanatory variables in equation (5), we run the regression model by dropping G-SIB indicator variable from the model. The new regression results without G-SIB variable in the model are reported in Table 6D. When we compare the results reported in Table 6D with that of Table 6A, we find the empirical results are quite robust and they are qualitatively similar. Once again, the coefficient of EUROPE across all risk models is positive and they are statistically significant in Model 1 and Model 3. The results reported in Table 6D suggest that shift in total risk and unsystematic risk from pre-GFC period to post-European debt crisis period are significantly affected by European global banks which were

Table 6D: Regression results for changes in risk measure of European global banks versus the rest of the global banks from the Pre- GFC crisis period (06/03/2006-07/31/2007) to the Post-European debt crisis period (12/15/2012- 12/13/2015)

	Institutions		
	Model 1	Model 2	Model 3
	∆variance	∆beta	∆error variance
Intercept	-0.0001 (0.0050)	-0.1064 (0.0938)	-0.0077 (0.0053)
Δ LNSIZE	0.0027** (0.0013)	-0.0464 (0.0241)	0.0022 (0.0014)
Δ CAPITAL	-0.3188*** (0.1138)	-0.7697 (2.1493)	0.1175 (0.1210)
Δ TLNASS	-0.0030 (0.0170)	-0.1365 (0.3208)	-0.0182 (0.0181)
Δ LLPTLN	0.0579 (0.0416)	0.9111 (0.7850)	0.0371 (0.0442)
Δ ROA	3.2079*** (0.7520)	-28.1441** (14.2016)	1.0886 (0.7996)
Δ NINTINC	-0.0003 (0.0206)	0.1911 (0.3888)	-0.0146 (0.0219)
Δ DEPLIAB	-0.0072 (0.0100)	-0.0610 (0.1887)	-0.0094 (0.0106)
EUROPE	0.0323*** (0.0109)	0.1823 (0.2050)	0.0333*** (0.0115)
N	47	47	47
Adjusted R^2	0.3745	0.1273	0.2118
F-Value	4.440***	1.84*	2.55**

Notes: $|p| \leq 0.01$, ***; $0.01 \leq |p| \leq 0.05$, **; $0.05 \leq |p| \leq 0.10$, *.

vulnerable to the European sovereign debt crisis. Even after the European debt crisis ended in 2012, investors did not seem to perceive that European banking system is safer during the post-European debt crisis period relative to the pre-GFC period.

6. Conclusions

In this paper, we examine the impact of the Dodd-Frank Act (DFA) and Basel III regulations on risk profiles of Global Systemically Important Banks (G-SIBs). We argue that several provisions in the DFA and Basel III, such as systemic regulation, orderly liquidation authority, minimum leverage ratio requirement and derivatives regulations are likely to have had significant impact on the competitive environment in global banking system as well as on risk profiles of stockholders of global banks. We test whether G-SIBs are perceived less risky by reducing their risk-taking behavior during the post- GFC period as well as during the post-European crisis period relative to the pre-global financial crisis period.

We measure market-based risk (e.g., total risk, systematic risk, and idiosyncratic) of global banks over three time periods: pre-GFC crisis period (June 3, 2006 - July 31, 2007), post-GFC period (January 1, 2010 - December 13, 2015), and post-European debt crisis period (December 12,

2012 – December 13, 2015). Specifically, our study highlights the changing nature of market-based risk of G-SIBs from the pre- global financial crisis (GFC) period to the post-European debt crisis period. Our results show a significant increase in each measure of risk (total risk, market risk, and idiosyncratic) for G-SIBs from the pre-GFC period to the post-GFC period. This is not surprising since the post-GFC period coincided with a period when the global banking system was exposed to another systemic risk (financial contagion) arising from the European sovereign debt crisis. While the level of risk for G-SIBs on average, declined from the post-GFC period to the post-European debt crisis, the level of risk for G-SIBs on average, contrary to our expectations, remained significantly higher during the post-European debt crisis period relative to the pre-GFC period.

We further test whether changes in risk measures of risk of global banks are related to the change in bank-specific characteristics, such as bank size, capital ratios, non-performing loans, type of global bank (e.g., G-SIBs versus non- G-SIBs) and the type of home-country regulators (e.g., Europe versus non-Europe). We find that change in asset size, change in capital-to-asset ratio, change in total loans-to-asset ratio, and change in profitability ratio are significant determinants of shift in total risk, while the change in profitability ratio, and change in loan-loss provisions-to-asset ratio are significant determinants of a bank's shift in idiosyncratic risk. The results of our findings suggest that European global banks contributed significantly to the shift in total risk from the pre-GFC period to the post-GFC period. In contrast, European banks relative to non-European banks contributed significantly to the shift of idiosyncratic and total risks from the pre-GFC period to the post-European debt crisis period.

Overall, our results show that sweeping reforms such as DFA and Basel III enacted by national and international regulatory authorities during the post-GFC era have not been effective in reducing the risk of global banks. These findings are likely to have significant implications for bank managers, shareholders, regulators and policymakers.

REFERENCES

[1] Aharony, J., Saunders, A., & Swary, I., 1988. The effects of DIDMCA on bank stockholders' returns and risk. *Journal of Banking and Finance* 12, 317–31.

[2] Akhigbe, A., & Whyte, A., 2004. The Gramm-Leach-Bliley Act of 1999: risk implications for financial services industry. *Journal of Financial Research* 27(3), 436-446.

[3] Akhigbe, A. & Whyte, A., 2001a. The market's assessment of the Financial Services Modernization Act of 1999. *Financial Review* 36, 119–38.

[4] Akhigbe, A. & Whyte, A., 2001b. The impact of FDICIA on bank returns and risk: evidence from the capital markets. *Journal of Banking and Finance* 25, 393-417.

[5] Akhigbe, A. & Whyte, A., 2003. Changes in market assessments of bank risk following the Riegle-Neal Act of 1994. *Journal of Banking and Finance* 27, 87-102.

[6] Akhigbe, A., Martin, A., & Whyte, A., 2015. Dodd-Frank and risk in the financial services industry, *Review of Quantitative and Financial Accounting* 47 (2), 395-415.

[7] Allen, L., Bali, T., & Tang, Yi., 2012. Does systemic risk in the financial sector predict future economic downturns? *Review of Financial Studies* 25, 3000–3036.

[8] Amihud, Y., DeLong, G., & Saunders, A., 2002. The effects of cross-border bank mergers on bank risk and value. *Journal of International Money and Finance* 21 (6), 857-877.
[9] Balasubramnian, B., & Cyree, K., 2014. Has market discipline improved after the Dodd-Frank Act? *Journal of Banking and Finance* 41, 155-166.
[10] Baily, M., & Elliot, D., 2013. Five years after Lehman, we're much safer, Brookings Institution, September 9th, 2013.
[11] Batten, J., & Szilagyi, P., 2012. International banking during the Global Financial Crisis: U.K. and U.S. perspectives. *International Review of Financial Analysis* 25, 136-141.
[12] Beltratti, A., & Stulz, R., 2012. Why did some banking institutions perform better during the credit crisis? *Journal of Financial Economics* 105(1), 1-17.
[13] Bhargava, R. & Fraser, D., 1998. On the wealth and risk effects of commercial bank expansion into securities underwriting: An analysis of Section 20 subsidiaries. *Journal of Banking and Finance* 22, 447–65.
[14] Bhattacharya, S., & Purnanandam, A., 2012. Risk-taking by banks: What did we know and when did we know it? Presented at the *American Finance Association* (AFA) Annual Meetings, Chicago.
[15] Bhimjee, D., Ramos, S., & Dias, J., 2016. Banking industry performance in the wake of global financial crisis. *International Review of financial Analysis* 48, 376-387.
[16] Bundt, T., Cosimano, T., & Halloran, J., 1992. DIDMCA and bank market risk: theory and evidence. *Journal of Banking and Finance* 16, 1179–93.
[17] Bruyckere, V., Gerhardt, M., Schepens, G., & Vennet, R., 2013. Bank/sovereign risk spillovers in the European debt crisis. *Journal of Banking and Finance* 37, 4793-480.
[18] Calluzo, P., & Dong, G., 2015. Has the financial system become safer after the crisis? the changing nature of financial institution risk. *Journal of Banking and Finance* 53, 233-248.
[19] Demsetz, R., & Strahan, P., 1997. Diversification, size, and risk at bank holding companies. *Journal of Money, Credit and Banking* 29 (3), 300-313.
[20] Gao, Y., Liao, S., & Wang, X., 2018. Capital markets' assessment of the economic impact of the Dodd-Frank Act on systemically important of financial firms. *Journal of Banking and Finance* 86, 204-223.
[21] Geyfman, V., & Yeager, T., 2009. On the riskiness of universal banking: evidence from banks in the investment banking business pre- and post-GLBA. *Journal of Money Credit and Banking* 41, 1649-1669.
[22] Gropp, R., Gruendl. C., & Guetter, A., 2014. The impact of public guarantees on bank risk-taking: evidence from natural experiment. *Review of Finance* 18(2), 457-488.
[23] Houston, J., Lin, C., Lin, P., & Ma, Y., 2010. Creditor rights, information sharing, and bank risk taking. *Journal of Financial Economics 96*(3), 485-512.
[24] Huang, X., Zhou, H., & Zhu, H., 2012. Assessing the systemic risk of a heterogeneous portfolio of banks during the recent financial crisis. *Journal of Financial Stability* 8, 193–205.
[25] Kleinow, J., & Horsch, A., 2014. The impact of state guarantees on banks rating and risk behavior. *Journal of Governance and Regulations* 3 (1), 42-57.
[26] Laeven, L., & Levine, R., 2009. Bank governance, regulation and risk-taking, *Journal of Financial Economics* 93, 259-275.
[27] Moenninghoff, S., Ongena, S., & Wieandt, A., 2015. The perennial challenge to counter Too-Big-to-Fail in banking: empirical evidence from the new international regulation dealing with Global Systemically Important Banks. *Journal of Banking and Finance* 61, 221-236.

[28] Peltzman, S., 1976. Toward a more general theory of regulation. *Journal of law and Economics* 19, 211-240.
[29] Rajan, R., 2010. Faulty Lines: How Hidden Fractures Still Threaten the World Economy. Princeton University Press, Princeton, N.J.
[30] Skeel, D., & Cohan, W., 2011. The new financial deal: understanding the Dodd-Frank Act and its (unintended) consequences. Wiley.
[31] Stiroh, K., 2006. A portfolio view of banking with interest and non-interest activities. *Journal of Money Credit and Banking* 38, 1351-1361.
[32] Sundaram, S., Rangan, S., & Davidson S., 1992. The market valuation effects of the Financial Institutions Reform, Recovery and Enforcement Act of 1989. *Journal of Banking and Finance,* 16(6), 1097-1122.
[33] Yildirim, H., Kwag S., & Collins, M., 2006. An examination of the equity market response to the Gramm-Leach-Bliley Act across commercial banking, investment banking, and insurance firms, *Journal Business Finance Accounting* 33 (9), 1629-1649.

APPENDIX-A: SAMPLE DISTRIBUTION OF GLOBAL BANKS

# Obs.	List of Global Banks	G-SIBs* =1, Non G-SIBs =0	Group: US=1, Europe=2, Asia=3, Others=4
1	HSBC	1	2
2	JP Morgan Chase	1	1
3	Barclays	1	2
4	BNP Paribas	1	2
5	Citigroup	1	1
6	Deutsche Bank	1	2
7	Bank of America	1	1
8	Credit Suisse	1	2
9	Goldman Sachs	1	1
10	Mitsubishi UFJ FG	1	3
11	Morgan Stanley	1	1
12	Bank of New York Mellon	1	1
13	ING Bank	1	2
14	Mizuho FG	1	3
15	Santander	1	2
16	Société Générale	1	2
17	State Street	1	1
18	Sumitomo Mitsui FG	1	3
19	UBS	1	2
20	Wells Fargo	1	1
21	Lloyds	1	2
22	BBVA Banco Franc	0	4
23	Banco Macro SA	0	4
24	Banco Santander Rio S.A.	0	4
25	Grupo Financiero Galicia Sa, Buenos Aires	0	4
26	Australia & New Zealand Banking Group Ltd	0	3
27	National Australia Bank Ltd	0	3
28	Westpac Banking Corp	0	3
29	Credicorp Ltd	0	4
30	Banco Bradesco Sa Brad	0	4
31	Itau Unibanco Holding SA	0	4
32	Bank of Montreal	0	4
33	Bank of Nova Scotia (The)	0	4

34	Canadian Imperial Bank of Commerce	0	4
35	Royal Bank of Canada	0	4
36	Toronto-Dominion Bank (The)	0	4
37	Banco De Chile	0	4
38	Banco Santander-Chile	0	4
39	Bancolombia Sa Bancolombia, Colombia	0	4
40	National Bank of Greece	0	2
41	H D F C Bank Ltd	0	3
42	Icici Bank Ltd	0	3
43	Bank of Ireland	0	2
44	Shinhan Financial Group Co Ltd	0	3
45	Banco Latinoamericano de Comercio Exterior SA	0	4
46	DBS Group Holdings Ltd	0	3
47	United Overseas Bank Ltd	0	3

Source: Sample of global banks is obtained from *Compustat Research Insight.*

*G-SIBs are global systemically important banks (G-SIB=1), while Non-G-SIBs are cross-border banks that are not classified as global systemically important banks (Non-G-SIBs = 0). The FSB and the BCBS provide the list of 29 G-SIBs, using November 4, 2011 data. Eight G-SIBs are excluded from the list of 29 banks due to lack of availability of consistent data.