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EVALUATING RISK-BASED CAPITAL REGULATION

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Abstract

Risk-based capital (RBC) ratios are an important component of US banking regulation, yet empirical evidence on the effectiveness of RBC regulation has been mixed. Avery and Berger (1991) find that the RBC ratio improves upon the standard capital ratio of equity over assets. This paper identifies some potential flaws in the Avery and Berger (1991) methodology and proposes a more direct method of comparing capital and RBC. We evaluate the capital and RBC ratios of US commercial banks from 2001 through 2011 and find the standard capital ratio to be a significantly better predictor of bank performance than the RBC ratio. The results have significant implications for US banking regulation.

JEL Codes

G21, G28, G32

Keywords

bank, capital, risk-based capital, regulation

Evaluating Risk-Based Capital Regulation

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I. Introduction

The standard capital ratio of equity over assets has long been used as an important indicator of bank risk. Banks with more equity are less affected by asset depreciation than are other banks because a drop in the value of their assets affects only their equity and not their liabilities. In response to the savings and loan crisis of the 1980s, the Federal Reserve adopted risk-based capital (RBC) regulations in 1991 based on the Basel Committee on Bank Supervision (1988, hereafter "Basel Accords") to improve the effectiveness of US banking regulation and to standardize the US banking system with other systems around the world. The RBC ratio measures equity as a percentage of risk-weighted assets (RWA); each category of assets is assigned a weight appropriate to its perceived level of risk. Banks with riskier assets must maintain more capital, while banks with safer assets require less capital. However, if this method of assessing risk is flawed, its use may increase, rather than decrease, systemic risk in the banking system.

Critics of the Basel system have pointed out several ways in which RBC regulation has increased risk in the banking system.[1] First, RBC can encourage risk-taking by individual banks, especially if regulators have not properly identified the riskiness of a particular class of assets. Jablecki (2009, 16) shows that the misrating of risky assets in the Basel Accords has encouraged US banks to adopt "regulatory capital arbitrage techniques, in particular securitization." This problem cannot be resolved simply by reevaluating the assets' risk weightings, because

[1] In terms of theory, "the literature offers widely divergent conclusions about . . . whether risk-based capital regulation truly makes individual banks and the banking system as whole 'safer'" (VanHoose 2007, 3694).

regulators themselves cannot be certain of all potential risks. Indeed, regulators seriously underestimated the riskiness of mortgage-backed securities (MBS), which were viewed in the 1980s as safe, low-risk assets but are now recognized as very high in risk. Second, risk-weighting systems can create systemic risk by encouraging many banks to invest heavily in the same class of assets. Friedman's (2011) work explains how RBC regulations give banks an incentive to hold certain classes of risky assets, such as MBS and Greek government bonds, and that this approach has increased systemic risk in the United States and the European Union respectively.[2]

It is possible, however, that the benefits of RBC regulation might outweigh the potential costs. Some studies, such as Estrella, Park, and Peristiani's (2000), have proposed that optimal banking regulation might utilize some combination of capital and RBC regulations. The Fed currently employs such a system (discussed further in the next section), which is based on the Basel Accords. If the RBC ratio is, in fact, an effective predictor of bank risk, then the RBC ratio might help regulators identify particularly risky banks, and this advantage might offset the disadvantage of increased systemic risk. However, if the RBC ratio does not improve the predictive power of the capital ratio, then RBC regulation may cause significant harm without providing any added benefit. Therefore, we must turn to the empirical question of whether or not the RBC ratio is better than the capital ratio as a predictor of bank performance.

Avery and Berger's (1991) paper is among the first empirical studies to validate the use of RBC as a measure of bank performance, and it is widely cited in support of RBC regulation.[3]

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[2] In particular, see chapters "How Securitization Concentrated Risk in the Financial Sector" (183–99) by Acharya and "A Regulated Meltdown: The Basel Rules and Banks' Leverage" (200–27) by Richardson, Jablecki, and Machaj, and well as the introductory chapter by Friedman himself.

[3] Avery and Berger's (1991) study currently has 40 citations according to the Social Science Citation Index and 175 citations on Google Scholar. It is often described as providing empirical evidence for the effectiveness of RBC regulations, sometimes with the caveat that the risk weights used by regulators may not be properly calibrated.

This study uses FDIC Call Report data to calculate the RWA of all US commercial banks from 1982 to 1989. The authors find that RWA is correlated with several indicators of bank performance, such as income, nonperforming loans, and bank failures.[4] In addition to evaluating RWA as a predictor of bank risk, Avery and Berger (1991) examine the levels of capital required under the new and old regulatory capital standards. Banks whose levels of capital failed to meet the new standard were found to have significantly worse performance than banks whose levels of capital failed to meet the old standard, leading the authors to conclude that the new RBC standards provide a better indication of risk. However, there are shortcomings in their method of analysis. First, the RWAs calculated by Avery and Berger (1991) differ significantly from those reported by the banks themselves. We use instead the RWA values reported by banks in their FDIC Call Reports. Second, this approach compares specific policies rather than comparing the capital and RBC ratios as analytical tools. For example, comparing a 6% capital ratio with an 8% RBC ratio may only tell us that an 8% ratio is better than a 6% ratio, and not necessarily whether the capital ratio or the RBC ratio is a better indicator of performance. Third, the regression analysis of Avery and Berger (1991) examines the influence of RWA separately from capital requirements, whereas RBC regulations depend crucially on the interaction between capital and RWA. (For example, banks with higher RWA may still be considered safe if they are highly capitalized.)

We contribute to the debate on bank regulation by comparing the capital and RBC ratios reported by US commercial banks in their Call Reports as indicators of performance. Contrary to

[4] Other evidence regarding RBC as a predictor of bank performance is mixed. Resti and Sironi (2007) find that the RBC risk weights assigned to European corporate bonds are highly related to their yield spreads, a common indicator of risk. Estrella et al. (2000, 33) find that "the risk-weighted ratio does not consistently outperform the simpler ratios, particularly with short horizons." Demirgüç-Kunt, Detragiache, and Merrouche (2011, 1) write that "the relationship between stock returns and capital is stronger when capital is measured by the leverage ratio rather than the risk-adjusted capital ratio."

Avery and Berger (1991), we find evidence that the capital ratio is a better indicator of bank performance than the RBC ratio. The next section discusses our sample of bank-income and balance-sheet data, including some summary statistics. In section 3, we describe the analysis used by Avery and Berger (1991) and discuss some shortcomings of their approach. Section 4 proposes a more direct method of comparing capital and RBC ratios. Section 5 provides the results of our analysis, which indicate that the standard capital ratio is a significant predictor of the measures of bank performance used by Avery and Berger (1991). In contrast, the RBC ratio is not a significant predictor of performance, even when used in conjunction with the capital ratio. Section 6 concludes our study.

II. Data

Data for our study are taken from the FDIC's *Consolidated Reports of Condition and Income* (Call Reports) administered by Federal Financial Institutions Examination Council (FFIEC). Using annual reports from 2001 through 2011, we reproduce the RWA calculations used by Avery and Berger (1991), which approximate the Fed's risk-weighting system from data available in Federal Reserve press releases. We attempt to replicate their data set as closely as possible, with a few minor changes where indicated.

We note that the Call Report data are only freely available back to 2001. Although our sample is longer than the one used in Avery and Berger (1991), one could argue that this period is not representative due to the unusual turmoil in the banking sector during this time. On the other hand, volatility during this period is likely to increase the difference between safe banks and risky banks, thereby improving the identification of risky banks and the accuracy of our regressions. In fact, the instability during this period perhaps makes our analysis more relevant, since it is during times of crisis that the effectiveness of bank capital regulation is likely to matter most.

The goal of Avery and Berger (1991) is to evaluate the regulatory reforms of 1991, which introduced risk-weighted capital as the primary measure of bank capital. They write, "Under the old standards effective beginning in 1981, all banks were subject to the same minimum capital/asset ratios, irrespective of risk. Primary capital (equity, loan loss reserves, and some convertible debt and preferred stock) had to be at least 5.5% of total on-balance sheet assets, and total capital (primary capital plus subordinated debt and the remaining preferred stock) had to be at least 6% of balance sheet assets" (1991, 851). Thus, banks were required to meet two restrictions, both measured as unweighted capital ratios.

Beginning in 1991, the Fed adopted RBC ratios as measures of bank risk. The new standards, estimated by Avery and Berger (1991) from Fed press releases, included three capital requirements, two of which were based on RWA. As shown in table 1, each bank must maintain Tier 1 capital of 4% of RWA, Tier 1 plus Tier 2 capital of 8% of RWA, and Tier 1 capital of 3% of total assets.[5] To analyze the effectiveness of the new regulations, Avery and Berger (1991) divide their analysis into two parts. First, they compare their estimated RWAs to several measures of bank performance; second, they compare the performance of banks that failed to meet the new capital standards with the performance of banks that failed to meet the old capital standard. These tests are discussed further in the next section. In section 4 we employ the bank performance variables used by Avery and Berger (1991), but we compare them to the actual RBC ratio reported by each bank in its FDIC Call Reports, rather than to the estimated RWAs.

[5] This final requirement of Tier 1 capital as a percentage of total assets is similar to the pre-1991 requirements of primary and total capital as percentages of total assets.

We also compare the capital and RBC ratios directly in our regressions, so there is no need to use separate variables to represent the new and old capital standards, as Avery and Berger do (1991).

Table 1 shows definitions for the estimated RWA standards from Avery and Berger (1991). The table is divided into two parts: risk categories and capital requirements. Bank assets are sorted into four risk categories (A1–A4). Each category has a different risk weight ranging from 0% to 100%, based on the perceived riskiness of the assets in that category. The A1 category has a 0% risk weight because it contains safe assets, such as cash and US Treasuries. Category A2 has a 20% risk weight. It includes riskier assets, such as interbank deposit and claims, non-OECD deposits and securities, and some MBS.[6] Category A3 has a 50% weight and contains loans secured by properties and municipal bonds. The most risky category, A4, has a 100% risk weight and consists of loans to private entities and individuals, some real estate assets, investments in subsidiaries, and claims against non-OECD governments and banks. Category A4 is critical in measuring RWA because its high-risk assets are likely to have a disproportionately large impact on bank performance.

Banks' off-balance activities are also considered in the RBC standards. Avery and Berger (1991) group such activities into two categories: counterparty guarantees (category B1) and market-risk contracts (category B2). In category B1, the main assets are bank guarantees of counterparty risk, such as letters of credit and loan comments. The B2 category assets are primarily market-risk contracts that fluctuate with market prices—swaps, forward contracts, and other derivative products.

[6] The term "non-OECD deposits" refers to those held in any country other than the 34 countries of the Organization for Economic Co-operation and Development.

After defining each subcategory, total RWA can be calculated as the sum of all assets in the subcategory from A1 to B2 multiplied by their respective risk weights:

$$RWA = 0.0 \times A1 + 0.2 \times A2 + 0.5 \times A3 + 1.0 \times A4 + B1 + B2.$$

RWA is used as a tool for monitoring the relationship between a bank's investing activities and its level of capital. All commercial banks regulated by the FDIC are required to hold minimum capital level (K) as a percentage (α) of RWA:

$$K = \alpha \times (RWA).$$

As previously described, the Fed's current RBC regulations, based on the Basel Accords, require each bank to maintain minimum standards regarding several measures of capital. Table 1 shows that banks are required to maintain Tier 1 plus Tier 2 as 8% of RWA.[7] Because these capital requirements are measured as percentages of RWA, higher levels of RWA imply that more capital is necessary to meet the required minimum percentage.

Definitions of the variables in Avery and Berger (1991) are displayed in table 2. This table presents two types of independent variables, risk variables and failure variables, and a set of performance variables that are used as dependent variables in our analysis. Risk variables in table 2 are divided into RWA categories and subcategories. The first section of the table lists the risk-weighted variables used to calculate RWA. The RWA variables *RWA20*, *RWA50*, and *RWA100* represent the on-balance sheet assets in each risk-weight category as a percentage of

[7] As mentioned earlier, banks must also maintain Tier 1 capital as 4% of RWA and 3% of total assets.

total adjusted assets. *COUNTER* and *MKTRISK* include off–balance sheet activities in the B1 and B2 categories, respectively, of table 1. *RWA* is the sum of all the variables of *RWA20*, *RWA50*, *RWA100*, *COUNTER*, and *MKTRISK*.

The second section of table 2 lists four more risk variables, *REALEST*, *C&I*, *CONSUMER*, and *COMMIT*. *REALEST* is the value of real estate loans as a percentage of a bank's adjusted assets (total assets plus loan loss reserves). *C&I* refers to commercial and industrial loans, *CONSUMER* to consumer loans, and *COMMIT* to loan commitments. Each of these variables represents a specific class of bank assets that might significantly affect RWA. For example, *REALEST* refers to one to four family real estate loans, which may have carried significant risk during the recent recession and housing bust. Avery and Berger (1991) include these four variables in their regressions to account for misassignment of risk weights in the event that the riskiness of these assets was not properly classified in the RWA categories.

The third and fourth sections of table 2 define several variables related to the new and old capital standards. All except *SHORTFALL* and *EXCESS* are dummy variables set to 1 if a bank fails a certain requirement. The variable *NEW* equals 1 if a bank's minimum capital does not meet any component of the new RBC standards' requirements. The variable *OLD* equals 1 if a bank's minimum capital level does not satisfy any part of the old standards. The value of *NEWONLY* is 1 if a bank fails any of the new RBC standards but passes the old capital standards. The new capital standard failure subcategory indicates whether a bank has passed or failed a specific component of the new RBC standards. The variable *FAILT1* equals 1 if a bank's Tier 1 capital ratio is less than 4% of its risk-weighted assets; the variable *FAILTOT* equals 1 if a bank's total minimum capital is less than 8% of its total assets. The variable *FAILLEV* equals 1 if a bank's leverage does not meet the leverage standards. *SHORTFALL* indicates the amount of capital by which a bank has fallen short of its leverage or total capital requirements. *SHORTFALL* will be 0 if a bank's minimum capital meets every part of the capital requirements. *EXCESS* indicates the amount of capital by which the bank exceeds its leverage and the total capital requirements.

The final section of table 2 describes the bank performance measures Avery and Berger (1991) used as dependent variables in their regression analysis. We reproduced these variables as closely as possible, using them as dependent variables in our analysis in section 4. We calculated *INCOME* as the bank's net income for the year as a percentage of adjusted assets. We also computed *NONPERFORM* as the value of nonperforming loans, and *CHARGEOFF* as the value of loan charge-offs during the year, with both variables given as percentages of adjusted assets. We included *FAILURE* as a dummy variable that is set to 1 if the bank failed within two years of the end-of-year Call Report. One other performance measure, *INCOMESTD*, represents the standard deviation of each bank's *INCOME* over the 10 years of our sample. Because this variable has only one entry for each bank, the regressions using *INCOMESTD* as the dependent variable are cross-sectional. Consequently, the number of observations in the *INCOMESTD* regressions is much lower than the number of observations in the other regressions we estimate. For the independent variables in the regressions on *INCOMESTD*, we took the averages of the categories of bank assets for each bank over all years of the sample.

Because bank assets at the start of the year should predict performance at the end of the year, we lagged independent variables one year relative to performance variables, as in Avery and Berger's study (1991). Data for the independent variables (of risk categories, dummies for failing the old and new standards, and time dummies for each year) run from 2001 to 2010, while data for the dependent variables run from 2002 to 2011. The one-year lag structure measures whether the independent variables predict future bank performance. Like Avery and Berger (1991), we excluded banks from the *NONPERFORM* and *CHARGEOFF* regressions if a bank failed in the year preceding a measurement date; unlike Avery and Berger,[8] we also eliminated banks from the *INCOME* regressions if the bank had failed in the previous year.

Following Avery and Berger (1991), we divide the sample into small banks and large banks because bank risk and performance may differ substantially according to size. The small-bank sample included all banks with total adjusted assets (gross assets plus loan loss reserves) of less than $250 million, measured in 1989 dollars, during the entire sample period; the large-bank sample consisted of banks with real adjusted assets of more than $250 million in at least one year. We excluded very small banks (those with less than $10 million in assets) from the sample. Our sample contained a total of 61,591 small-bank and 10,635 large-bank observations, respectively, for the *INCOME* and *FAILURE* regressions, and 61,300 small-bank and 10,537 large-bank observations, respectively, for the *NONPERFORM* and *CHARGEOFF* regressions. For the *INCOMESTD* regression, we had 8,034 small-bank observations and 1,051 large-bank observations.

We have provided descriptive statistics for the sample in tables 3 and 4. Table 3 contains the mean, minimum, maximum, and standard deviation (*SD*) of each variable. We present figures showing the changes in bank income and asset composition in the Appendix. Table 4 compares the sample means for small banks, large banks, and the full sample to those of Avery and Berger (1991). Most of the means and standard deviations we report are similar to those in Avery and Berger's work, with a few exceptions. *INCOMESTD* is higher in our sample, which reflects the 2008 bust in the banking sector (see figure A.1). Our subsample of large banks has a mean

[8] For failed banks, Avery and Berger (1991, 855) estimated income in the year of failure as "the negative of existing capital at the end of the previous year minus the FDIC's estimated net outlay for the bank."

CHARGEOFF of 0.58%, which is consistent with Avery and Berger's data (1991). The small banks in our sample, however, appear to have fewer loan charge-offs than in Avery and Berger's sample.[9] Real estate loans averaged only 8.86% of bank assets in Avery and Berger's study but are higher throughout our sample (see figure A.3).[10]

One variable, *MKTRISK*, has mean and maximum values that are orders of magnitude larger in our sample than in Avery and Berger's. However, the primary reason for the increase in *MKTRISK* is that one extreme outlier bank, Goldman Sachs, reported 2008 off-balance-sheet assets of more than 100 times the value of the total assets of the bank itself. (Figure A.4 shows the resulting spike in *MKTRISK* in 2008.) Excluding this outlier, average *MKTRISK* grew from 0.17% to 0.74% over the period, with a mean of 0.37%. This is higher than the mean of 0.17% from Avery and Berger (1991) and illustrates increased use of off-balance-sheet activities over the period.

To summarize, our data set is similar to the sample used by Avery and Berger (1991), and the differences are mostly attributable to unusual conditions during the recession and financial crisis of 2007 to 2009. In addition, banks have increased their holdings of real estate loans and off-balance-sheet activities, partly because of incentives created by the deficiencies in the new RBC standards described by Blaško and Sinkey (2006), Jablecki (2009), and Friedman (2011). These factors appear to account for all notable discrepancies between our data set and that of Avery and Berger (1991).

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[9] One potential explanation for this difference is that small banks tend to have lower loan default rates, but their defaults were unusually high in the 1980s. Indeed, Berger et al. (2005) show that small banks tend to make better use of "soft" information in their lending practices. Cornett and Tehranian (1990) demonstrate that small banks were disproportionately affected by the savings and loan crisis of the 1980s, while Afonso, Kovner, and Schoar (2011) show that large banks were disproportionately affected in the 2008 crisis, due to increased counterparty risk.

[10] This is consistent with the work of Blaško and Sinkey (2006), which describes how regulatory incentives caused US banks to increase their real estate exposure through the 1990s.

III. Risk-Weighted Assets

Avery and Berger (1991) employ two regressions to demonstrate the relationship between RWA and banks' future performance, and they confirmed the efficacy of the RBC standards as indicators of bank performance. Five bank performance measurements (*INCOME*, *INCOMESTD*, *NONPERFORM*, *CHARGEOFF*, and *FAILURE*) are regressed against the risk and failure variables shown in table 2. In the following regression equations, we use Π_{it} to represent performance variable of bank *i* in year *t*. We let Ω_t represent year dummies over the period. Equation 1 shows the regression of performance on the five subcategories of RWA. It also includes the specific asset categories of real estate loans (*REALEST*), consumer loans (*CONSUMER*), commercial and industrial loans (*C&I*), and loan commitments (*COMMIT*) to account for any misweighting of these asset categories:

$$(1) \qquad \Pi_{it} = \beta_0 + \beta_1 RWA20_{it-1} + \beta_2 RWA50_{it-1} + \beta_3 RWA100_{it-1} + \beta_4 COUNTER_{it-1} + \beta_5 MKTRISK_{it-1} + \beta_6 REALEST_{it-1} + \beta_7 C\&I_{it-1} + \beta_8 CONSUMER_{it-1} + \beta_9 COMMIT_{it-1} + \Omega_t + \varepsilon_{it}.$$

To test whether RWA_{it} is an effective overall indicator of bank performance, Avery and Berger (1991) regress each measure of performance against RWA_{it} alone (including time dummies) in equation 2:

$$(2) \qquad \Pi_{it} = \beta_0 + \beta_1 RWA_{it-1} + \Omega_t + \varepsilon_{it}.$$

For all variables except *INCOME*, Avery and Berger (1991) expect the regressions to yield positive coefficients for *RWA20*, *RWA50*, and *RWA100*. Banks that hold higher quantities of risky assets should have lower income but higher standard deviation of income, more nonperforming loans, more loan charge-offs, and a higher likelihood of failure. Moreover, if the risk weights are correct, the coefficients of *RWA20*, *RWA50*, *RWA100*, *COUNTER*, and *MKTRISK* in equation 1 should not differ significantly from the coefficient of *RWA* in equation 2, and the fit of the two regressions should be similar. If the risk weights of the RWA calculations are correct, then the categories *RWA20*, *RWA50*, and *RWA100* will properly account for the riskiness of real estate, consumer, commercial, and industrial loans, and other loan commitments, which means that the coefficient estimates for *REALEST*, *C&I*, *CONSUMER*, and *COMMIT* should not be significant.

Avery and Berger (1991) determine that RWA is a significant inverse predictor of bank performance. They found that coefficient estimates of *RWA20*, *RWA50*, *RWA100*, and total *RWA* were positive statistically significant predictors of *INCOMESTD*, *NONPERFORM*, *CHARGEOFF*, and *FAILURE* and negative statistically significant predictors of *INCOME*. The coefficient estimates for *REALEST*, *C&I*, *CONSUMER*, and *COMMIT* were sometimes statistically significant, which indicates that some assets were assigned improper risk weights.

In addition to testing the significance of *RWA*, Avery and Berger (1991) also test for differences between the new and old capital standards. They regress the variable *NEW*, which represents the failure of the new RBC standards, and the variable *OLD*, which represents a failure of the old standards, against their five measures of bank performance. Their results show that *NEW* is a better inverse predictor of bank performance than *OLD*. The authors conclude that the new RBC standards are better predictors of bank performance than the old standards based on the regular capital ratio. Replicating their study using our more recent data set produces similar results.[11] However, it is not clear that these results are sufficient to support their conclusions. As indicated earlier, the analysis of Avery and Berger (1991) has several potential flaws that might cause their results to be misleading or incorrect.

First, the RWAs calculated by Avery and Berger (1991) do not always reflect the RWAs reported by commercial banks. One possible reason for this is that the asset category definitions may be ambiguous. An asset may fall into more than one category of risk weighting, which leaves its reporting status up to the bank. For example, MBS from government-sponsored enterprises might be classified as either MBS (with a risk weighting of 20.0%) or agency securities (with a risk weighting of 0.0%). In such cases, a bank is likely to use the lower weighting. In fact, banks are instructed that "if a particular asset, derivative contract, or off-balance sheet item has features that could place it in more than one risk category, it is assigned to the category that has the lowest risk weight" (FDIC, 2012, 1).

Another reason that the calculated RWAs may differ from the actual RWAs is that banks are given significant flexibility in the classification of assets. Many banks were allowed to assess their own risk exposure and categorize their asset risk accordingly as long as their risk models were approved by federal regulators. In addition, the official method employed by the FDIC may have changed after the publication of Avery and Berger's work (1991). The regulatory capital schedule in the FDIC Call Reports is significantly more complex than the calculations we use in section 2. To avoid any errors in calculating RWAs, we use the RWAs reported by each bank in their FDIC Call Reports.

[11] These results are available from the authors upon request. As Avery and Berger (1991) do, we find that RWA is a significant inverse predictor of bank performance and that the new RBC standards are better predictors of bank performance than the old capital standards.

Second, RWA is not an ideal measure of bank risk because it ignores the level of capital employed by a bank. The capital ratio of equity to assets has long been used as a measure of bank risk, with higher capital indicating lower risk. As Avery and Berger (1991, 849) write, "a mandatory increase in capital has the direct effect of reducing insolvency risk by creating a 'buffer stock' of reserve funds to absorb losses." The RBC ratio is intended to improve upon the capital ratio by weighting capital and assets according to their relative riskiness. Banks that hold risky assets can offset this risk by maintaining higher levels of capital. RWA alone is an insufficient measure of bank risk because this metric neglects the bank's level of capital. Therefore, rather than using RWA as the predictor of bank performance, we use the RBC ratio, which is total capital divided by RWA.

Third, the method used by Avery and Berger (1991) does not directly compare bank capital ratios to their RBC ratios. Their analysis is separated into multiple sets of regressions. One set regresses bank performance on *RWA* and finds that *RWA* is related to bank performance; the second set regresses bank performance on the percentage of banks that fail the old and new capital standards, finding that failing the new capital standards is a better indicator of poor bank performance. The authors interpret this as evidence that *RWA* (and, by extension, the RBC ratio) is a better indicator of performance than the capital ratio, but their conclusion may not be valid.

The old capital standards and the new ones developed by the Basel Accords and implemented specifically by the Federal Reserve are each composed of multiple policies. One difference between the old and the new standards is that the rules of the old standards are based on the capital ratio, whereas the rules of the new standards are based on the RBC ratio. Another difference is the number of rules. The old standard has only two conditions—one for primary capital, and one for total capital. By contrast, the new standard has three conditions—tier 1 capital, total capital, and leverage. In addition, the rates required by the new standard are higher than those of the old. The old standard requires that equity be a minimum of 6% of a bank's assets, while the new standard requires that equity be 8% of RWA. Thus, Avery and Berger's (1991) finding (i.e., that the new standard is a better predictor of performance than the old standard) may simply reflect the fact that the new standard is higher than the old standard. Their analysis compares the collective policies of the new and old capital standards rather than directly comparing the RBC and capital ratios. Therefore, a better method of analysis is necessary to properly evaluate the capital and RBC ratios as indicators of bank performance.

IV. Comparing Capital Ratios

To evaluate the effectiveness of the RBC ratio relative to the standard capital ratio, we compare coefficients for these two variables directly in our estimating equations. The first step in this procedure is similar to the analysis from section 3, but we replace RWA with the RBC and capital ratios as indicated by the following four regressions. As before, Π_{it} represents the performance variable of bank *i* in year *t*, and Ω_t represents time dummies for all years. Equations 3 and 4 incorporate the banks' reported RBC ratio as an independent variable:

(3)
$$\Pi_{it} = \beta_0 + \beta_1 RBC_{it-1} + \beta_2 COUNTER_{it-1} + \beta_3 MKTRISK_{it-1} + \beta_4 REALEST_{it-1} + \beta_5 C\&I_{it-1} + \beta_6 CONSUMER_{it-1} + \beta_7 COMMIT_{it-1} + \Omega_t + \varepsilon_{it}.$$

(4)
$$\Pi_{it} = \beta_0 + \beta_1 RBC_{it-1} + \Omega_t + \varepsilon_{it}.$$

Equations 5 and 6 replace RBC_{it} with the banks' capital ratios (CAP_{it}) as an independent variable:

$$(5) \qquad \Pi_{it} = \beta_0 + \beta_1 CAP_{it-1} + \beta_2 COUNTER_{it-1} + \beta_3 MKTRISK_{it-1} + \beta_4 REALEST_{it-1} + \beta_5 C\&I_{it-1} + \beta_6 CONSUMER_{it-1} + \beta_7 COMMIT_{it-1} + \Omega_t + \varepsilon_{it}.$$

$$(6) \qquad \Pi_{it} = \beta_0 + \beta_1 CAP_{it-1} + \Omega_t + \varepsilon_{it}.$$

The results of this analysis tell us whether CAP_{it} and RBC_{it} are individually related to our measures of bank performance. Each of these ratios had assets in the denominator, so we expect coefficients to be the opposite sign of those found using RWA_{it}. Higher levels of capital and RBC should lead to better bank performance, demonstrated by higher income and lower standard deviation of income, fewer nonperforming loans, fewer charge-offs, and fewer bank failures.

The second step of the analysis is to directly compare capital and RBC ratios as indicators of bank performance. Assuming that both variables are individually significant indicators of performance, we want to know which of the two is the better indicator. We begin by estimating equations 7 and 8, which include both CAP_{it} and RBC_{it}:

$$(7) \qquad \Pi_{it} = \beta_0 + \beta_1 RBC_{it-1} + \beta_2 CAP_{it-1} + \beta_3 COUNTER_{it-1} + \beta_4 MKTRISK_{it-1} + \beta_5 REALEST_{it-1} + \beta_6 C\&I_{it-1} + \beta_7 CONSUMER_{it-1} + \beta_8 COMMIT_{it-1} + \Omega_t + \varepsilon_{it}.$$

$$(8) \qquad \Pi_{it} = \beta_0 + \beta_1 RBC_{it-1} + \beta_2 CAP_{it-1} + \Omega_t + \varepsilon_{it}.$$

Regression equations 7 and 8 revealed the effects of CAP_{it} and RBC_{it} on bank performance when included in the same regression. Testing the difference in the coefficient estimates for CAP_{it} and RBC_{it} produced by these equations requires accounting for the covariation between CAP_{it} and RBC_{it} (as in Wooldridge 2003, 141). Because equations 7 and 8 do not account for covariance between CAP_{it} and RBC_{it}, they do not statistically measure the difference between these variables. This problem can be corrected in one of two ways. One option is to measure the covariance between variables and include it in the analysis. However, a simpler way is to follow Wooldridge's (2003, 141–42) method. We began by defining a new coefficient, $\theta_1 = \beta_1 - \beta_2$, where β_1 and β_2 were from equations 7 and 8, and we created a new variable, $TOTCAP_{it}$, that was the sum of CAP_{it} and RBC_{it} (see equation 9):

$$(9) \qquad TOTCAP_{it} = CAP_{it} + RBC_{it}.$$

Because our purpose here is to establish whether or not the RBC ratio provides new and useful information, we will include $TOTCAP_{it}$ and θ_1 in the regressions with RBC_{it}:[12]

$$(10) \qquad \Pi_{it} = \beta_0 + \theta_1 RBC_{it-1} + \beta_2 TOTCAP_{it-1} + \beta_3 COUNTER_{it-1} + \beta_4 MKTRISK_{it-1} + \beta_5 REALEST_{it-1} + \beta_6 C\&I_{it-1} + \beta_7 CONSUMER_{it-1} + \beta_8 COMMIT_{it-1} + \Omega_t + \varepsilon_{it}.$$

$$(11) \qquad \Pi_{it} = \beta_0 + \theta_1 RBC_{it-1} + \beta_2 TOTCAP_{it-1} + \Omega_t + \varepsilon_{it}.$$

[12] We could, alternatively, include $TOTCAP_{it}$ and CAP_{it} (but not RBC_{it}) in equations 10 and 11. The regression coefficients θ_1 would be the same but with the opposite sign.

As previously described, this method is more effective than including both CAP_{it} and RBC_{it}, because it accounts for the covariance between variables when statistically assessing whether there is a difference between β_1 and β_2 in equations 7 and 8.[13]

If the estimated coefficient θ_1 of RBC_{it} in regressions 10 and 11 is significant, this indicates that CAP_{it} and RBC_{it} are significantly different from each other. In this case, the sign of the RBC_{it} coefficient indicates whether RBC_{it} is significantly better or significantly worse than CAP_{it} as a predictor of performance. As previously discussed, higher levels of capital and RBC should lead to better bank performance. Thus, if the coefficient of RBC_{it} is significant in predicting better performance (positive for income and negative for the other dependent variables), then the RBC ratio is a significantly better predictor of bank performance than the capital ratio. If the coefficient of RBC_{it} is significant in indicating worse performance (negative for income and positive for the other dependent variables), then the capital ratio is a better indicator of bank performance than the RBC ratio.

V. Results

This section presents the results of our regressions comparing the actual capital and RBC ratios of commercial banks as predictors of bank performance. Tables 5 through 8 give the coefficients estimated in equations 4, 6, 8, and 11, respectively. We do not present results for equations 3, 5, 7, and 10 because they are consistent with results for equations 4, 6, 8, and 11. The magnitudes of the coefficients for *CAP* and *RBC* fluctuated marginally, but their signs and statistical significance remained the same regardless of whether extra controls for *COUNTER*, *MKTRISK*, *REALEST*, *C&I*, *CONSUMER*, and *COMMIT* are included or not.

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[13] For a more detailed explanation of the method we employ here, please see Wooldridge (2003, 141).

Tables 5 and 6 display results for *RBC* and *CAP* separately. Both tables show positive coefficients of *CAP* and *RBC* for dependent variables *INCOME* and *INCOMESTD*. The positive coefficients for *CAP* are statistically significant at the 5% threshold and below. However, the positive coefficients for *RBC* are statistically insignificant. The findings suggest that banks that hold more capital tend to have more income and that the income level varies considerably. Looking at the dependent variables *CHARGEOFF*, *NONPERFORM*, and *FAILURE*, coefficients of *CAP* and *RBC* are negative in tables 5 and 6. The *CAP* coefficients are statistically significant at the 1% level, while the *RBC* coefficients are statistically insignificant. The evidence suggests that banks that hold more capital tend to have fewer charge-offs, fewer nonperforming loans, and a lower likelihood of failure. Since none of the coefficient estimates for *RBC* are significant, we cannot reject the null hypothesis that the RBC ratio is not a significant predictor of bank performance.

The results show that for almost every variable of bank performance, *CAP* is statistically significant with the expected sign. The one exception is *INCOMESTD*, which is significant but has a different sign than that predicted by Avery and Berger (1991).[14] By contrast, the coefficient estimate of *RBC* is not significant in any case. From this evidence alone, we can conclude that the capital ratio is a better predictor of bank performance than the RBC ratio. However, we would like to know if *CAP* is a significantly better predictor or if the difference is only marginal. We would also like to test whether a combination of *CAP* and *RBC* in our regression analysis

[14] Avery and Berger (1991) predicted that *INCOMESTD* would be negatively related to RWA because riskier assets are likely to increase income volatility. As discussed previously, however, the incorrect weighting of some assets, such as MBSs, enabled banks to simultaneously increase both their capital and their holdings of risky assets. This explanation is consistent with table 3, which compares our data set to the data set of Avery and Berger (1991). Relative to their sample, large banks in our sample have lower *RWA100* and less capital (higher *OLD* and *FAILLEV*), while small banks in our sample have higher *RWA100* and more capital (lower *OLD* and *FAILLEV*). Thus, our positive coefficient estimate of *INCOMESTD* is consistent with the evidence of banks' purchases of risky assets in pursuit of capital relief.

improves the accuracy of our estimation process. To test these hypotheses, we compare *CAP* and *RBC* directly in equations 8 and 11.

Table 7 provides results of equation 8 with *RBC* and *CAP* estimated jointly. The results are noticeably similar to those of tables 5 and 6, where *RBC* and *CAP* are estimated separately: Coefficients for *CAP* maintain similar statistical significance levels and the same signs as in table 6, with positive coefficients for *INCOME* and *INCOMESTD* and negative coefficients for *CHARGEOFF*, *NONPERFORM*, and *FAILURE*. As in table 5, coefficients for *RBC* are statistically insignificant for *INCOME*, *INCOMESTD*, *NONPERFORM*, and *CHARGEOFF*. The *RBC* coefficient for *FAILURE* is positive and statistically significant at 5%. However, the size of the coefficient is only 0.0003, which is two orders of magnitude lower than the coefficient for *CAP.* This suggests that *RBC* is not an important or economically significant predictor for bank failure.

Comparing tables 5, 6, and 7, we see that *CAP* is always statistically significant, usually at the 1% level, while *RBC* is almost never statistically significant. This holds true even when both *CAP* and *RBC* are included in the same regression. Furthermore, *RBC* is more statistically significant when *CAP* is included as a regressor. Contrary to the hypothesis that optimal capital regulation will be some combination of the capital and RBC ratios, our data indicates that use of the RBC ratio will not improve the effectiveness of bank capital regulation. In addition, the R-Squared statistics in table 7 are exactly the same as those in table 6, again indicating that inclusion of the RBC ratio does not improve the accuracy of the estimation process. Thus, the combination of capital and RBC ratios is no better than the use of the capital ratio alone in predicting bank performance.

Table 8 shows the results of equation 11 comparing *RBC* with *TOTCAP* as indicators of bank performance. The coefficients for *RBC* have a statistically significant negative correlation at the 1% level with *INCOME* and *INCOMESTD*, after controlling for *TOTCAP*. For the other dependent variables—*NONPERFORM*, *CHARGEOFF*, and *FAILURE*—*RBC* has positive coefficients with statistical significance at the 1% threshold for *NONPERFORM* and *FAILURE* and no statistical significance for *CHARGEOFF*, after controlling for *TOTCAP*. The results suggest that the standard capital ratio is more reliable than the RBC ratio as an indicator of bank performance because of the statistically significant negative coefficient on *INCOME* and the statistically significant positive coefficients on *NONPERFORM* and *FAILURE*. Our results are consistent with those of Estrella et al. (2000), who found that RBC ratios do not consistently outperform simple standard capital ratios as measures of bank performance.

Equations 8 and 11 each include multiple variables that are based on measures of bank capital. They are, therefore, likely to be highly correlated—and even at risk of multicollinearity, in which case estimates of the coefficients would be less precise. Excluding the *RBC* coefficient for *FAILURE*, standard errors in table 7 for coefficients of *RBC* and *CAP* do not appear significantly different from standard errors in tables 5 and 6 for coefficients of *RBC* and *CAP*, indicating that multicollinearity is unlikely. To test more formally, we conducted a variance inflation factor (VIF) analysis based on equation 8 to test for multicollinearity between *RBC* and the other variables, including *CAP*. The VIF statistic is estimated at 1.28, indicating that *RBC* is over 94% independent of the other variables. Multicollinearity is not considered significant until VIF statistics approach the range of 5 to 10, so we concluded that multicollinearity is not a significant issue.

To check the robustness of our results, we inverted the capital and RBC ratios in the expectation that this would result in coefficient signs (and significance) similar to the RWA tests in Avery and Berger's equations 1 and 2 (1991). The resulting coefficients were found to be similar to those in tables 5 through 8, but with opposite signs. This confirms that the differences between the capital and RBC ratios found in this section result from the use of the actual RBC ratios reported in the banks' Call Reports and are not due to the structures of the RBC or RWA formulas.

VI. Conclusion

The RBC ratio has become a fundamental component of US commercial bank regulation. However, recent evidence suggests that this new metric may cause more harm than good. As discussed earlier, several studies show that banks are able to circumvent the RBC risk-weighting system and that RBC standards encourage banks to buy risky assets, such as MBS. Not only do RBC standards increase the individual bank's level of risk, but they also increase systemic risk in the banking system by reducing diversification and increasing fragility. No individual or group can expect to know, much less quantify, the complete set of factors affecting risk in the banking system. The RBC system has the general defect of presupposing that a centralized group of regulators is able to predict ex ante risk when, in fact, many risks can only be identified ex post.

Despite the dangers endemic to RBC regulation, some economists argue that the RBC ratio is a superior metric for predicting bank performance and should, therefore, continue to be used in banking regulation. Avery and Berger's (1991) work is among the first studies to empirically test the effectiveness of RBC regulation. Although their study does expose some potential shortcomings of the new methodology, the authors conclude that the new RBC standards "constitute an improvement over the current flat-rate deposit insurance scheme" (1991, 872). Their work is widely cited as proof of the effectiveness of RBC standards.

This study reevaluates the hypothesis of Avery and Berger (1991) that the RBC ratio is a better predictor of bank performance than the capital ratio of equity over assets. We attempt to improve on their analysis by using the actual RBC ratios reported by commercial banks in their FDIC Call Reports and by comparing the capital and RBC ratios directly in the same regression. In contrast with Avery and Berger (1991), we find that the RBC ratio is significantly less accurate than the capital ratio as a predictor of bank performance. Regressing bank performance on the capital and RBC ratios together, we find that capital is a statistically significant indicator of performance even after accounting for RBC. The RBC ratio, on the other hand, is almost never statistically significant regardless of whether capital is included in the regression. When we regressed bank performance on the RBC ratio and the sum of capital and RBC ratios, we find the RBC ratio to have statistically significant negative coefficients for income and for the standard deviation of income, and statistically significant positive coefficients for nonperforming loans and bank failures. This indicates that the capital ratio is a significantly better indicator of bank performance than the RBC ratio.

Our results have important implications for US banking regulation. The Federal Reserve has adopted the RBC ratio as its primary indicator of bank risk and intends to increase its reliance on the RBC system through further implementation of the Basel Accords. However, the evidence from this study suggests that the Fed should move in exactly the opposite direction. The risk-based weighting system is inherently flawed and easily exploitable. Other studies have shown that the capital ratio is less subject than the RBC ratio to the danger of regulatory arbitrage, which creates harm to individual banks and the entire banking system. This paper shows that the standard capital ratio is a superior metric for evaluating bank risk.

Although some economists recommend that regulators employ a combination of RBC and capital ratios, as the Fed does, we find that using capital and RBC ratios together does not improve the accuracy of our estimations of bank performance. Whether used alone or in conjunction with the capital ratio, the RBC ratio is almost never a significant predictor of performance. We therefore conclude that RBC regulation has the potential to create significant harm with little or no added benefit. The Fed should abandon its use of the RBC ratio and return to the simple and effective capital ratio as a measure of bank risk.

Table 1. Summary of the Risk-Based Capital Standards

Risk categories

- Category A1 (0% weight)
  Cash, Federal Reserve Bank balance
  Securities of the US Treasury, OECD governments, and some US agencies
- Category A2 (20% weight)
  Cash items in the process of collection
  US and OECD interbank deposits and guaranteed claims
  Some non-OECD bank and government deposits and securities
  General obligation municipal bonds
  Some mortgage-backed securities
  Claims collateralized by the US Treasury and some other government securities
- Category A3 (50% weight)
  Loans fully secured by first liens on one to four family residential properties
  Other municipal bonds
- Category A4 (100% weight)
  All other on-balance sheet assets not listed above, including
  loans to private entities and individuals, some claims on non-OECD governments and banks, real assets and investment in subsidiaries
- Category B1 (off-balance sheet counterparty guarantees; weights in parentheses)
  Direct-credit-substitute standby letters of credit (mainly 100%)
  Performance-related standby letters of credit (mainly 50%)
  Unused portion of loan commitments with original maturity of more than 1 year (mainly 50%); other loan commitments (0%)
  Commercial letters of credit (20%)
  Bankers' acceptances conveyed (20%)
- Category B2 (off-balance sheet market risk contracts; weights in parentheses)
  Interest rate swaps, forward commitments to purchase foreign exchange and other items (between 0 and 5% of the notional value, plus the market-to-market value of the contract, capped at 50%)

Capital requirements

- Tier 1
  Common equity, some preferred stock, minority interest in consolidated subsidiaries less goodwill
  Tier 1 capital must be at least 4% of risk-weighted asset
- Tier 2
  Loan loss reserve (limited to 1.25% of risk-weighted asset), subordinated debt (limited to 50% of Tier 1), and other preferred and convertible stock
  Tier 2 capital cannot be larger than Tier 1 capital
  Tier 1 plus Tier 2 capital must be at least 8% of risk-weighted assets
- Leverage requirement
  Tier 1 capital must be at least 3% of total on-balance sheet assets

Source: Avery and Berger (1991, 853).

Table 2. Variable Definitions

Risk-weighted assets[a]	
RWA 20	0.2 times ratio of 20% weight on-balance sheet assets to adjusted assets[b] (includes cash, deposits, municipal bonds, mortgage securities)
RWA 50	0.5 times ratio of 20% weight on-balance sheet assets to adjusted assets (includes loans and other municipal bonds)
RWA 100	1.0 times ratio of 20% weight on-balance sheet assets to adjusted assets (includes loans to private entities and individual, claims on non-OECD governments and banks, real assets and investments in subsidiaries)
COUNTER	Ratio of counterparty off-balance sheet assets to adjusted assets
MKTRISK	Ratio of market risk off-balance sheet assets to adjusted assets
RWA	Ratio of total risk-weighted assets to adjusted assets
Risk-weighted asset subcategories	
REALEST	0.5 times ratio of 1–4 family real estate loans to adjusted assets
C&I	1.0 times ratio of commercial and industrial loans to adjusted assets
CONSUMER	1.0 times ratio of consumer loans to adjusted assets
COMMIT	Ratio of loan commitments (adjusted by their risk-weighted asset weights) to adjusted assets
New and old capital standard failure dummies	
NEW	Dummy; equals one for failing any portion of the new capital standard (the minimum capital does not meet either the Tier 1 capital requirement, Tier 2 capital requirement, or leverage capital requirement)
OLD	Dummy; equals one for failing either the primary or the total capital portion of the old standard
NEWONLY	Dummy; equals one for failing any portion of the new standard and passing the old standard (the minimum capital satisfies the old capital requirements but fails the new capital requirements)
New capital standard failure components	
FAILT1	Dummy; equals one for failing Tier 1 standard (Tier 1 capital less than 4% of RWA)
FAILTOT	Dummy; equals one for failing total standard (Tier 1 plus Tier 2 capital less than 8% of RWA)
FAILLEV	Dummy; equals one for failing leverage standard (Tier 1 capital less than 3% of on-balance sheet assets)
SHORTFALL	Ratio of capital shortfall (maximum of capital deficiency in meeting leverage or total standards) to adjusted assets. Zero if the bank does not fail either part of the standards
EXCESS	Ratio of excess capital (the minimum overage of the leverage and total standard) to adjusted assets
Performance measure	
INCOME	Ratio of net income to total adjusted assets.
INCOMESTD	Sample standard deviation of *INCOME* for each bank
NONPERFORM	Ratio of nonperforming loans (past due and nonaccruing) to adjusted assets
CHARGEOFF	Ratio of loan charge-off to adjusted assets
FAILURE	Dummy; equals one if the bank fails within 2 years

[a] Following Avery and Berger (1991), assumptions were made to construct historically consistent series for these variables, which do not correspond exactly to Call Report categories.

[b] Total adjusted assets are total assets plus loan loss reserves.

Source: Avery and Berger (1991, 856).

Table 3. Descriptive Statistics of Small and Large Banks

	Large Banks				Small Banks			
	Mean	*SD*	Min	Max	Mean	*SD*	Min	Max
INCOME	0.0081	0.0202	-0.3637	0.5504	0.0079	0.0266	-1.3561	3.6171
INCOMESTD	0.0097	0.0852	0.0000	7.2689	0.0086	0.0150	0.0000	0.1739
NONPERFORM	0.0192	0.0248	0.0000	0.3319	0.0191	0.0228	0.0000	0.4143
CHARGEOFF	0.0058	0.0134	0.0000	0.4081	0.0034	0.0078	0.0000	0.6541
FAILURE	0.0092	0.0956	0.0000	1.0000	0.0047	0.0686	0.0000	1.0000
RWA20	0.0268	0.0229	0.0000	0.1998	0.0221	0.0223	0.0000	0.1972
RWA50	0.0828	0.0644	0.0000	0.4775	0.0832	0.0603	0.0000	0.4259
RWA100	0.5151	0.2160	0.0000	1.0000	0.5110	0.2145	0.0000	1.0000
COUNTER	0.0196	0.0208	0.0000	0.4536	0.0091	0.0121	0.0000	0.2201
MKTRISK	0.0262	1.1873	0.0000	121.7247	0.0014	0.0284	0.0000	5.1764
RWA	0.6562	0.2148	0.0007	12.8077	0.6289	0.1910	0.0000	6.7483
REALEST	0.0898	0.0669	0.0000	0.4810	0.0886	0.0627	0.0000	0.4570
C&I	0.1008	0.0856	0.0000	0.9555	0.0075	0.0314	0.0000	0.7344
CONSUMER	0.0533	0.1102	0.0000	1.0097	0.0526	0.0593	0.0000	0.9707
COMMIT	0.0129	0.0167	0.0000	0.4536	0.0063	0.0104	0.0000	0.2067
NEW	0.1187	0.3234	0.0000	1.0000	0.0148	0.1206	0.0000	1.0000
OLD	0.0990	0.2987	0.0000	1.0000	0.0088	0.0933	0.0000	1.0000
NEWONLY	0.0217	0.1458	0.0000	1.0000	0.0078	0.0878	0.0000	1.0000
FAILT1	0.0942	0.2921	0.0000	1.0000	0.0036	0.0601	0.0000	1.0000
FAILTOT	0.0990	0.2987	0.0000	1.0000	0.0088	0.0933	0.0000	1.0000
FAILLEV	0.0937	0.2915	0.0000	1.0000	0.0036	0.0602	0.0000	1.0000
SHORTFALL	0.0076	0.0233	0.0000	0.0800	0.0003	0.0046	0.0000	0.0972
EXCESS	0.0516	0.0497	0.0000	0.9144	0.0711	0.0621	0.0000	0.9699

Source: Federal Reserve Reports of Condition and Income.

Table 4. Descriptive Statistics Comparison

	Our sample			Avery and Berger		
	Large	Small	Full	Large	Small	Full
INCOME	0.0081	0.0079	0.0080	0.0069	0.0043	0.0046
INCOMESTD	0.0097	0.0086	0.0096	0.0011	0.1350	0.1211
NONPERFORM	0.0192	0.0191	0.0191	0.0313	0.0290	0.0292
CHARGEOFF	0.0058	0.0034	0.0038	0.0058	0.0059	0.0059
FAILURE	0.0092	0.0047	0.0054	0.0171	0.0192	0.0190
RWA20	0.0268	0.0221	0.0228	0.0361	0.0352	0.0353
RWA50	0.0828	0.0832	0.0832	0.0762	0.0801	0.0797
RWA100	0.5151	0.5110	0.5116	0.5323	0.4734	0.4796
COUNTER	0.0196	0.0091	0.0107	0.0342	0.0086	0.0113
MKTRISK	0.0262	0.0014	0.0051	0.0001	0.0000	0.0000
RWA	0.6562	0.6289	0.6329	0.6788	0.5972	0.6058
REALEST	0.0898	0.0886	0.0888	0.0513	0.0556	0.0551
C&I	0.1008	0.0075	0.0212	0.1682	0.0453	0.0582
CONSUMER	0.0533	0.0526	0.0527	0.1392	0.1167	0.1191
COMMIT	0.0129	0.0063	0.0072	0.0237	0.0054	0.0073
NEW	0.1187	0.0148	0.0301	0.1021	0.0343	0.0414
OLD	0.0990	0.0088	0.0221	0.0815	0.0329	0.0380
NEWONLY	0.0217	0.0078	0.0098	0.0589	0.0129	0.0177
FAILT1	0.0942	0.0036	0.0170	0.0179	0.0138	0.0142
FAILTOT	0.0990	0.0088	0.0221	0.1016	0.0338	0.0409
FAILLEV	0.0937	0.0036	0.0169	0.0160	0.0154	0.0155
SHORTFALL	0.0076	0.0003	0.0014	0.0014	0.0008	0.0009
EXCESS	0.0516	0.0711	0.0682	0.0251	0.0379	0.0366

Source: Federal Reserve Reports of Condition and Income, Avery and Berger (1991, 856).

Table 5. Regressions Testing Risk-Based Capital Ratios

	INCOME	*INCOMESTD*	*NONPERFORM*	*CHARGEOFF*	*FAILURE*
RBC	0.0029	0.0126	−0.0011	−0.0003	−0.0009
	(0.0024)	(0.0118)	(0.0007)	(0.0002)	(0.0007)
2003	−0.0000		−0.0015***	−0.0001	0.0001
	(0.0003)		(0.0002)	(0.0001)	(0.0003)
2004	0.0004		−0.0032***	−0.0007***	−0.0003
	(0.0003)		(0.0002)	(0.0001)	(0.0002)
2005	0.0007**		−0.0034***	−0.0011***	−0.0003
	(0.0003)		(0.0002)	(0.0001)	(0.0002)
2006	0.0006		−0.0022***	−0.0012***	−0.0001
	(0.0004)		(0.0002)	(0.0001)	(0.0002)
2007	−0.0009		0.0022***	−0.0007***	0.0024***
	(0.0006)		(0.0003)	(0.0001)	(0.0006)
2008	−0.0074***		0.0093***	0.0012***	0.0164***
	(0.0003)		(0.0003)	(0.0001)	(0.0015)
2009	−0.0106***		0.0132***	0.0042***	0.0193***
	(0.0003)		(0.0004)	(0.0002)	(0.0017)
2010	−0.0078***		0.0119***	0.0038***	0.0126***
	(0.0003)		(0.0004)	(0.0002)	(0.0014)
2011	−0.0048***		0.0078***	0.0026***	0.0035***
	(0.0003)		(0.0004)	(0.0002)	(0.0008)
Constant	0.0102***	0.0071***	0.0156***	0.0030***	0.0004*
	(0.0004)	(0.0019)	(0.0002)	(0.0001)	(0.0002)
R-Squared	0.03	0.01	0.08	0.05	0.01
Observations	72,226	9,085	71,837	71,837	72,226

Note: Robust standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6. Regressions Testing Capital Ratios

	INCOME	*INCOMESTD*	*NONPERFORM*	*CHARGEOFF*	*FAILURE*
CAP	0.0598***	0.1825**	−0.0220***	−0.0028***	−0.0375***
	(0.0111)	(0.0778)	(0.0011)	(0.0010)	(0.0030)
2003	−0.0002		−0.0014***	−0.0001	0.0002
	(0.0003)		(0.0002)	(0.0001)	(0.0003)
2004	0.0002		−0.0032***	−0.0007***	−0.0001
	(0.0003)		(0.0002)	(0.0001)	(0.0002)
2005	0.0005		−0.0033***	−0.0011***	−0.0001
	(0.0003)		(0.0002)	(0.0001)	(0.0002)
2006	0.0002		−0.0021***	−0.0012***	0.0001
	(0.0004)		(0.0002)	(0.0001)	(0.0002)
2007	−0.0015***		0.0025***	−0.0007***	0.0028***
	(0.0005)		(0.0003)	(0.0001)	(0.0006)
2008	−0.0082***		0.0096***	0.0013***	0.0170***
	(0.0003)		(0.0003)	(0.0001)	(0.0015)
2009	−0.0110***		0.0134***	0.0043***	0.0196***
	(0.0003)		(0.0004)	(0.0002)	(0.0017)
2010	−0.0080***		0.0120***	0.0038***	0.0128***
	(0.0003)		(0.0004)	(0.0002)	(0.0014)
2011	−0.0049***		0.0078***	0.0026***	0.0036***
	(0.0003)		(0.0004)	(0.0002)	(0.0008)
Constant	0.0045***	−0.0113	0.0177***	0.0032***	0.0041***
	(0.0011)	(0.0081)	(0.0002)	(0.0001)	(0.0004)
R-Squared	0.05	0.03	0.09	0.05	0.01
Observations	72,226	9,085	71,837	71,837	72,226

Note: Robust standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7. Regressions Testing Risk-Based Capital and Capital Ratios

	INCOME	*INCOMESTD*	*NONPERFORM*	*CHARGEOFF*	*FAILURE*
RBC	0.0011	0.0034	−0.0004	−0.0002	0.0003**
	(0.0013)	(0.0060)	(0.0003)	(0.0002)	(0.0001)
CAP	0.0561***	0.1703***	−0.0207***	−0.0022*	−0.0385***
	(0.0109)	(0.0659)	(0.0014)	(0.0011)	(0.0032)
2003	−0.0002		−0.0014***	−0.0001	0.0002
	(0.0003)		(0.0002)	(0.0001)	(0.0003)
2004	0.0002		−0.0032***	−0.0007***	−0.0001
	(0.0003)		(0.0002)	(0.0001)	(0.0002)
2005	0.0005		−0.0033***	−0.0011***	−0.0001
	(0.0003)		(0.0002)	(0.0001)	(0.0002)
2006	0.0002		−0.0021***	−0.0012***	0.0001
	(0.0004)		(0.0002)	(0.0001)	(0.0002)
2007	−0.0015***		0.0025***	−0.0007***	0.0028***
	(0.0005)		(0.0003)	(0.0001)	(0.0006)
2008	−0.0082***		0.0096***	0.0013***	0.0170***
	(0.0003)		(0.0003)	(0.0001)	(0.0015)
2009	−0.0110***		0.0134***	0.0043***	0.0196***
	(0.0003)		(0.0004)	(0.0002)	(0.0017)
2010	−0.0080***		0.0119***	0.0038***	0.0128***
	(0.0003)		(0.0004)	(0.0002)	(0.0014)
2011	−0.0049***		0.0078***	0.0026***	0.0036***
	(0.0003)		(0.0004)	(0.0002)	(0.0008)
Constant	0.0047***	−0.0105	0.0176***	0.0032***	0.0042***
	(0.0011)	(0.0073)	(0.0002)	(0.0001)	(0.0004)
R-Squared	0.05	0.03	0.09	0.05	0.01
Observations	72,226	9,085	71,837	71,837	72,226

Note: Robust standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8. Regressions Evaluating Risk-Based Capital Ratios

	INCOME	*INCOMESTD*	*NONPERFORM*	*CHARGEOFF*	*FAILURE*
RBC	−0.0550***	−0.1669***	0.0203***	0.0020	0.0388***
	(0.0112)	(0.0635)	(0.0016)	(0.0012)	(0.0033)
TOTCAP	0.0561***	0.1703***	−0.0207***	−0.0022*	−0.0385***
	(0.0109)	(0.0659)	(0.0014)	(0.0011)	(0.0032)
2003	−0.0002		−0.0014***	−0.0001	0.0002
	(0.0003)		(0.0002)	(0.0001)	(0.0003)
2004	0.0002		−0.0032***	−0.0007***	−0.0001
	(0.0003)		(0.0002)	(0.0001)	(0.0002)
2005	0.0005		−0.0033***	−0.0011***	−0.0001
	(0.0003)		(0.0002)	(0.0001)	(0.0002)
2006	0.0002		−0.0021***	−0.0012***	0.0001
	(0.0004)		(0.0002)	(0.0001)	(0.0002)
2007	−0.0015***		0.0025***	−0.0007***	0.0028***
	(0.0005)		(0.0003)	(0.0001)	(0.0006)
2008	−0.0082***		0.0096***	0.0013***	0.0170***
	(0.0003)		(0.0003)	(0.0001)	(0.0015)
2009	−0.0110***		0.0134***	0.0043***	0.0196***
	(0.0003)		(0.0004)	(0.0002)	(0.0017)
2010	−0.0080***		0.0119***	0.0038***	0.0128***
	(0.0003)		(0.0004)	(0.0002)	(0.0014)
2011	−0.0049***		0.0078***	0.0026***	0.0036***
	(0.0003)		(0.0004)	(0.0002)	(0.0008)
Constant	0.0047***	−0.0105	0.0176***	0.0032***	0.0042***
	(0.0011)	(0.0073)	(0.0002)	(0.0001)	(0.0004)
R-Squared	0.05	0.03	0.09	0.05	0.01
Observations	72,226	9,085	71,837	71,837	72,226

Note: Robust standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix: Summary Statistics

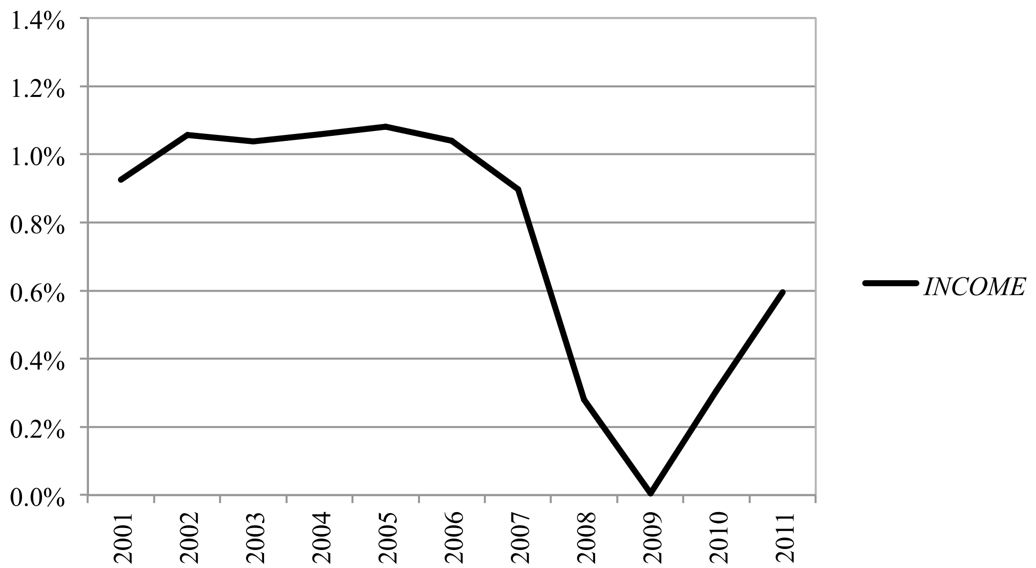

Figure A.1. Income as a percentage of adjusted assets.

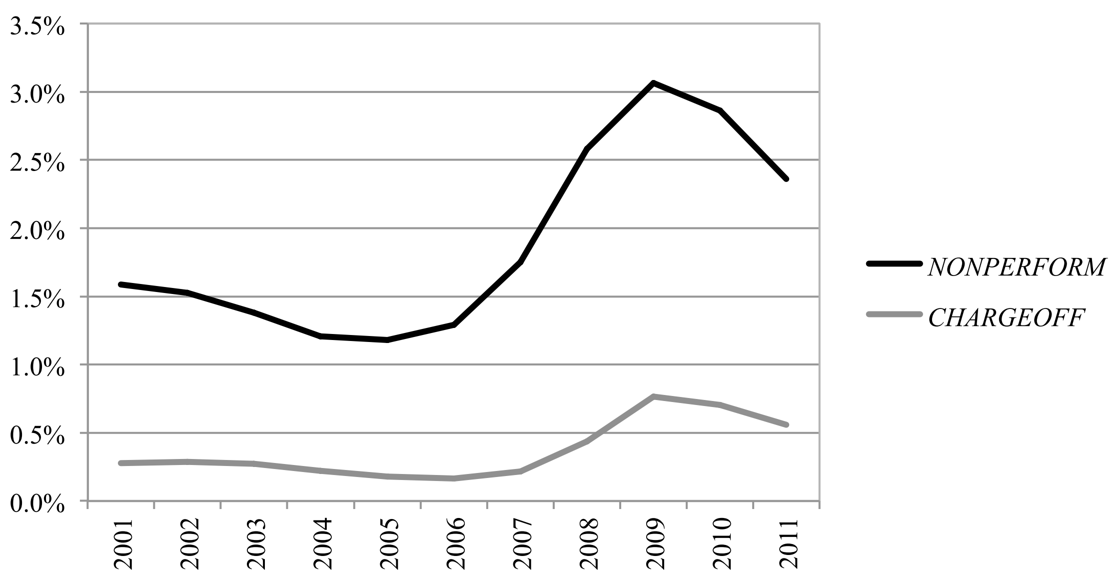

Figure A.2. Nonperforming loans and loan charge-offs as percentages of adjusted assets.

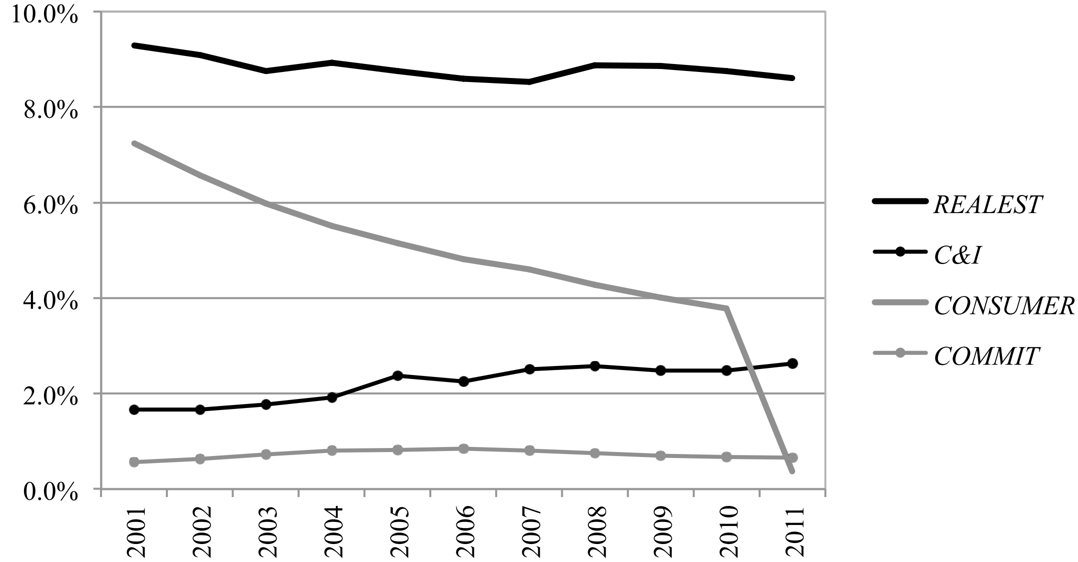

Figure A.3. Real estate loans, commercial and industrial loans, consumer loans, and loan commitments as percentages of adjusted assets.

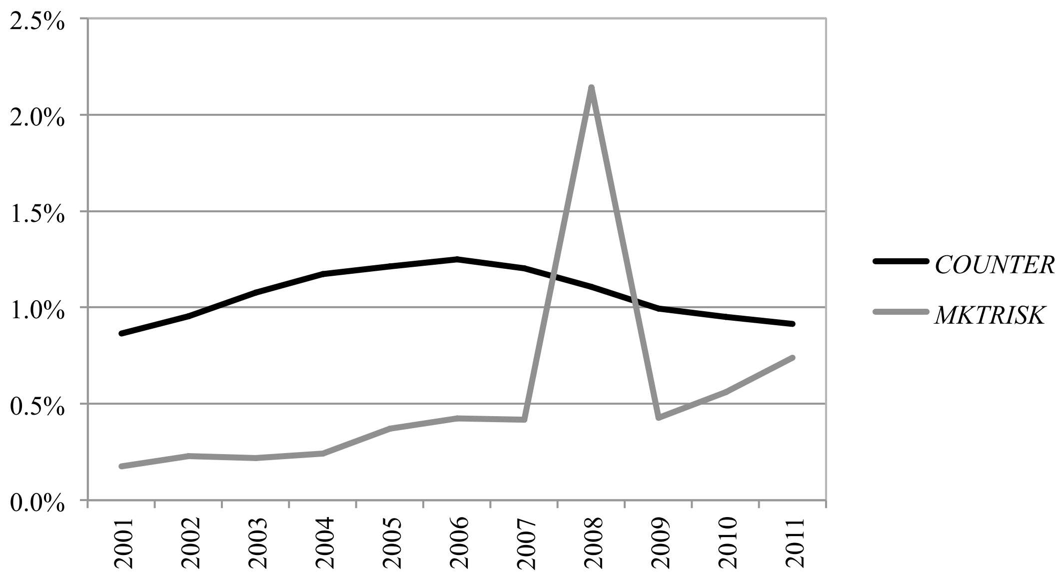

Figure A.4. Assets representing counterparty risk and market risk as percentages of adjusted assets.

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