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RISK-BASED CAPITAL REGULATION AND BANK ASSET ALLOCATIONS

by Kristine Johnson

Abstract
In light of the financial crisis and subsequent regulatory efforts, some have called the Basel Accord framework for risk-based capital standards into question. Scholars, policymakers, and market participants have criticized the risk-weighting component of this regulation, and some of the negative impacts have been revealed.[1] Further, there is no overwhelming evidence showing the benefits of these requirements. This paper offers preliminary evidence from US bank holding company (BHC) data that banks, on average, alter holdings of some assets after changes in risk-based capital requirements. If the portfolio effects of these regulations are present—but come with no benefit of increased stability—then policymakers should reconsider the current risk-based capital regime.

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[1] In revising its framework following the financial crisis, the Basel Committee admitted that "a main contributing factor [of losses and the buildup of leverage] was that the current capital framework for market risk […] does not capture some key risks" (Basel Committee on Banking Supervision 2009, 1).

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Abbreviations

BCBS	Basel Committee on Banking Supervision
BHC	bank holding company
CoCos	contingent convertibles
Dodd-Frank Act	Dodd-Frank Wall Street Reform and Consumer Protection Act
ESRB	European Systemic Risk Board
FDIC	Federal Deposit Insurance Corporation
GSE	government-sponsored enterprise
HQLA	high-quality liquid assets
LCR	liquidity coverage ratio
MBS	mortgage-backed security
NRSRO	nationally recognized statistical rating organization
OCC	Office of the Comptroller of the Currency
RBC	risk-based capital
RWA	risk-weighted assets

1. Introduction

Following the 2008 financial crisis, financial regulators around the world began crafting new regulations in an attempt to strengthen banks' positions and mitigate another systemic failure. Risk-based capital requirements are one such regulation that has become an increasingly important, yet controversial, tool in the regulators' toolkit. In 2010, the Basel Committee on Banking Supervision (BCBS) released its latest framework (Basel III),[2] which is the basis for the current risk-based capital rules being implemented in the United States. These new rules impose additional layers of regulatory capital and leverage requirements on banks. The BCBS is currently deliberating on yet another set of changes that some are calling Basel IV. Since their introduction in 1988, multiple overhauls of the risk-based capital standards have been implemented with revisions, new requirements, and added complexity, but a consensus on the overall efficacy of these efforts has not been reached.[3]

The intuition behind capital adequacy requirements for banks is quite simple. Capital serves as a buffer, to absorb losses, so banks with higher capital levels should be able to withstand a larger drop in the price of their assets. In theory, this system would be good for depositors as well as for bank solvency more generally. The Basel Accords,[4] which set the global standard for capital requirements and are followed closely by the United States, take the idea a step further and impose a minimum capital requirement based on a risk-weighted measurement of a bank's assets. Broad categories of assets are

[2] BCBS, "Basel III: International Framework for Liquidity Risk Measurement, Standards and Monitoring" (December 2010), http://www.bis.org/publ/bcbs188.pdf.
[3] See Van Hoose (2007) for literature on both sides of the debate.
[4] The accords are a set of international agreements on bank capital regulation set by the BCBS and frequently updated; see http://www.bis.org/bcbs/history.htm.

assigned a risk weight based on the perceived risk associated with those assets, and banks must hold commensurate capital levels. The risk-based capital framework requires banks to hold more capital for assets considered more risky by regulators and less capital for assets considered more safe, thus changing the relative price of holding various assets.

In principle, risk-based capital requirements have some appeal because they have the potential to take varying risk into account rather than imposing an indiscriminate capital charge. Unfortunately, imposing imperfect standards is not without cost; there are problems with imposing crude and somewhat arbitrary risk weights for broad asset categories, as will be discussed later in detail. In addition, the impetus for changes to the standards appears to be increasingly political in nature rather than concerned with the safety and soundness of the banking system.[5] Some significant consequences of the risk-based capital requirements have been brought to light,[6] while the benefits are not readily agreed upon. Furthermore, in recent years, similar risk-based ratios have been employed in additional financial regulations such as liquidity requirements.[7] Thus, at a minimum, a critical examination of these standards by policymakers is warranted.

This paper contributes to this discussion by exploring potential portfolio effects created by the risk weights set by US federal financial regulators. While various changes to the levels of capital, risk-measurement approaches, and other requirements have been made, risk weights remain at the core of capital regulation. Many scholars have referenced the "herding" effect whereby banks invest in certain assets that are treated favorably under these standards, but little empirical work has examined this question,

[5] See Admati and Hellwig (2014, 184, 192) for further details.
[6] See section 3 of this paper. Also see Admati and Hellwig (2014, 312–13).
[7] For example, Liquidity Coverage Ratio: Liquidity Risk Measurement Standards, 79 Fed. Reg. 197 (October 10, 2014), 61440–541.

especially from the inception of Basel I to the present. Ultimately, some may argue that causing banks to hold certain assets deemed safe by regulators is a welcome goal of capital regulation. However, two questions to consider are these: (1) What if the regulators don't get the risk right? and (2) What are the costs associated with changing banks activities? This preliminary analysis suggests that banks, on average, do alter holdings of some assets following changes to the requirements. If the changes bring no added stability, that would bolster existing calls for the United States to reconsider risk-based capital requirements. In the next section, I briefly describe the impetus for and evolution of these standards. Section 3 reviews the issues surrounding risk weights for capital requirements. Section 4 describes the data and analysis. Results and discussion are reported in section 5, with potential policy alternatives given in section 6. Section 7 will conclude.

2. Background

Risk-based capital requirements evolved from the complex interaction of efforts at creating financial standards. Regulators' motivations for creating international standards were similarly complex.

The Origin of Global Risk-Based Capital Standards

International cooperation on financial regulation took root in the early 1970s. Following the failures of large banks like the Herstatt Bank in Germany and Franklin National Bank in New York in 1974, the G10 central bank governors convened and formed what is now the Basel Committee on Banking Supervision (BCBS) (Kapstein 1994). Although risk-based capital requirements are now a widely accepted standard in financial regulation, the origin of these requirements is quite tenuous. Kapstein shows that the impetus for an

international agreement on capital adequacy was political and not "a self-evident response to the problems facing international banking in the 1970s and 1980s" (1994, 4).

When Federal Reserve Chairman Paul Volcker first brought up the need for convergent capital standards to the Basel group in 1984, his presentation was "greeted with a yawn" (Kapstein 1994, 17). While there was some concern about "deteriorating capital levels" among international banks, other factors motivated the adoption of a global standard.

According to Peter Cooke, then chair of the BCBS and pioneer of the first Basel Accord (Basel I), the desire was to have "greater homogeneity in the levels of capital employed by major banks operating internationally" (Shah 1996, 280). This concept of "leveling the playing field" was a concern of US bank representatives, who argued that they were at a competitive disadvantage compared with French and Japanese banks that had lower capital levels and thus could price their products more cheaply (Kapstein 1994, 15; Shah 1996, 281). Peter Cooke also noted that a fundamental reason for choosing capital adequacy was that it was seen as a convenient measure for standardization across countries, relative to the other regulatory requirements that could have been standardized (Shah 1996). Indeed, given the complex nature of converging international standards, capital adequacy was the low-hanging fruit in terms of what could reasonably be achieved. But getting these standards "right" has been problematic.

Thus, as Shah (1996, 278) shows, Basel I "was influenced by tradition, convenience and likely acceptability rather than by any serious considerations of regulatory objectives and potential effectiveness of the capital adequacy reforms." According to Peter Cooke, the 8 percent minimum capital ratio "was settled upon because

there was a broad consensus in member countries that it reflected levels of capital currently maintained by the better-capitalized banks and that it was a reasonable target level…" (Cooke 1991, 330). Further, he noted that "there is no other argument which shows that 8 percent capital is correct, and I admit that" (Shah 1996, 282). For the purposes of this paper, the more relevant concerning factor is that the risk-weighted system was also chosen out of convenience.

Before Basel I, the United States had a simple capital requirement of 5.5 percent of adjusted total assets,[8] while some European countries employed a risk-weighted ratio (Shah 1996). The BCBS chose the risk-weighted system since it took into account perceived risks, including off-balance sheet activities, but it noted that "the choice of weights is inevitably somewhat arbitrary" (Bank for International Settlements 1986, 17).

With both the political concerns and the limitations of creating a global standard among vastly different banking and regulatory regimes, it's unsurprising that the result was crude and somewhat arbitrary. The flaws in Basel I were apparent, and the BCBS has continually overhauled the standards.[9] Some may argue that the regulators are simply adjusting the requirements in search of the proper settings, but few have stopped to examine why exactly we have these standards in the first place. No explicit objectives related to safety and soundness—that could be measured ex post—were ever stated. As a result, we observe the BCBS and US financial regulators playing a cat-and-mouse game with the financial system.

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[8] See FDIC, "Basel and the Evolution of Capital Regulation: Moving Forward, Looking Back" (January 14, 2003), https://www.fdic.gov/bank/analytical/fyi/2003/011403fyi.html.

[9] See "BCBS Publications," Bank for International Settlements website, https://www.bis.org/bcbs/publications.htm?a=1&set=1&mp=any&pi=title&bv=list for changes and discussion.

Evolution of Risk-Based Capital Requirements in the United States

Risk-based capital requirements in the United States have evolved in various ways. An in-depth description of each amendment is outside the scope of this paper, but a brief review of the major changes is useful.

The fundamental changes in the requirements have dealt with the definition of what is included as capital, the approach and scope of measuring risk, the handling of recourse, and the levels of required capital. As mentioned, before Basel I, the United States had a simple capital ratio of 5.5 percent of adjusted total assets. With the introduction of Basel I in 1989, the United States began implementing the Basel I minimum risk-based capital ratio of 8 percent.[10] Basel I dealt solely with credit risk, but the BCBS quickly decided that developments in financial markets necessitated accounting for banks' market risks also (BCBS 1993, 4). Thus, in 1996, the Market Risk Amendment was adopted in the United States.[11] It required banks to use a "value-at-risk" technique to measure market risk.

In 1994, US financial regulators had begun considering various parts of what would become the Recourse Rule, which was finalized in 2001.[12] This rule slightly reduced (increased) the capital charge for highly rated (low-rated) assets transferred with

[10] Federal Reserve System, Capital: Risk-Based Capital Guidelines, 54 Fed. Reg. 17 (January 27, 1989), 4185–221.

[11] Office of the Comptroller of the Currency, Federal Reserve System, and Federal Deposit Insurance Corp., Risk-Based Capital Standards: Market Risk, 61 Fed. Reg. 174 (September. 6, 1996), 47358–78.

[12] Office of the Comptroller of the Currency, Federal Reserve System, Federal Deposit Insurance Corp., and the Thrift Supervision Office, Capital Maintenance: Capital Treatment of Recourse, Direct Credit Substitutes and Residual Interests in Asset Securitizations, 66 Fed. Reg. 230 (November 29, 2001), 59614–67.

recourse and introduced the use of nationally recognized statistical rating organizations (NRSROs) for credit ratings, namely Moody's, Standard & Poor's, and Fitch—the "big three" NRSROs. However, after much criticism following the 2008 financial crisis, the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) removed the reliance on NRSROs from banking regulation and authorized the Securities and Exchange Commission to impose penalties on ratings agencies for misconduct or unreliable ratings.[13] The United States began producing rules to implement Basel II in 2007. Although the implementation was largely superseded by the crisis, as Friedman and Kraus (2011) show, the Recourse Rule and Basel II risk weights for private-label structured products were nearly identical.

Following the BCBS's release of the Basel III framework in late 2013, US financial regulators released their final rule implementing Basel III along with requirements mandated in the Dodd-Frank Act.[14] These rules levy layers of additional capital requirements and buffers on banks—for example, a stricter definition of capital, a liquidity ratio, and a leverage ratio. The regulatory requirements that emerged from the crisis are so massive and complex that they are still being implemented today.

3. Risk Weights for Capital Requirements

The minimum risk-based capital (RBC) ratio determines the amount of capital a bank must hold given its risk-weighted assets (RWA). The ratio is calculated as follows:

[13] Pub. L. 111-203, 124 Stat. 1376 (July 21, 2010).
[14] Office of the Comptroller of the Currency and Federal Reserve System, Regulatory Capital Rules: Regulatory Capital, Implementation of Basel III, Capital Adequacy, Transition Provisions, Prompt Corrective Action, Standardized Approach for Risk-Weighted Assets, Market Discipline and Disclosure Requirements, Advanced Approaches Risk-Based Capital Rule, and Market Risk Capital Rule, 78 Fed. Reg. 198 (October 11, 2013), 62018–291.

$$RBC\ Ratio = \frac{Capital}{RWA} = \frac{Capital}{\Sigma\, \omega_i . \times \alpha_i}$$

"where α_i is the value invested in asset i, and ω_i is the risk-weight of asset i" (Hogan and Meredith 2016). The primary asset categories are 0, 20, 50, and 100 percent. Examples of assets in each category are shown in table 1.

Table 1. Sample of Assets in Each Risk-Weight Category

0 percent	Cash, US Treasury securities
20 percent	Claims on and claims secured by government-sponsored enterprises (Fannie Mae, Freddie Mac), state and local general obligation bonds
50 percent	Loans secured by first liens on 1-4 family residential mortgages, state and local revenue bonds
100 percent	All other loans to private obligors (i.e., loans to consumers and businesses)

To see how the risk weights affect a bank's RBC ratio, consider the simplistic example shown in table 2 of a hypothetical bank with total capital of $3,000.

Table 2. Bank Balance Sheet with Equity Capital of $3,000

Balance Sheet Assets	
Cash	$15,000
US Treasuries	$20,000
Loans secured by first liens on 1-4 family residential mortgages	$5,000
Loans to private corporations	$30,000
Total balance sheet assets	*$70,000*
Risk-Weighted Equivalents	
Cash	$15,000x0 = 0
US Treasuries	$20,000x0 = 0
Loans secured by first liens on 1-4 family residential mortgages	$5000x.50 = $2,500
Loans to private corporations	$30,000x1=$30,000
Total Risk-Weighted Assets	*$32,500*
RBC Ratio ($3,000/$32,500) = 9.23%	

In this example, it is quite easy to see how the risk weights change the relative prices of assets for banks. Especially if a bank is capital constrained, it has a greater incentive to hold government bonds than to lend to a private business. In the literature, issues arising from this system come from improperly rated risk categories, concentration risk, credit

crunch, increased securitization, and regulatory arbitrage—which is made easier by the complexity of the regulations.

Maximilian Hall (1994, 271) describes the issue as "a spurious methodological approach to the assessment of portfolio risk." As he explains, "standard portfolio theory … teaches us that portfolio risk … depends, inter alia, on the variance of expected returns for the individual assets and on the correlations between those expected returns." Thus, Hall notes, the Basel approach, which simply sums the individual risks, makes no allowance for portfolio diversification or hedging.[15]

Furthermore, in the assessment of credit risk, the indiscriminate categories of assets cannot take into account specific local knowledge of the bank, such as the characteristics of the obligor, which is a necessity in assessing true credit risk (Hall 1994). Cordell and King (1995), for example, show that the risk-asset ratios bear little resemblance to market assessments of risk. As Hall (1994) and other scholars have noted, there are knowledge problems associated with an enormous task like setting proper risk-based capital standards.[16] As Friedrich A. Hayek (1945) pointed out, knowledge is dispersed and any single entity has but a minute fraction of the knowledge available. Thus, we must employ a system that allows people to best utilize all of the dispersed knowledge. Since the financial system is extremely complex, with moving parts that interact and cause circumstances to constantly change and evolve, the more precision applied in trying to regulate capital requirements, the less robust the regulations will be.[17]

[15] See also Admati and Hellwig (2014, 312): "A major flaw of the entire approach is that it assumes that risks are independent. Correlations are neglected.…"
[16] For more on capital requirements and the knowledge problem, see Hogan and Manish (2016).
[17] See Haldane (2012), http://www.bis.org/review/r120905a.pdf.

Others have mentioned a possible "credit crunch" effect. If the portfolio effects of risk-based capital requirements are strong, the requirements may disincentivize lending to the private economy—lending that might otherwise generate greater economic activity. Furfine (2000) finds evidence of a credit crunch, supporting the idea that banks respond to incentives. His analysis is limited to the years surrounding the implementation of Basel I and shows that "shortly after the passing of the Basel Accord…[b]anks simultaneously reduced their investments in commercial lending and began to hoard government securities" (Furfine 2000, 1). Peek and Rosengren (1995) also discuss the effects of the credit crunch. These forgone opportunities are a potential unseen effect of the regulation.

However, some authors have suggested the requirements incentivize banks to hoard government securities. This activity is commonly referred to as "herding" and gives rise to concentration of risk. To the extent that capital requirements encourage banks to hold more of a particular asset than they otherwise might, they may not serve the economy well. Friedman (2011) shows how the BCBS's equal treatment of sovereign debt led banks to accumulate large quantities of Greek sovereign debt, which was revealed as unsafe. As Admati and Hellwig (2014, 184) note, such debt is still treated as riskless "even after the Greek default of March 2012." Many European leaders have acknowledged precisely this issue, and it underlies current debates in the European Union over changing the treatment of sovereign debt under the capital requirements.[18] A 2015 report by the European Systemic Risk Board (ESRB) found that "the current regulatory framework may have led to excessive investment by financial institutions in government debt" (European Systemic Risk Board 2015, 5). Proposals have called for the removal of

[18] See European Systemic Risk Board (2015); Christie (2016); and Goves, Spies, and Tentori (2016).

the zero risk weight for sovereign debt, or a cap limiting the proportion of total assets that sovereign debt can account for. Friedman and Kraus (2011, 70) document how changes in the risk weights following implementation of the Recourse Rule could have contributed to the massive expansion of private label mortgage-backed securities and collateralized debt obligations, resulting in "overconcentration of securitized mortgage risk in the commercial banks." Erel, Nadauld, and Stulz (2014) point out that US bank holding companies (BHCs) involved in securitizing assets were incentivized to hold the highest rated tranches instead of the traditional, riskiest equity tranche. They found no direct evidence that holding companies that reported more highly rated tranche holdings did so for regulatory arbitrage purposes, but they conjecture that securitizing holding companies would have been the ones most likely to take advantage of the arbitrage. Miller (2017), however, documents how the largest banks that were active in securitizing assets increased their holdings of private-label securitizations following the 2001 Recourse Rule in the lead up to the crisis. This finding helps explain why securitizing BHCs could have been exposed to losses that could have wiped out holding company equity capital as the crisis began to unfold in 2008.

The ongoing debate in Europe reflects a larger, unique issue facing this type of risk-based capital framework. There is an inherent tension in these requirements between structuring the risk weights in an attempt to best reflect actual risk, and supporting or propping up government funding of debt liabilities. Admati and Hellwig (2014, 313) note that calls to change the treatment of sovereign debt are met with resistance "from countries that have a long tradition of using banking regulation to ensure that banks pay for government deficits" and that "zero risk weights for government debt are a key

political concern of many governments." The 2015 ESRB report explicitly notes that it "recognises the difficulty in reforming the existing framework without generating potential instability in sovereign debt markets, as well as the intrinsic difficulty of redesigning regulations so as to produce the right incentives for financial institutions" (ESRB 2015, 5).

An example that sheds light on the perverse political nature of these requirements can be seen in a recent change the Federal Reserve made to the Basel III liquidity coverage ratio (LCR) rule. While this rule is directed at liquidity rather than capital, it similarly employs asset categories with imposed thresholds. In October 2014, US financial regulators finalized the rule which "requires a covered company to maintain an amount of [high-quality liquid assets (HQLA)] that is no less than 100 percent of its total net cash outflows over a prospective 30 calendar-day period."[19] The financial regulators chose which assets would be considered for inclusion and placed them into categories 1, 2A, and 2B according to their determined liquidity characteristics. In the original proposal, municipal bonds and debt securities issued by state and local government entities were not considered HQLAs. Because municipal bonds fund state and local public projects, congressional interest in this determination was high from the start.

In February 2016, the US House of Representatives passed a bill pressuring regulators to categorize municipal bonds as HQLA for the purposes of the LCR rule.[20] After much interest from Congress and input from special interest groups, in April 2016,

[19] Office of the Comptroller of the Currency, Federal Reserve System, and Federal Deposit Insurance Corp., Liquidity Coverage Ratio: Liquidity Risk Measurement Standards, 79 Fed. Reg. 197 (October 10, 2014), 61440–541.
[20] H.R. 2209, "To Require the Appropriate Federal Banking Agencies to Treat Certain Municipal Obligations as Level 2A Liquid Assets, and for Other Purposes," 114th Congress (February 1, 2016).

the Federal Reserve amended its original LCR rule to include municipal bonds as level 2B liquid assets in HQLA.[21] The Fed did so despite analysis from the Securities and Exchange Commission and others finding that municipal bonds are generally not very liquid. Moving forward, analysis of the portfolio effects following these changes should pay attention to BHCs' municipal bond holdings. Unsurprisingly, what makes sense from a risk and financial stability standpoint is sometimes politically unpopular or infeasible.

Still another strain of literature brings into question the effectiveness of the RBC ratio as a predictor of risk—an important consideration if a goal of financial regulation is to mitigate risk in the financial system. The potential problem that arises is summarized in the following quotation from Avery and Berger (1991, 849): "…authors agree that a mandatory increase in capital has the direct effect of reducing insolvency risk by providing an increased 'buffer stock' of reserve funds to absorb losses. However, portfolio changes may also be induced, creating indirect effects on insolvency risk." The reasons the RBC ratio would be an inefficient predictor of risk are many and may contribute to all of the issues mentioned above. Whatever the reason, the empirical results suggest that the RBC ratio is an inferior predictor of risk and are sufficient to call into question regulations that adopt it (Acharya, Engle, and Pierret 2014; Haldane 2012; Hogan 2015).

The risk-weighting system has come under scrutiny from the academic community as well as figures in both the public and the private sector. As Van Hoose (2007, 3680) shows, "the mixed conclusions in the academic literature on banking certainly do not provide unqualified support for moving to an even more stringent and

[21] Federal Reserve System, Liquidity Coverage Ratio: Treatment of U.S. Municipal Securities as High-Quality Liquid Assets," 81 Fed. Reg. 69 (April 11, 2016), 21223–33.

costly system of capital requirements." In reviewing the theoretical literature, he argues, "the intellectual foundation for the present capital-regulation regime is not particularly strong" (Van Hoose 2007, 3680).

In trying to evaluate the impacts of these regulations, this paper will contribute by mapping out bank holdings of various assets in each risk-weight category over time, beginning with the inception of Basel I in 1989. It is too early to seriously examine how the vastly complex requirements levied after the financial crisis have affected banks' balance sheets. However, the historical mapping of potential portfolio effects should be telling and useful. While other facets of risk-based capital regulation play a role, this particular feature of the regulation is worth examining to determine how significant these clearly undesirable effects of the risk-weight system are.

4. Data and Analysis

The data used to assess the potential portfolio effects of RBC requirements come from the Federal Reserve's Consolidated Financial Statements for Holding Companies, form FR Y-9C, housed at the Federal Reserve Bank of Chicago.[22] Every quarter beginning with the third quarter (Q3) of 1986 and ending in Q3 of 2016 is included unless otherwise noted. Specifically, I examine data from Schedule HC: Consolidated Balance Sheet, Schedule HC-A: Securities, and Schedule HC-B Part I: Loans and Lease Financing Receivables. A detailed description of the variables is in the appendix, and each variable is calculated as a percentage of total assets.

[22] See Federal Reserve System of Chicago, "Holding Company Data," https://www.chicagofed.org/banking/financial-institution-reports/bhc-data.

To examine the portfolio effects of changes in RBC requirements, this paper examines BHCs' holdings of cash, Treasuries, mortgage-backed securities (MBSs), mortgages, municipal bonds, and private loans. The three main regulatory changes documented are the implementation of the first risk-based capital requirements in 1989, the 2001 Recourse Rule, and a preliminary examination of the Basel III rules that have been implemented.

The first RBC rule implementing Basel I was published by the Federal Reserve and Office of the Comptroller of the Currency (OCC) in January 1989. The framework for calculating the ratios began almost immediately, with the minimum ratios taking effect by December 1, 1990, and the requirements fully phased in by December 1, 1992.

The assumption is that banks begin reacting as soon as the rules are published in order to work toward meeting the minimum requirement by the time required. The capital rules applied to all OCC national banks, all state member banks, and BHCs other than "small" BHCs with less than $150 million in total assets. Since the Basel I rules applied to all banks except very small BHCs, holdings across all banks are included to look for potential changes.

At the introduction of Basel I, if the requirements induced portfolio effects, then increased holding of Treasuries and cash, which receive a 0 percent risk weight, and decreased private loans, which receive a 100 percent risk weight, could be expected. First liens on residential mortgages receive a 50 percent risk weight, which could incentivize and influence holdings of mortgage loans, but the effect would likely be less evident in comparison to 100 percent and 0 percent risk-weighted assets. The expected effects on state and local municipal bonds are less clear, as general obligation municipals receive a

20 percent risk weight, while revenue municipal bonds receive a higher 50 percent risk weight. The Y-9C does not break out municipals by general obligation and revenue; they are all reported together, so the expected result is not entirely clear. Given the favorable treatment, an increase could be expected.

Before 1994, the line item containing MBS (BHCK0381) was primarily for reporting private MBS, even if the MBS contained agency pass-throughs (see the appendix), where private MBS could receive a treatment as high as the highest risk weight appropriate for any underlying mortgage or security.[23] For this measure of MBS, a decline could be expected, since the majority of MBS reported in this item were privately issued.

The Recourse Rule was introduced in November 2001. If, before the effective date of the final rule, banks had entered into transactions that would result in a reduced risk-based capital requirement under the new rule, then they could apply the final rule immediately. If banks had entered into transactions that would result in increased regulatory capital requirements under the new rule, they could delay application until December 2002.[24] The rule applied to OCC national banks, primarily affecting the large national banks, and BHCs other than "small" BHCs with total assets less than $50 million. The Recourse Rule introduced the use of ratings by NRSROs and significantly reduced the capital charge for highly rated private-label securitizations. This had the effect of reducing the highest rated tranches of privately issued MBS to the 20 percent

[23] Office of Comptroller of the Currency, Risk-Based Capital Guidelines, 54 Fed. Reg. 17 (January 27, 1989), 4173.
[24] Office of the Comptroller of the Currency, Federal Reserve System, Federal Deposit Insurance Corp., and the Office of Thrift Supervision, Risk-Based Capital Guidelines; Capital Adequacy Guidelines; Capital Maintenance: Capital Treatment of Recourse, Direct Credit Substitutes, and Residual Interests in Asset Securitizations, 66 Fed. Reg. 230 (November 29, 2001), 59628–29.

risk-weight category given to government-sponsored enterprise (GSE) MBS. The new ratings for privately issued securitized assets are shown in table 3.

Table 3: Risk-Weights for Securitizations under Recourse Rule

Long-term rating category	Examples	Risk weight (In percent)
Highest or second highest investment grade	AAA, AA	20
Third highest investment grade	A	50
Lowest investment grade	BBB	100
One category below investment grade	BB	200

Source: Office of the Comptroller of the Currency, Federal Reserve System, Federal Deposit Insurance Corp., and the Office of Thrift Supervision, Risk-Based Capital Guidelines; Capital Adequacy Guidelines; Capital Maintenance: Capital Treatment of Recourse, Direct Credit Substitutes, and Residual Interests in Asset Securitizations, 66 Fed. Reg., 59656.

As became apparent after the crisis, these securitizations could be highly rated despite the underlying quality of the assets. Thus, if MBS could easily be given a high rating, and banks could receive a significantly reduced capital charge, we should expect private MBS and maybe mortgages in general to increase around the time of the 2001 Recourse Rule if banks responded to these incentives. Beginning in 1994, BHCs reported their MBS guaranteed or issued by GSEs or collateralized by other MBS issued or guaranteed by GSEs separately from private-label MBS (see the appendix), so the analysis for MBS at the time of Basel I will be done separately from the analysis for 1994–present.

Finally, in July 2013, federal financial regulators issued final rules implementing Basel III and provisions of the Dodd-Frank Act, with a phase-in period beginning January 1, 2014, for advanced-approaches banks ($250 billion or more in consolidated assets, or on-balance-sheet foreign exposures of $10 billion or more) and January 1, 2015, for smaller, less complex institutions.[25] Under Basel III, Treasuries and cash remain 0

[25] Office of Comptroller of the Currency and Federal Reserve System, Regulatory Capital Rules: Regulatory Capital, Implementation of Basel III, Capital Adequacy, Transition Provisions,

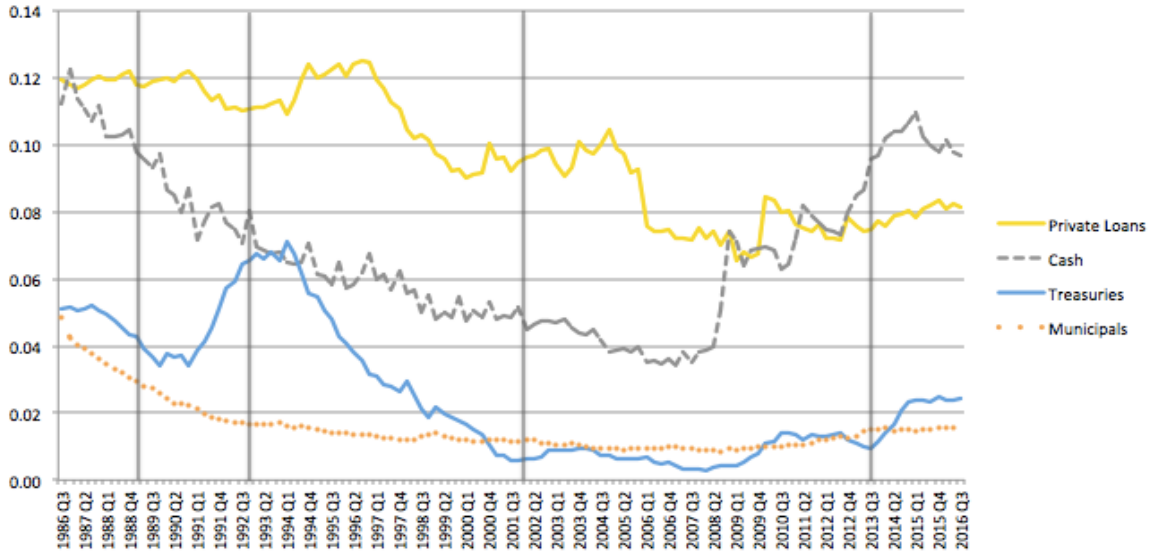
percent risk weighted, mortgages retain a 50 percent risk weight, municipal bonds retain their respective 20 and 50 percent risk weights, and GSE exposures remain 20 percent risk weighted. For private securitization exposures, the external credit ratings-based approach is replaced with a "simplified supervisory formula approach," which installs a minimum risk-weight floor of 20 percent for securitization exposures and also takes into account other measures, such as the risk weight of the underlying exposures. Banks may choose to apply the new simplified supervisory formula approach consistently across all of their exposures, to apply a "gross-up" approach, or they may assign a 1,250 percent risk weight to any exposure. It is not completely obvious what portfolio effects we might expect from the Basel III changes. However, the rules try to more carefully account for risk in securitizations and increase overall capital and leverage requirements; in addition, they add buffers, such as the countercyclical capital buffer, capital conservation buffer, and supplementary leverage ratio for the biggest banks. Generally, if the requirements are more stringent and binding, as the goals of the new framework suggest, banks may need to shift into lower risk-weight assets to meet the new minimum requirements. Since the new rules have long phase-in schedules, it is currently only possible to examine preliminary changes.

5. Results and Discussion

As can be seen in figure 1, banks did not seem to alter their holdings of cash following changes to the Basel capital requirements.

Prompt Corrective Action, Standardized Approach for Risk-Weighted Assets, Market Discipline and Disclosure Requirements, Advanced Approaches Risk-Based Capital Rule, and Market Risk Capital Rule, 78 Fed. Reg. 198 (October 11, 2013), 62028–29.

Figure 1. Private Loans, Cash, Treasuries, and Municipals as a Percentage of Total Assets



Source: Federal Reserve Form FR Y-9C; author's calculations.

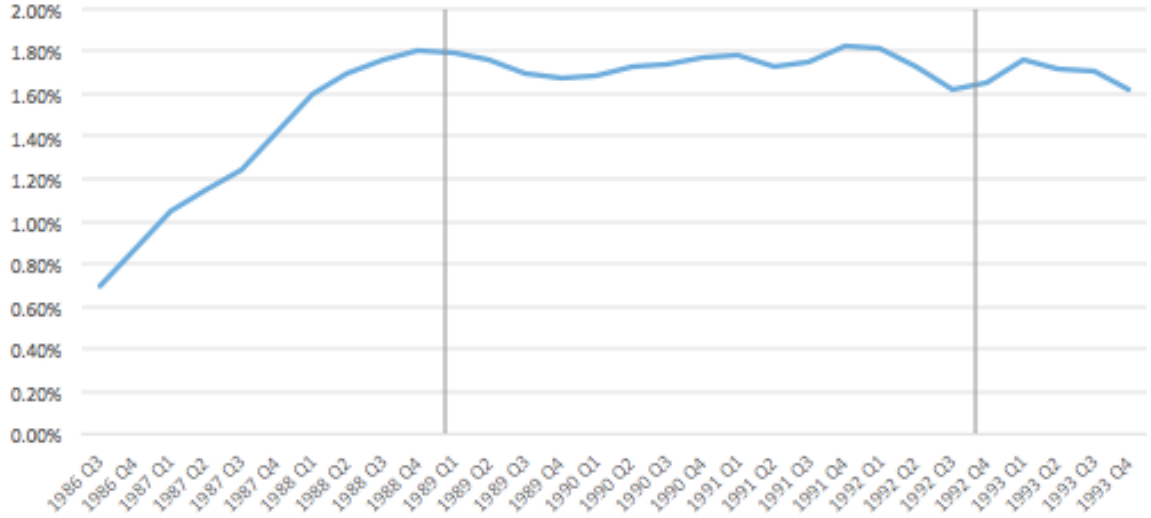
Cash holdings were trending downward for all banks and continued to do so with the announcement and phase-in of Basel I. The only time in the series when cash holdings changed was following the 2008 crisis.

Treasuries, however, seem to trend closely with the announcement and implementation of Basel I. Treasury holdings were on a downward trend and then, right around the time of the Basel I release, began a sharp increase. By the fully phased-in date of December 1992 (second vertical line on figure 1), holdings of Treasuries for all banks had increased from 4.3 percent of assets before the January 1989 Basel I final rule to 6.5 percent (although they declined a couple years later). There also appears to be an increase in holdings following the 2001 Recourse Rule, but it is not clear why this would be the case or if it has anything to do with the rule. Following the release of the Basel III rules in 2013, Treasury holdings have begun to climb sharply again, an expected result given all of the new stringent rules being levied, especially on big banks.

Municipal bond holdings were on a sharp decline before Basel I, and they continued to decline after Basel I, with no particularly notable observations. As Furfine (2000) notes, private loans do decline immediately surrounding the Basel I phase-in, but the overall trend is downward and there is not enough data before Basel I to suggest that the decline is Basel related; however, a connection cannot be ruled out. This measure captures loans to private individuals, in particular, but it would also be valuable to observe commercial and industrial loans and other such private loans.

Figure 2 shows that MBS holdings were rising before the final Basel I rule and then seemed to decline right after the final rule.

Figure 2. MBS as a Percentage of Total Assets, 1986–1993

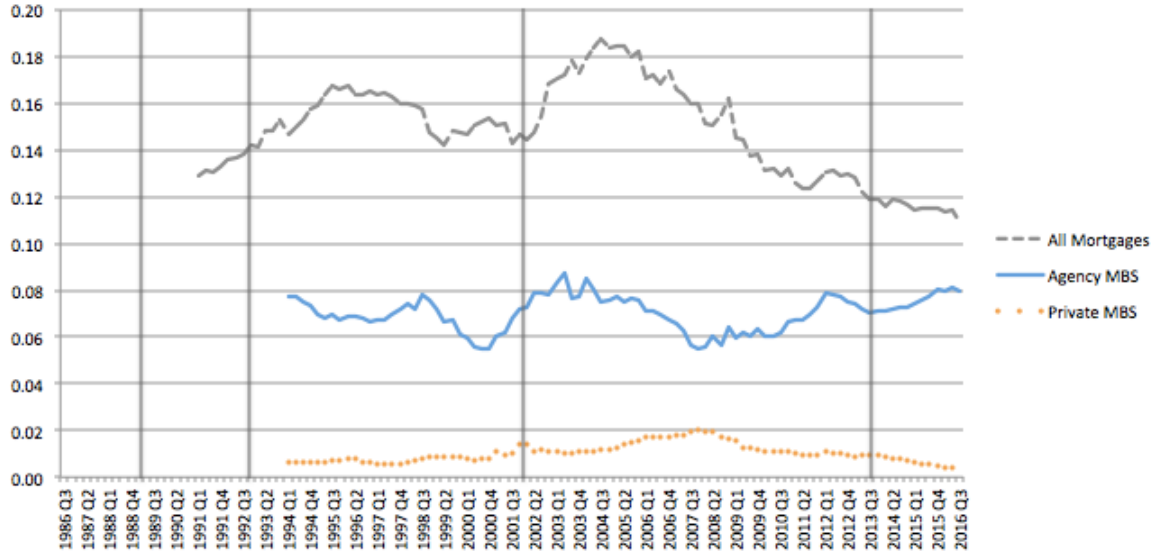


Source: Federal Reserve Form FR Y-9C; author's calculations.

As mentioned, since this line item was for reporting private MBS, which could carry up to a 100 percent risk weight, this finding is consistent with what would be expected, although the results are not conclusive.

In figure 3, beginning in 1994 we can observe agency MBS holdings separately from private MBS.

Figure 3. Mortgage Loans, Agency MBS, and Private MBS as a Percentage of Total Assets



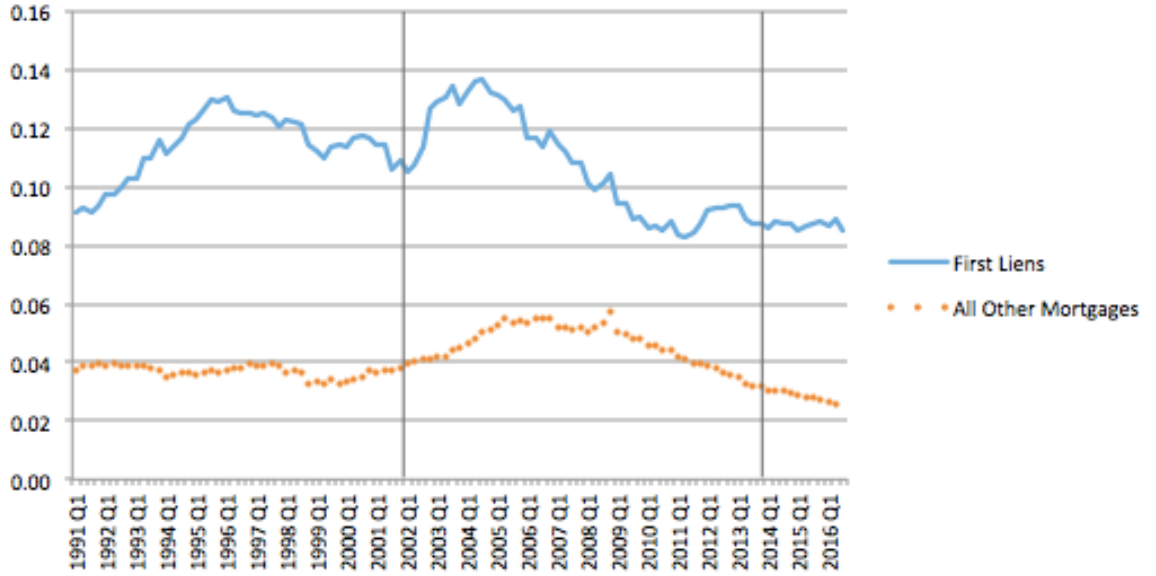
Source: Federal Reserve Form FR Y-9C; author's calculations.

Agency MBS, which carried a 20 percent risk weight before the 2001 Recourse Rule and retained that weight, appear ambiguous with respect to the final rule. While holdings did increase, the steep climb appears to have started in the beginning of 2001. Private-label MBS were also increasing before the rule but increased sharply following the rule. In the third quarter of 2001 before the final rule, banks held 0.99 percent of total assets in private MBS, and that amount increased steadily to a high of 2.04 percent right before 2008. Since the data reflect overall trends in holdings of these asset categories, it is not possible to gather precise observations related only to the Recourse Rule, as the rule treated highly rated and lower-rated securitization tranches in opposite ways. Since overall holdings significantly increased, it may be that MBS were disproportionately given higher ratings; and since banks could receive a significantly reduced capital charge by holding those securities, the favorable charge outcome outweighed the charge on low-rated tranches. As mentioned, after the crisis, it became clear that securitizations could be highly rated despite the underlying quality of the assets and that there were issues with

the NRSRO rating system. However, an analysis that breaks down holdings by risk weight—such as Erel, Nadauld, and Stulz (2014) or Miller (2017)—is more useful for observing the nuances of the 2001 rule.

As can be seen in figure 3, mortgage loans increased significantly at the time of the Recourse Rule. First liens in particular received a preferential treatment of 50 percent risk weight under Basel, while some other mortgage loans received 100 percent. Since first-lien mortgages would also have a more favorable treatment when securitized, this rating would also apply for securitizations. Figure 4 shows first-lien and all other mortgage loans separately.

Figure 4. First Liens and All Other Mortgages as a Percentage of Total Assets, 1991–Present



Source: Federal Reserve Form FR Y-9C; author's calculations.

First-lien mortgages really took off compared to other mortgage loans, which remained about stable following Basel I, and then seemed to increase at the time of the Recourse Rule. Since holdings of other mortgages loans were already generally lower than first liens in 1991 when the banks began to report them separately, it cannot be states

with certainty whether the Basel I treatment had an impact. The sharp increases at the time of the Recourse Rule, however, are notable. Of course, it cannot be determined from this analysis whether the Recourse Rule directly caused this result, but it is interesting that the increase occurred in 2001 rather than earlier when other commonly cited housing policies were taking effect.

Based on this preliminary examination, cash and municipal bonds yielded no notable changes that coincide with Basel capital requirement changes. For cash, this finding is not surprising given the other strong supply and demand factors that affect banks' cash holdings. Treasury holdings resemble the strongest potential portfolio effects, and this would be a great starting point to add controls and further examine banks' holdings of Treasuries. Mortgage and MBS holdings also present interesting findings for further analysis on the Recourse Rule effect. For many reasons, this rudimentary analysis is not sufficient to show stronger portfolio effects, even if they exist. Although the rule changes affect the relative price of holding assets, an examination of other controls—especially the banks' RBC ratios—would help shed light on whether they were capital constrained and how binding we might expect the regulations to be. In responding to increases in capital requirements, banks have various options and, given the complex nature of the regulations, may even engage in regulatory arbitrage to game the risk weights rather than change their asset portfolio. This introductory mapping should provide a useful starting point for examining these effects further.

6. Policy Suggestions

Many scholars have suggested alternatives to capital requirements, generally, and risk-based capital requirements, specifically. These alternatives have been met with varying

levels of support. One popular suggestion is to get rid of risk weights and instead use a "simple capital ratio" whereby all assets are treated equally. Thomas Hoenig (2016), vice chair of the Federal Deposit Insurance Corporation (FDIC), recently remarked of the Basel III framework, "the mere fact that risk-based approaches must always be constrained and negotiated by regulators—through the complex processes of flooring inputs and outputs, for example—only underscores the necessity of a simple, robust, and uncompromised leverage ratio." Hoenig (2015) has in fact proposed regulatory relief from Basel calculations and capital standards for community banks with a standard (not risk-weighted) capital ratio of 10 percent; and he continues to call for simpler, but higher capital requirement for banks. Hogan and Meredith (2015) find that the simple capital-to-assets ratio is a better predictor of risk than the RBC ratio. Haldane (2012, 11) finds that "for a set of the world's most complex banks, simple-weighted measures appear to have greater pre-crisis predictive power than risk-weighted alternatives" and argues that under conditions of information imperfections, less is more. While other issues—such as the procyclical nature of capital requirements and market versus book value accounting—are known, a simple capital ratio would prevent the alteration of relative prices and distortion of incentives. This would be true even if using a simple capital ratio would require higher overall capital levels, as is usually suggested. The current requirements replace banks' judgment with regulators' crude evaluation of risk, allowing portfolio allocation to be largely influenced by an arbitrary standard.

Another commonly supported alternative is the use of contingent convertibles (CoCos) with a market-based trigger, to serve as a backstop. Calomiris and Herring (2011), Flannery (2014a, 2014b), and Haldane (2011) all show support for these

instruments. If used with a market trigger, then—once market signals indicate a bank has reached a certain level of distress—some of its debt is converted into equity. Haldane (2011) shows that three simple market measures, which are proven indicators of distress, could be used as the trigger to invoke CoCos. He argues that CoCos would be simpler and timelier and have better incentive-alignment for managers, regulators, and investors alike.

Both of these policy alternatives may be an improvement over the current risk-based capital regime; however, one policy action should be taken immediately. Federal financial regulators need to retrospectively review and evaluate existing regulations and conduct some sort of benefit-cost analysis of the Basel framework. Following the 2008 financial crisis, regulators got something of a "free pass" when it came to any sort of analysis or quantitative impact study, because immediate regulatory action was deemed necessary to thwart further and future financial instability. Now, seven years past the crisis, a retrospective review of some of the Dodd-Frank Act rules should be conducted before moving forward with any further capital regulation.

7. Conclusion

Risk-based capital requirements have potential, unintended consequences. Yet the current ever-expanding risk-based capital framework continues, largely unchallenged. If the goal of financial regulation is actually to ensure solvency and mitigate against systemic risk, then the current requirements should be evaluated in light of those intentions. Additionally, the unintended consequences, like those resulting from portfolio effects, must be considered.

As shown in this paper, the reasons to doubt the efficacy of current risk-based capital requirements are many and the portfolio effects appear to be visible. The foundations for these global standards were shaky and not justified, as the RBC requirements have no strong theoretical basis. Thus, when we turn to the empirical investigations, unsurprisingly, the results are mixed, and the literature in opposition to the standards is growing. No doubt, the complexities involved in setting this type of standard contribute to the difficulties that have arisen. In dealing with something as complex as the financial system, simpler standards may very well be more effective.

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Appendix - Variables

<table>
<tr><td>Variable Name</td><td colspan="2">FR Y-9C Line Items</td></tr>
<tr><td>Cash</td><td colspan="2">1986–present
BHCK0081+BHCK0395+BHCK0397
(Cash and balances due from depository institutions)</td></tr>
<tr><td>Treasuries</td><td colspan="2">1986–1993
BHCK0400
1994–present
BHCK0211+BHCK1287</td></tr>
<tr><td>Municipals</td><td colspan="2">Q3 1986–Q2 1987
BHCK0212
Q3 1987–Q4 1993
BHCK0301+BHCK0303
1994–2000
BHCK8531+BHCK8534+BHCK8535+BHCK8538
2001–present
BHCK8496+8499</td></tr>
<tr><td>Mortgages*</td><td>First Lien Mortgages
Q1 1991–Q4 1991
BHCK5367+BHDM5367
Q1 1992–present
BHDM5367</td><td>All Other Mortgages
Q1 1991–Q4 1991
BHCK1797+BHCK5368+
BHDM1797+BHDM5368
Q1 1992–present
BHDM1797+BHDM5368</td></tr>
<tr><td rowspan="2">Mortgage-backed securities (MBS)</td><td colspan="2">Q3 1986–Q4 1993
BHCK0381**</td></tr>
<tr><td>Private
Q1 1994–Q1 2009***
BHCK1709+BHCK1713+
BHCK1733+BHCK1736
Q3 2009–present
BHCKG308+BHCKG311+
BHCKG320+BHCKG323</td><td>Agency
Q1 1994–Q1 2009***
BHCK1698+BHCK1702+
BHCK1703+BHCK1707+
BHCK1714+BHCK1717+
BHCK1718+BHCK1732
Q3 2009–present
BHCKG300+BHCKG303+
BHCKG304+BHCKG307+
BHCKG312+BHCKG315+
BHCKG316+BHCKG319</td></tr>
<tr><td>Private loans to individuals</td><td colspan="2">Q3 1986–present
BHCK1975*+</td></tr>
</table>

*Due to changes in reporting, data prior to Q3 1990 are not particularly useful because, from 1986 until Q3 1990, all real estate loans were reported together (BHCK1410); then, in Q3 1990, they were separated into 1-4 family residential and other real estate loans, such as construction; for Basel I reporting beginning Q1 1991, they were broken out even further into 1-4 family, first lien, junior lien, other real estate, and so on. I nonetheless looked at 1986–1990 and found nothing significant.

**MBS were reported as BHCK0381 before 1994. They were mainly pools of residential mortgages not guaranteed by the US government and not held in trading accounts. However, Collateralized Mortgage Obligations (CMOs), Real Estate Mortgage Investment Conduits (REMICs), and stripped MBS were included even if the collateral for the CMO/REMIC or the stripped MBS consisted of Government National Mortgage Association (Ginnie Mae) pass-throughs, Federal Home Loan Mortgage Corporation (Freddie Mac) participation certificates, or Federal National Mortgage Association pass-throughs. This inclusion is not ideal for examining the effects of Basel I, but it can be expected to result in majority higher risk weights (50–100%).

***Before Q1 2001, only banks with $1 billion or more in total assets reported these.

*+ In 1991 and 2011, other categories of private loans to individuals were added, such as automobile loans and other consumer loans, but for consistency I used BHCK1975 throughout, as it was available for the entire sample.