UNIVERSITY of OULU
OULUN YLIOPISTO

OULU BUSINESS SCHOOL

Liviu Cucerenco

DID FAIR VALUE ACCOUNTING CONTRIBUTE TO THE 2008 FINANCIAL CRISIS?

Master's Thesis

Accounting Department

May 2015

UNIVERSITY OF OULU
Oulu Business School

ABSTRACT OF THE MASTER'S THESIS

Unit
Department of Accounting

Author
Liviu Cucerenco

Supervisor
Juha-Pekka Kallunki

Title
Did fair value accounting contribute to the 2008 financial crisis?

Subject	Type of the degree	Time of publication	Number of pages
Accounting	Master's thesis	May 2015	67

Abstract

The 2008 financial crisis generated a heated debate over the role of fair value accounting (FVA) during the economic downturn. The debate has focused on the financial industry as it makes the most extensive use of FVA in its financial statements. The critics have argued that FVA provisions had exacerbated the crisis by forcing otherwise sound financial institutions to write down their assets to distorted market prices. The written-down prices can become benchmarks for other institutions, thus creating contagion effects within the economy. As the decreases in asset values depletes banks' regulatory capital, it might force them to sell assets at the distorted prices. The defenders, on the other hand, argue that FVA did not have the effects alleged by the critics. This paper examines both sides of the debate and creates an empirical model to test the effects of fair value gains/losses on bank regulatory capital.

I examine a sample of all US FDIC insured banks with both domestic and foreign offices which issue Call reports, over the period 2007-2011. I find that fair value gains/losses are significant determinants of changes in bank regulatory capital ratios. More specifically, realized gains/losses on AFS and HTM securities, and trading gains/losses are significant determinants of changes in bank capital adequacy as measured by the tangible common equity, the Tier 1 leverage, and the Tier 1 capital ratios.

Additionally, unrealized gains/losses on AFS securities are significant determinants of changes in the tangible common equity ratio, but not the Tier 1 leverage ratio, or the Tier 1 capital ratio.

I also find that the statistical significance of my findings does not result in economic significance. Despite the significant negative trends experienced by fair value gains/losses, the capital adequacy ratios remained largely unaffected during the crisis. My findings suggest that FVA had little to no role in amplifying the financial crisis of 2008.

Keywords
fair value accounting, financial crisis, capital adequacy, banks

Additional information

Acknowledgement

I could not have accomplished this overwhelming task without the insightful comments and advice of professor Juha-Pekka Kallunki.

I would also like to thank my wife, Maia, for her support and encouragement, as well as hours of proofreading and editing.

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

1.1 Overview

The 2008 financial crisis brought about a debate about the role of fair value accounting (FVA) practices during the downturn, especially as applied to the banking sector. According to Beatty & Liao (2014), the recent focus of the fair value debate[1] on the banking industry is due to three factors. Firstly, banks make extensive use of FVA. Secondly, FVA can influence bank regulatory capital[2]. Thirdly, "fair value accounting has evolved around banking crises including the great depression, the S&L [Savings & Loan] crisis, and the most recent financial crisis" (Beatty & Liao 2014: 357). FVA can potentially affect banks due to its effect on bank regulatory capital. Bank regulation under BASEL II imposes minimum capital requirements for government insured banks, based on measures derived from financial reporting. Thus, the choice of accounting method can affect financial statement numbers, and consequently bank capital. It has been argued that FVA exacerbated the effect of the crisis on bank regulatory capital, rendering many, otherwise healthy institutions, bankrupt.

A significant body of research has examined these problems in the recent academic literature, with results on both sides of the debate. The critics usually employ the procyclicality argument, that it, FVA amplifies financial cycles. Namely, FVA is argued to produce inflated asset values in times of economic growth, and generate excessive write-offs in times of economic downturn (Laux & Leuz 2010; Jager 2014). A number of researchers, however, argue that the accusations of the critics are ungrounded (Shaffer 2010), and that FVA was targeted by banks and regulators in order to divert attention from the real reasons behind the crisis (Badertscher, Burks & Easton 2012; Barth & Landsman 2010).

[1] The fair value vs. historical cost accounting debate is much older than the recent financial crisis and will be discussed in section *3.1.1*.
[2] In fact, "U.S. banking regulators were actually early critics of fair value measurement applied in the absence of active markets" (Beatty & Liao 2014).

This paper will examine the arguments and the evidence on both sides of the debate. Additionally, I will conduct an empirical examination of the extent to which FVA losses affected bank regulatory capital during the recent financial crisis in the US.

1.2 Prior related research

FVA has been widely criticized, both generally, and more specifically vis-à-vis its role in the recent financial crisis (Barth & Landsman 2010). The financial press blamed FVA for exacerbating the crisis (Hughes & Tett 2008; Johnson 2008; Rummell 2008). The financial industry warned that FVA rules could lead to forced sales at distressed prices (International Monetary Fund 2008). Theoretical models predicted similar outcomes (Allen & Carletti 2008; Plantin, Sapra & Shin 2008). Some empirical studies provided support for the accusers based on mortgage backed securities (MBS) and collateralized debt obligations (CDO) write-downs during the crisis (Dontoh, Elayan, Ronen, & Ronen 2012; Brunnermeier & Pedersen 2008).

The main arguments of the critics regarding to role of FVA during the recent financial crisis can be divided into two different, but closely related, parts. FVA could have contributed to excessive leverage during the economic upswing preceding the crisis, and/or it could have led to excessive write-downs during the crisis itself (Laux & Leuz 2010). The two arguments are closely related as both imply that FVA amplifies financial cycles.

The first argument is based on the observation that economic booms are associated with rising asset values, which, under a FVA reporting regime, would encourage banks to expand their balance sheets by leveraging, which can make them increasingly susceptible to negative shocks in values (Plantin, Sapra, & Shin 2008a; De Jager 2014; Persaud 2008; Adrian & Shin 2009).

Secondly, FVA is criticized for its lack of relevance and reliability during times of financial distress (Barth & Landsman 2010). The reasoning behind these criticisms is eloquently described by Laux and Leuz (2010): the researchers explain that the "mechanism through which fair-value accounting could contribute to a financial crisis involves the link between accounting and bank capital regulation" (2010: 95). Since

market prices do not always reflect fundamental values (Shleifer & Vishny 1992, 1997), especially during crises (Stanton & Wallace 2011), banks might end up depleting their capital by writing down assets to distorted market prices. The sale of assets at these "fire-sale" prices might become relevant information for other banks, thus forcing them to sell at similar prices (Laux & Leuz 2010). This process is widely referred to as "contagion".

The following two subsections will outline the existing research related to the above criticisms. The counterarguments of the defendants will be presented in subsection 1.2.3.

1.2.1 Excessive leverage during booms

De Jager (2014) develops a theoretical model of the economy which predicts that FVA can amplify the business cycle booms in banks through a feed-back loop in which money supply can drive money demand. The author starts with a simple capital ratio[3] and the assumption that bank management maximizes return on equity (ROE) subject to the mandatory capital requirements constraint. In these circumstances, a positive exogenous shock to asset fair values would increase the capital ratio of the bank, while decreasing ROE. Thus, the management of the bank would take action to neutralize the change by issuing more assets (e.g. loans) financed with debt (e.g. deposits). This, in turn, would increase money supply and stimulate spending, which would increase the demand for financial assets, increasing their values. In this way the expansion cycle would start over. As the cycle repeats, the banks are encouraged to invest in increasingly riskier assets in order to secure increasingly higher returns, what De Jager (2014:106) calls "bad capital driving out good capital". According to De Jager (2014), this is the way in which FVA contributes to excessive leverage during economic booms, while also decreasing the quality of bank capital.

A similar argument is advanced by Plantin et al. (2008a), who argue that FVA amplifies price movements. Coupled with market inefficiencies, this means that FVA might also amplify noise volatility in prices. Bank balance sheets and the market might be reacting to each other, leading to a potentially unstable growth in asset market values and in bank

[3] $C=(A-L)/\sum r_i a_i$: that is, equity over risk-weighted total assets (De Jager 2014 equation 2: 103).

leverage. Indeed, empirical evidence points to the fact that financial intermediaries are very quick to expand their balance sheets when in possession of excess capital. In these circumstances, fair value gains on assets might be seen as "surplus capacity" by the bank, thus prompting further increases in leverage (Adrian & Shin 2009). According to Adrian and Shin (2009:32), banks' "urge" to use the extra capacity can be very strong, as "in the sub-prime mortgage market in the United States (...) when balance sheets [were] expanding fast enough, even borrowers that [did] not have the means to repay [were] granted credit". The findings of Adrian and Shin (2009) support De Jager's (2014) model, in that FVA creates positive feed-back loops during economic booms, generating dangerous increases in leverage and deteriorating the quality of the balance sheet.

1.2.2 Excessive write-downs during busts

Hellwig (2009) argues that FVA was one of the key factors which allowed the US subprime mortgage crisis to become a global financial crisis. According to the author, the spread of the crisis was possible due to the exposure of financial institutions to market circumstances, through the medium of MTM accounting. The author proceeds by explaining how market prices are likely to be distorted during crisis times and how writing-down assets to such distorted prices can lead to fire sales and contagion effects for other financial institutions. Hellwig's (2009) discussion, is supported by a number of theoretical studies.

Allen and Carletti (2008) construct a theoretical model which predicts that, in times of crisis, MTM accounting can distort true asset values by pricing liquidity, or lack of liquidity, rather than expected future benefits arising from the assets. If assets are written down to these distorted values, banks might be forced to liquidate parts of their balance sheets in order to stay solvent, thus incurring unnecessary losses. These "fire sales" can, in turn, lead to contagion, as other banks would try to adjust their portfolios before the prices decrease even further (Adrian & Shin 2009). While FVA provisions allow banks to deviate from MTM accounting when markets are illiquid, Allen and Carletti (2008) claim that the standard setters' definition of liquidity is too narrow. According to the authors, a market should be considered illiquid not only when there is lack of trading

activity, but also when the market is not able to absorb "large amounts of extra supply without the price changing significantly" (Allen & Carletti 2008: 376). Thus, under the current FVA provisions, it is possible that assets be marked to distorted market values from illiquid markets.

The liquidity problems arising during crises were examined by Brunnermeier and Pedersen (2008), who developed a model with two interdependent types of liquidity, namely the "funding liquidity" of traders, and the "market liquidity" related to assets. According to the authors, "traders provide market liquidity, and their ability to do so depends on their availability of funding", thus funding liquidity directly impacts market liquidity (Brunnermeier & Pedersen 2008: 2201). Based on this framework, the authors are able to explain empirical phenomena observed during the crisis. Changes in funding liquidity are transferred to market liquidity for all assets, thus movements in market liquidity are correlated across different types of assets. Given a strong enough shock to funding liquidity due to imperfect information, market liquidity can dry up suddenly, and for all assets (Brunnermeier & Pedersen 2008). Most importantly, the authors show that "market liquidity and funding liquidity are mutually reinforcing", which can lead to "liquidity spirals" under certain conditions (Brunnermeier & Pedersen 2008: 2201). This suggests that in times of crisis, all market prices might be unreliable. Theoretical analysis, thus, predicts that market liquidity is an important determinant of market price (Allen & Carletti 2008) and that it is procyclical, thus likely to be severely affected by economic downturns (Brunnermeier & Pedersen 2008). Additionally, according to Allen and Carletti (2008), existing FVA regulation[4] does not effectively insulate the books from onerous market values. Together, these models show how a liquidity crisis can affect the banks' books through the medium of MTM accounting.

A number of empirical studies have tested some of the predictions generated by the theoretical research. Dontoh et al. (2012), for example, examine a sample of write-down announcements in the period January 1, 2007 – June 30, 2010. They found that writing-down assets under FAS 157, was associated with abnormal negative returns, increased

[4] Existing regulation refers to regulation in place at the time the paper was published. The April 2009 FVA rule clarification might have remedied some of the authors' concerns.

trading volume, and increased default risk in their sample. Moreover, the study shows that similar firms (from a matched samples approach) which did not experience write-downs register similar abnormal negative returns at the same time with the firms which did write-down assets. The authors interpret these findings as evidence of contagion induced by MTM accounting practices.

Additional evidence comes from Bhat, Frankel, and Martin (2011), who conduct an analysis of contagion during the crisis based on the relation between MBS holdings and prices. Their tests uncover evidence of feedback effects between MBS prices and holdings in support of the contagion argument. There is, however, significant cross-sectional variation in the results. Banks with poor performance and those with larger holdings of uncertain MBS (unsecured by any government entity) seem to drive the detected relationship. The above effect was significantly reduced by the April 2009 FVA rule clarification by the FASB, which provided supplementary guidance as to when a market can be considered distressed and should not be used to determine asset values (Katz 2009). Additionally, the authors find higher abnormal returns on event dates related to the April 2, 2009 rule clarification for banks with more uncertain MBS holdings and more distressed loans, which suggests that the stockholders of those banks benefitted from the FVA rule relaxation. Taken together, these findings suggest there existed contagion effects in the market for MBSs during the crisis, and that FVA was perceived by the market as having a significant role to that end (Bhat et al. 2011).

1.2.3 In defense of FVA

Laux and Leuz (2010) discuss the role of FVA during the 2008 financial crisis and analyze its effects based on the sample of the three largest investment banks and four largest bank holding companies in the US at the time of the study. They find that the assets of their sample banks were overvalued during the crisis, which contradicts the excessive write-downs argument.

Badertscher, Burks, and Easton (2012) conduct and empirical analysis of the effects of FVA on bank capital during the crisis. They find that “fair value accounting did not affect the commercial banking industry in the ways commonly alleged by critics” (2012:

60). The authors attempt to quantify the magnitude of the fair value losses and their effects on bank capital. To that end, they analyze other than temporary impairments (OTTI) as the main item affecting regulatory capital, since unrealized gains/losses do not affect the accounting bottom line. Additionally, Badertscher et al. (2012) assessed the extent to which FVA generated fire sales and contagion during the crisis. They find that security sales were indeed "correlated with the magnitude of OTTIs and bad debt expenses and with decreases in capital ratios" (2012: 61). However, the researchers also find that the banks with the lowest capital ratios were also least likely to sell securities, in contradiction of procyclicality. Furthermore, the interrelated selling activity of banks during the crisis does not seem to have increased. Thus, Badertscher et al. (2012) do not find significant evidence of either fire sales by distressed banks, or of interrelated sales (contagion).

Kolev (2009) seeks to shed some light on the reliability of assets reported at fair values, based on their market pricing. He finds that all three levels[5] of FVA disclosures are priced significantly positively by the market, with level 2 and level 3 disclosures registering larger discounts. His model estimates that only the discount on level 3 disclosures is statistically significant and does not exceed 35%. These findings suggest that investors perceive FVA disclosures as sufficiently reliable in order to incorporate them into stock prices.

Similarly, Goh, Ng, and Young (2009) examine the market pricing of assets reported at fair values during the financial crisis. The authors find that all three levels of fair value assets are priced at significant discounts by the market, the discount being significantly larger for level 2 and 3 disclosures. More specifically, they estimate that during the first 9 months of 2008, each dollar of levels 1, 2, and 3 fair value assets was priced "at $0.85, $0.63, and $0.49, respectively" (Goh et al. 2009: 5). Additionally, the researchers examine the evolution of the discounts over time and find that the pricing of a dollar of level 2 and level 3 disclosures decreased by 30.6% and 56.9% respectively over the first three quarters of 2008, while the pricing of a dollar of level 1 disclosures increased by

[5] The fair value hierarchy under SFAS 157 will be discussed in more detail in Section 3 – Fair Value Accounting.

19.6% over the same period. Based on the decision usefulness approach to financial accounting theory, these findings suggest that fair value accounting disclosures are valued by investors. Moreover, as the crisis unfolded and the uncertainty associated with marked to model assets increased, so did their reliance on pure mark to market values.

Following the same line of methodology, Huizinga and Laeven (2012) examine the theoretical prediction that FVA leads to understated asset values during crises. Their research is motivated by the asymmetrical evolution in market values and book values during the crisis. The proportion of US banks with a market to book ratio of less than one rose from 8% in 2001 to 60% in 2008, while the Tier 1 capital ratio experienced a decline from 12% to 11% over the same period (Huizinga and Laeven 2012). The researchers find that banks severely overstated their assets and understated their losses during the crisis. More specifically, real estate assets, such as MBS, were priced a large discounts by the market during the crisis, and the discount increased as the crisis unfolded. Additionally, banks with large MBS holdings recognized significantly lower loan charge-offs. Finally, authors uncover evidence pointing to the opportunistic reclassification of MBS securities from the AFS to the HTM category. Thus, it seems that banks exercised significant accounting discretion during the crisis, concealing the full extent of their distress (Huizinga and Laeven 2012). This finding contradicts the common claims of the critics that FVA forced banks to write-down assets to unrealistically low levels, thus depleting their capital. The real evidence points to the fact that banks overstated their books and that their regulatory capital was barely affected by the crisis.

Hodder & Hopkins (2010) adopt an indirect approach to measuring the effects of FVA on banks. They examine the responses of bank representatives to the FASB 2010 Exposure Draft, which among other things, proposed the reporting of loans at both historical cost and fair value. According to the authors, the reporting of loan fair value information was met with most resistance by the banking sector. The authors test three alternative, but not exclusive, hypotheses. Firstly, the resistance should be associated with accounting slack, since fair value reporting would increase transparency and reduce the capacity for slack. Secondly, the resistance should be associated with agency

problems, as the increase in transparency generated by fair value reporting would be detrimental to managers used to reaping private benefits from control. Thirdly, the resistance should be associated with the most commonly claimed reasons for resisting, namely "firms with difficult to value loans and firms that mostly hold loans to maturity" should be more likely to resist the regulation. The results of the study support the first two hypotheses and not the third one. Thus, it seems that most of the resistance to FVA comes from corporate governance issues and not from real problems associated with FVA (Hodder & Hopkins 2010). While this evidence does not directly address the effects of FVA on bank capital ratios, it sheds some light on the credibility of FVA criticism coming from the industry.

Gartenberg and Serafeim (2009) extend the analysis to non-financial firms. They examine a large sample of US publicly traded firms which make use of FVA provisions in their financial reporting practices. The researchers specifically observe the stock returns of their sample firms during the 4th quarter of 2008, which marked the largest losses of the year. The authors examine the relationship between the 4th quarter equity returns and the proportion of instruments reported at fair value on the balance sheets of the sample firms. They find that higher proportions of fair-valued assets were associated with higher stock returns. Gartenberg and Serafeim (2009) interpret these findings as evidence against the critics of FVA. According to the authors, if FVA had a negative effect during the crisis, firms with more assets reported at fair values would have been penalized by the market in the form of depressed stock prices. The evidence seems to point at investors valuing the transparency of FVA over the stability of historical cost accounting

1.3 Purpose

Theoretical and empirical literature on the role of FVA during the financial crisis came up with compelling arguments on both sides of the debate. The purpose of my study is to contribute to that debate with an empirical examination of the effects of FVA losses on bank regulatory capital during the financial crisis, in the US. I examine a comprehensive dataset of all FDIC insured banks with foreign and domestic offices that issue Call

Reports with FFIEC. In order to make sense of my findings I conduct a review of the theory behind bank capital regulation and FVA.

1.4 Structure

In order to study the role of FVA practices in the 2008 banking crisis, a certain theoretical background is appropriate. Firstly, this paper will overview select literature on the banking industry. I will discuss the role of banks in the economy, and how it is defined by information asymmetry. I will explain how banks remedy the information asymmetry between borrowers and lenders which could potentially plague the financial markets. Financial intermediation by banks creates a moral hazard problem between the banks and their creditors (depositors), resulting in the risk of bank runs. I will outline the emergence of deposit insurance and bank regulation as a solution to the bank runs problem. Finally, I will briefly discuss the historical development of bank regulation around crises, culminating the BASEL accords.

Having a good understanding of banking and bank capital regulation, we can turn to FVA, and its effect on bank regulatory capital. In order to do that, we first need to examine the theoretical foundations behind FVA as an accounting measurement methodology. This will necessarily lead us to the FVA versus historical cost accounting (HCA) debate and to the trade-offs faced by financial accounting regulatory bodies. The theoretical background will allow us to examine the role of FVA in modern banks and its potential effects on bank regulatory capital. Finally, I will conduct a descriptive analysis and an empirical analysis of the significance on FVA gains/losses as determinants of changes in the bank capital ratios during the financial crisis in the US.

The rest of the paper will proceed as follows: section 2 will overview the theoretical foundations of banking and develop the link between banking regulation and accounting practice; section 3 will overview the development of FVA and its effects on banks' financials; section 4 will overview existing theoretical models that can explain the effects of FVA in crises and will develop an empirical model to test the effects; section 5 will present and discuss the empirical findings; and section 6 will provide concluding remarks and suggestions for further research.

2 OVERVIEW OF BANKING

In order to analyze how accounting practice can affect bank balance sheets and regulatory capital, it is important to understand the role of banks in the economy. Section 2.1 will explain the concept of information asymmetry and how it gives rise to the need of financial intermediation; section 2.2 will further discuss information asymmetry in the context of depositor – bank manager and bank manager – company manager relationships and monitoring; section 2.3 will bring up the necessity of bank regulation and discuss its evolution over time.

2.1 Information asymmetry

Mainstream economic theory cannot identify a role for banks in the economy, since the models it generates are generally based on the assumption of perfect information (Beatty & Liao 2014). In a perfect information environment households can pass their savings to firms without the need for a financial intermediary (Freixas & Rochet 2008; Santos 2001). The concept of information asymmetry bridges this theoretical gap. According to Beatty and Liao (2014: 342), "the emergence of the asymmetric information paradigm has provided an explanation for both usefulness of accounting and the role of banks in the economy". Freixas and Rochet (2008: xvii) claim this paradigm incorporates "the assumption that different economic agents possess different pieces of information on relevant economic variables and will use this information for their own profit". Information asymmetry raises the problems of moral hazard and adverse selection. In the context of a household (saver) – firm (investor) relationship, savers cannot usually control to what end their money will be used, once lent out. Having gotten the money, firms have an incentive to invest in risky projects with high upwards potential, since they do not stand to lose much if projects fail. Namely, "the borrower has to take an action that will affect the return to the lender, yet the lender has no control over this action" (Freixas & Rochet 2008: 143). This is the moral hazard problem. Additionally, when investors have more information about risk than the lenders, the latter are more likely to finance the riskier investments which will appear to be more profitable. This is the essence of the adverse selection problem. In such circumstances, savers can be very reluctant to lend, to the extent that the market may cease to work. Few individual lenders

would be able to overcome these information asymmetry problems, at a significant cost. Moreover, the process would be Pareto sub-optimal, because of the duplication of information by each individual lender. These information considerations give rise to the place of banks in the economy.

2.2 Role of banks

According to Santos (2001: 44), "the two most prominent explanations for the existence of [financial] intermediaries (…) are the provision of liquidity and the provision of monitoring services". The following subsections will develop on these explanations.

2.2.1 Provision of liquidity

The liquidity provision role of banks is usually embodied in the creation of financial instruments by banks that offer protection from idiosyncratic shocks to consumption (Santos 2001). Namely, the bank transfers liquidity from those who have it but don't need it to those who need it but don't have it, thus smoothing consumption for all parties (Diamond & Dybvig 1983). In this way, the bank insures the borrowers against unexpected withdrawals by lenders (depositors) and eliminates the information asymmetry between the two parties. However, while the provision of liquidity explanation accounts for the assets part of a bank's balance sheet, it does not explain the motivation of depositors to delegate their money to the bank.

2.2.2 Provision of monitoring services

Banks are important to investors (e. g. depositors) "as providers of monitoring services because they act as delegated monitors (…) and thus avoid the duplication of monitoring costs" (Santos 2001: 45). Santos (2001) claims that firms generally have more information regarding their projects than do outside investors (adverse selection), thus the latter would have to incur significant costs in order to eliminate this information asymmetry before providing the former with liquidity. This cost would be passed on to firms as higher cost of capital. Banks are able to avoid the duplication of these monitoring costs, thus providing cheaper financing for firms and safer returns to depositors due to risk sharing between many depositors and across many borrowers.

Since banks invest in many projects simultaneously, by using a bank as a financial intermediary, all depositors essentially buy a fraction of the diversified portfolio of all the bank's investments. As such, no single depositor puts all their money into one project, which significantly reduces their risk. Moreover, banks might be able to attract liquidity from small investors, for whom the information costs associated with direct financing would have been a significant barrier to entry into the market. Thus the economic outcome of banking is superior allocation of funds.

A bank that manages the money of multiple lenders (depositors) is in a much better position to monitor the activities of firms at a much lower cost, thus reducing information asymmetry between lenders and borrowers (Beatty & Liao 2014). This intermediation, however, creates information asymmetry between the bank and its depositors. Since most bank assets are long-term and illiquid, their value is not certain at any single point in time, while their liquidation value will always be below the value of their liabilities (Santos 2001). This fact can cause bank runs, which can bankrupt even healthy institutions. Additionally, significant negative shocks to investor confidence may cause systemic bank runs and, respectively failures. According to Santos (2001: 46): "the risk of a systemic crisis and the inability of depositors to monitor banks (…) are […the] justifications that are often presented for regulating banks".

2.3 Bank regulation

The business model of a bank is investing long-term (e. g. loans) by incurring short-term liabilities (e. g. deposits). Based on the presumption that depositors will never cash-out all at the same time, the bank is able to generate profits on the yield difference between long-term and short-term securities. Given a normal yield curve, long-term assets generate higher return due to time-risk. While this process provides optimal risk sharing among people with different consumption preferences over time, it leaves the bank vulnerable to confidence crises. Due to the maturity difference, the liquidation value of the bank's assets is generally below the total value of its liabilities (Santos 2001). Thus, given a negative shock to the confidence of depositors, their optimal course of action becomes to withdraw all their money, since not all depositors are going to get their money back. Coupled with information asymmetry about which banks are healthy, a

confidence crisis could easily turn into a systemic bank run that could have devastating consequences for the economy (Santos 2001).

According to Santos (2001), multiple potential solutions to the bank run problem have been argued in the academic literature, including: “narrow banks” which would only invest in risk-free securities; equity instead of debt funding; suspension of convertibility; the establishment of a “lender of last resort” (LLR) institution (Bagehot 1873); and governmental deposit insurance.

Narrow banking is nonsensical based on the Diamond and Dybvig (1983) model, as shown by Wallace (1996). Equity funding cannot match demand deposits in provision of risk sharing for “fairly general preference structures”, but it solves the bank run problem (Jacklin 1987: 27). According to Dybvig (1993), suspension of convertibility can effectively solve the problem of bank runs in theory, but it is a very expensive and inconvenient solution for depositors, as they might end up with their funds locked in the bank when they most need them, due to the impracticality of estimating the number of early and late withdrawals.

Although none of the advocated solutions turned out optimal, “government deposit insurance has proven very successful in protecting banks from runs” (Santos 2001: 49). Its success comes with a cost to society though and potential deadweight loss, as deposit insurance is funded with tax money and it creates a moral hazard problem. Firstly, if the insurance plan charges the bank with a flat fee, the bank management has an incentive to take on more risk. Furthermore, when deposits are insured, depositors lose the incentive to monitor banks, thus offering bank management an additional incentive to take on more risk. In order to address the moral hazard problem while keeping banks protected from runs, capital structure regulation and/or risk sensitive premiums could be introduced alongside deposit insurance (Santos 2001). In these circumstances, bank regulation comes into play.

2.3.1 Theory of bank regulation

The remediation of the bank runs problem is one of the explanations for bank regulation. According to Diamond and Dybvig (1983) the business model of the banking sector has

an endogenous exposure to bank runs, due to the maturity mismatch between bank assets and liabilities. Government insurance of deposits coupled with bank regulation by the government can overcome the negative externality arising from bank failures due to confidence crises. Acharya (2009) also discusses the positive and negative externalities arising from bank failures. Additionally, the author examines systemic risk shifts due to the crowding of banks in their investment appetites. These considerations give rise to specific normative conclusions regarding the regulation of banks. According to Flannery, Kwan, and Nimalendran (2004), investors can have difficulties when valuing banking assets, due to the intrinsic 'opacity' of bank balance sheets. Bank regulation can be seen as a transparency facilitator, in these circumstances. Finally, "when high-risk claims are held by dispersed and potentially unsophisticated investors (…) the government may be required to become the delegated monitor", which justifies bank regulation (Dewatripont & Tirole 1994 via Beatty & Liao 2014).

Regardless of the objective reality behind capital regulation, it has been a subject of extensive research over the years. More importantly, bank capital regulation can potentially be the conduct through which accounting methodology has real economic impacts on the financial position of a bank (Laux & Leuz 2010). Thus, it is important to take a closer look at the current banking regulation provisions and to examine how they came into being.

2.3.2 History of bank regulation

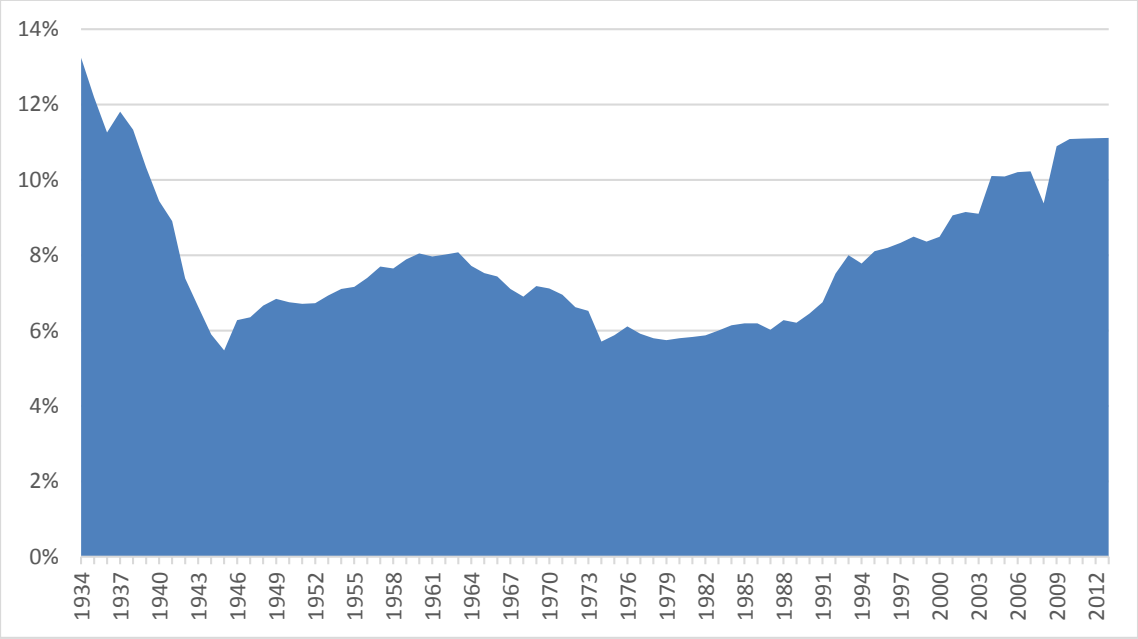
According to Burhouse, Feid, French, and Ligon (2003), a bank can finance its operations in two essential ways: borrowing (including deposits) or owners' capital. The higher the proportion of owners' capital, the less likely the bank is to face liquidity, and subsequently solvency problems, and "this simple reasoning is the basis for the longstanding emphasis bank supervisors have placed on capital adequacy as a key element of bank safety and soundness" (Burhouse et al. 2003).

However, forcing banks to hold more capital is costly, as it reduces the ability of banks to lend out money. This, in turn, affects the availability of funds in the economy (money supply).

Consider a simple economy with only one bank. The bank gathers deposits of 100 and lends out 95 in the form of a loan, as capital regulation requires it to hold 5% as capital. Simplifying the flow of money in the economy, assume that the 95 are deposited back. Then the bank lends out 90.25 and retains 4.75 as capital. At this point, the total amount of deposits is 195, and the total amount lent out is 185.25. This process can be described mathematically by a geometric series and it converges upon a specific number which depends on the capital reserve requirement. The maximum amount of money created by the bank can be calculated by multiplying the initial deposit by the money multiplier, defined as 1/R, where R is the required capital ratio. In our case, R is equal to 5%, thus, the money multiplier is 20 (1/.05). Consequently, the total amount of money in the economy due to a 100 initial deposit is 2000. The initial deposit can be thought of as the money base in the economy, which is total currency in circulation plus total reserves. Now consider what happens when we increase R by 1%. The money multiplier falls to 16.7, and the total money supply in the economy falls to 1667, that is, by 16.65%.

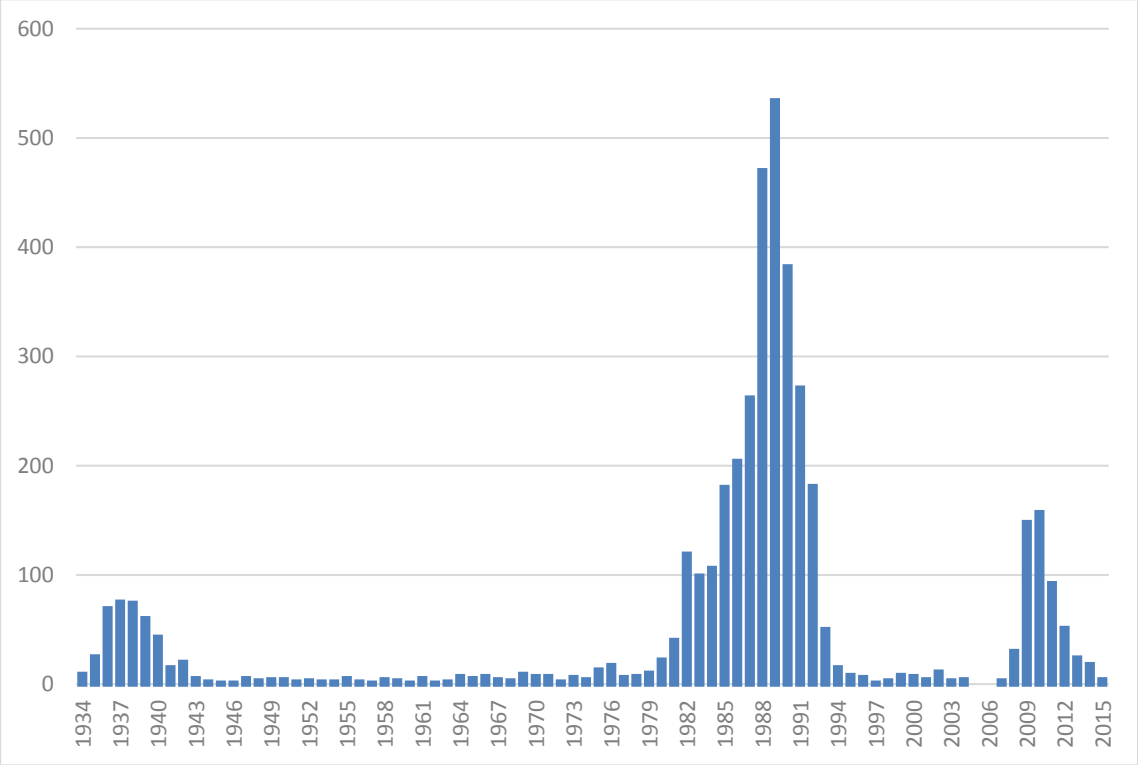
Thus, bank capital adequacy regulation has been a subject of debate and discussion ever since it was first implemented. It is important to note, however, that capital adequacy was not always regulated. Before the 1980s “bank supervisors in the United States did not impose specific numerical capital adequacy standards” and instead, focused on “informal and subjective” ways to assess the capital adequacy of different institutions (Burhouse et al. 2003). Therefore, before the 1980s, judgement was the basis of bank capital regulation, and it seemed to work well enough until the early 1970s: the capital ratio was in the range of 5-8% and the number of bank failures was low, as can be seen from Figures 1 and 2 below (Burhouse et al. 2003).

Figure 1: Equity as a percentage of total assets for all US banks from 1934 to 2013



Source: FDIC historical statistics on banking

Figure 2: Yearly number of bank failures in the US from 1934 to 2015



Source: FDIC historical statistics on banking

The 1970s showed with consistently high inflation and economic depression (stagflation). In this period some of the important banks at the time suffered failures, attracting the attention of regulators (Burhouse et al. 2003). By the beginning of the 1980s, the economic circumstances have only worsened, leaving a large number of FDIC insured institutions vulnerable. In these circumstances, in 1981, US bank regulators introduced specific minimum capital requirements.

Although different agencies did not fully agree on the figures, the minimum capital requirements, defined as primary capital over average total assets, were set at 5-6%, depending on the agency and the type of financial institution (Burhouse et al. 2003). The International Lending and Supervision Act of 1983 (ILSA) followed. ILSA adjusted the minimum capital requirement to 5.5% for all banks, with a ratio of less than 3% resulting in regulatory action. Additionally, ILSA emphasized some of the key concerns in capital regulation, such as "comprehensive risk assessment, including off-balance-sheet risks", the necessity for supplementary capital, and the "need for international convergence of capital standards in maintaining a level playing field" (Burhouse et al. 2003).

Finally, in 1988, after years of research and discussions about the best way to correlate regulation with actual bank risk, the Basel Capital Accord (BASEL I) was adopted by the G-10 central bank governors[6]. According to Burhouse et al. (2003):

> this risk-based capital framework (…) provides systemic procedures for factoring both on and off-balance-sheet risks into the supervisory assessment of capital adequacy, reducing disincentives to holding liquid, low risk assets, and fostering coordination among supervisory authorities from major industrialized countries.

Under BASEL I, the minimum capital requirement are 8% of total risk-weighted assets. Additionally, in the US, banks must meet a minimum leverage ratio requirement and are subject to Prompt Corrective Action (PCA), in the case of inadequate capital (Burhouse

[6] The BASEL I provisions were not fully implemented in the US until 1992 (Beatty & Liao 2014).

et al. 2003). The adoption of BASEL I coincided with the reversal of trend in bank failures, as can be seen on Figure 2 above.

Although the 1980s regulation significantly reduced the element of discretion in the assessment of bank capital adequacy, bank regulators received a lot of criticism during the savings and loan (S&L) crisis (1988-1991), on the grounds of regulatory forbearance (Kane 1989). The regulatory response was the Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA). Under FDICIA, institutions are assigned to different groups based on capital adequacy, namely well capitalized, adequately capitalized, undercapitalized, and significantly undercapitalized (Valencia et al. 2013). As the bank falls in rank it is subject to more stringent restrictions and to regulatory involvement (Kim & Kross 1998).

As financial engineering developed over the 1990s and early 2000s, regulators were concerned about "the divergence between the BASEL risk weights and the actual economic risks such as securitization and credit derivatives that increase risk exposure but lower BASEL risk weights" (Beatty & Liao 2014: 12). These concerns resulted in BASEL II, in 2004, which adjusted the risk weighting approach to account for the developments in the financial markets. BASEL II was implemented in the US only "for large, internationally active banks with more than $250 billion in total assets or with foreign exposures greater than $10 billion" (Beatty & Liao 2014: 12).

Finally, in response to the financial crisis, regulators have developed the most recent regulatory framework, BASEL III. BASEL III introduces many changes to the way regulatory capital is calculated and imposes stricter requirements than its predecessors[7]. For a better illustration of the development and calculation of capital regulation see Appendix 3.

[7] For a detailed list of changes see Basel Committee on Banking Supervision (2010).

3 FAIR VALUE ACCOUNTING

This study, so far, has referred to fair value accounting (FVA), FVA disclosures, and FVA standards repeatedly with the implicitly assumed familiarity of the reader with these concepts. The role of this section is to eliminate these assumptions by defining and explaining the concepts related to FVA as employed by this paper.

3.1 Accounting measurement alternatives

The underlying theory behind FVA concepts traces back to accounting measurement and its objectives, and will be discussed in section 3.2. First, I will define FVA and HCA so I can freely use them in the following sections.

3.1.1 Fair value accounting

FVA provisions are a function of the regulatory environment. In the US, the Financial Accounting Standards Board (FASB) creates the set of rules and principles that define financial reporting – the Generally Accepted Accounting Principles (GAAP), which are catalogued as Financial Accounting Standards (FAS). FAS 157 sets up the reporting framework of FVA and defines it as "the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date". Of course, not all assets and liabilities trade on active markets with readily available prices. Thus, the standard outlines three categories (levels) of inputs into the computation of fair values, based on their reliability (Laux & Leuz 2010). Level 1 inputs are prices from active and liquid markets for identical assets. Given the existence of such markets, these are the inputs that should be used to determine fair values. When active and liquid markets do not exist, the determination of fair values requires some assumptions. Level 2 inputs are "quoted prices for similar assets and other relevant market data (e.g. interest rates)" (Laux & Leuz 2010: 97). If level 2 inputs are not sufficient, the determination of fair values involves modeling of unobservable inputs – level 3 inputs (e.g. valuation models). While level 1 inputs are rather rigid and offer little opportunity for manipulation, level 2 inputs offer some, and level 3 inputs offer significant discretion to the reporting entity (Laux & Leuz 2010).

An important note at this point is that level 1 fair value items are the only ones that fall under the definition of mark-to-market (MTM) accounting. MTM is often used in research studies to proxy for FVA (De Jager 2014, Hellwig 2009, Allen & Carletti 2008, etc.). The extrapolation of the findings of those studies to FVA in general is problematic, as MTM constitutes a limited part of FVA, especially during the financial crisis (Laux & Leuz 2009, 2010).

3.1.2 Historical cost accounting

When discussing FVA, and especially its role during the crisis, it is important to consider its direct alternative – reporting balance sheet items at historical cost. While historical cost does not seem like a viable alternative for certain financial items (e.g. bank trading assets), it is often explicitly considered or at least implied as a viable substitute for FVA. Moreover, it is argued to be a better alternative (Laux & Leuz 2009).

Historical cost (HC) accounting is the practice of recording financial items (assets and liabilities) at cost (which is usually the fair value at the time of recognition) and adjusting them through depreciation/amortization and impairment (Laux & Leuz 2010). Depreciation is the accounting procedure of systematic allocation of the cost of an asset over its useful life, so as to match it to the economic benefits derived from the given asset. Amortization is the equivalent procedure for intangible assets. Impairments are non-systematic write-downs of assets undertaken when their fair values are below their carrying values on the balance sheet. Under HC accounting, increases in the values of assets are not recognized. This asymmetric treatment is the main theoretical distinction between HC and FVA. In practice, however, impairment tests are conducted differently for different assets, and "there is considerable discretion with respect to whether an asset is treated as impaired" (Laux & Leuz 2010: 97).

3.2 Financial reporting

In a market with perfect information, the value of an asset or liability would be obvious and undisputable – it would be defined as the sum of all future cash flows related with the asset or liability discounted with a known interest rate. Under these circumstances, commonly referred to as "ideal conditions", net income is defined as the change in the

present values of future cash flows and plays no role in firm valuation, as the balance sheet value (assets less liabilities) is the true value of the company.

3.2.1 Theory of financial reporting

When information about future outcomes is not perfect, which is the case in the real world, the values of assets are associated with significant uncertainty. Besides the general lack of information about the future, information about economic outcomes is not symmetrically distributed among different economic agents. As discussed in the previous section, information asymmetry raises the moral hazard and adverse selection problems. The adverse selection problem, in this context, is caused by the superior knowledge of firm managers about the future prospects of the firm. As such, they could manipulate information when presenting it to potential investors. The moral hazard problem is caused by the inability of the firm owners to observe managerial effort. In these circumstances, the values of assets are defined by probability density functions, and since probabilities are also uncertain, different economic agents assign different probabilities to different states of the world/outcomes. As such, there is no one true net income figure. Financial reporting is the historical solution to this problem, as it can produce a net income figure with which everybody can agree. Financial reporting can reduce the adverse selection problem faced by investors by communicating inside information to the market. It can also reduce the moral hazard problem through the net income figure, which can be used as a proxy for managerial effort.

As such, the role of financial reporting is twofold. The valuation role of accounting information is to provide the required transparency for the functioning of capital markets. The stewardship role of accounting information is to allow for the measurement of managerial performance (Pinnuck 2012). The fundamental problem with this approach is that the two roles require different information, thus, presenting the accounting profession with a trade-off. Investors are concerned with adverse selection, so they would like to know the value of the company as accurately as possible. In these circumstances, no value is more relevant than the market price.

Owners, on the other hand, would like to remunerate managers based on the latter's effort, so they would like a noise-free net income which correlates as much as possible with the work of the managers. In these circumstances, market values are not the best approach to financial reporting, as market values tend to fluctuate a lot, and incorporate macro-economic influences outside the managers' control. Arguably, HCA is a better measurement approach for stewardship purposes. The net income in this approach is better able to capture the value created by the managers of the firm, based on the assets they have purchased.

In the US, publicly traded firms "are required by the Securities and Exchange Commission (SEC) to prepare and file quarterly financial statements [which] are prepared using 'generally accepted accounting principles' (GAAP) and enforced by auditors, the SEC, and private securities litigation" (Laux & Leuz 2010: 96). The establishment of GAAP is delegated to the Financial Accounting Standards Board (FASB), which is a private company. The scope of GAAP is "to facilitate financial transactions in markets and contracting in the economy" by establishing comparable accounting standards which can be used by all market participants (Laux & Leuz 2010: 96). The accounting standards they produce must be 'relevant and reliable', but the two often present a trade-off, as the most relevant information (e.g. market price) can be unreliable, and the most reliable information (e.g. historical cost) can lack relevance. Additionally, different information is relevant for different parties, as discussed in the previous paragraphs. Thus, FASB face a number of trade-offs when producing standards, and the direction of the trade-off has not been constant over time.

3.2.2 History of financial reporting

The argument between the proponents of the two accounting measurement techniques has been going for around a century, with FVA and HC succeeding each other as the dominant influence on financial accounting standards in the US several times. Fair value accounting was criticized for generating frequent upward asset revaluations before the Great Depression (Scott 2011). Friedman and Schwartz (1971), show how MTM accounting practices contributed to bank capital depletion during the Great Depression. As the SEC was established in 1934, in order to avoid another depression in the future, a

shift towards HC accounting occurred, under SECs supervisory influence (Zeff 2007). The shift dominated the financial accounting standard setting environment in the US until the 1970s. The Savings and Loans (S&L) crisis of the 1980s followed, embodied in a range of control frauds in S&L enterprises, popular at the time (Black 2005). HCA was argued to have provided the opportunity for fraud as it disguised the real values of the S&Ls' assets which allowed the fraud to remain undetected. Arguably, if fair value accounting were used, the solvency problems of the S&L enterprises could have been detected in a much timelier manner (Young 1995).

More recently, the two major financial reporting standard setters, the FASB and the IASB have committed to a joint effort of harmonization of accounting standards around a new 'conceptual framework' (IASB 2001). This framework is focused on FVA and trades off reliability in favor of relevance, based on the idea that the main role of financial reporting is the valuation role. As such, the number of financial reporting standards favoring FVA has significantly increased recently, and the list is likely to expand even further (Ball 2006). The FASB 2010 exposure draft, for example, included proposals to report bank loans at both HC and FV (Hodder & Hopkins 2010). Given the recent focus of regulatory bodies on FVA, it is not surprising that it received part of the blame for the early 2000s accounting scandals and for the financial crisis sprung in 2008.

3.3 Role of FVA during the financial crisis

The most widely used criticism of FVA during the crisis relates to the link between accounting and bank capital regulation (Laux & Leuz 2010). Since market prices deviate from fundamentals (Shleifer & Vishny 1992, 1997, Brunnermeier & Pedersen 2008), MTM accounting can force financial institutions to write down assets to distorted prices, thus depleting the regulatory capital of potentially healthy institutions (Laux & Leuz 2010, Allen & Carletti 2008). A number of studies promoting this view have been presented in subsection 1.2.2. Most of those studies, however, specifically refer to MTM accounting, and some of them proxy for FVA by looking at MTM accounting. Laux and Leuz (2010) stress the importance of the distinction between FVA and MTM accounting. The existence of an active market is a necessary condition for MTM

accounting. In the absence of active markets, assets can still be reported under FVA provisions, based on some assumptions, modeling, and/or markets for similar assets, as discussed in subsection 3.1.1. So, the concept of FVA is not nearly as rigid as that of MTM, the latter is only a part of the former.

Moreover, "fair-value accounting as stipulated by U.S. accounting rules has several safeguards against marking to potentially distorted market prices" which reduces the potential negative effects of pure MTM accounting (Laux & Leuz 2010: 106). FAS 157 specifies that fair value should not be derived from a forced transaction such as a forced liquidation or a distress sale. This provision should prevent contagion from fire sales, although it might be difficult to separate such prices in practice (Laux & Leuz 2010). Additionally, FAS 157 stipulates that in the absence of active markets for similar instruments, level 2 or 3 instruments can be used to determine fair value, as explained above. Indeed, according to Laux and Leuz (2010), the usage of level 1 inputs by large bank holding companies decreased from 34% of all assets reported at fair value in the first quarter of 2007 to 19% in the first quarter of 2009, mirrored by an increase in level 2 and 3 inputs usage. Table 1 illustrates the usage of the three input levels over the course of the crisis for a sample[8] of large US banks. Clearly, the shift towards level 3 instruments was more pronounced for the bank holding companies.

Finally, according to FAS 115, the initial classification of instruments on the balance sheet is largely up to the managers, thus giving them significant discretion over what securities would affect regulatory capital. Moreover, banks have the possibility to reclassify securities: "for example, in the fourth quarter of 2008, Citigroup reclassified debt securities with a carrying value of approximately $60 billion to held-to-maturity", thus insulating the income statement from their fair values (Laux & Leuz 2010: 106).

[8] Investment banks: Goldman Sachs, Morgan Stanley, and Merrill Lynch; Bank holding companies: JP Morgan, Bank of American, Citigroup, and Wells Fargo (Laux & Leuz 2010: Table 2: 108).

Table 1: Assets measured at Fair Value (FV) under FAS 157 over time for a constant sample of major US banks

	Major investment banks (n = 3)					*Major bank holding companies (n = 4)*				
	FV/ total assets	*L1/FV*	*L2/FV*	*L3/FV*	*Net transfers*	*FV/ total assets*	*L1/FV*	*L2/FV*	*L3/FV*	*Net transfers*
2007 Q1	44.9%	27.4%	65.6%	7.0%	NA	32.4%	33.5%	57.2%	9.2%	NA
2007 Q2	43.2%	26.5%	65.5%	8.0%	0.13%	33.6%	36.4%	55.0%	8.6%	0.15%
2007 Q3	46.7%	26.1%	64.2%	9.7%	1.27%	32.2%	30.1%	58.9%	11.0%	0.76%
2007 Q4	48.0%	25.5%	64.6%	10.2%	−0.04%	32.0%	29.3%	59.6%	11.1%	1.46%
2008 Q1	49.6%	23.3%	65.9%	10.9%	0.84%	32.4%	27.2%	60.7%	12.1%	1.99%
2008 Q2	48.5%	23.4%	65.9%	10.7%	−0.54%	33.3%	26.7%	59.0%	14.3%	1.38%
2008 Q3	49.6%	23.6%	65.6%	10.8%	0.27%	31.0%	26.2%	57.7%	14.6%	1.48%
2008 Q4	51.8%	15.5%	70.2%	14.3%	0.90%	29.9%	18.7%	68.2%	13.2%	−0.67%
2009 Q1	55.2%	22.1%	64.0%	13.9%	−2.43%	31.6%	19.3%	67.4%	13.4%	1.30%
Cumulative L3 transfers	2008 Q1: 43.12%		2008 Q4: 53.58%			2008 Q1: 82.90%		2008 Q4: 131.23%		

Source: Table 2 Laux and Leuz (2010: 108)

Overall, it seems that in practice companies have significant flexibility in the implementation of FVA. Moreover, evidence points to the fact that banks could have overvalued their assets during the crisis. According to Laux and Leuz (2010), the four largest bank holding companies in the US[9] valued their loans (fair value footnote disclosures from 10Q and 10K reports) significantly above external estimates of those values. Their findings in this regard are summarized in Table 2.

Having discussed the potential of FVA to exacerbate crises, it is worth examining closer the shape that FVA takes on bank financial statements.

[9] Bank of American, Citigroup, JP Morgan, Wells Fargo.

Table 2: Loan loss estimates implied by reported fair values versus external estimates

	Loans held		*Reported loss expectation*		*Estimated loan losses*			
	Amortized cost (A)	*Fair value (B)*	*Allowance for loan and lease losses (C)*	*Total implied loss (A – B) + C*	*SCAP prediction*	*Citigroup report*	*Citadel report*	*Goldman Sachs report*
Bank of America	866.2	841.6	23.1	47.7	104.1	83.8	148.4	93.4
Citigroup	660.9	642.7	29.6	47.8	79.4	NA	102.6	71.0
JP Morgan	721.7	700.0	23.2	44.8	79.3	111.9	113.6	73.6
Wells Fargo	849.6	835.5	21.1	35.1	74.3	51.5	124.9	77.3

Source: Table 4 Laux and Leuz (2010: 114)

3.4 FVA in banks

Most of the assets on a bank's balance sheet (typically more than 50%) are loans, which are largely reported under HC accounting (Laux & Leuz 2010). Under FAS 115 securities held by banks are classified into *trading* and *other* securities. *Other* securities are further divided into *held-to-maturity* (HTM) and *available for sale* (AFS). Trading securities are bought and sold short-term. Gains and losses on the trading portfolio are recognized on the income statement. AFS securities are reported at fair value, however, the gains and losses on these securities are only recognized in the income statement if they are "other than temporary" (OTT), and are otherwise reported in other comprehensive income as unrealized gains/losses. HTM securities fall under HC accounting, however, OTT impairments on these securities are reported in the income statement as realized. Table 3 shows the average weights of HTM, AFS, and trading securities as percentages of total assets of most FDIC insured US banks with domestic and foreign offices in the period 2006-2011.

As the table clearly illustrates, AFS and Trading securities alone make up around 20 – 25% of the assets of an average bank, however, banks can choose to report any other financial items at fair values under the "fair value option" of FAS 159. According to

some studies, the percentage is higher for larger banks and even larger for investment banks (Laux & Leuz 2010).

Table 3: FV instruments on bank balance sheets, as percentages of total assets

	HTM	AFS	Trading
2006	0.42%	15.00%	8.24%
2007	0.27%	12.75%	9.90%
2008	1.01%	12.74%	9.01%
2009	1.05%	17.91%	7.25%
2010	0.76%	18.62%	7.74%
2011	1.24%	18.22%	7.20%

4 METHODOLOGY

4.1 Data and descriptive statistics

My data includes all the US banks with both domestic and foreign offices that file Reports of Condition and Income (Type 031 Call Reports) with the Federal Financial Institutions Examination Council (FFIEC). I get my data from the FFIEC Central Data Repository's Public Data Distribution web site, which offers free access to the Call Reports. Following related research, my sample period spans the years 2007 – 2011, which is meant to capture the most recent global financial crisis and the immediate aftermath. I use differenced variables in my model, so my actual data spans the years 2006 – 2011 resulting in 686 firm year observations. I proceed by calculating the differenced variables, thus losing one year of data and I adjust the data for outliers. Additionally, some firm-years do not register any gains/losses associated with fair value instruments. Including these observations in the analysis would bias the estimation results while providing no extra information. The only downside of excluding these observations from the analysis is the additional loss of observations. My final sample is an unbalanced panel consisting of 509 firm-year observations.

My main variables of interest are the changes in the Tier 1 Capital Ratio, the Tier 1 Leverage Ratio and the Tangible Common Equity (TCE) Ratio. The first two ratios are mandated and enforced under the BASEL accord provisions, while the third one was widely used by investors and analysts during the crisis to assess the ability of banks to absorb losses (Tarullo 2011). In this study, the three ratios are defined as follows:

$$T1_{CapR} = \frac{Tier\ 1\ Capital}{Total\ Risk\ Adjusted\ Assets} \tag{1}$$

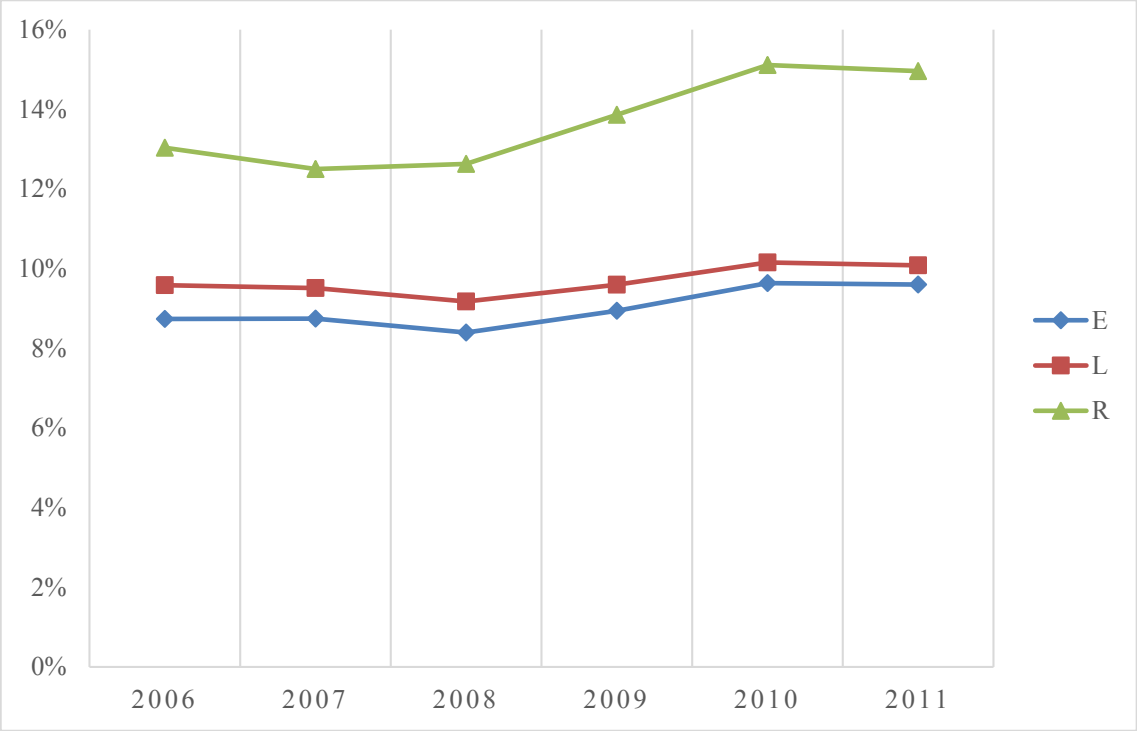
$$T1_{LevR} = \frac{Tier\ 1\ Capital}{Average\ Total\ Assets\ for\ Leverage\ Purposes} \tag{2}$$

$$TCER = \frac{Tangible\ Common\ equity}{Tangible\ Assets} \quad (3)$$

Tier 1 capital is the highest quality regulatory capital and is defined in the BASEL accord provisions. It is essentially total equity capital adjusted for accumulated other comprehensive income and other non-qualifying items, which include portions of preferred stock, deferred tax assets, goodwill, intangibles, minority interest, and other items. The exact definition of what constitutes a qualifying item is complex and is beyond the purpose of this study. The calculation of risk adjusted assets involves the weighing of all the assets on the balance sheet by their risk. As such, a very risky asset (e.g. a mortgage backed security (MBS) with junk rating) might get a risk weight of 0% while a very certain asset (e.g. a T-bill) might get a weight of 100%. Average Total Assets for Leverage Purposes are average total assets adjusted for disallowed goodwill and other intangibles, as well as deferred tax assets and other items. The TCE ratio is not a fixed regulatory item, so it is defined in a number of different ways in different sources. In this study, TCE is total equity capital adjusted for preferred stock, goodwill, and intangibles; and Tangible Assets are defined as total assets minus goodwill and intangibles.

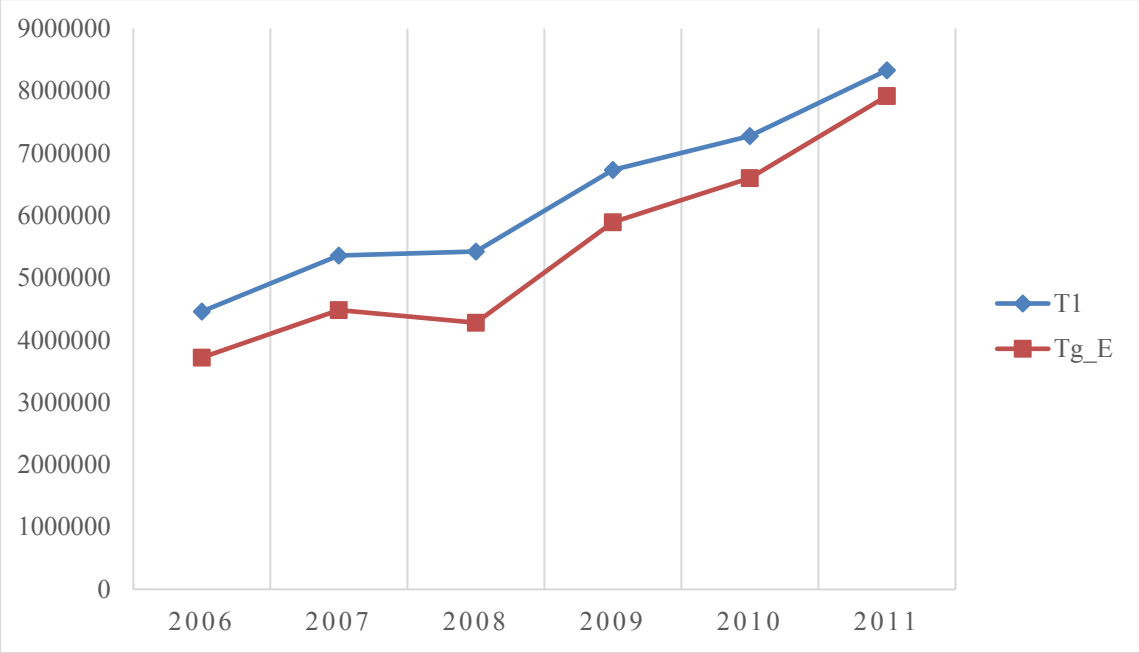
Figure 3 shows the evolution of the TCE (E), Tier 1 leverage (L), and Tier 1 capital (R) ratios over the sample period based on mean values. The 2008 financial crisis is observable as a slight decrease in all three ratios, with the minimum in 2007 for R and in 2008 for E and L. The three ratios remain surprisingly robust throughout the sample period. This is an interesting observation, since the average US bank with foreign offices seems to have remained largely unaffected in terms of capital adequacy ratios, despite the severity of the crisis. The Tier 1 capital ratio, in fact, increased throughout the crisis.

Figure 3: The evolution of the capital adequacy ratios during the crisis



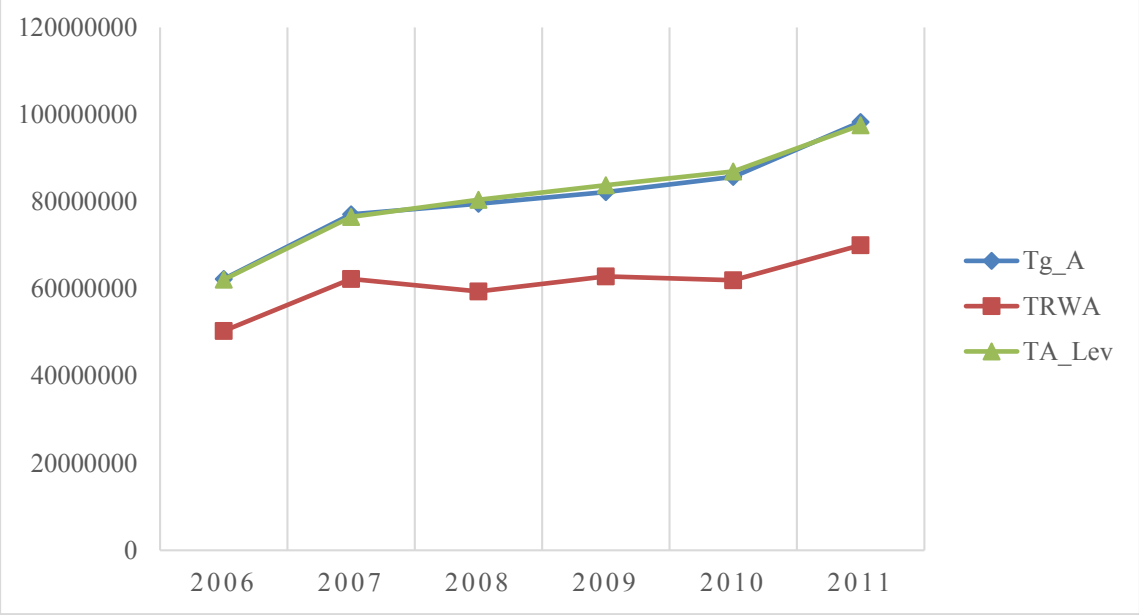
Figures 4 and 5 break down the three ratios by numerator and denominator figures in order to get more insight into their behavior during the sample period. Figure 4 registers the 2008 financial crisis as a slow-down in the growth of Tier 1 capital and a slight decrease in mean tangible equity. Both growths pick up quite rigorously in 2009 though. Figure 5 reveals similar patterns: tangible assets and assets for leverage purposes increase steadily throughout the crisis, although their rate of growth slows down in the period 2007 – 2010. Risk weighted assets lag behind a little and do not exhibit a clear trend in the period 2007 – 2010. As such, the capital adequacy ratios, as well as their components, seem to have been only marginally affected by the financial crisis of 2008.

Figure 4: The evolution of Tier 1 capital (T1) and tangible equity (Tg_E) during the crisis



Vertical axis in thousands of dollars.

Figure 5: The evolution of tangible assets (Tg_A), average total risk weighted assets (TRWA) and total assets for leverage purposes (TA_Lev) during the crisis



Vertical axis in thousands of dollars.

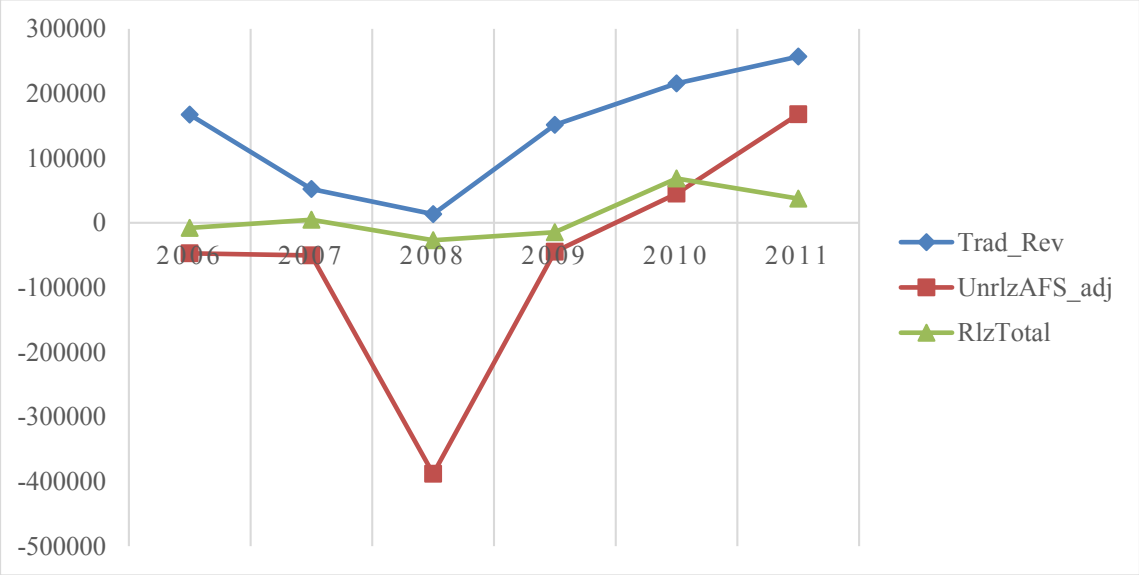
This conclusion is especially interesting when contrasted with Figure 6, which graphs means of the fair value gains/losses during the crisis. These values are captured by three variables: Trad_Rev is trading revenue, UnrlzAFS_adj are unrealized gains/losses from AFS items adjusted for gains/losses on equity AFS securities (which are treated differently in regulatory capital calculation), and RlzTotal is the sum of realized gains/losses on AFS and HTM securities[10].

The financial crisis can be seen much more clearly on Figure 6. Trading revenues for the average bank in the sample have declined from $167 million in 2006 to $13 million in 2008, a drop of around 92%. At the same time, unrealized losses on AFS securities increased from around $(50) million in 2006 and 2007 to $(390) million in 2008, an increase of about 7.7 times. Similarly, $4 million of realized gains on AFS and HTM securities in 2007 fall to an average loss of $(27). The cumulative loss for the average bank in the sample due to items reported at fair values in 2008 relative to the previous two years adds up to around $(520) million.

Based on Figure 6, one can conclude that FVA did, in fact, have a significant impact on banks in the US. Figures 3 through 5, however, largely invalidate this conclusion. While $500 million seems like a large number, it only constituted around 10% of the average 2007 Tier 1 capital and around 12% of the average 2007 tangible equity. For comparison, it is worth noting that Tier 1 capital increased by 1% from 2007 to 2008 and tangible equity decreased by 5%. Whether the 2008 FVA loss is a statistically significant determinant of these changes is the main empirical question of this study.

[10] The summing of realized gains/losses on AFS and HTM securities was motivated by two reasons. Firstly, the share of this number due to HTM securities is very small. Secondly, the realized gains/losses on HTM securities variable has too many zero observations, which renders its separate consideration impracticable.

Figure 6: The evolution of trading (Trad_Rev), unrealized (UnrlzAFS_adj), and realized (RlzTotal) gains/losses during the crisis



Based on the discussion in the previous paragraph, my variables of interest become changes in the three capital adequacy ratios, rather than the level ratios. Table 4 presents select descriptive statistics for these variables.

Table 4: Descriptive Statistics

	Mean	Median	Max.	Min.	Std. Dev.	Skew.	Kurt.	N
DE	0.00178	0.00218	0.08348	-0.12339	0.0204	-0.54	9.81	509
DE_RLZ	-0.00023	0.00004	0.01313	-0.05157	0.0043	-6.60	65.50	509
DE_TR	0.00064	0.00000	0.02040	-0.02337	0.0027	1.08	33.54	509
DE_UNRLZ	-0.00059	0.00003	0.00729	-0.04264	0.0045	-5.04	41.56	509
DL	0.00060	0.00090	0.08811	-0.12591	0.0208	-0.86	10.08	509
DL_RLZ	-0.00022	0.00004	0.01253	-0.04718	0.0042	-6.28	59.26	509
DL_TR	0.00063	0.00000	0.01950	-0.02174	0.0026	0.95	30.76	509
DL_UNRLZ	0.00004	0.00000	0.00350	-0.00141	0.0004	3.24	24.92	509
DR	0.00270	0.00255	0.14700	-0.26288	0.0322	-2.10	18.65	509
DR_RLZ	-0.00040	0.00005	0.37911	-0.29208	0.0258	2.91	130.20	509
DR_TR	0.00087	0.00000	0.02317	-0.02713	0.0033	0.82	24.10	509
DR_UNRLZ	0.00003	0.00000	0.00514	-0.00284	0.0005	3.78	41.66	509
L_TA	7.05854	7.07321	9.25808	5.45239	0.9174	0.16	2.29	509
ROE	0.00995	0.05182	1.41646	-4.59532	0.2969	-7.92	119.40	509

DE, DL, and DR are the dependent variables in my regressions and represent changes in the TCE, Tier 1 Leverage, and Tier 1 Capital ratios respectively. The independent variables of interest are X_Y (where X ∈ {DE, DL, DR} and Y ∈ {RLZ, UNRLZ, TR}) – the portion of the change in X attributable to Y, where RLZ stands for realized gains/losses on AFS and HTM securities, UNRLZ stands for unrealized gains/losses on AFS securities, and TR stands for trading revenues. L_TA is logged total assets, and ROE is return on equity. The last two variables are meant to control for size and profitability respectively. The X_Y variables are derived following Song (2014) and are used to predict the signs of the estimation coefficients.

The Tier 1 Leverage Ratio (L) is defined as Tier 1 Capital (T) divided by Average Total Assets for Leverage Purposes (A). Rewriting equation 2 for convenience:

$$L_0 = \frac{T_0}{A_0} \tag{4}$$

Assuming a realized fair value gain/loss α which changes T_0 by k percent (that is k= α/T) the new leverage ratio becomes:

$$L_1 = \frac{T_1}{A_1} = \frac{T_0 + \alpha}{A_0 + \alpha} = \frac{(1+k)T_0}{A_0 + kT_0} \tag{5}$$

α affects the numerator through net income and the denominator through the change in value of the specific asset reported at fair value. Given equations 4 and 5, the change in the leverage ratio can be described as:

$$\Delta L = L_1 - L_0 = \frac{L_0 k(1 - L_0)}{L_0 k + 1} \tag{6}$$

For L_0<1:

$$for\ k > 0, \Delta L > 0$$
$$for\ k < 0, \Delta L < 0$$

ΔL here is the change in the Tier 1 Leverage Ratio attributable to a realized fair value gain/loss, namely DL_RLZ in Table 4. So, I expect a positive sign on the coefficient of DL_RLZ in the regression analysis. The effect of an unrealized gain/loss on AFS

securities can be predicted in a similar fashion, the only difference being that unrealized items affect only the denominator, because of the exclusion of the unrealized gains/losses from the calculation of Tier 1 capital, known as the Accumulated Other Comprehensive Income (AOCI) filter. So it can be shown that for an unrealized fair value gain/loss:

$$\Delta L = -\frac{L_0^2 k}{L_0 k + 1} \tag{7}$$

In equation 7, for $L_0<1$:

$$for\ k > 0, \Delta L < 0$$
$$for\ k < 0, \Delta L > 0$$

So, I expect a negative sign on the coefficient of DL_UNRLZ in the regression analysis. The full derivations for all the X_Y variables will not be presented here, but can be found in Appendix 1.

Having defined all the variables in Table 4, we can turn to its interpretation. Firstly, it is important to notice that DE, DL, and DR (the changes in the TCE, Tier 1 Leverage, and Tier 1 Capital ratios) have positive means over the sample period, reflecting the net growth of the three ratios throughout the crisis pointed out by Figure 1. All the X_Y variables have non-negative medians, reflecting the general trend in the base ratios. Some of the means of the X_Y variables are negative, which can be explained for most of them (except DR_RLZ) by the strong negative skew of the data. All the variables besides L_TA exhibit very high kurtosis, which explains the large spread of the data noticeable in the differences between means and extremes. It is important to note that the variables exhibit highly non-normal properties, even after adjusting for outliers. Additional trimming would reduce the already small sample size even further, thus affecting the reliability of the analysis. Logging the data is not practicable due to the large proportion of negative values. Another important fact is the large proportion of zero observations in the X_Y variables. This latter fact is responsible for the zero medians in Table 4.

Table 5: Correlation Matrix

	DE	DE_RLZ	DE_TR	DE_UNRLZ	DL	DL_RLZ	DL_TR	DL_UNRLZ	DR	DR_RLZ	DR_TR	DR_UNRLZ
DE		-0.003	0.088**	0.099**	0.853***	-0.001	0.083*	-0.060	0.532***	0.028	0.080*	-0.099**
DE_RLZ	0.045		-0.026	0.197***	0.015	0.999***	-0.026	-0.185***	0.001	0.230***	-0.031	-0.103**
DE_TR	0.093**	-0.015		-0.079*	0.161***	-0.025	0.998***	0.041	0.039	-0.012	0.973***	0.088**
DE_UNRLZ	0.130***	0.241***	-0.009		0.016	0.203***	-0.082*	-0.924***	0.008	0.009	-0.124***	-0.783***
DL	0.830***	0.032	0.113**	0.047		0.015	0.154***	-0.006	0.568***	0.052	0.147***	-0.040
DL_RLZ	0.046	1.000***	-0.016	0.241***	0.031		-0.025	-0.191***	0.001	0.231***	-0.030	-0.106**
DL_TR	0.092**	-0.015	1.000***	-0.009	0.112**	-0.017		0.043	0.038	-0.012	0.978***	0.091**
DL_UNRLZ	-0.123***	-0.224***	0.006	-0.991***	-0.043	-0.224***	0.005		-0.051	0.009	0.074*	0.818***
DR	0.638***	-0.023	0.068	0.071^	0.665***	-0.023	0.068	-0.063		0.288***	0.031	-0.171***
DR_RLZ	0.002	0.814***	-0.020	0.190***	-0.012	0.814***	-0.021	-0.166***	-0.022		-0.013	-0.056
DR_TR	0.094**	-0.009	0.999***	-0.004	0.113**	-0.010	0.999***	0.002	0.066	-0.014		0.141***
DR_UNRLZ	-0.142***	-0.216***	-0.010	-0.976***	-0.072^	-0.216***	-0.010	0.979***	-0.081*	-0.178***	-0.014	

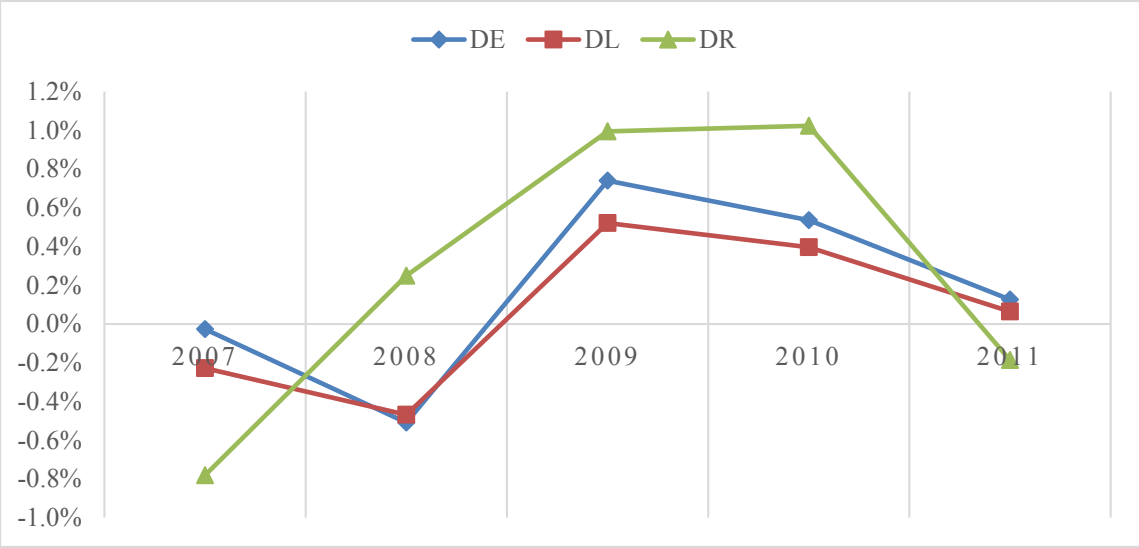
Spearman correlations below main diagonal;
Pearson correlations above main diagonal;
1, 5, and 10 % significance marked by ***, **, and * respectively;
Marginal significance at the 10% level marked by ^.

A preliminary assessment of the relationships between variables can be inferred from Table 5, which presents the correlations between the main variables of interest, namely the changes in the three capital adequacy ratios and the deduced X_Y variables. Firstly, it is important to note that significant correlations exist between the X_Y variables and the corresponding Xs. Both Pearson and Spearman correlations agree that DE is significantly positively correlated with DE_TR and DE_UNRLZ. DL seems to be significantly positively correlated with DL_TR, according to both correlation techniques. Finally, DR is significantly negatively correlated with DR_UNRLZ, according to both techniques, and it is significantly positively correlated with DR_RLZ based on the Pearson correlation, suggesting a linear relationship. All the correlation signs agree with expectations. A noteworthy observation is that DE, DL, and DR are all significantly positively correlated, suggesting that they supply very similar information about capital adequacy.

4.2 Model development

Academic literature examining the role of FVA during the financial crisis on bank capital adequacy did not produce any empirical models testing the predictive ability of FV gains/losses to predict changes in the bank capital adequacy ratios. Thus, I start by examining trends in the variables of interest over the sample period. Figure 7 illustrates the trends in the changes of the three capital adequacy ratios over time. These will be my dependent variables, as I will try to explain the three trends with FV gains/losses over the same time span.

Figure 7: Changes in the tangible equity (DE), Tier 1 leverage (DL), and Tier 1 capital (DR) ratios over time



4.2.1 Hypotheses development

Three trends to explain directly lead to three testable hypotheses. Additionally, the effects of different FV gains/losses can have different impacts on the dependent variables. Thus, my hypotheses become as follows:

H1a: realized gains/losses on AFS and HTM securities are a significantly positive determinant of changes in the tangible common equity ratio;

H1b: gains/losses on the trading portfolio are a significantly positive determinant of changes in the tangible common equity ratio;

H1c: unrealized gains/losses on AFS securities are a significantly positive determinant of changes in the tangible common equity ratio;

H2a: realized gains/losses on AFS and HTM securities are a significantly positive determinant of changes in the Tier 1 leverage ratio;

H2b: gains/losses on the trading portfolio are a significantly positive determinant of changes in the Tier 1 leverage ratio;

H2c: unrealized gains/losses on AFS securities are a significantly negative determinant of changes in the Tier 1 leverage ratio;

H3a: realized gains/losses on AFS and HTM securities are a significantly positive determinant of changes in the Tier 1 capital ratio;

H3b: gains/losses on the trading portfolio are a significant determinant of the changes in the Tier 1 capital ratio;

H3c: unrealized gains/losses on AFS securities are a significantly negative determinant of the changes in the Tier 1 capital ratio.

The sign predictions incorporated in the hypotheses are derived from Appendix 1.

Figures 8, 9, and 10 provide some early confirmatory value for H1, H2, and H3 respectively. These figures illustrate the trends in DE, DL, and DR alongside the trends in the respective explanatory variables derived from FV gains/losses. A visual analysis of the three figures suggests some co-movement between the dependent and independent variables. DL_UNRLZ and DR_UNRLZ do not exhibit much visible variation over the sample period, suggesting possible insignificant coefficients.

Figure 8: Changes in the TCE ratio against the DE_Y variables

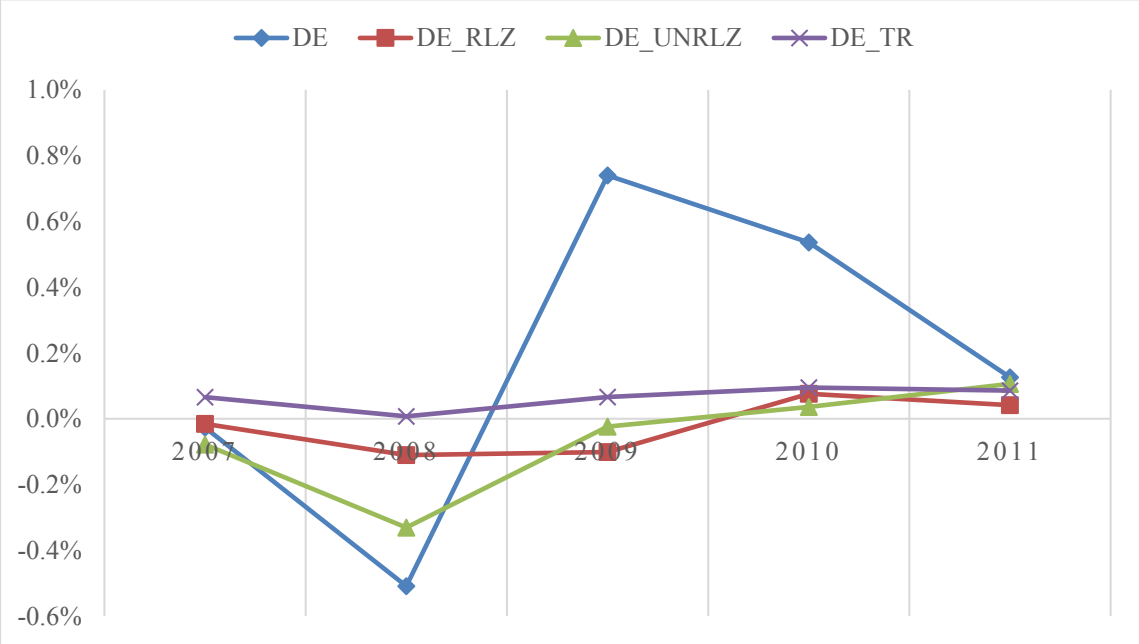


Figure 9: Changes in the Tier 1 leverage ratio against the DL_Y variables

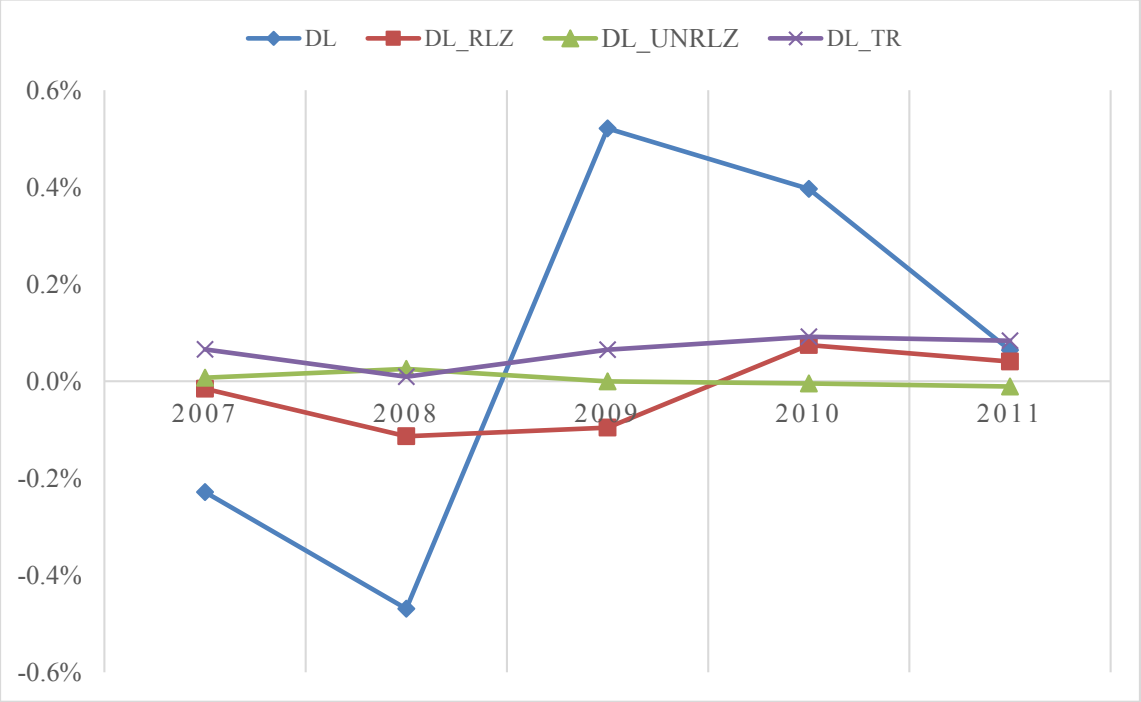
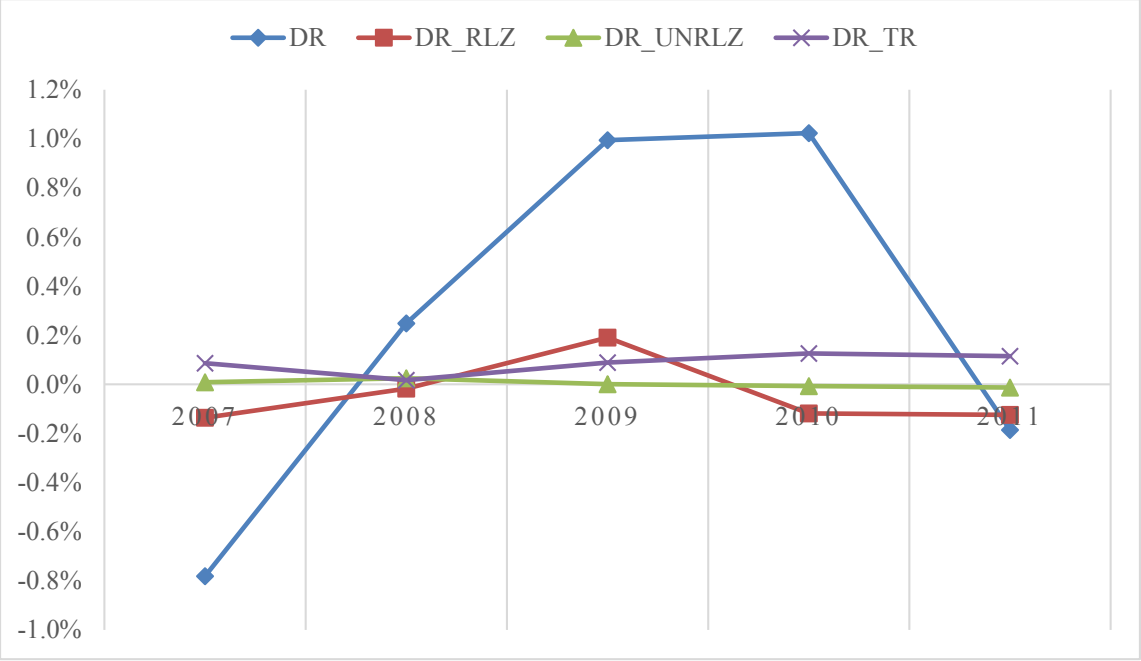


Figure 10: Changes in the Tier 1 capital ratio against the DR_Y variables



4.2.2 Model development

Based on the theoretical sections of this paper as well as on the descriptive analysis in section 4.1, the theoretical models to be tested become:

$$DE = f(DE_{RLZ}, DE_{TR}, DE_{UNRLZ}) \tag{8}$$

$$DL = f(DL_{RLZ}, DL_{TR}, DL_{UNRLZ}) \tag{9}$$

$$DR = f(DR_{RLZ}, DR_{TR}, DR_{UNRLZ}) \tag{10}$$

The corresponding testable empirical models are:

$$DE_{it} = \alpha_1 DE\_RLZ_{it} + \alpha_2 DE\_TR_{it} + \alpha_3 DE\_UNRLZ_{it} + \alpha_4 L(TA)_{it} + \alpha_5 RESID\_DL_{it} + \alpha_6 RESID\_DR_{it} + \alpha_7 T_t + \varepsilon 1_{it} \tag{11}$$

$$DL_{it} = \beta_1 DL\_RLZ_{it} + \beta_2 DL\_TR_{it} + \beta_3 DL\_UNRLZ_{it} + \beta_4 L(TA)_{it} + \beta_5 RESID\_DE_{it} + \beta_6 RESID\_DR_{it} + \beta_7 T_t + \varepsilon 2_{it} \tag{12}$$

$$DR_{it} = \gamma_1 DR\_RLZ_{it} + \gamma_2 DR\_TR_{it} + \gamma_3 DR\_UNRLZ_{it} + \gamma_4 L(TA)_{it} + \gamma_5 RESID\_DL_{it} + \gamma_6 RESID\_DE_{it} + \gamma_7 T_t + \varepsilon 3_{it} \tag{13}$$

L(TA) is logged total assets and is used as a proxy for size. T is a vector of yearly dummies, controlling for time specific effects. RESID_DE are the residuals from the regression of DE on DE_RLZ, DE_TR, and DE_UNRLZ. RESID_DL, and RESID_DR have been calculated similarly. The RESID_X variables are included because of the strong correlations between the changes in the three ratios, as illustrated in Table 5. Including the DL and DR in the DE regression, though can cause methodological problems. Since DL and DR might already contain the information that should be captured by the DE_Y variables, the addition of these variables to the equation might

suppress and bias the coefficients on the DE_Y variables. For that reason, DL and DR are regressed on DL_Y and DR_Y respectively, and the residuals from these regressions are used in the DE regression. Note that the residuals, in this case, should be purged of the effects of FV gains/losses, and should not bias the coefficients on the other DE_Y variables. The same logic applies to all three regressions.

5 RESULTS

Table 6 summarizes the regression results. The predicted signs are derived from the relationships estimated in Appendix 1 and partly in the previous section. I expect positive signs on the X_RLZ and X_TR coefficients in all three regressions. The coefficient on X_UNRLZ is expected to be positive in the DE regression and negative in the DL and DR regressions. The coefficients on the RESID_X vector are expected to be significant and positive since DE, DL, and DR are strongly positively correlated. I also expect a positive sign on ROE since more profitable banks are less likely to run into capital adequacy problems. I do not have a clear expectation regarding the sign on the L_TA coefficient. It might be that larger institutions are better placed to absorb losses arising from FVA, which would suggest a positive coefficient on L_TA. It might also be that larger institutions had more exposure to FVA related items, which would suggest a negative coefficient.

The results partly meet the expectations. The DE regression estimates positive coefficients on DE_TR and on DE_UNRLZ at the 1% and 5% significance levels respectively, and a significantly (10%) negative coefficient on DE_RLZ. Based on the estimation results, an increase (decrease) in trading revenues should increase (decrease) the TCE ratio. Similarly, unrealized gains (losses) on AFS securities should increase (decrease) the TCE ratio. Against expectations, the model finds that realized gains (losses) on AFS and HTM securities should decrease (increase) the TCE ratio.

The significance of the DE_RLZ coefficient is very sensitive to model specifications and the magnitudes of the two positive coefficients are significantly higher. Additionally, Table 5 shows a significant positive correlation between DE_RLZ and DE_UNRLZ, which contradicts the observed coefficients signs. In these circumstances, the negative coefficient could be explained by the inability of DE_RLZ to capture any variation in DE over and above that captured by DE_TR and DE_UNRLZ. Since those variables better capture the existing variation, DE_RLZ captures some inversely related noise.

The estimated coefficient on ROE is positive and significant at the 5% level, suggesting that change in the TCE ratio is positively associated with profitability. This is an

intuitive result, as net income is a direct input into the numerator of the ratio, thus more profitable firms are likely to experience larger increases in the TCE ratio. The estimated

Table 6: Regression results

	Predicted sign	DE	DL	DR
DE_RLZ	+	-0.087*		
		(0.059)		
DE_TR	+	0.521***		
		(0.000)		
DE_UNRLZ	+	0.281**		
		(0.042)		
DL_RLZ	+		0.113*	
			(0.061)	
DL_TR	+		1.209***	
			(0.000)	
DL_UNRLZ	-		-0.787	
			(0.536)	
DR_RLZ	+			0.310**
				(0.019)
DR_TR	+			0.382**
				(0.041)
DR_UNRLZ	-			-9.093
				(0.171)
RESID_DE	+		0.787***	0.243
			(0.000)	(0.140)
RESID_DL	+	0.781***		0.613***
		(0.000)		(0.000)
RESID_DR	+	0.045	0.117***	
		(0.179)	(0.000)	
L_TA	?	0.000	0.000	0.003***
		(0.879)	(0.816)	(0.000)
ROE	+	0.006**	-0.003	0.009***
		(0.040)	(0.291)	(0.005)
C	?	0.001	0.001	-0.015***
		(0.927)	(0.829)	(0.001)
Adj. R		0.746	0.755	0.445
N		509	509	509

p-values in parentheses;

*,**,*** for 10%, 5%, and 1% significance respectively.

coefficient on RESID_DL is also positive and significant at the 1% level. This result suggests that DL and DE tend to move together and confirms the observed trend in Figure 1. In confirmation of the same figure, the coefficient on RESID_DR is not significant, as the Tier 1 capital ratio tends to move somewhat differently from the other two ratios. An interesting observation is that size seems to be completely irrelevant in determining changes in the TCE ratio, as the coefficient on L_TA is highly insignificant and zero in magnitude.

The DL regression estimates positive and significant coefficients on DL_RLZ (10%) and DL_TR (1%), and an insignificant negative coefficient on DL_UNRLZ. The estimated signs in this regression meet expectations. It seems that realized gains (losses) on AFS and HTM securities should increase (decrease) the Tier 1 leverage ratio. Similarly, increases (decreases) in trading revenues should increase (decrease) the Tier 1 leverage ratio. Unrealized gains/losses on AFS securities seem to have no significant effect on the Tier 1 leverage ratio.

The coefficients on RESID_DE and RESID_DR are both positive and significant at the 1% level, suggesting that changes in the TCE ratio and in the Tier 1 capital ratio are good proxies for changes in the Tier 1 leverage ratio. The magnitude of the coefficient on RESID_DE is relatively large, in conformity with the observed trends in Figure 1, namely, the Tier 1 capital ratio seems to vary over time somewhat differently from the other two ratios. Profitability and size seem to play no role in the determination of the Tier 1 leverage ratio.

Similarly to the DL regression, the DR regression estimates positive and significant (5%) coefficients on DR_RLZ and DR_TR, and a negative insignificant coefficient on DR_UNRLZ. Thus, realized gains (losses) on AFS and HTM securities should increase (decrease) the Tier 1 capital ratio. Similarly, increases (decreases) in trading revenues should increase (decrease) the Tier 1 capital ratio. Unrealized gains/losses on AFS securities seem to have no significant effect on the Tier 1 capital ratio.

RESID_DL seems to be a positive and significant at the 1% level determinant of changes in the Tier 1 capital ratio. The adjusted R^2 of this regression is smaller than

those of the other two regressions. This difference is due to the trend observed in Figure 1, namely the Tier 1 capital ratio varies over time somewhat differently from the other two ratios. As such, RESID_DL, although a significant determinant of DR, is not able to capture much of the variation.

Lastly, ROE and L_TA both have positive and significant (1%) coefficients. The inability of ROE and L_TA to capture much variation in the DE and DL regressions might be explained by the presence of the RESID_DL and RESID_DE variables in the specific regressions. Due to the co-movement of the TCE and the Tier 1 leverage ratios over time, RESID_DL explains most of the variation in DE and RESID_DE explains most of the variation in DL. It is very likely that part of the variation captured by the two residual variables is due to size and profitability, thus limiting the explanatory power of the ROE and L_TA variables. Since the Tier 1 capital ratio does not co-move with the other two ratios, RESID_DL does not capture enough variation in DR to suppress the significance of ROE and L_TA.

The quantitative interpretation of my regression results is not straight forward, though, an approximate assessment is possible. An understanding of the economic significance of the estimated coefficients could be acquired by substituting mean values into the regression equation. Holding everything else constant, the mean realized gains/losses on AFS and HTM securities in 2008 contributed to the change in the TCE ratio by a factor of $(-8.7)*10^{-2}*(-1.1)*10^{-3}=9.57*10^{-5}$, where $(-1.1)*10^{-3}$ is the mean value of DE_RLZ in 2008. Now compare this number with the mean change in the TCE ratio (that is DE) in 2008, of $(-5.01)*10^{-3}$. The calculated factor of $9.57*10^{-5}$ represents around 2% of the mean value of DE in 2008, and it points in the opposite direction. It can be clearly seen that the economic significance of this effect is very small. A similar approach can be applied to the estimation of the impacts of DE_TR and DE_UNRLZ. It would yield factors of $3.93*10^{-5}$ and $(-9.3)*10^{-4}$ respectively, equivalent to 1% and -18% of the mean DE in 2008 respectively. Since DE_RLZ and DE_TR predict a positive DE, the net change in DE capture by the three variables is 15%. So, out of the 5% decrease in the TCE ratio, FVA explains about three fourths of a percent.

While such calculations can be useful in getting some intuition about the magnitude of the estimated effects, they are not very reliable, since the estimated effects of the X_Y variables never occur ceteris paribus. The real effect on a ratio due to any FVA item would be described by a complex interaction of factors. In such circumstances, it would be potentially impossible to isolate the effects of a single FVA item (e.g. trading revenues). Having established the limited scope of the quantitative interpretation of the coefficients, it is worth noting that the significant X_Y variables explain much higher percentages of the variation in the changes in the capital adequacy ratios in the year preceding the crisis (2007), and in the years immediately following it (2010-2011). Appendix 2 includes the calculations for all the X_Y variables in all the years. This suggests the existence of some other factor(s) which dampened the effects of the X_Y variables in the crisis years (2008, 2009). Following the research of Huizinga and Laeven (2012), this dampening could be explained by a combination of a surge in opportunistic accounting practices and regulatory forbearance during the peak of the crisis.

6 Conclusion

The recent financial crisis has generated a heated debate regarding the role that FVA played in the recession. Critics argue that FVA contributed to excessive leverage and balance sheet fragility during economic boom preceding the crisis, thus setting up the financial system for inevitable failure. Additionally, FVA is blamed for exacerbating the economic downturn by forcing financial institutions to write down assets to distorted market prices. Moreover, the written down assets can become benchmarks for other institutions, thus causing contagion in the financial system and mass forced sales. The defenders, on the other hand, argue that FVA had little to do with the severity of the crisis, and that it only helped realize the losses quicker, so that the economy can be set back on track.

This paper has discussed the arguments on both sides of the debate as well as the theory behind FVA and banking regulation. Additionally, I have developed an original empirical test of the effects of FVA gains and losses in bank regulatory capital. Namely, I have examined whether realized gains/losses on AFS and HTM securities, trading gains/losses, and unrealized gains/losses on AFS securities are significant determinants of changes in bank capital adequacy ratios. I have the effects of the above mentioned FVA items on the TCE ratio, on the Tier 1 leverage ratio, and on the Tier 1 capital ratio. The TCE ratio was widely used by investors during the crisis to assess the ability of banks to absorb losses. The other two ratios are subject to minimum levels under BASEL II. I find that realized AFS and HTM gains/losses and trading gains/losses were significant determinants of changes in all three capital adequacy ratios. Unrealized AFS gains/losses were significant determinants of changes in the TCE ratio, but not the Tier 1 leverage ratio or the Tier 1 capital ratio.

It is important to note, however, that the statistical significance of my results does not imply an economic significance, as according to my descriptive analysis, the three capital adequacy ratios were not significantly affected by the crisis. Contrarily, all the FVA items analyzed (AFS and HTM realized gains/losses, trading gains/losses, and unrealized AFS gains/losses) show significant negative trends during the peak of the crisis. These observations suggest that FVA related gains/losses, although statistically

significant, were not economically significant contributors to the capital adequacy problems faced by the financial industry during the crisis.

The contribution of my study is twofold. Firstly, I conduct a comprehensive review of the studies that examined the effect of FVA during the financial crisis. Secondly, I develop an original empirical test of the effects of FVA gains/losses on bank capital adequacy ratios.

This study is subject to a number of limitations. Firstly, I examine the sample of all FDIC insured banks which issue type 31 Call Reports. This shotgun approach might overlook the effects of FVA during the crisis for narrower groups, such as the largest institutions, or investment banks. Secondly, the period I selected might not be appropriate. A similar study spanning 2007-2008, might, perhaps uncover very different results. Additionally, my sample size prohibited me from employing lagged variables in my analysis. A quarterly sample might have more degrees of freedom in that respect.

This research is relevant for bank regulators when creating/adjusting standards. It is also relevant for future researchers looking into the FVA, the financial crisis, or bank regulation in general. Future researchers might refine the econometric methodology employed in this study, for more precise results. Additionally, very limited research has been conducted on the effects of FVA during the period of economic growth directly preceding the crisis.

Appendix 1

A1.1 Variables in the tier 1 capital ratio regression.

Assume that:

α: realized gain/loss;

β: unrealized gain/loss;

x_0: tier 1 capital (time 0);

y_0: average total risk weighted assets (time 0);

R_0: tier 1 capital ratio (time 0);

k: percentage change in x_0 due to α;

m: percentage change in x_0 due to β;

W: weight assigned to the fair value gain/loss in risk-weighting (50% in this paper).

Then:

$$R_0 = \frac{x_0}{y_0}; \quad R_1 = \frac{x_1}{y_1}$$

$$k = \frac{\alpha}{x_0}; \quad m = \frac{\beta}{x_0}$$

Since the denominator of the tier 1 capital ratio is risk weighted assets, the realized gain/loss would affect the denominator of the ratio adjusted by a certain weight W. The numerator is affected directly through net income. Thus, given a realized gain/loss α:

$$\Delta R = R_1 - R_0 = \frac{x_0 + \alpha}{y_0 + \alpha W} - \frac{x_0}{y_0} = \frac{y_0 x_0 k - x_0^2 k W}{y_0(y_0 + x_0 k W)}$$

Dividing by $x_0 k$ we get:

$$\Delta R = \frac{y_0 - x_0 W}{\frac{y_0}{R_0 k} + y_0 W} = \frac{x_0(\frac{1}{R_0} - W)}{y_0(\frac{1}{R_0 k} + W)} = \frac{1 - R_0 W}{\frac{1}{R_0 k} + W}$$

Given that $0 < R_0, W < 1$, for every $k < 0$, $\Delta R < 0$, and for every $k > 0$, $\Delta R > 0$. Thus, I expect a positive coefficient on *DR_RLZ*.

An unrealized gain/loss does not affect tier 1 capital since the item is not recognized in the income statement. It does, however, the denominator of the tier 1 capital ratio. As such, given an unrealized gain/loss β:

$$\Delta R = R_1 - R_0 = \frac{x_0}{y_0 + \beta W} - \frac{x_0}{y_0} = -\frac{x_0^2 m W}{y_0(y_0 + x_0 m W)}$$

Dividing by $x_0 k$ we get:

$$\Delta R = -\frac{x_0 W}{\frac{y_0}{R_0 m} + y_0 W} = -\frac{R_0 W}{\frac{1}{R_0 m} + W}$$

Given that $0 < R_0, W < 1$, for every $m < 0$, $\Delta R > 0$, and for every $m > 0$, $\Delta R < 0$. Thus, I expect a negative coefficient on *DR_UNRLZ*.

DR_TR is weighted by 100%, so its derivation is identical to that of *DL_RLZ* and *DL_TR*.

A1.2 Variables in the tier 1 leverage ratio regression.

The assumptions for α, β, x_0, k, and m, are identical to the ones in A1.1. Different assumptions:

y_0: average total assets for leverage purposes (time 0);

L_0: tier 1 leverage ratio (time 0).

Thus, given a realized gain/loss α:

$$\Delta L = L_1 - L_0 = \frac{(1+k)x_0}{kx_0 + y_0} - \frac{x_0}{y_0} = \frac{kx_0 y_0 - kx_0^2}{kx_0 y_0 + y_0^2}$$

Dividing b$x_0 k$ y we get:

$$\Delta L = \frac{y_0 - x_0}{y_0 + \frac{y_0}{L_0 k}} = \frac{x_0(\frac{1}{L_0} - 1)}{y_0(1 + \frac{1}{L_0 k})} = \frac{L_0 k(1 - L_0)}{L_0 k + 1}$$

Given that $0 < L_0 < 1$, for every $k < 0,\ \Delta R < 0$, and for every $k > 0,\ \Delta R > 0$. Thus, I expect a positive coefficient on *DL_RLZ*, on *DL_TR*, and on *DR_TR*.

An unrealized gain/loss would not affect the numerator of the tier 1 leverage ratio, as it would not be recognized in net income. It would, however, affect the denominator of the ratio. As such, given an unrealized gain/loss β:

$$\Delta L = L_1 - L_0 = \frac{x_0}{\beta + y_0} - \frac{x_0}{y_0} = -\frac{\beta x_0}{\beta y_0 + y_0^2}$$

Dividing by $x_0^2 m$ we get:

$$\Delta L = -\frac{1}{\frac{1}{L_0^2 m} + \frac{1}{L_0}} = -\frac{L_0^2 m}{1 + m L_0}$$

Given that $0 < L_0 < 1$, for every $m < 0,\ \Delta R > 0$, and for every $k = m > 0,\ \Delta R < 0$. Thus, I expect a negative coefficient on *DL_UNRLZ*.

The variables in the tangible equity ratio (i.e. *DE_RLZ*, *DE_TR*, and *DE_UNRLZ*) were derived similarly to *DL_RLZ* since any accounting gain/loss, realized or unrealized, affects both the numerator and the denominator in a manner identical to the effect of a realized gain/loss on the tier 1 leverage ratio, as explained above.

Appendix 2: Share of changes in capital adequacy ratios explained by the X_Y variables

Table A2: Share of changes in capital adequacy ratios explained by the X_Y variables

	DE_RLZ	DE_UNRLZ	DE_TR	DL_RLZ	DL_TR	DR_RLZ	DR_TR
2007	5%	-83%	129%	-1%	35%	-5%	4%
2008	2%	-18%	1%	-3%	2%	-2%	3%
2009	1%	-1%	5%	-2%	15%	6%	3%
2010	-1%	2%	9%	2%	28%	-4%	5%
2011	-3%	24%	35%	7%	158%	-21%	24%

Appendix 3

Table A3.1: Bank regulatory capital changes

Date	Requirement	Accounting Implication
1981	Inconsistent explicit numerical capital requirements introduced by three U.S. bank regulators	The effects of accounting on capital requirements differed across banks by regulator
1985	Uniform capital requirement with common definition of regulatory capital adopted by three U.S. bank regulators.	Add back of the loan loss allowance to primary capital made loan loss provision increase regulatory capital ratio
1990	Basel risk based capital adopted with additional leverage ratio requirement in the U.S.	Loan loss provision decreased Tier 1 capital but increased Tier 2 capital
1991	FIDICIA enacted	Required evaluation of internal controls, prompt corrective action and regulatory accounting that is at least as strict as GAAP
1993	Bank regulators opted to include unrealized FAS 115 AFS gains in regulatory capital	Holding gains and losses affect regulatory capital calculations
1994	Bank regulators reversed decision and excluded unrealized FAS 115 gains from regulatory capital	AFS FAS 115 fair values do not affect regulatory capital calculations

Source: Beatty and Liao (2014: 10) – Figure 3

Table A3.2: Regulatory capital calculation

	Numerator	Denominator	Effect of Loan Loss Provision on Capital Ratio
Pre-BASEL	1. Common equity, 2. perpetual preferred stock, 3. minority interests, 4. mandatory convertible instruments, 5. loan loss allowance	Average total assets	A one dollar increase in the loan loss provision increases regulatory capital by the tax rate times one dollar. Specifically, while one dollar loan loss provision decreases earnings and regulatory capital by one dollar times (1-tax rate), one dollar provision is added back to regulatory capital. As a net, once dollar provision increased regulatory capital by the tax rate times one dollar.
Post-BASEL			
Tier 1 Risk-Based Capital Ratio	1. Common equity, 2. perpetual preferred stock, 3. minority interests, 4. mandatory convertible instruments, Deduct: goodwill and intangibles, unrealized gain and loss on available for sale securities (exception: unrealized loss on available for sale equity securities is included in Tier 1 capital)	Risk weighted assets: 0%: cash, gold and claims unconditionally guaranteed by the US or OECD central governments, 20%: shorter-term claims guaranteed by US and foreign banks, and claims conditionally guaranteed by the US or OECD central governments, 50%: loans fully secured by first liens on 1-4 family residential properties and loans to state and local government, 100%: all other assets not assigned to the lower weight categories.	A one dollar increase in loan loss provisions decreases Tier 1 capital by one dollar times (1-tax rate), because loan loss allowance is not added back to Tier 1 Capital.
Leverage Ratio	1. Common equity, 2. perpetual preferred stock, 3. minority interests, 4. mandatory convertible instruments, Deduct: goodwill and intangibles unrealized gain and loss on available for sale securities (exception: unrealized loss on available for sale equity securities is included in Tier 1 capital)	Average total assets Deduct: goodwill and intangibles	A one dollar increase in loan loss provisions decreases Tier 1 capital by one dollar times (1-tax rate), because loan loss allowance is not added back to Tier 1 Capital.
Total Risk-Based Capital Ratio	Tier 1 Capital plus the followings: 1. qualifying subordinated debt, 2. redeemable preferred stock, 3. loan loss allowance up to 1.25% of risk weighted assets, 4. unrealized gains on available for sale securities up to 45% of the pretax net unrealized holding gain on available-for-sale equity securities	Risk weighted assets: 0%: cash, gold and claims unconditionally guaranteed by the US or OECD central governments, 20%: shorter-term claims guaranteed by US and foreign banks, and claims conditionally guaranteed by the US or OECD central governments, 50%: loans fully secured by first liens on 1-4 family residential properties and loans to state and local government, 100%: all other assets not assigned to the lower weight categories.	There are two possible scenarios: 1. When loan loss allowance is less than 1.25% of risk-weighted assets, a one dollar increase in the loan loss provision increases regulatory capital by the tax rate times one dollar. 2. When loan loss allowance is higher than 1.25% of risk-weighted assets, a one dollar increase in loan loss provisions decreases total capital by one dollar times (1-tax rate).

Source: Beatty and Liao (2014: 11) – Figure 4

References

Acharya, V. V. (2009). A theory of systemic risk and design of prudential bank regulation. *Journal of Financial Stability*, 224-255.

Adrian, T., & Shin, H. S. (2009). Liquidity and leverage. *Journal of Financial Intermediation*, 418-437.

Allen, F., & Carletti, E. (2008). Mark-to-market accounting and liquidity pricing. *Journal of Accounting and Economics*, 358-378.

Badertscher, B. A., Burks, J. J., & Easton, P. D. (2012). A convenient scapegoat: Fair value accounting by commercial banks during the financial crisis. *The Accounting Review*, 59-90.

Bagehot, W. (1873). *Lombard street: a description of the money market.* London: Henry S. King and Co.

Ball, R. (2006). International financial reporting standards (IFRS): pros and cons for investors. *Accounting and Business Research*, 5-27.

Barth, M. E., & Landsman, W. R. (2010). How did financial reporting contribute to the financial crisis? *European Accounting Review*, 399-423.

Beatty, A., & Liao, S. (2014). Financial accounting in the banking industry: A review of the empirical literature. *Journal of Accounting and Economics*, 339-383.

Bhat, G., Frankel, R., & Martin, X. (2011). Panacea, Pandora's box, or placebo: feedback in bank mortgage-backed security holdings and fair value accounting. *Journal of Accounting and Economics*, 153-173.

Black, W. K. (2005). *The best way to rob a bank is to own one: how corporate executives and politicians looted the S&L industry.* Austin: University of Texas Press.

Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *The Review of Financial Studies*, 2201-2238.

Burhouse, S., Feid, J., French, G., & Ligon, K. (2003). *Basel adn the evolution of capital regulation: moving forward, looking back.* Federal Deposit Insurance Corporation.

Dewatripont, M., & Tirole, J. (1994). *The prudential regulation of banks.* Fundación BBV, Centro de Estudios Bancarios.

Diamond, D. W., & Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *Journal of political economy*, 401-419.

Dontoh, A. K., Elayan, F. A., Ronen, J., & Ronen, T. (2012, January). Unfair "fair value" in an opaque credit default swap market: how marking-to-market pushed the international creidt crunch. *Working paper*, Available at: http://ssrn.com/abstract=1985833.

Dybvig, P. H. (1993). Remarks on banking and ddeposit insurance. *Federal Reserve Bank of St. Louis Review*, 21-24.

FFIEC. (2015). *Federal Financial Institutions Examination Council Central Data Repository*. Retrieved from https://cdr.ffiec.gov/public/

Flannery, M. J., Kwan, S. H., & Nimalendran, M. (2004). Market evidence on the opaqueness of banking firms' assets. *Journal of Financial Economics*, 419-460.

Freixas, X., & Rochet, J.-C. (2008). *Microeconomics of banking 2nd ed.* Cambridge, Mass: MIT Press.

Friedman, M., & Schwartz, A. J. (1971). *A monetary history of the united states, 1867-1960.* Princeton University Press.

Gartenberg, C. M., & Serafeim, G. (2009). Did fair valuation depress equity values during the 2008 financial crisis? *Workin Paper*.

Goh, B. W., Ng, J., & Young, K. O. (2009). Market pricing of banks' fair value assets reported under SFAS 157 during the 2008 economic crisis. *Working Paper*.

Hellwig, M. F. (2009). Systemic risk in the financial sector: an analysis of the subprime-mortgage financial crisis. *De Economist*, 129-207.

Holod, D., & Peek, J. (2007). Asymmetric information and liquidity constraints: a new test. *Journal of Banking & Finance*, 2425-2451.

Hughes, J., & Tett, G. (2008, March 13). *An unforgiving eye: bankers cry foul over fair value accounting rules*. Retrieved from Financial Times: http://www.ft.com/intl/cms/s/0/19915bfc-f137-11dc-a91a-0000779fd2ac.html#axzz3XhcEhNsm

Huizinga, H., & Laeven, L. (2012). Bank valuation and accounting discretion during a financial crisis. *Journal of Financial Economics*, 614-634.

International Monetary Fund. (2008). *Global financial stability report: containing systemci risks and restoring financial soundness.* Washington, D.C.: International Monetary Fund.

Jacklin, C. J. (1987). Demand deposits, trading restrictions, and risk sharing. In E. C. Prescott, & N. Wallace, *Contractual arrangements for intertemporal trade* (pp. 26-47). Minneapolis: University of Minnesota Press.

Jager, P. d. (2014). Fair value accounting, fragile bank balance sheets and crisis: a model. *Accounting, Organizations and Society*, 97-116.

Johnson, S. (2008, March 19). *The fair-value blame game*. Retrieved from CFO.com: http://ww2.cfo.com/accounting-tax/2008/03/the-fair-value-blame-game/

Kane, E. J. (1989). *The S&L insurance mess: how did it happen?* Washington D.C.: The Urban Institute Press.

Katz, I. (2009, April 2). *FASB eases fair-value rules amid lawmaker pressure*. Retrieved from Bloomberg: http://www.bloomberg.com

Kim, M.-S., & Kross, W. (1998). The impact of the 1989 change in the bank capital standards on loan loss provisions and loan write-offs. *Journal of Accounting & Economics*, 69-99.

Laux, C., & Leuz, C. (2010). Did fair-value accounting contribute to the financial crisis? *Journal of Economic Perspectives*, 93-118.

Persaud, A. D. (2008). Regulation, valuation and systemic liquidity. *Banque de France Financial Stability Review No 12 - Valuation and financial stability*, 75-83.

Pinnuck, M. (2012). A review of the role of financial reporting in the global financial crisis. *Australian Accounting Review*, 1-14.

Plantin, G., Sapra, H., & Shin, H. S. (2008). Fair value accounting and financial stbility. *Banque de France Financial Stability Review No 12 - Valuationa and financial stability*, 85-94.

Plantin, G., Sapra, H., & Shin, H. S. (2008). Marking-to-market: Panacea or Pandora's box? *Journal of Accounting Research*, 435-460.

Rummell, N. (2008, March 24). *Fair-value rules get more blame for crunch*. Retrieved from Financial Week: http://www.financialweek.com/apps/pbcs.dll/article?AID=/20080324/REG/854569832

Santos, J. A. (2001). Bank capital regulation in contemporary banking theory: a review of the literature. *Financial Markets, Institutions & Instruments*, 41-84.

Scott, W. R. (2011). *Financial Accounting Theory 6th ed.* Prentice Hall.

Shaffer, S. (2010). *Fair value accounting: Villain or inocent victim. Exploring the links between fair value accounting, bank regulatory capital and the recent financial crisis.* Boston: Federal Reserve Bank of Boston.

Shleifer, A., & Vishny, R. W. (1992). Liquidation values and debt capacity: a market equilibrium approach. *The Journal of Finance*, 1343-1366.

Shleifer, A., & Vishny, R. W. (1997). The limits of arbitrage. *The Journal of Finance*, 35-55.

Shleifer, A., & Vishny, R. W. (2010). Unstable banking. *Journal of Financial Economics*, 306-318.

Stanton, R., & Wallace, N. (2011). The bear's lair: index credit default swaps and subprime mortgage crisis. *The Review of Financial Studies*, 3250-3280.

Supervision, B. C. (2010). *Basel III: a global regulatory framework for more resilient banks and banking systems.* Bank for International Settlements.

Tarullo, D. K. (2011, November 9). The Evolution of Capital Regulation. *Speech at the Clearing House Business Meeting and Conference*. New York: Board of Governors of the Federal Reserve System.

Wallace, N. (1996). Narrow banking meets the diamond-dybvig model. *Federal Reserve Bank of Minneapolis Quarterly Review*, 3-13.

Young, J. J. (1995). Getting the accounting "right": accounting and the savings and loan crisis. *Accounting, Organizations and society*, 55-80.

Zeff, S. A. (2007). The SEC rules historical cost accounting: 1934 to the 1970s. *Accounting and Business Research*, 49-62.