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Market Forces at Work in the Banking Industry: Evidence from the Capital Buildup of the 1990s

Mark J. Flannery
Department of Finance, Insurance and Real Estate
Graduate School of Business
University of Florida
Gainesville, FL 32611-7168
flannery@ufl.edu

Kasturi P. Rangan
Department of Banking and Finance
Weatherhead School of Management
Case Western Reserve University
Cleveland, OH 44106
kpr2@po.cwru.edu

ABSTRACT

We document the build-up of regulatory and market equity capital in large U.S. bank holding companies between 1986 and 2000. During this time, large banking firms raised their capital ratios to the highest levels in more than 50 years. Since 1995, essentially none of the 100 largest U.S. banking firms have been constrained by *de jure* regulatory capital standards. Nor do these firms appear to be protecting themselves explicitly against falling below supervisory minimum capital standards. Variation in bank equity ratios reliably reflects portfolio risk, and we attribute the capital increase to enhanced market incentives to monitor and price large banks' default risks.

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The U.S. banking industry has long enjoyed access to a federal safety net composed of deposit insurance, a lender of last resort, and payment system finality. If this safety net insulates counterparties from the full effects of a bank's default, the usual market incentives to maintain adequate capital would be blunted. Indeed, U.S. bank capital ratios exhibited a steady decline for thirty-five years following the Second World War. Regulators imposed formal restrictions on bank leverage in 1981, which stopped the decline. As capital ratios remained near the regulatory minimum through the early 1980s, many industry analysts inferred that competition inevitably drives profit-seeking banks to hold the minimum *permissible* capital level in the presence of a federal safety net. This corner solution has become a standard feature of many academic banking models. Although a bank's desire to hold minimal equity may have reasonably characterized the 1980s (particularly after Continental Illinois was officially labeled "too big to fail"), we find that this view became less appropriate during the 1990s.

Figure 1 extends Saunders and Wilson's [1999, page 553] data from 1893-1992 through the end of 2000, showing the ratio of large U.S. banks' common equity to total assets, using both the book and market values of equity. The 1990s data exhibit a particularly sharp increase in bank equity ratios. During the past century, only the trends in the 1920s resemble this recent rise in market-valued capitalization. Figure 2 presents similar data for the 100 largest U.S. bank holding companies (BHC) over a shorter time period (note the left-hand scale). In 1986, these firms had book equity equal to 6% of their total assets, which increased to 7.97% by the end of 2000. The market value of BHC common equity rose even more sharply, from 7.7% of the banks' asset market values to 17.1% over the 1986-2000 period, after peaking at 20.6% in 1998.

A number of factors could have caused this decade-long accumulation of bank capital. First, external effects on passive bank managers might spuriously have raised BHC capital. Bank earnings attained record levels after about 1993, which may have raised equity ratios unless the banks explicitly acted to increase dividend payments or share repurchases. Our regression estimates indicate that this factor accounts for less than 8% of the observed increase in market capital. The sharp increase in equity's market value ratio following 1991 naturally suggests that the decade's broad stock market boom might have generated much of the banks' increased market capitalization. We estimate that across-the-board share price increases account for 25 to 38% of the capital growth at the largest 100 BHC. In short, passive factors can account for less than half of the observed increase in bank capital over our 1986-2000 sample period.

Second, supervisors may have raised the *de facto* or *de jure* amount of required capital. This would explain the observed increases in book capital ratios, which are the objects of regulatory concern. The timing of this explanation fits the data well. U.S. regulators implemented the 1988 Basle Accord between yearend 1990 and yearend 1992, and Figure 2 indicates that book equity ratios rose most abruptly during the first half of the 1990s. Our examination of the data indicates that supervisory tightening probably played a role in the early 1990s (when book capital ratios were rising), but it had no effect in the latter half of the decade (when market equity ratios really took off).

We find the most support for a third hypothesis about large banks' capital growth: that it has been a deliberate response to market changes. Large banking firms' conjectured government guarantees weakened during the 1990s as the Federal Deposit Insurance Corporation Improvement Act (FDICIA) changed failed-bank resolution methods and curtailed supervisors' ability to ignore banks operating with low capital ratios. Counterparties have thus become more exposed to a bank's true risk of default. Our analysis indicates that banks are holding more equity per unit risk in the 1990s when compared with 1980s, thus directly linking the reduction in conjectural guarantees to the observed increase in equity capitalization.

Over the sample period, BHC portfolio risks were also increasing. The right-hand scale in Figure 2 shows that portfolio risks measured as the annualized, implied standard deviation of asset returns rose from a mean of 1.85% in 1986 to 7.36% in 2000. We calculate that the combination of the market's greater aversion to bank risk and an increase in banks' portfolio risks explains more than 60% of our sample BHCs' increase in equity capitalization over the 1986-2000 period.

The conclusion that market forces now exert a prominent influence on bank leverage decisions directly challenges an important theoretical assumption in the academic banking literature, that banks hold as little capital as supervisors will permit. Perhaps more importantly, it puts a new face on financial sector supervision: market forces have replaced (or, at least, substantially augmented) regulatory effects on bank leverage. The on-going revisions to Basle capital standards must recognize that the First Pillar of Basle's supervisory approach (Capital Supervision) may be less relevant to bank operations than is commonly thought, while the Third Pillar (Market Discipline) may be much more important.

The remainder of this paper is organized as follows. Section I discusses the determinants of bank leverage and the relationship between a banking firm's book value of equity (the object of supervisory concern) and its market value of equity (the presumed object of market concern). Section II documents that bank capital ratios and portfolio risks both increased *and* became more dispersed during the 1986-2000 sample period, and the following section suggests several hypotheses to explain these developments. Section IV describes our empirical model, which estimates a 2sls, pooled regression to explain market-value equity ratios. Section V reports the main results. We find that the relationship between capitalization and a bank's asset portfolio risk has become stronger during the 1990s, and we attribute this change to a weakening of large bank counterparties' perceived conjectural guarantees. Section VI tests the hypothesis that higher bank capital ratios reflect an increased supervisory cost of falling below required minimum book ratios. We find no support for this hypothesis after 1994. Section VII provides robustness results, and the final section discusses implications for banking theory and regulation.

I. *Determining a Bank's Optimal Leverage*

In an unregulated market, a firm's fixed claimants ("bondholders") are repaid only if the firm's asset market value exceeds the present value of promised payments (Merton [1973]). The interest rate demanded by bondholders therefore reflects the amount by which a firm's assets exceed its liabilities – that is, the firm's equity capital ratio. Although capital structure is irrelevant under extreme financial market conditions (Modigliani and Miller [1958]), theory implies an optimal leverage due to corporate taxation, bankruptcy costs, and various agency problems. Firms seek to maximize their market value by jointly selecting operating (portfolio) risk and financial (leverage) risk. If conditions change (e.g., through a change in perceived asset risk), firms should change their preferred level of equity capital.

Banking firms have unique access to a (formal and informal) federal safety net, which may require less compensation for risk exposure than market investors do (Billett, Garfinkel, and O'Neal [1998]). When all bank liabilities are guaranteed by federal insurance at a fixed premium, Merton [1977] shows that bank shareholders wish to maximize both their leverage and portfolio risk. However, this single-period result does not generalize to multi-period models when the bank expects to earn economic quasi-rents (Marcus [1984]). In a multi-period model with valuable banking charters, Merton [1978] shows that the value-maximizing choice for equity holders balances two effects: maximizing risk to take advantage of the immediate deposit-insurance subsidy vs. constraining risk to increase the expected duration of the anticipated quasi-rents.[1] Keeley [1990], Berger [1995], and Demsetz, Saidenberg, and Strahan [1996] demonstrate that these rents do affect capital decisions.

Investors have sometimes viewed U.S. regulators as *de facto* insuring all liabilities, especially at the largest banks (O'Hara and Shaw [1990]). However, supervisory and political reactions to the 1980s' thrift debacle almost surely weakened bank creditors' *de facto* protection during the 1990s.[2] In 1991, FDICIA limited the insurer's ability to engineer "purchase and assumption" transactions that protected uninsured bank claimants from default losses. Furthermore, the Omnibus Budget Reconciliation Act of 1993 subordinated all non-deposit financial claims to a failed bank's deposits. In states without prior depositor preference laws, unsecured non-deposit investors thereby became much more exposed to default losses. In reaction to these increased risks, large liability-holders would demand higher returns on their claims, reducing bank equity values. In an effort to mitigate this increase in funding costs, bank owners would likely raise their equity and/or lower asset risk. Such a response might be particularly important for the largest banks, whose

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[1] These rents or quasi-rents could derive from several sources. First, banks may have monopoly protection as analyzed by Keeley [1990]. Second, durable bank-borrower relationships may reduce the cost of loan origination and hence make lending more profitable (Berger and Udell [1995], Petersen and Rajan [1995]). Third, productive efficiency tends to bestow rents in a competitive market. Stiroh [1999] provides evidence that bank holding companies in the 1990's have had higher productivity and better scale economies, which has translated into improved performance.

[2] Evidence of this change in perceived policy can be seen in banks' subordinated debenture spreads. Avery *et al*. [1988] and Gorton and Santomero [1990] find no evidence that subordinated debenture rates reflect bank risks in 1983-4. Flannery and Sorescu [1996] show that this situation had changed by about 1989, after a regulatory transition toward letting market participants share the losses when a banking firm fails. See also Jagtiani *et al*. [1999] or Morgan and Stiroh [1999].

creditworthiness affects their ability to trade in OTC derivatives markets and to provide credit enhancements for commercial paper issuers.[3]

While most nonfinancial firms choose their optimal capital ratios primarily in response to market constraints, regulated financial institutions must also heed their supervisors' capital adequacy requirements. Banking firms must therefore satisfy two types of equity constraint: uninsured market counterparties price their claims on the basis of equity's *market* value, while supervisors impose *book* value restrictions.[4] Although these two capital ratios reflect similar features of the firm, they are not perfectly correlated. For our sample BHCs, the simple correlation between book and market capital ratios is 0.68 across the full time period. Cross-sectional correlations within a year range from 0.49 to 0.71, with a mean of 0.59. Figure 3 graphs the yearly Pearson and rank correlations between market and book capital ratios for the banks in our sample.[5] GAAP accounting conventions provide managerial options to raise book capital ratios independent of the market's valuation. For example, many BHCs sold their headquarters building in the late 1980s, booked a capital gain, and then leased it back from the purchaser. A bank can also "cherry-pick" its securities portfolio, realizing the gains on appreciated securities while postponing the sale of assets with unrealized losses. Loan provisioning provides another (notorious) avenue for troubled banking firms to boost their book capital. This reserving system is designed to effectively mark the loan book to market (Flannery [1989]), but managers have substantial latitude about how much inside information to reflect in their reported loan loss allowance.[6]

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[3] Many "market discipline" discussions focus on the cost of uninsured debt as an indicator of bank condition. A bank's decision to reduce its leverage in order to reduce funding costs and to maintain a high credit rating also constitutes "market discipline," although this perspective is less prominent in the published literature.

[4] Despite the known faults with book value measures of bank equity, supervisors have chosen to use book values for two main reasons. First, many U.S. banks have no publicly traded equity. An initial effort to treat all regulated banks similarly therefore mandated use of book values. Second, supervisors in the U.S. and (especially) abroad suspect that market values are excessively volatile and potentially inaccurate. Kane and Ünal [1990] model the deviations of market from book values, and show that these differences vary systematically with market conditions.

[5] This positive correlation complicates the process of identifying whether managers seek to control their market or their book equity ratios.

[6] Note that each of these three strategies for raising book capital simultaneously increases the present value of the firm's tax obligations.

Finance theory indicates that the creditors of any large corporation should assess their default risk exposure on the basis of equity market valuations instead of book valuations.[7] We can see no good reason to deviate from this judgment for banking firms and hence use market equity ratios as our primary variable of analysis. Book values are inherently backward looking, while default probabilities depend on future developments, which investors strive to impound into the firm's stock prices.[8] For example, Saunders [2000] comments that:

> The concept of [a financial institution's] economic net worth is really a *market value accounting* concept. … Because it can actually distort the true solvency position of an FI, the book value of capital concept can be misleading to managers, owners, liability holders, and regulators alike. (pp. 444-445)

Marcus [1983] and Keeley [1990] have previously used market values in their studies of bank leverage decisions. Many other studies rely on book values (e.g., Berger [1995], Osterberg and Thomson [1996]), probably because book value data are readily available for many firms on bank Call Reports and bank holding company Y-9C reports.

Despite our theoretical and empirical preference for market equity values as the relevant determinant of BHC default risk, we cannot ignore book capital regulations, which may limit a bank's ability to return unwanted capital to shareholders. For example, dividends and share repurchases reduce book and market capital by (roughly) the same dollar amount. Unless a bank can freely exercise GAAP options to increase stated book equity, its ability to reduce market capital ratios may be limited by supervisory constraints on book capital. Since we are interested in the impact of supervisors and market forces on bank equity ratios, our empirical specification must control for possible book equity constraints on market value equity ratios.

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[7] The value of market-driven default measures is further validated by the fact that KMV, LLC successfully markets its "EDF™ Credit Measure," which estimates a firm's credit quality from its market value and equity return volatility.

[8] Suppose a bank's equity market value exceeds its book market value. Further assume that the bank suffers losses that more than exhaust its book capital. Will uninsured creditors necessarily suffer default losses? Not if some investor can benefit by adding new equity (up to the amount by which asset market values exceed liability market values) to prevent the firm's demise. Hence equity's *market* value determines the probability of credit loss.

II. *Rising U.S. Bank Capitalization, 1986-2000*

We begin by establishing that BHC equity ratios rose during our sample period for the 100 largest BHC, in terms of both book and market values.[9] Section III then discusses the possible causes for this capital increase.

A. The Supervisors' Focus: Book Capital Ratios

Supervisors' minimum capital requirements are multi-facetted. Before the Basle Accord came into effect at the end of 1990, U.S. regulators employed a simple leverage ratio to assess capital adequacy: "primary" capital (the sum of equity plus loan loss reserves) had to exceed 5.5% of assets, while the total amount of primary plus "secondary" (primarily qualifying subordinated debentures) capital had to exceed 6% of assets. The Basle Accord sought to relate equity capital more closely to portfolio credit risks by introducing the concept of risk-weighted assets (RWA), which weights on-book assets and off-balance sheet commitments in proportion to their presumed credit risks.[10] The Basle Accord also established two components of regulatory "capital" (Saunders [2000], page 457):

> ***Tier 1*** includes common equity, noncumulative preferred stock, and minority interests in consolidated subsidiaries.
>
> ***Tier 2*** includes the loan loss allowance (up to a maximum of 1.25% of RWA), cumulative and limited-life preferred stock, subordinated debentures and certain hybrid securities (such as mandatory convertible debt).

Under the Basle Accord, U.S. regulators set the minimum acceptable level of Tier 1 capital at 4% of RWA, while the sum of Tier 1 plus Tier 2 capital must exceed 8% of RWA.[11] Well-managed banks' capital levels were intended to exceed these minima, and in 1991 FDICIA specified that an institution with at least 5% Tier

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[9] We find very similar patterns in the equity ratios of smaller BHC (asset ranks 101-1000), but we focus our attention on the largest 100 BHC, which hold more than 71% of all (FDIC insured) banking assets.

[10] The original Accord did not deal with interest rate risk exposures.

[11] U.S. supervisors implemented the Basle capital standards in two steps. At yearend 1990, banks and BHCs were required to hold Tier 1 capital of at least 3.625 percent of (RWA) and total capital (Tier 1 plus Tier 2) of at least 7.25 percent. At yearend 1992, the minimum acceptable ratios were raised to 4 and 8 percent of RWA. BHCs were also subject to a "leverage" requirement: Tier 1 capital had to exceed 3 percent of total (unweighted) assets. This constraint has not been a major factor for our sample banks, so we neglect it in our analysis.

1 and 10% Tier 2 ratios would be considered "well-capitalized" and therefore freed from a few regulatory constraints.

The solid line in Figure 2 illustrates that the mean ratio of book equity to total assets rose from an average of 6.0% in 1986 to 7.97% in 2000.[12] Figure 4 plots the 100 largest banks' mean Tier 1 and (Tier 1 plus Tier 2) capital ratios relative to their required minimum values of 4% and 8% respectively.[13] The average bank has always exceeded the minimum required capital ratio by a comfortable margin, and this margin expanded considerably during the sample period. We estimate that Tier 1 (total) capital stood at 7.26% (9.44%) of RWA in 1986. These ratios rose quite sharply during the early 1990s, to 11.1% (13.8%), and changed little thereafter. As average capital ratios have risen, the number of individual banks constrained by capital adequacy regulations has fallen sharply. Figure 5 plots the proportion of BHC constrained by *de jure* capital standards. The Figure uses two alternative definitions of "constrained": relative to the pre-Basle simple capital ratio and relative to the final Basle ratios. To recognize the difference between "adequate" and "well-capitalized" institutions, constrained firms have a cushion of "excess" book capital less than 1.5% of the corresponding asset measure. We conjecture that banks this close to the minimum are not free to adjust their capital ratios downward. (Replacing the 1.5% cushion with 1% or 2% makes relatively little difference to the number of banks constrained, or to their pattern over time.) Figure 5 demonstrates that the percentage of constrained BHC trended down from the start of the sample period, and it dropped sharply after the Basel standards were implemented at year-end 1990. Indeed, supervisory capital restrictions became effectively irrelevant to the 100 largest U.S. BHC after about 1992, when mean book and market equity ratios began their upward moves. (See Figures 2 and 4.)

To summarize, the evidence indicates that book capital ratios at the largest U.S. BHC have risen to the point that the banks may be effectively unconstrained by supervisory minima.

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[12] Although an increase of only 2 percentage points might seem small, U.S. book capital ratios are currently higher than they have been in more than half a century.

[13] The Y-9 forms have included explicit computations of RWA, Tier 1 and Tier 2 capital only since 1996. Between 1992 and 1996, the two capital amounts were explicitly reported in Y-9C and the data to compute RWA were readily available. For dates preceding 1992, we estimated Basle capital ratios with a methodology explained in the Appendix.

B. Investors' Focus: Market Capital Ratios

The dotted line in Figure 2 plots the mean ratio of common equity's market value to the market value of total assets (defined as the sum of equity's market value plus liabilities' book value).[14] This equity ratio stood at 7.7% in 1986, declined until about 1990, and then began a rapid increase. The mean market capital ratio peaked in 1998 at 20.6%, before ending the decade at 17.1%. At the end of our sample period, bank equity ratios were almost three times their 1990 value (5.8%) and more than double their 1986 value. Figure 6 plots histograms showing the distribution of capital ratios during 1986-88 and 1998-2000. The sample's central tendency clearly shifts rightward. Equally striking is the near doubling of the capital ratios' cross-sectional standard deviation, from 3.53% to 6.71%.[15]

In addition to BHC capital ratios, we also constructed a quarterly estimate of each BHC's asset return volatility. In most of our analysis, we use a simple volatility measure, constructed by de-levering the bank's equity risk in three steps.

1) Compute the standard deviation of the BHC's daily equity returns over a calendar quarter.

2) Multiply that equity return volatility by the end-of-period ratio of market equity to the market value of assets, to yield an estimated volatility for daily asset returns.

3) Annualize this volatility by multiplying the daily standard deviation by the square root of 250 (the approximate number of trading days in a year).

We call the resulting volatility "asset risk" for convenience, although it incorporates *all sources* of uncertainty about the firm's share value: asset returns, liability returns, changes in the off-balance-sheet book, operating efficiencies, and so forth.

Figure 7 indicates that the sample BHCs' mean asset return volatility rose from 1.77% during 1986-88 to 6.40% in 1998-2000. At the same time, the cross-sectional standard deviation of asset volatilities more than tripled, from 0.98% to 3.54%. This concurrent increase in mean capitalization and mean asset risk

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[14] For each calendar year, we plot the mean quarter-end value.

[15] A similar, although less dramatic, pattern occurred for book equity ratios, which rose from a mean 6.12% in 1986-88 to 8.19% in 1998-2000, while the cross-sectional standard deviation of this ratio rose from 1.32% to 1.81%.

suggests that the changes may be related to one another. The fact that both capital ratios and asset volatilities became more dispersed over the period should permit strong statistical tests of the hypothesis that riskier banks have added more to their capital ratios, presumably in response to external pressures.

III. *Possible Causes of the Increased Capitalization*

Why have large BHC increased their capital ratios, and what is responsible for the greater cross-sectional variation in capital? One clear possibility is that the observed increases were not a result of deliberate actions on the part of banks, but were an artifact of the sample period under study. The 1990s were exceptionally profitable for the banking industry, and Berger (1995) reports that commercial bank "dividends do not fully respond to changes in earnings, so part of earnings changes accumulate into future changes in the level of capital." (page 454)[16] Our BHCs clearly exhibit this type of behavior: their mean earnings rose from 5.24% of book equity during 1986-91 to 9.11% during 1992-2000, while dividends rose from 2.9% of book equity to only 3.3%. Hence part of the observed increase in capital could be attributed to the 'passive' retaining of earnings due to the stickiness of dividend payouts.

Share prices also rose very sharply during the 1990s. Perhaps banks simply rode this boom, accepting whatever level of market capitalization was associated with its share prices. Indeed, if banks felt that the market overvalued their shares, they may have *issued* new shares to take advantage of investors' optimism. Either the stock price effect alone or endogenous share issues would tend to raise bank capital ratios even if bankers were not trying to provide capital protection consistent with their asset risk exposures.

While the above two 'passive' factors are worth investigating (and we do so), the banks' new security issuances during the 1990s suggest that they were actively trying to manage their market capital positions. The bar-graph in Figure 8A, shows the twenty largest BHCs' annual change in the outstanding values of common stock, preferred stock, and subordinated notes and debentures (SND) over the sample period. The issue

[16] Hovakimian, Opler and Titman [2001] reach a similar conclusion for nonfinancial firms: "although past profits are an important predictor of observed debt ratios, firms often make financing and repurchase decisions that offset these earnings-driven changes in their capital structures. " (page 22)

amounts are scaled by the end-of-prior-year sum of common plus preferred book equity. The line graph in Figure 8A plots the market equity ratio of the top 20 BHC. These "Mega" banks issued substantial amounts of equity in 1991 and 1992, presumably to replace lost capital from the previous recession and to comply with the new Basel standards. After 1992, SND become the dominant security issued, as net new equity issues fell to approximately zero in 1994-5 and become negative thereafter.[17] These transactions increased book leverage (*ceteris paribus*) while share price increases were reducing market leverage. After 1992, securities issued by the Mega banks suggest that managers were trying to "undo" some of the impact of the stock boom on the market value of their leverage.[18] (Obviously, their efforts did not completely offset the impact of rising share prices.) The trend in "Large" BHCs (size ranks 21-100) book equity ratios is not as clear in Figure 8B.[19] (Note that Figures 8A and 8B have slightly different scales on their left-hand axes.). Like the Mega banks, Large banks reduced their book leverage (*ceteris paribus*) between 1987 and 1992. Then as market capitalization rose over the next few years, they curtailed equity issues relative to new debt, with the effect of partially un-doing the capital accretions associated with share prices.

Why did large banks choose to raise their equity ratios? We offer the hypothesis that higher capitalization was a rational response to changes in market conditions. FIRREA and FDICIA legislated less generous government "bailouts" and nationwide depositor preference made non-deposit claims more junior. Evidence from the bank debenture market shows that conjectural government guarantees weakened around 1990 (Flannery and Sorescu [1996], Morgan and Stiroh [1999]). As a result, bank counterparties should have become more sensitive to the default risk of banks. While uninsured counterparties should have been feeling more exposed to bank default risks, BHCs' asset volatilities were also rising. (See Figure 7 and the right-hand

[17] Hirtle [1998] also finds that large banks' share repurchases increased during the decade.

[18] Unfortunately, an important regulatory change may be responsible for at least part of this increase in book leverage. On October 21, 1996, the Federal Reserve Board decided that deeply subordinated debentures issued to a trust financed by preferred stock ("trust preferred shares") would count as Tier I regulatory capital. BHC thereby acquired an incentive to replace some of their Tier I capital (e.g. common and preferred shares) with the new debentures. Even with this caveat, the evidence in Table 8 suggests active capital management in 1994-5 and perhaps 1996. And the question remains why counterparties tolerated the resulting increase in BHCs' book leverage. One plausible explanation is that counterparties were focusing primarily on the *market* value of banks' capital.

[19] This is consistent with our finding in Table 3 below that the Large banks' market capitalization was more heavily influenced by passive factors than the Mega banks were.

scale in Figure 2.)[20] In response to both of these developments, banks would rationally increase capital ratios to reduce their default risk and hence their funding costs.

We next estimate a model of bank capital decisions that focuses on the determinants of equity's market value while recognizing that supervisory restrictions on book capital may prevent a bank's complete adjustment to its desired market ratio. Our results indicate that passive factors – retained earnings and stock prices – account only for a minority of the observed change in BHC capitalization. Section VI then compares the impact of market vs. supervisory forces on the observed increase in BHC equity capitalization.

IV. *Regression Model*

A bank's supervisors and counterparties care primarily about its risk of default, which is determined jointly by leverage and portfolio risk decisions. We are therefore interested in estimating regressions of the general form:

$$MKTRAT_{it} = \alpha + \beta \sigma_{A_{it}} + \gamma Z + \tilde{\varepsilon}_{it} \qquad \text{(1A)}$$

$$\sigma_{A_{it}} = \eta + \kappa\, MKTRAT_{it} + \lambda X + \nu_{it} \qquad \text{(1B)}$$

where $MKTRAT_{it}$ is the market value of the i[th] bank's common equity at time t, divided by the market value of its total assets.

$\sigma_{A_{it}}$ is the bank's asset risk.

X, Z are sets of predetermined variables (specified below).

α, β, and the vectors γ and λ are coefficients to be estimated.

(1A) and (1B) represent a simultaneous equation system for the equity ratio and risk, but identifying the system completely is difficult. As we are primarily interested in the determinants of *MKTRAT*, we use a 2sls

[20] Identifying the source of increased asset risks lies beyond the scope of this paper. However, asset risk could have increased because deregulation permitted banks to enter new product and geographic markets. The continuing economic boom may have lead some bankers to increase their default risk exposures. Finally, capital markets became more competitive providers of traditional banking services.

procedure to estimate (1A) alone.[21] To construct the instrument for $\sigma_{A_{it}}$, we regressed the observed $\sigma_{A_{it}}$ on the predetermined variables in (1A), the BHC's asset portfolio shares, year dummies, and firm dummies.[22] That is,

$$\sigma_{A_{it}} = \delta_0 + \delta_1 Z + \sum_{k=2}^{13} \delta_k S_{ikt} + \delta_{14} H_{it} + \text{year dummies} + \text{time dummies} + \xi_{it}$$

where S_{ikt} are the asset portfolio shares reported on the Y-9C form: securities, federal funds and repos, trading assets, commercial loans, real estate loans, agricultural loans, other loans, intangible assets, other real estate owned, past due loans, all other assets and the notional value of off-balance sheet assets, all expressed as a ratio of total assets on the balance sheet.

H_{it} = a Herfindahl Index of the loan portfolio shares.

The estimated β in (1A) measures the response of the typical bank's capital ratio to a unit increase in portfolio volatility. Theory predicts β > 0 for a firm subject to normal market forces: counterparties (e.g. uninsured liability holders) demand more stringent terms from firms with high default probabilities and BHCs therefore control their perceived riskiness by offering large capital cushions.

Researchers frequently observe that high asset risk could enhance a bank's equity value simply because the value of the safety-net subsidy increases with asset risk. Because equity and asset market values enter the computation for σ_A, our asset risk measures may also be biased in unknown ways. It seems unlikely that our sample BHC will be substantially affected by this factor. Mispriced government insurance is most valuable for banking firms with low market capitalization, and our sample firms were not generally in this situation. Nevertheless, failure to recognize the potential subsidy value in *MKTRAT* would make the meaning of a positive β coefficient ambiguous. It could either reflect market discipline – uninsured counterparties demand more capital from firms with higher asset risks – or government subsidies. We therefore applied the method of Ronn and Verma [1986] to estimate the value of each BHC's deposit insurance subsidy at each

[21] Even though we are less confident about the results, estimating the system (1A) and (1B) via 3SLS yields comparable results to the ones reported here.

[22] Estimation results using an alternative instrumental variable are described in Section VII.

point in time. We show in Section VII that re-estimating our basic regression model using these adjusted market values and asset risks has no effect on our statistical inferences.

Our main interest lies in determining whether supervisory changes in the early 1990s induced banks to hold more equity per unit of portfolio risk. If we knew exactly when market assessments changed, we could add a single "shift" variable to the specification (1A) and estimate:

$$MKTRAT_{it} = \alpha + (\beta_0 + \beta_1 D\} \sigma_{A_{it}} + \gamma Z + \tilde{\varepsilon}_{it}$$

where D equals zero early in the 1986-2000 time period and unity later in the period. If the banks increased their capital per unit of risk, β_1 in equation (1A) would be positive. Because it is unclear when the risk parameter actually shifted – or, how many shifts there may have been -- we divided the sample period into five 3-year segments and let the data indicate when the sensitivity of ***MKTRAT*** to asset risk changed.[23] We also added control variables and fixed effects to get the final regression specification:

$$\begin{aligned} MKTRAT_{it} = {} & \alpha_0 + (\beta_0 + \sum_{k=1}^{4} \beta_k D_k)\hat{\sigma}_{A_{it}} + \alpha_1 HMB_{it} + \alpha_2 REGP_{it} + \alpha_3 LNTA_{it-1} + \\ & \alpha_4 ROA_{it-1} + \alpha_5 Fitted\_MKTRAT_{it} + Year\ and\ Firm\ Fixed\ Effects + \tilde{\varepsilon}_{it} \end{aligned} \tag{2}$$

where D_1 = 1 during 1989-91 and zero otherwise,

D_2 = 1 during 1992-94 and zero otherwise,

D_3 = 1 during 1995-97 and zero otherwise, and

D_4 = 1 during 1998-2000 and zero otherwise.

The omitted time period is 1986-88, for which the risk-sensitivity of ***MKTRAT*** is captured by β_0. If BHC provided greater equity protection to their counterparties after 1988, (2) should include one or more significantly positive β_k coefficients.

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[23]The three-year sub-periods correspond to several logical "break points" in the institutional conditions. Flannery and Sorescu [1996] detect increased risk-sensitivity in subordinated debt pricing by year-end 1989. Morgan and Stiroh [1999] contend that FDICIA (passed in late 1991) substantially removed *de facto* insurance on large liabilities. Hovakimian and Kane [2000, p. 462] also examine whether FDICIA had significant effects on bank leverage decisions, concluding that the "regulatory changes improved capital discipline, but not enough to eliminate risk-shifting incentives."

The next three structural determinants of ***MKTRAT*** are the BHC's charter value (***HMB***), the extent to which it is constrained by book capital requirements (***REGP***), and asset size (***LNTA***).

HMB. Banks will protect a valuable charter by lowering their asset risk and/or leverage (Marcus [1984], Keeley [1990], Demsetz, Saidenberg, and Strahan [1996]). Researchers frequently proxy for a bank's charter value with Tobin's q, but the dependent variable in (2) (***MKTRAT***) is likely to be correlated with q by construction because both variables include the market value of equity in their numerator. We mitigate this induced correlation by constructing a dummy variable ***HMB***, which takes the value of 1 if a BHC's market-to-book ratio is in the top 25 percent of sample BHCs in that year. Theory indicates that the coefficient on ***HMB*** (as a proxy for charter value) should be positive in (2).

REGP. Banks with relatively low book equity ratios may be subject to ***REG***ulatory ***P***ressure, which constrains their choice of leverage. The dummy variable REGP identifies constrained banks: ***REGP*** = 1 if a bank's capital ratio does *not* exceed the regulatory capital minimum by at least 1.5%. Otherwise ***REGP*** = 0. The sign of ***REGP***'s coefficient is theoretically ambiguous: regulatory pressure might raise ***MKTRAT*** by forcing a BHC to hold more capital than is justified by its asset risk, or it might lower ***MKTRAT*** if the constraint depresses the bank's equity value.

LNTA. Larger banks may be more widely followed by market investors, and may therefore have better access to wholesale liabilities, loan sale markets, and so forth. With better access to these liquidity sources, larger banks may therefore require less capital. Alternatively, larger banks have more complex balance sheets, which are optimally financed with a larger proportion of equity capital. We include the natural logarithm of total assets (***LNTA***) in the ***MKTRAT*** equation to control for size-related effects.

The next two independent variables in (2) measure the tendency for market capital ratios to increase *passively*, through sticky dividends or market-wide increases in equity values. First, we include lagged ***ROA*** (the BHC's net current operating earnings per dollar of assets) in (2) because a BHC with higher earnings could retain more equity.[24] Second, we constructed the variable ***Fitted_MKTRAT**$_{it}$* to imitate a "do nothing" strategy in the face of stock value changes. We assume that a BHC's liabilities were determined by contemporaneous factors, while its equity value changed only with market-wide stock prices, so that: [25]

$$Fitted\_MKTRAT_{i,t} = \left(\frac{MVEQ_{i,t-1}(1+R_{t-1,t})}{TL_{i,t} + MVEQ_{i,t-1}(1+R_{t-1,t})} \right) \tag{3}$$

where $MVEQ_{i,t-1}$ is the market value of the i^{th} BHC's common stock at the end of the prior period.

$R_{t-1,t}$ is the return on the S&P 500 index in the period ending at time t, and

$TL_{i,t}$ is the i^{th} BHC's actual liabilities at time t.

We chose the S&P 500 index return for (3) because a bank stock index reflects active efforts to change bank capital ratios. We therefore felt that computing $R_{t-1,\,t}$ from bank stock returns would mis-state the impact of the stock market runup on BHC capital ratios. If large banks' capital ratios were primarily driven by stock market price movements, the coefficient on *Fitted_MKTRAT* should be close to unity.

Finally, we include year dummies and firm fixed effects to control for omitted factors unique to individual years or institutions in the sample.

V. *Estimation Results*

We collected balance sheet and income statement data from the quarterly Consolidated Financial Statements for Bank Holding Companies (FR Y-9C). The sample period begins on June 30, 1986, when the Y-9C reports were substantially revised. The sample firms comprise the 100 largest U.S. bank holding companies, as measured by book value of total assets. We re-select the 100 largest BHC at the end of each

[24] Banks with high earnings may also hold equity to protect their charter value. However, if ***HMB*** adequately controls for this effect, we are left with Berger's [1995] hypothesis about the effect of earnings on capitalization. Section VII demonstrates that our results are not affected by excluding HMB from the specification.

[25] The construction of (3) describes each year's change in ***MKTRAT***, but does not carry tracking errors forward from period to period. ***Fitted_MKTRAT*** resembles the inert debt ratio variable constructed by Welch [2002, equation (2)] in his study of capital structure determinants across many industries. Another way to proxy for a "do nothing" capital sequence would be to take each BHC's initial (t = 1986) equity market value and cumulate changes equal to each period's S&P500 return. This proxy ignores (endogenous) additions to capital and hence results in an unrealistically high leverage by the end of the sample period. Even so, substituting that definition of ***Fitted_MKTRAT*** for (3) did not change the estimated relationship between ***MKTRAT*** and σ_A.

year's third quarter. We estimate our regression model for the subset of these 100 BHC with end-of-quarter stock prices available on CRSP and at least thirty days of reported stock returns within the quarter. The final data set included 1,185 BHC-year observations with which to estimate an annual version of the pooled regression (2). The total number of banks represented in the sample was 151, and the mean (median) number of banks in each cross-section was 79 (80). Sample BHC held between 61% and 88% of all U.S. banking assets during the sample period. Table 1 presents summary statistics for the variables used in estimating regression (2).

We initially estimated (2) for all BHCs with complete data. However, the largest 20 "Mega" banks undertake qualitatively different activities from the merely "Large" banks (asset size ranks 21 – 100). The hypothesis that the estimated regression coefficients were equal across these two groups is rejected ($F_{38,968} = 1.84$, $p < 0.01$). Therefore, we estimate (2) separately for "Mega" and "Large" BHC subsamples.

A. Large BHC

The left half of Table 2 presents the results of estimating (2) for the sample's "Large" BHCs (asset ranks 21 – 100). For our primary variables of interest -- the effect of asset risk on ***MKTRAT*** in different time periods – Table 2 reports both the estimated coefficients and the "implied absolute" slope for each 3-year time period. The estimated β_0 coefficient (-0.166) indicates that Large banks' ***MKTRAT*** was (insignificantly) negatively related to portfolio risk during 1986-88. The impact of asset risk on ***MKTRAT*** is insignificantly negative through the 1989-91 period, but subsequently rises sharply, consistent with the hypothesis that regulatory changes affected banks' desired capitalization. The response of ***MKTRAT*** to asset risk is also economically significant: for the 1998-2000 time period, a one standard deviation change in the Large banks' σ_A (3.8%) causes a 3.45% change in the dependent variable, which is 0.56 standard deviations of the Large BHCs' ***MKTRAT*** during this period. It thus appears that supervisory efforts to make Large banks' counterparties feel more exposed to default risk had the intended effect.

The other coefficient estimates in the Large bank regression also provide interesting information. First, we find that Large banks with more charter value (***HMB***) protect it with significantly higher capital, as previously concluded by Keeley [1990] and Demsetz, Saidenberg and Strahan [1996]. The negative coefficient on ***LNTA*** indicates that larger BHC tend to hold less capital, but this effect is not statistically significant. The insignificant coefficient on ***REGP*** implies that the Large banks' market equity ratios are not directly affected by the supervisors' book capital standards. The last two coefficients in Table 2 shed light on the possibility that the BHC industry's increase in market capitalization reflects passive policy decisions. If capital were set purely in terms of balance sheet risks , the flow of income should have little effect on equity ratios. However, we find that lagged ***ROA(-1)*** carries a significant coefficient of 0.918 (t=7.16). Clearly, more profitable Large banks maintained higher capital ratios, but we calculate in Table 3 below that this effect does not account for much of the observed change in BHC capitalization. Finally, the proxy for a passive response to stock price changes (***Fitted_MKTRAT***) carries a highly significant (t=9.86) coefficient, which indicates that 34% of the increase in Large BHCs' market capitalization can be attributed to the general increase in stock market share prices.

B. Mega BHC

Regression (2) coefficient estimates for the Mega banks are reported in the right-hand panel of Table 2. Prior to 1992, Mega banks exhibit no significant effect of portfolio risk ($\hat{\sigma}_A$) on capital. The total effect of risk on ***MKTRAT*** then becomes statistically significant, and remains so through the end of our sample period. During the final 3-year period, a one standard deviation change in σ_A (3.3%) causes a 4.93% change in the dependent variable, which is nearly two-thirds of a standard deviation in Mega BHCs' ***MKTRAT*** during this period. We infer that supervisory reforms in the 1989-1991 period had qualitatively similar effects on the Mega and Large banks in our sample. Also consistent with the Large bank sample estimates, we find that the Mega banks' ***MKTRAT*** depends significantly on ***HMB*** and lagged ***ROA***. The Mega banks' capital ratios decline (insignificantly) with size (***$LNTA_{t-1}$***), and are unrelated to the supervisory book capital standards (***REGP***).

In summary, the empirical results are consistent with the hypothesis that a change in regulatory stance increased the sensitivity of equity ratios to risk. We now de-compose the sample period's change in mean BHC capitalization into the factors measured in regression (2).

C. De-composing the Change in BHC Capitalization

The mean BHC market capital ratio increased between 1986 and 2000. Figure 9 illustrates that this sort of change can be attributed to two broad factors, "market" effects and "passive bank" effects. Banks operating under market discipline should exhibit an optimal combination of ***MKTRAT*** and σ_A that slopes (weakly) upward to the right. We approximate this with a linear relationship. The regression model's evidence indicates that risk sensitivity ($\beta_0+\beta_k D_k$) increased over time, corresponding to a leftward rotation of the equilibrium line in Figure 9. *Ceteris paribus*, this effect would make bank shareholders want to hold higher capital, in the amount **E1**. Bank portfolios also became riskier during our sample period, meaning that the initial σ_{A0} shifted right to σ_{A1}. The resulting increase in optimal equity can be divided into two parts. **E2** in Figure 9 is the extra capital associated with the change in risk alone (i.e., holding the slope constant its initial value β_0). **E3** measures the impact of combined changes in asset risk and market sensitivity. Finally, the solid line in Figure 9 will shift up in a *parallel* fashion if managers enhance capital passively and if earnings or stock price increases are independent of σ_A.

Table 3 reports computed magnitudes for the following five effects on BHCs' mean ***MKTRAT***:

E1. The impact of a change in market risk aversion, given by β_4

E2. The impact of a change in the asset portfolio risk, independent of the market's changed risk aversion, given by $\beta_0(\Delta\sigma_A)$.

E3. The interaction between E1 and E2, given by $\beta_4(\Delta\sigma_A)$.

E4. The retained earnings effect measures the impact of higher earnings on bank capital, given by $\alpha_4(\boldsymbol{\Delta ROA_{t-1}})$.

E5. The stock appreciation effect measures the impact of across-the-board security price increases on bank capital, given by α_5(***ΔFitted_MKTRAT***).

The estimated effects in Table 3 are computed separately for the Large and Mega banks, using the coefficients from Table 2. The separate effects are presented as a percentage of the observed change in the banks' mean equity ratio between 1986-88 vs. 1998-2000, and should therefore sum to approximately 100%.

The Large BHCs' mean market capital ratio rose by 9.52%, from 8.4% in 1986-88 to 17.9% in 1998-2000. "Market discipline" effects on bank capital ratios amount to a statistically significant ($p < .01$) 63.92% of the observed change. About 21% of the observed change reflects increased market risk aversion (effect **E1**), and this proportion differs from zero at the 1% confidence level. The immediate effect of the measured increase in asset risks (E2) has the surprising effect of *reducing* desired ***MKTRAT*** by 7.81% of the observed change, but this effect is statistically indistinguishable from zero.[26] The combined effect of greater risk aversion and riskier assets (**E3**) raises ***MKTRAT*** by 50.5% of the ratio's actual change. Taken together, the three "active" effects (E1 + E2 + E3) account for nearly two-thirds of the mean change in Large banks' capitalization. By contrast, the "passive bank" effects account for 44.24% of the observed change, with stock price increases providing a large majority of the effect.[27] The last two effects in Table 3 reflect changes in the sample firm's characteristics (***REGP***, ***LNTA***, firm fixed effects) and the annual fixed effects.

The second column of Table 3 shows the ***MKTRAT*** decomposition for Mega banks, which increased their market capital ratio from 5.4% in 1986-88 to 17.6% in 1998-2000. The individual market discipline effects (E1 + E2 + E3) sum to 80.52% of the observed change in Mega banks' mean market capitalization. Higher earnings (**E4**) contribute less than 8% of the Mega banks' increased market capitalization, while across-the-board share price increases (**E5**) account for more than a quarter.

We conclude that our model explains the observed increase in U.S. BHCs' capital ratios very well. Passive earnings and share price increases caused some of the observed changes, but active, risk-related

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[26] The negative sign on this effect results from the negative, but insignificant, coefficient on σ_A in (2) for the 1986-88 time period.

[27] The indicated contribution of market price change is much smaller than that found by Welch [2002], who concludes that "[O]bserved corporate capital structure is primarily driven by external stock returns, and not by managerial responses thereto" (page 28).

effects explain more than three-fifths of the sample's increased capitalization. The remaining question is whether this increased risk sensitivity derived from supervisory or market forces.

VI. *Do Higher Market Ratios Reflect Stricter Regulatory Constraints?*

When risk-based capital standards were introduced, bank supervisors also vowed to enforce capital standards more tightly. For example, FDICIA specifies a series of "prompt corrective actions" that supervisors must take if a bank becomes undercapitalized -- that is, if total risk-based capital falls below 8% of risk-weighted assets (Jones and King [1995], page 492). It was also understood that bank mergers would not be approved unless the surviving entity would be well capitalized (i.e. more than 10% of RWA). Perhaps, therefore, BHC capital ratios rose during the 1990s *not* because of market discipline, but rather because the supervisors imposed or enforced higher book capital standards.[28] We already know, from Figure 4, that during the 1990s regulatory capital rose more than the *supervisory* measure of risk (RWA). To determine whether book capital ratios are reliably related to a *market* measure of asset risk, we re-run regression (2) with the book capital ratio in place of *MKTRAT*.[29]

Table 4 presents these results. The Large banks' book capital exhibits no sensitivity to $\hat{\sigma}_A$ until the 1998-2000 time period. Even then, the estimated coefficient (0.165) is much smaller than the corresponding coefficient for *MKTRAT* in Table 2 (0.905). In the right half of Table 4, we see that the Mega banks' results for *Book_RAT* qualitatively resemble their *MKTRAT* estimates in Table 2. Book equity is significantly related to $\hat{\sigma}_A$ in 1986-1988, then not again until 1995. Overall, book equity ratios are less strongly tied to market

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[28] Darrell Duffie initially suggested this possibility to us, and it finds empirical support from Wall and Peterson [1995] for their 1989-92 sample period. Osterberg and Thomson [1996] study publicly-traded BHCs' leverage decisions in 1986-87, and conclude

> that the expected cost of violating the capital guidelines is … a cost of leverage and the leverage ratios of banks that are currently meeting the guidelines may still be affected by changes in capital requirements which change the probability of being in violation. (pp. 317-8)

[29] We omit REGP from the set of independent variables because its construction tends to make it correlated with less-capitalized banks. We also omit MKTRAT_Fitted from the regressions in Table 4, because stock price increases should not directly cause any change in the book equity ratio.

measures of bank risk, consistent with our hypothesis that banks will set their *market* capital ratios in response to competitive market forces.

In order to assess the marginal impact of supervisory standards on bank capital holdings, we can examine why bankers hold capital above the supervisory standards. If the cost of violating *de jure* or *de facto* supervisory standards were large, rational bankers would hold a cushion of "excess" book capital to prevent a loss from making their capital deficient.[30] This motivation for increased BHC equity ratios implies that the size of an institution's cushion should vary with its portfolio risk exposure. We therefore regress excess book capital on BHC risk

$$CUSHION_{it} = \delta_0 + \delta_1 \sigma_{A_{it}} + \tilde{\omega}_{it} \tag{4}$$

where ***CUSHION**$_{it}$* = the difference between observed *book* capital (equity plus debt) and the operative minimum requirement:[31]

6% of total assets during the period 1986-1990-III

7.25% of risk-weighted assets during the period 1990-IV through 1992-III

8% of risk-weighted assets starting in 1992-IV.

$\sigma_{A_{it}}$ = the instrument for observed asset volatility (described above).

We estimate a variant of (4) that includes year and firm fixed effects, and also permits the slope coefficient on $\sigma_{A_{it}}$ to change over time:

$$CUSHION_{it} = \delta_0 + \left(\delta_1 + \sum_{1}^{4} \lambda_k D_k\right) \sigma_{A_{it}} + \text{Year and Firm Fixed Effects} + \tilde{\omega}_{it} \tag{4a}$$

where the ***D**$_k$* dummy variables are defined in regression (2) above. The time pattern of the λ_k will indicate how a BHC's asset risk affected its excess capital over time. [32]

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[30] Under this hypothesis, the apparently "excess" book capital in Figure 4 is not truly available for distribution because supervisors have made it uneconomic to permit one's book capital ratio to approach the minimum.

[31] Note that the *de facto* capital standard could be above these minima – e.g 10% of RWA under Basle. Any uniform change in the CUSHION definition induces an exactly offsetting change in the constant, and the other coefficients in Table 3 are unaffected.

Table 5 reports the coefficients obtained when we estimated (4a) separately for the Large and Mega sub-samples. For the Large banks, excess capital is initially related to the market's assessment of BHC risk, but the magnitude of this sensitivity declines over the next two subperiods. By 1995, excess capital is no longer affected by $\sigma_{A_{it}}$, implying that the probability of falling below supervisory capital standards no longer influences the bankers' capital decisions. A similar story emerges for the Mega subsample. Initially, ***CUSHION*** was positively (but insignificantly) related to asset risk. This positive relationship became statistically significant during 1989 – 1994, before abating in the last two time periods. The results in Table 5 imply that supervisory standards affected bank capital standards before and during the application of the Basel Accord, but this influence had disappeared by the 1995-1997 period.

Given these results, the most plausible explanation for the increasing sensitivity of ***MKTRAT*** to $\sigma_{A_{it}}$ in Table 2 is that scaled-back conjectural guarantees caused market counterparties to demand higher capital ratios from large U.S. financial institutions. Regulatory minima may have hastened this adjustment, and they could play a more substantial role if losses again erode the industry's capitalization again. However, market forces best explain the late 1990's sharp increase in the market capital ratios of U.S. BHC.

VII. *Robustness*

We assess the robustness of our basic results by modifying several features of regression (2). Only the estimated impact of $\hat{\sigma}_A$ on ***MKTRAT*** is reported for each specification in Table 6. Again, we keep the Large and Mega samples separate. The revised results never fail to confirm that BHC asset risk became a highly significant influence on capitalization after 1994. In most cases, the increased risk aversion appears to follow the 1989-91 supervisory reforms.

(1) <u>Adjust for Possible Insurance Subsidies in *MKTRAT*</u>. We computed adjusted asset values and asset return volatilities using the method of Ronn and Verma [1986], to determine whether the positive

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[32] Including the other variables from (2) -- HMB, ROAL, and LNTAL -- on the right-hand side of (4) results in an identical pattern among the λ_k.

relation between $\hat{\sigma}_A$ and *MKTRAT* reflects a safety net subsidy that increases with asset volatility. The indicated changes were very small. Specifically, we found that the value of deposit insurance exceeded 0.25% of equity market value for fewer than 1% of the 1,185 sample BHC-dates. The first row of Table 6 demonstrates that using Ronn-Verma adjusted measures of asset value and return volatility leave the estimated coefficients on risk virtually identical to those reported in Table 2.[33]

(2) An Alternative Proxy for Asset Risk. The fitted value of asset risk in Table 2 comes from a regression of observed σ_A on portfolio shares of 13 different asset types, year dummies, firm fixed effects, and the other predetermined variables in regression (2). The portfolio shares serve to identify the equation system, but they could be considered endogenously determined. We therefore constructed an alternative instrument for asset risk, which substitutes two quarterly lags of σ_A for the portfolio shares. The estimated risk coefficients were only slightly affected by this substitution.

(3) The Timing of Equity and Risk Measurements. The specification (2) constrains ***MKTRAT*** to respond contemporaneously to the most recent quarter's measure of asset volatility. Row (2) of Table 5 reports estimates when $\hat{\sigma}_A$ is measured as a weighted average of the contemporaneous and past two-quarter's fitted asset volatilities (with weights of 30%, 40%, and 30%).[34] The estimated coefficients on asset volatility remain substantially the same.

(4) Alternative BHC Sample Composition. The firms included in the sample underlying Table 2 were among the 100 largest BHC (in asset book value) in the third quarter of *each* year. Accordingly, the sample's composition changed between years, as individual banks expanded, contracted, or were acquired. To be sure that changes in the sample composition did not bias our estimates, we replicated the basic regressions for the

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[33] We also estimated (2) for a dependent variable that entirely removes the insurance value from equity's market value. (Ronn and Verma [1986] point out that an extreme assumption underlies this adjustment: that competition forces none of the insurance value to be passed through to bank customers.) The results are virtually identical to the first row of Table 6.

[34] The balance sheet data required to construct $\hat{\sigma}_A$ were not available before June 1986. For the 1986 observation, we therefore estimated risk as an equally weighted sum of the second and third quarter proxies.

1986 set of Large and Mega banks, following them through time. Estimation results for this alternative sample confirm the Table 2 conclusion that $\hat{\sigma}_A$ did not positively affect ***MKTRAT*** before 1992.

(5) Quarterly Estimates. Table 2 is based on annual estimation intervals, but the data are available quarterly. When we ran the regression over all available observations the coefficient standard errors decline without changing the basic form of the risk-sensitivity results.

(6) Excluding *Fitted_MKTRAT*. Since ***Fitted_MKTRAT*** might track actual ***MKTRAT*** by construction, we omitted it from the specification to determine if it was affecting the risk coefficients. The estimated risk coefficients' magnitudes increased somewhat, but their time pattern remains very similar to the estimates in Table 2.

(7) Excluding the Charter Value Proxy. We used the proxy ***HMB*** ("high market-to-book") for charter value to reduce the possible effect of charter value's endogeneity on estimated coefficients. However, ***HMB*** could still be correlated with the residual in equation (2). To check whether this effect materially influences our coefficients of interest, we excluded ***HMB*** from the regression specification and obtained very similar estimates.

VIII. *Summary and Implications*

This paper has evaluated the capitalization decisions of large bank holding companies over the period 1986-2000, when financial supervisors were trying to reverse the market's conjecture that large banks' default risks were largely borne by the government. Toward this end, bank supervisors and the U.S. Congress reformed the methods for resolving failed institutions (late 1980's), introduced risk-based capital standards (effective at yearend 1990), mandated prompt corrective actions vis-à-vis poorly capitalized institutions (1991), and introduced nationwide depositor preference (1993). Over the same period, historical restrictions on permissible bank activities were removed, permitting BHC to select from a broader array of potential portfolio risks.

Bank counterparties (depositors, guarantee beneficiaries, FX and derivatives counterparties) became more exposed to banks' true operating risks during the early 1990s, and U.S. bank equity ratios attained their highest levels in more than 50 years. Concurrently, the cross-sectional variation in capital ratios increased dramatically. Our estimates of BHC asset volatility, which tripled in mean value between 1986 and 2000 while also becoming much more variable across the sample firms. Our regression estimates show that BHC capital levels became more responsive to perceived portfolio risks in the second part of our sample period. Moreover, we find no support for the hypothesis that stricter enforcement of supervisory capital minima have induced the high market capital ratios observed late in the period. After 1994, the possibility of falling below supervisory minimum capital levels appears to have no effect on large BHCs' capital decisions.

While a booming stock market and high bank profitability both contributed to the increase in bank equity market ratios, they can account for less than two-fifths of the observed increase in our sample BHCs. Market-related bank responses to counterparty risk exposures explain more than three-fifths of the sample banks' increased capital ratios between 1986-88 and 1998-2000. This result provides further support for the value market information in the supervisory process: as the salient risks changed for uninsured BHC investors, they were able to elicit more protection against bank defaults.

Two related implications follow from our analysis. First, academic and industry models of banking firms should not assume that supervisory capital standards always constrain a bank. Such an assumption is simply inconsistent with the existing facts, at least for the largest (and hence most important) U.S. banking firms. During the 1990s, sharply higher capital levels accompanied increased risk-taking within the banking sector. The second implication of our analysis is related to the first: market forces appear to have displaced supervisors as the binding constraint on banks' leverage. The on-going discussions of Basle capital reforms should incorporate these regularities, and recognize that market forces may have a larger impact on BHC capital ratios than the regulatory standards currently being re-designed in Basle.

APPENDIX: Estimating RWA for BHCs in the 1986-91 Period

The Basle Accord established risk weights of 0, 20, 50 and 100% for all asset categories on and off a BHC's balance sheet. The risk-weighted sum of the asset categories was termed "risk-weighted assets" (RWA), and capital standards (Tier1 and Tier2) were set as proportions of RWA. Prior to 1992 (pre-Basle period) the Y-9C does not provide enough detail to construct RWA or (therefore) the Tier 1 and Tier 2 capital ratios. Although RWA were not reported on the Y-9C forms until 1996, there is enough detail from 1992 to 1996 to construct it accurately. However, we cannot calculate RWA from Y-9C data in the pre-Basle period (1986-91). For the analysis in Figure 4, we estimate them using a methodology developed by Rangan [2001].

The basic idea is that we can use empirical regularities from the 1992-2000 period to estimate a BHC's RWA in an earlier year. First, we run a pooled regression of the following specification:

$$RWA_{jt} = a_0 + \sum_i b_i A_{ijt} + cO_{ijt} + \varepsilon_{jt} \qquad \text{(A-1)}$$

A_{ijt} is the dollar value of asset category i in BHC j's balance sheet at time t

O_{jt} is the notional value of all off-balance sheet assets of BHC j at time t.

The balance sheet asset categories correspond to those reported on the Y-9C form: securities, federal funds sold, trading account securities, premises and fixed assets, acceptances outstanding, loans secured by real estate, commercial and industrial loans, agricultural loans, "other" loans, intangible assets, bad loans (past due and non-accruing), other real estate owned, and miscellaneous other assets.

The estimated coefficients in (A-1) measure the risk-weight contribution of each balance sheet category to RWA over the estimation time period. In the second step, we use the estimated coefficients from equation (A-1) to predict each BHC's RWA in the pre-Basle period (1986Q3-1991Q4). Our implicit assumption for our second step is that the risk-weight contributions (coefficients) estimated from (A-1) are the same in the pre-Basle period.

Because asset composition varies greatly among BHCs of different sizes, we partition our sample into three size categories (asset ranks 1-20, 21-50 and 51-100), and estimate (A-1) separately for each size category. The R^2 of the regressions range from 0.92 to 0.98.

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Table 1: Balance Sheet Variables, 100 Largest BHC, 1986 - 2000

	Mean	Median	Min	Max.	Std. Dev.
MKTRAT	11.86%	10.77%	0.10%	52.00%	6.46%
σ_A	3.17%	2.36%	0.15%	27.09%	2.55%
HMB	0.25	0	0	1	0.43
REGP	0.12	0	0	1	0.33
TA ($ bill)	33.00	12.70	3.64	672.00	57.80
ROA	0.96%	1.06%	-5.05%	3.93%	0.75%
Fitted_MKTRAT	11.35%	9.98%	0.42%	41.43%	6.16%

MKTRAT = the ratio of the common stock's market value to the quasi-market value of assets (book value of liabilities + market value of equity).

$\sigma_{A_{it}}$ = unlevered standard deviation of asset returns, annualized and computed from the preceding quarter's daily equity returns.

HMB = dummy variable equal to one if the BHC's ratio of market to book asset values is in the highest quartile that period, and zero otherwise.

TA = book value of total assets, in billion dollars.

REGP = a dummy variable measuring of regulatory pressure to keep capitalization high. ***REGP*** equals one if a BHC's book equity capital lies within 1.5% of mandated minimum value, and zero otherwise.

ROA = ratio of net operating income to book value of total assets (TA).

Fitted_MKTRAT = an estimate of what a BHC's market capital ratio would have been if the only changes in equity capital were due to market-wide changes in share prices. Specifically,

$$Fitted\_MKTRAT_{i,t} = \left(\frac{MVEQ_{i,t-1}(1+R_{t-1,t})}{TL_{i,t} + MVEQ_{i,t-1}(1+R_{t-1,t})} \right)$$

where $R_{t-1,t}$ is the return on the S&P500 index for the period ending at time t,
$TL_{i,t}$ is the i^{th} BHC's actual liabilities at time t, and
$MVEQ_{i,t-1}$ is the market value of common stock at the end of the prior period.

Table 2: Estimation Results, Equity Market Value Capitalization

$$MKTRAT_{it} = \alpha_0 + (\beta_0 + \sum_{k=1}^{4} \beta_k D_k)\hat{\sigma}_{A_{it}} + \alpha_1 HMB_{it} + \alpha_2 REGP_{it} + \alpha_3 LNTA_{it-1} + \alpha_4 ROA_{it-1} + \alpha_5 Fitted\_MKTRAT_{it} + Year\ and\ Firm\ Fixed\ Effects + \tilde{\varepsilon}_{it} \quad (2)$$

Estimated using annual data from 1986-2000. ***MKTRAT*** is the ratio of common equity's market value to the market value of total assets. $\hat{\sigma}_{A_{it}}$ is an instrument for the prior quarter's annualized asset volatility, computed by de-levering the standard deviation of daily equity returns. ***HMB*** is a dummy variable equal to one when the BHC's market-to-book ratio is in the sample's highest quartile. ***REGP*** is a dummy variable equal to one when the BHC's capital ratio is less than 1.5% above the required minimum. ***LNTA*** is the log of total book assets. ***ROA*** is net current operating income divided by total book assets. *Fitted_MTKRAT* is a proxy for what the BHC's ***MKTRAT*** would have been if managers had followed a passive capital policy, so that their market value of capital changed only with overall stock market returns. We also include dummy variables identifying all sample BHC and all years, although these estimated coefficients are not reported. T-statistics are provided in parentheses

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

(continued)

Table 2, continued

	"Large" BHC		*"Mega" BHC*	
	Coefficient (t-stat)	**Implied Absolute Coefficient (t-stat)**	**Coefficient (t-stat)**	**Implied Absolute Coefficient (t-stat)**
$\hat{\sigma}_A$	-0.166 (-0.653)		0.188 (0.320)	
$\hat{\sigma}_A$ * $\mathbf{D_{1989\text{-}1991}}$	-0.117 (-0.536)	-0.282 (-1.246)	0.250 (0.370)	0.438 (0.826)
$\hat{\sigma}_A$ * $\mathbf{D_{1992\text{-}1994}}$	0.688*** (3.041)	0.522 ** (2.536)	0.862 (1.162)	1.050* (1.791)
$\hat{\sigma}_A$ * $\mathbf{D_{1995\text{-}1997}}$	0.770 *** (3.398)	0.605*** (3.695)	1.659 ** (2.561)	1.846*** (5.115)
$\hat{\sigma}_A$ * $\mathbf{D_{1998\text{-}2000}}$	1.071 *** (4.715)	0.905 *** (7.905)	1.306 ** (2.187)	1.493 *** (7.682)
HMB	0.024 *** (9.056)		0.023 *** (4.899)	
LNTA(-1)	-0.002 (-0.671)		-0.004 (-0.644)	
REGP	-0.000 (-0.095)		-0.005 (-0.871)	
ROA(-1)	0.918 *** (7.163)		0.744** (2.409)	
Fitted_MKTRAT	0.340 *** (9.859)		0.241 *** (3.941)	
CONSTANT	0.052 (0.945)		0.099 (0.928)	
Num. Obs.	905		280	
$\overline{R}^2$	0.929		0.930	

*** Significantly different from zero at the 1% level

** Significantly different from zero at the 5% level

* Significantly different from zero at the 10% level

Table 3: Percentage contributions to the observed mean change in market equity ratios, between 1986-88 and 1998-2000

Coefficient names refer to equation (2). Reported numbers represent the proportion of observed change in the mean market value of equity ratio (***MKTRAT***) from the 1986-88 period to the 1998-2000 period. The five "effects" are illustrated in Figure 9.

Contributions	Large BHC: Actual change in *MKTRAT* = 9.52 %	Mega BHC: Actual change in *MKTRAT* = 12.23 %
E1: Impact of a change in market risk aversion (β_4)	21.21% ***	14.75% ***
E2: The impact of higher asset portfolio risk, $\beta_0(\Delta\sigma_A)$.	-7.81%	8.27%
E3: The interaction between E1 and E2: $\beta_4(\Delta\sigma_A)$	50.53% ***	57.50% ***
The "market discipline" effect (E1 + E2 +E3):	63.92%***	80.52%***
E4: Change in Earnings: α_4(***ΔROA***)	5.83% ***	7.74% ***
E5: Proportion of change in ***MKTRAT*** due to across-the-board increase in share prices: α_5(*ΔFitted_**MKTRAT***)	38.41% ***	25.24% ***
The "passive bank" effect (E4 + E5):	44.24%***	32.98%***
REGP and ***LNTA*** effects	-0.71%	-1.51%
Entity and year fixed effects	-5.64%	-10.92%
Other (technical) effects:	-6.35%	-12.42%
Mean Predicted change in ***MKTRAT*** implied by regression model (2), as a proportion of the actual change in ***MKTRAT***	101.81%	101.08%

Table 4: Estimation Results, Equity Book Value Capitalization

$$Book\_RAT_{it} = \alpha_0 + (\beta_0 + \sum_{k=1}^{4} \beta_k D_k)\hat{\sigma}_{A_{it}} + \alpha_1 HMB_{it} + \alpha_3 LNTA_{it-1} + \alpha_4 ROA_{it-1} + Year\ and\ Firm\ Fixed\ Effects + \tilde{\varepsilon}_{it} \quad (2)$$

Estimated using annual data from 1986-2000. ***Book_RAT*** is the ratio of common equity's book value to the book value of total assets. $\hat{\sigma}_{A_{it}}$ is an instrument for the prior quarter's annualized asset volatility, computed by de-levering the standard deviation of daily equity returns. ***HMB*** is a dummy variable equal to one when the BHC's market-to-book ratio is in the sample's highest quartile. ***LNTA*** is the log of total book assets. ***ROA*** is net current operating income divided by total book assets. We also include dummy variables identifying all sample BHC and all years, although these estimated coefficients are not reported. T-statistics are provided in parentheses

(continued)

Table 4, continued

	"Large" BHC		***"Mega" BHC***	
	Coefficient (t-stat)	**Implied Absolute Coefficient (t-stat)**	**Coefficient (t-stat)**	**Implied Absolute Coefficient (t-stat)**
$\hat{\sigma}_A$	0.105 (0.974)		0.853*** (2.571)	
$\hat{\sigma}_A$ * $\mathbf{D_{1989\text{-}1991}}$	-0.023 (0.241)	0.082 (0.862)	-0.402 (-1.508)	0.451 (1.501)
$\hat{\sigma}_A$ * $\mathbf{D_{1992\text{-}1994}}$	-0.044 (0.452)	0.061 (0.708)	-0.551 (-1.403)	0.302 (1.008)
$\hat{\sigma}_A$ * $\mathbf{D_{1995\text{-}1997}}$	-0.119 (1.230)	-0.014 (0.213)	-0.035 (-0.099)	0.818*** (4.544)
$\hat{\sigma}_A$ * $\mathbf{D_{1998\text{-}2000}}$	0.058 (0.592)	0.163*** (3.630)	-0.467 (-1.421)	0.386*** (4.543)
HMB	-0.002 (1.336)		-0.004 (1.484)	
LNTA(-1)	-0.008*** (5.969)		0.002 (0.746)	
ROA(-1)	0.588*** (10.909)		0.356** (2.211)	
CONSTANT	0.194*** (8.273)		0.000 (0.000)	
Num. Obs.	905		280	
$\bar{R}^2$	0.798		0.728	

*** Significantly different from zero at the 1% level

** Significantly different from zero at the 5% level

* Significantly different from zero at the 10% level

Table 5: Effect of Market Risk on Excess Book Capital

$$CUSHION_{it} = \delta_0 + (\delta_1 + \sum_{1}^{4} \lambda_k D_k) \hat{\sigma}_{Ait} + \tilde{\omega}_{it} \quad (4a)$$

Estimated using annual data from 1986-2000. ***CUSHION**$_{it}$* is excess regulatory capital: total regulatory capital (equity plus qualifying debt) less the required supervisory minimum, as a proportion of total assets (before 1991) or Risk-Weighted Assets (after 1990). $\hat{\sigma}_{Ait}$ is the prior quarter's annualized asset volatility, computed by de-levering the standard deviation of daily equity returns. D_k are dummies marking four successive three-year periods, identified by the subscripts on the "D" variables in the table below. The regression also includes annual and firm fixed effects, whose coefficients are not reported to save space. T-statistics are reported in parentheses.

	Large Banks		**Mega Banks**	
	Estimated Coefficient	Implied Absolute Coefficient	Estimated Coefficient	Implied Absolute Coefficient
$\hat{\sigma}_A$	0.315**		0.152	
	(2.464)		(0.942)	
$\hat{\sigma}_A$ * $D_{1989\text{-}91}$	-0.025	0.291*	0.429	0.581*
	(-0.157)	(1.823)	(1.249)	(1.794)
$\hat{\sigma}_A$ * $D_{1992\text{-}94}$	-0.085	0.231**	0.730**	0.882***
	(-0.543)	(2.021)	(2.355)	(3.108)
$\hat{\sigma}_A$ * $D_{1995\text{-}97}$	-0.246*	0.069	-0.253	-0.100
	(-1.689)	(1.065)	(-0.932)	(-0.471)
$\hat{\sigma}_A$ * $D_{1998\text{-}00}$	-0.182	0.134	-0.218	-0.065
	(-1.115)	(1.480)	(-1.108)	(-0.658)
Constant	0.002		0.007**	
	(0.389)		(2.533)	
Num. Obs.	992		288	
$\overline{R}^2$	0.703		0.664	

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table 6: Robustness Results

Variations on the basic regression specification estimated in Table 2.

$$MKTRAT_{it} = \alpha_0 + (\beta_0 + \sum_{k=1}^{4} \beta_k D_k)\hat{\sigma}_{A_{it}} + \alpha_1 HMB_{it} + \alpha_2 REGP_{it} + \alpha_3 LNTA_{it-1} + \alpha_4 ROA_{it-1} + \alpha_5 Fitted\_MKTRAT_{it} + Year\ and\ Firm\ Fixed\ Effects + \tilde{\varepsilon}_{it} \quad (2)$$

The first row of coefficients reports the individual β_k for k = 0, 4. The second row of coefficients is the sum of $\beta_0 + \beta_k$ for k = 1, 4. T-statistics are reported in parentheses. In the left-hand column, "N =" indicates the number of observations in the Large and Mega regression respectively.

	LARGE BHC					MEGA BHC				
	β_0 (1986-88)	β_1 (1989-91)	β_2 (1992-94)	β_3 (1995-97)	β_4 (1998-00)	β_0 (1986-88)	β_1 (1989-91)	β_2 (1992-94)	β_3 (1995-97)	β_4 (1998-00)
(1) Adjust asset values and return volatilities for safety-net subsidies (N=904, 280)		-0.115	0.663***	0.756***	1.052***		0.216	0.815	1.618***	1.270**
	-0.179	(-0.532)	(2.949)	(3.364)	(4.668)	0.190	(0.324)	(1.107)	(2.532)	(2.145)
	(-0.714)	-0.294	0.484**	0.578***	0.874***	(0.330)	0.405	1.005*	1.807***	1.460***
		(-1.315)	(2.386)	(3.63)	(7.795)		(0.778)	(1.721)	(5.007)	(7.497)
(2) Alternate Proxy for Asset Risk (N = 866,266)	0.662***	0.038	0.730***	0.907***	1.017***		0.809	1.269**	2.265**	1.932***
	(2.642)	(0.171)	(3.307)	(3.996)	(4.483)	0.060	(1.343)	(2.100)	(3.825)	(3.369)
		0.700***	1.393***	1.569***	1.680***	0.102	0.869*	1.329***	2.325***	1.992***
		(3.555)	(9.272)	(10.422)	(15.777)		(1.819)	(3.169)	(6.888)	(9.877)
(3) Portfolio risk measured as weighted average of current, past fitted asset volatilities (N = 905,280)	0.120	-0.128	0.815***	0.896***	1.058***		0.430	1.088	2.116***	1.690**
	(0.425)	(-0.568)	(3.467)	(3.687)	(4.397)	0.010	(0.601)	(1.430)	(2.970)	(2.546)
		-0.008	0.935***	1.016***	1.178***	(0.016)	0.441	1.098*	2.127***	1.700***
		(-0.032)	(4.211)	(5.087)	(9.037)		(0.719)	(1.899)	(5.121)	(7.795)

Table 6, continued

	LARGE BHC					MEGA BHC				
	β0 (1986-88)	β1 (1989-91)	β2 (1992-94)	β3 (1995-97)	β4 (1998-00)	β0 (1986-88)	β1 (1989-91)	β2 (1992-94)	β3 (1995-97)	β4 (1998-00)
(4) Constant sample composition: 100 largest BHC as of 1986-III (N = 637,198)	0.093	-0.401*	0.782***	0.348	1.736***	0.704	-0.160	1.438*	1.772***	0.807
	(0.324)	(-1.748)	(2.863)	(1.241)	(5.939)	(1.345)	(-0.235)	(1.670)	(2.970)	(1.530)
		-0.307	0.875***	0.442**	1.839***		0.544	2.142***	2.476***	1.511***
		(-1.132)	(3.057)	(2.332)	(12.542)		(0.980)	(2.714)	(7.079)	(8.506)
(5) Estimation on quarterly data (N = 3703,1085)	-0.226**	0.157**	0.325***	0.397***	0.514***	0.009	0.296	0.118	0.765***	0.586***
	(-2.129)	(1.973)	(3.946)	(4.645)	(6.033)	(0.044)	(1.334)	(0.510)	(3.579)	(2.996)
		-0.069	0.099	0.171**	0.288***		0.305	0.127	0.774***	0.595***
		(-0.705)	(1.096)	(2.095)	(5.505)		(1.452)	(0.626)	(5.058)	(6.146)
(6) Exclude *Fitted_MKTRAT* (N = 971,281)	-0.302	-0.029	0.818***	0.874***	1.366***		0.447	1.408*	2.138***	1.687**
	(-1.125)	(-0.131)	(3.529)	(3.772)	(5.685)	0.265	(0.639)	(1.869)	(3.223)	(2.745)
		-0.331	0.516**	0.572***	1.064***	(0.431)	0.712	1.674***	2.403***	1.952***
		(-1.374)	(2.448)	(3.499)	(9.896)		(1.307)	(2.866)	(6.866)	(11.806)
(7) Exclude *HMB* (N = 905,280)	0.364	-0.242	0.492*	0.518*	0.669**		0.729	1.011	1.672**	1.189*
	(1.236)	(-0.926)	(1.784)	(1.845)	(2.436)	0.506	(0.944)	(1.206)	(2.292)	(1.780)
		0.122	0.856***	0.882***	1.033***	(0.776)	1.234**	1.516**	2.178***	1.695***
		(0.474)	(3.865)	(5.017)	(8.269)		(2.094)	(2.350)	(5.455)	(8.244)

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 1% level

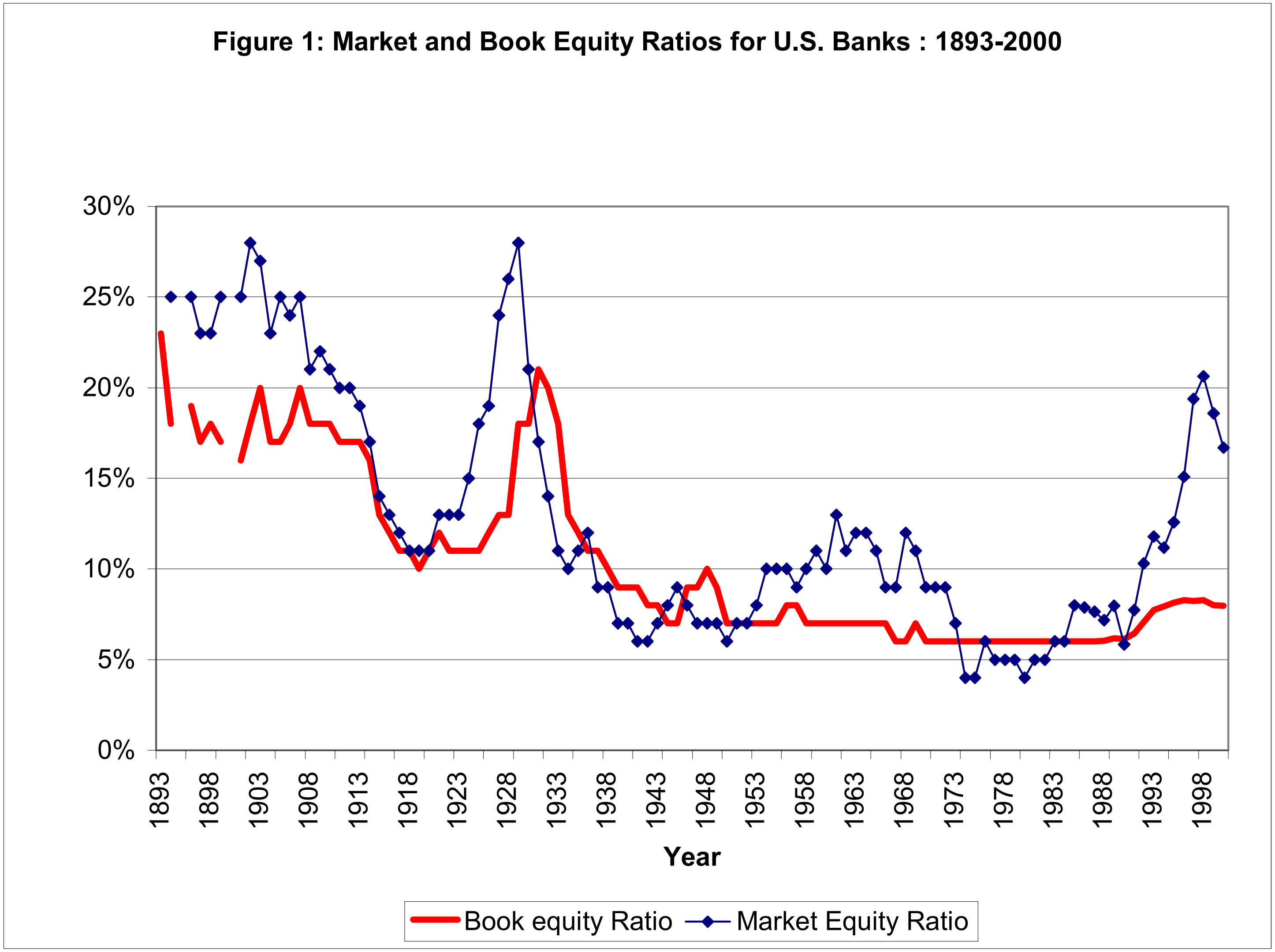
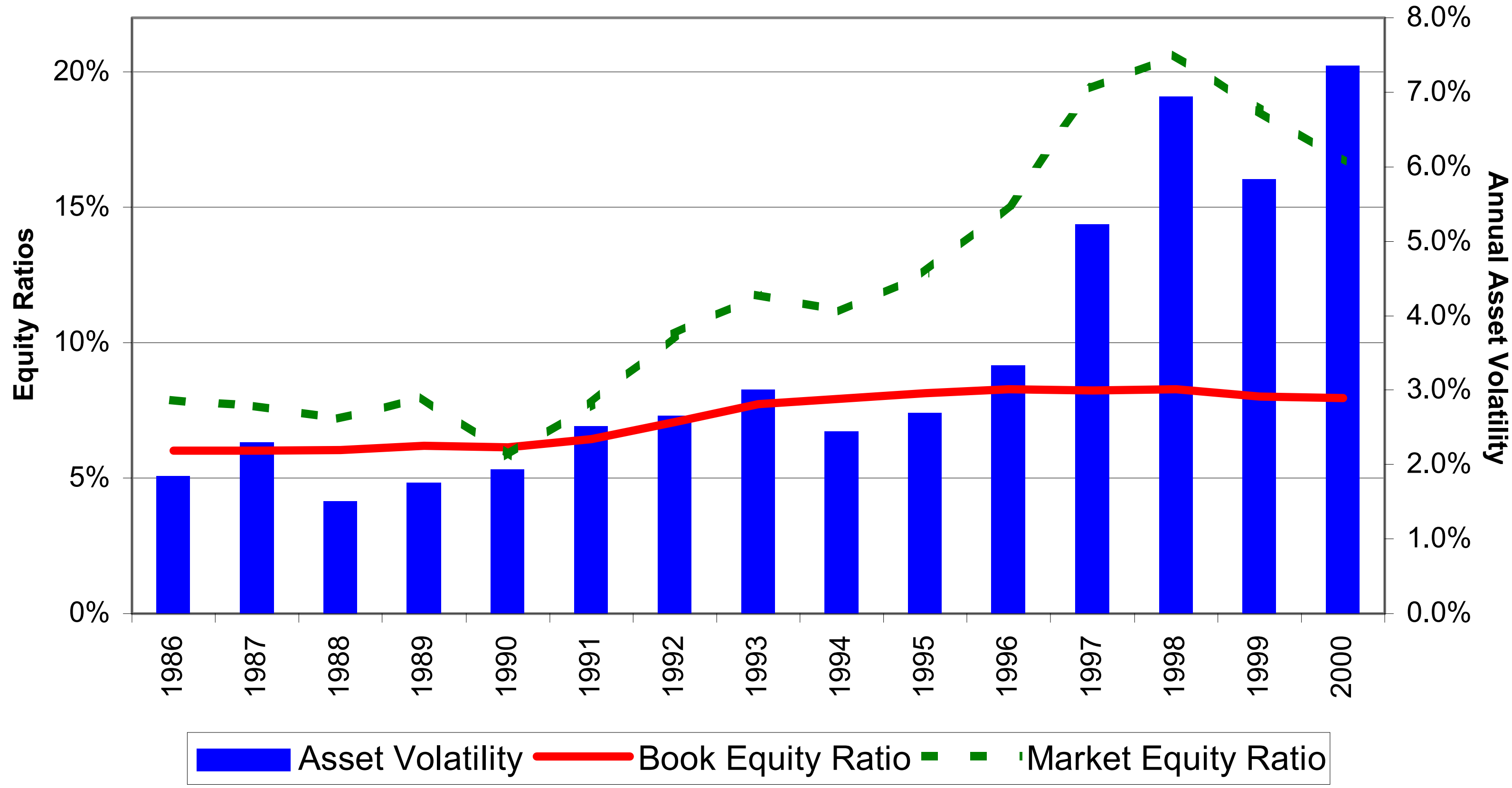


Figure 1: Market and Book Equity Ratios for U.S. Banks : 1893-2000
30%
25%
20%
15%
10%
5%
0%
1893
1898
1903
1908
1913
1918
1923
1928
1933
1938
1943
1948
1953
1958
1963
1968
1973
1978
1983
1988
1993
1998
Year
Book equity Ratio
Market Equity Ratio

Figure 2: Market and Book Equity Ratios, and Asset Volatility for the 100 Largest U.S. BHCs



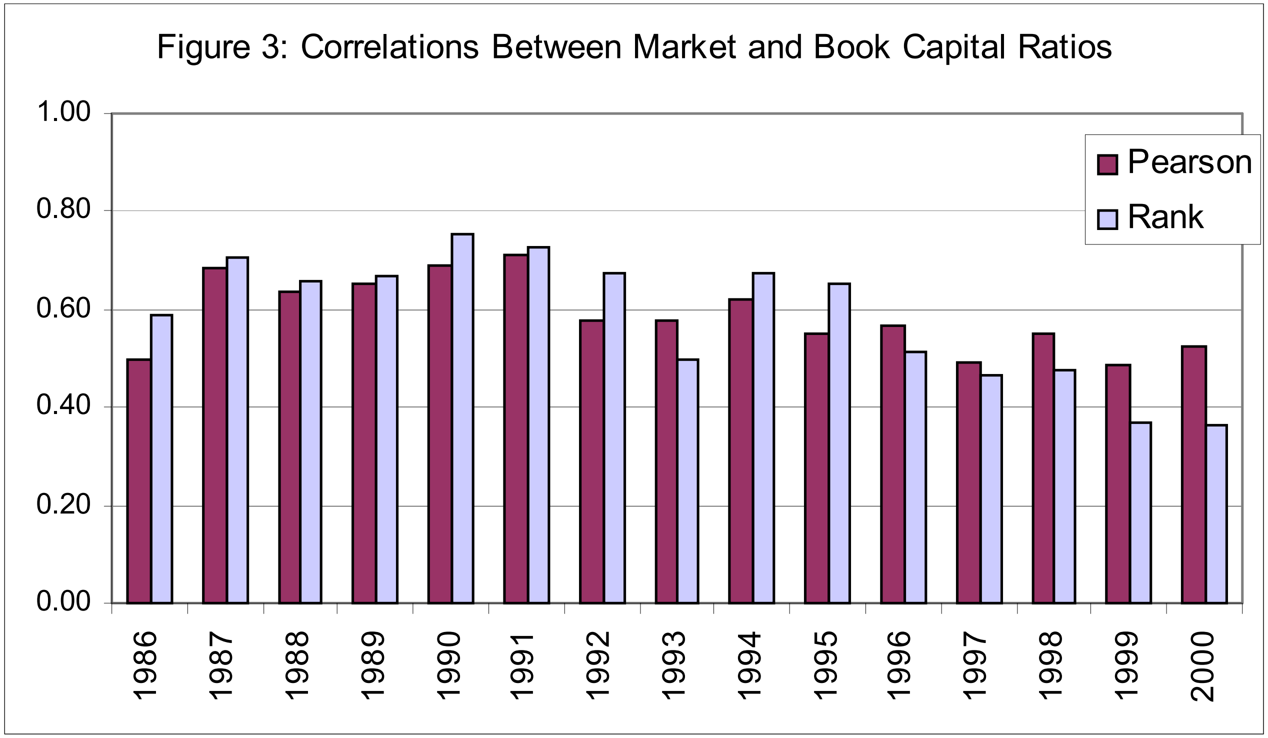


Figure 3: Correlations Between Market and Book Capital Ratios
1.00
0.80
0.60
0.40
0.20
0.00
Pearson
Rank
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000

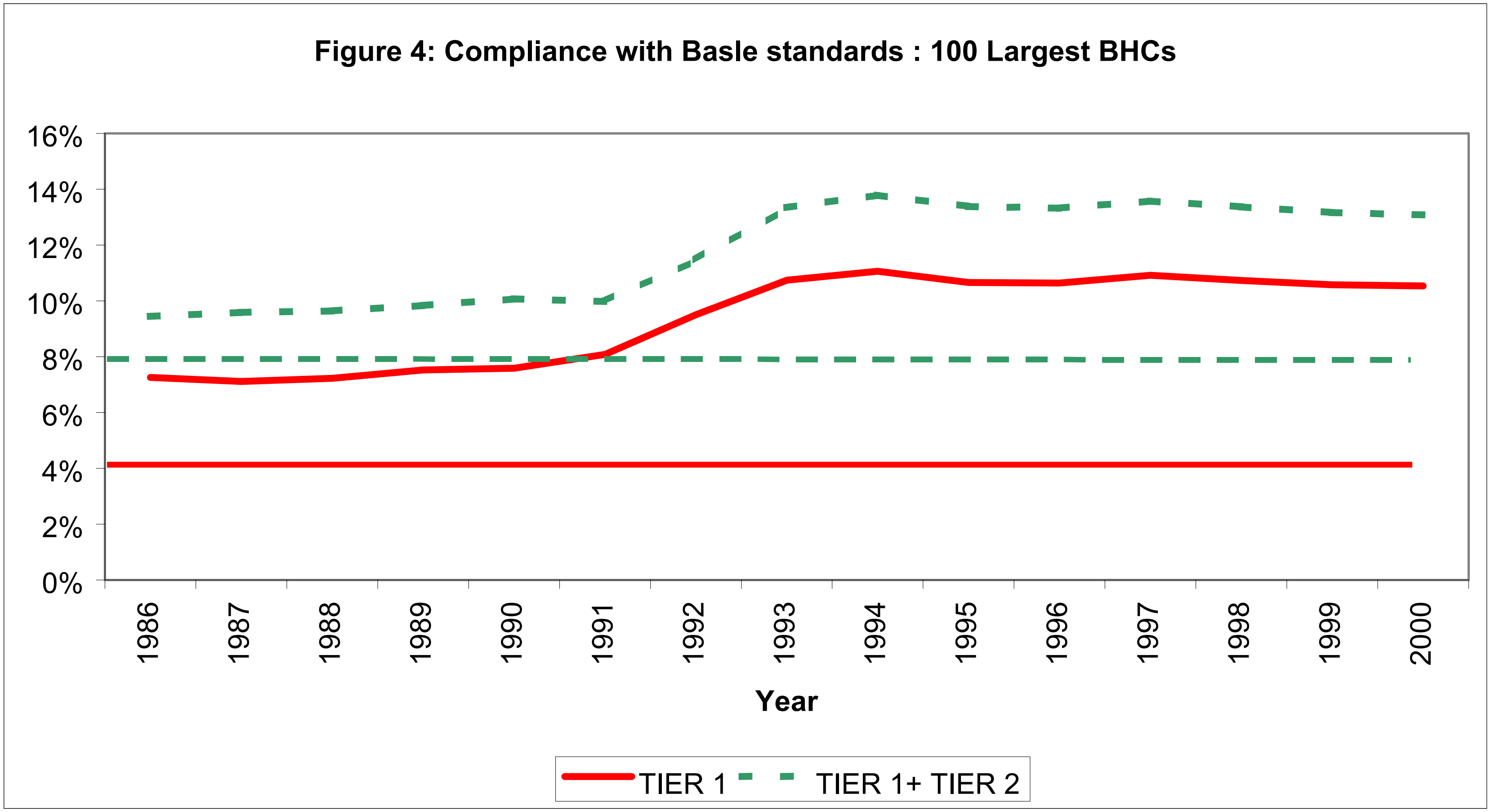
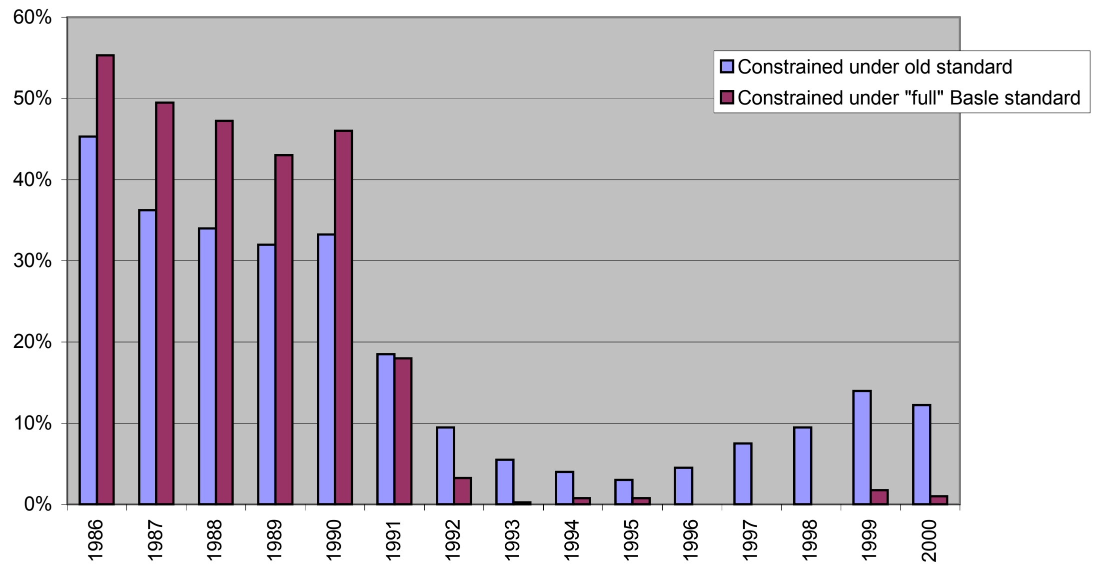


Figure 4: Compliance with Basle standards : 100 Largest BHCs
16%
14%
12%
10%
8%
6%
4%
2%
0%
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Year
TIER 1
TIER 1+ TIER 2

Figure 5: Percentage of 100 Largest BHC Constrained by Supervisory Capital Standards



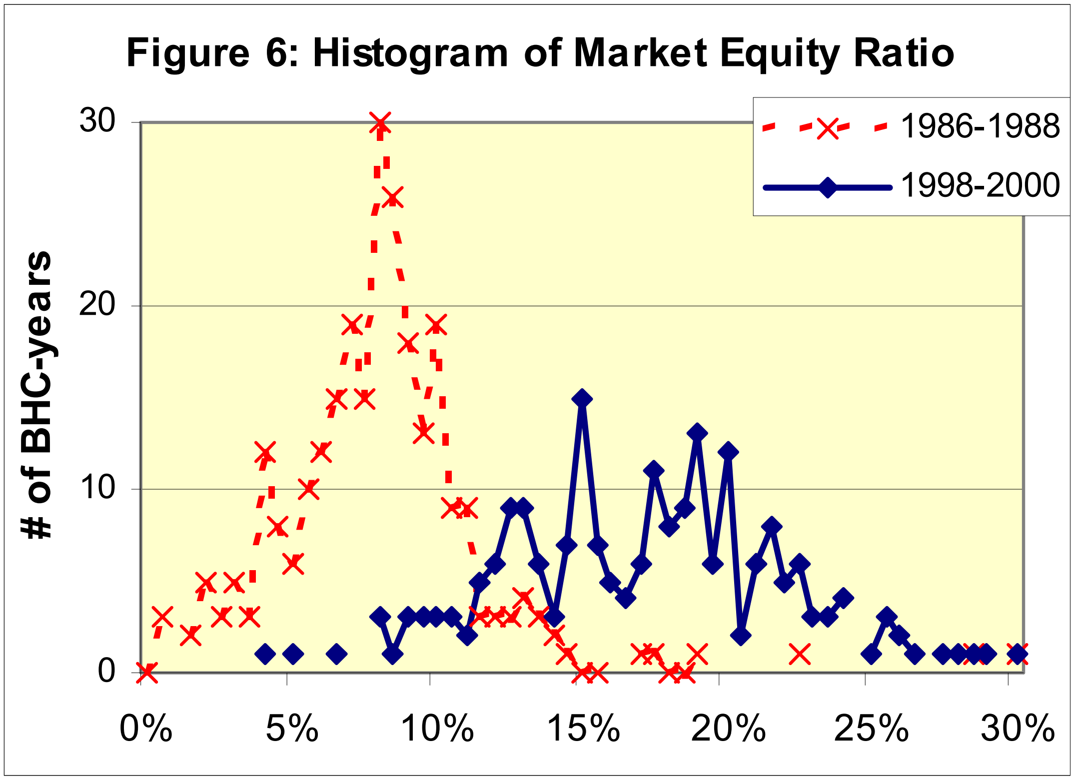


Figure 6: Histogram of Market Equity Ratio
# of BHC-years
30
20
10
0
0%
5%
10%
15%
20%
25%
30%
1986-1988
1998-2000

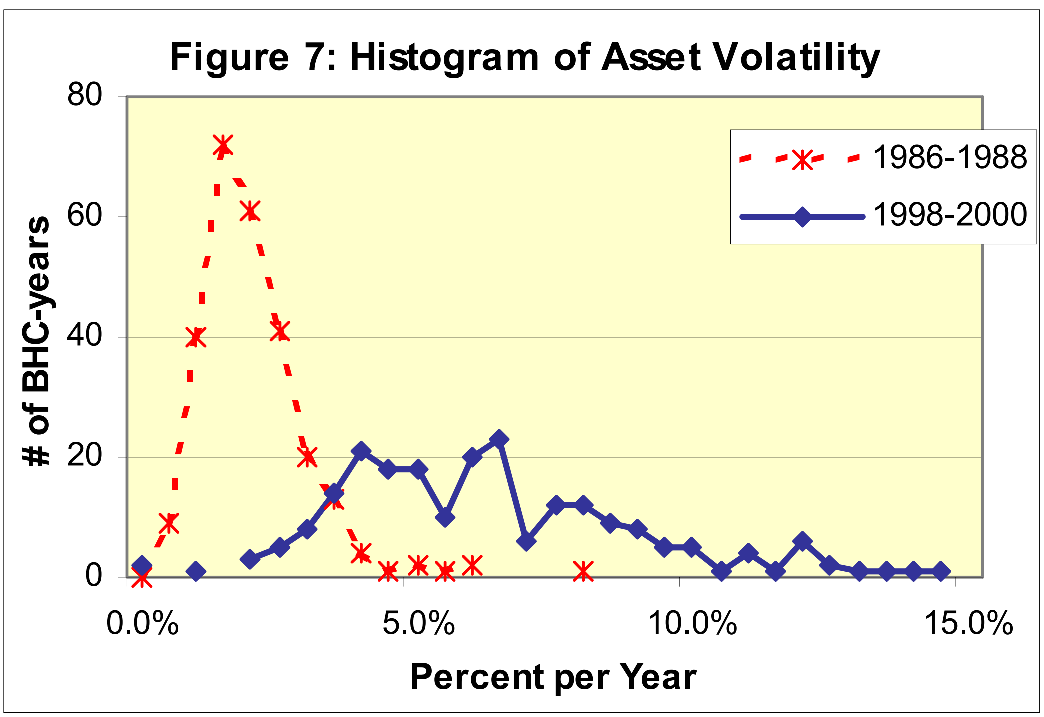


Figure 7: Histogram of Asset Volatility
# of BHC-years
80
60
40
20
0
0.0%
5.0%
10.0%
15.0%
Percent per Year
1986-1988
1998-2000

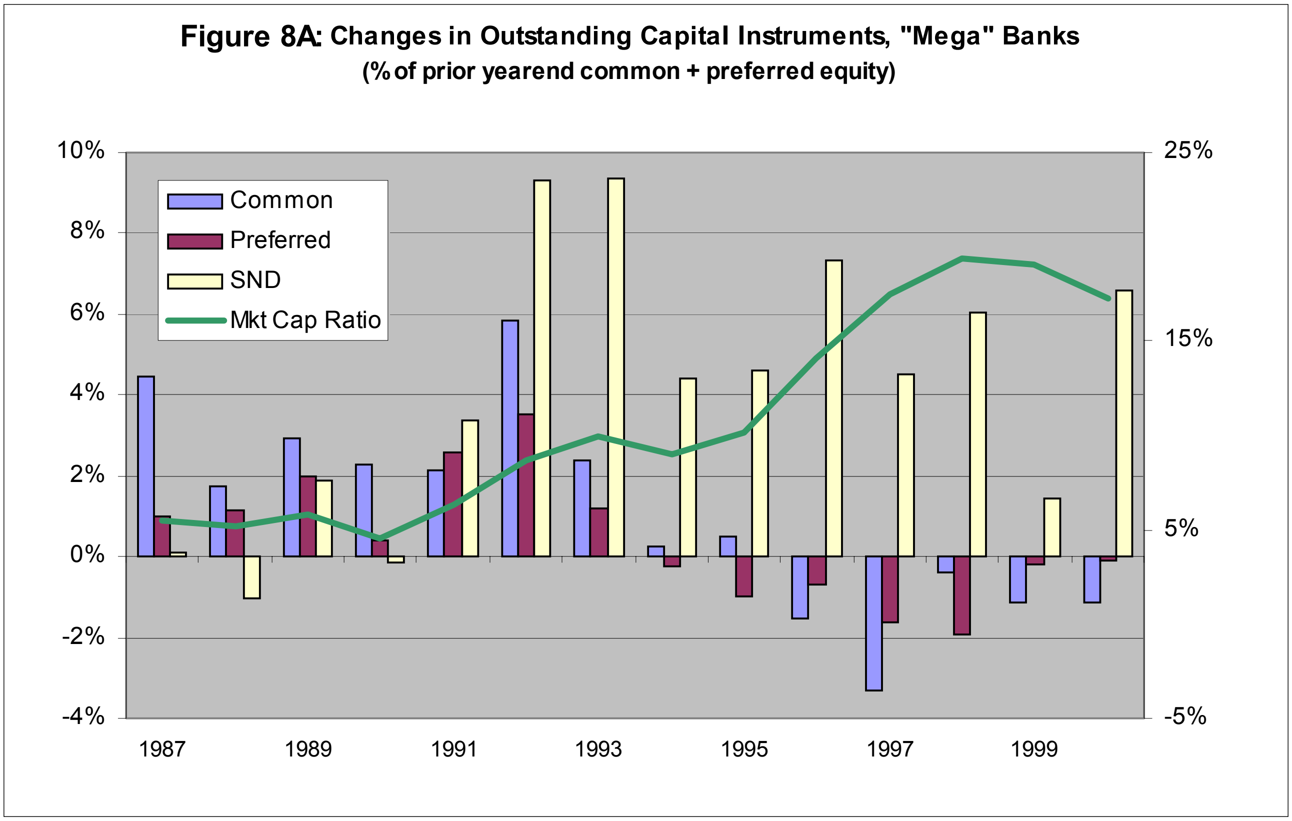


Figure 8A: Changes in Outstanding Capital Instruments, "Mega" Banks
(% of prior yearend common + preferred equity)
Common
Preferred
SND
Mkt Cap Ratio
10%
8%
6%
4%
2%
0%
-2%
-4%
25%
15%
5%
-5%
1987
1989
1991
1993
1995
1997
1999

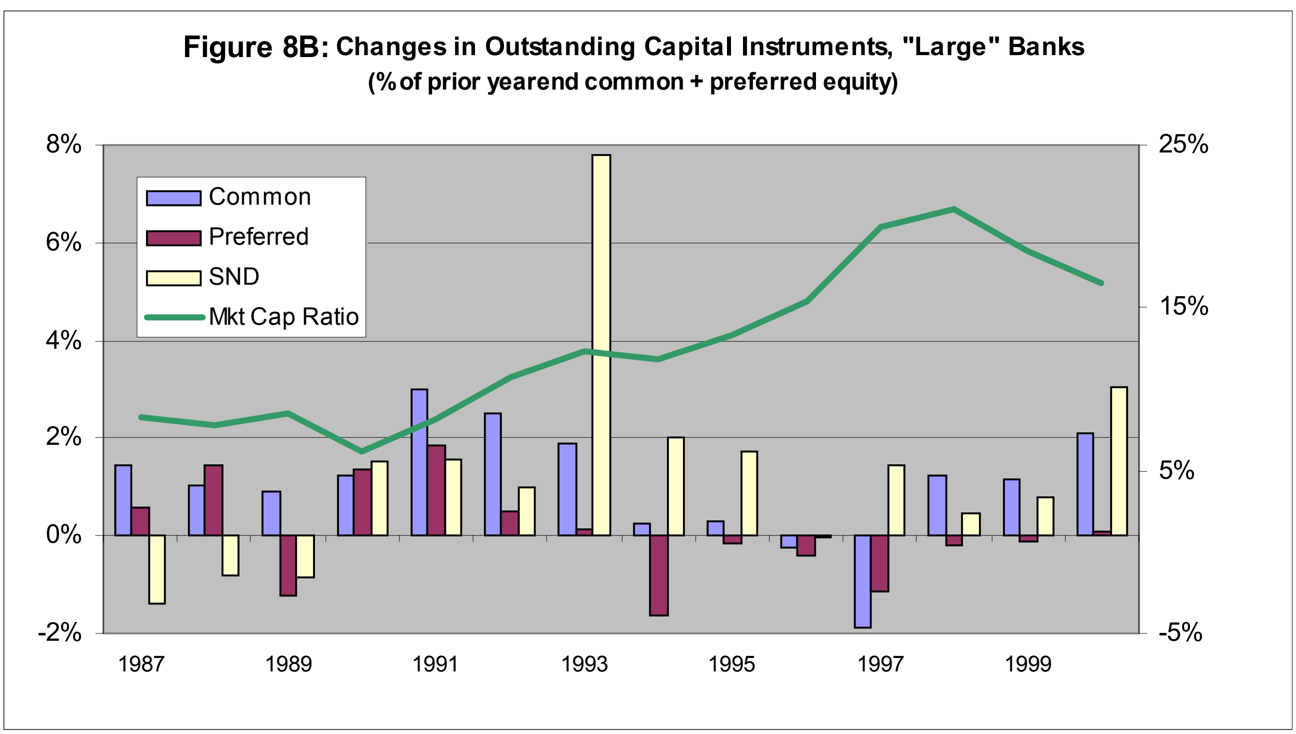
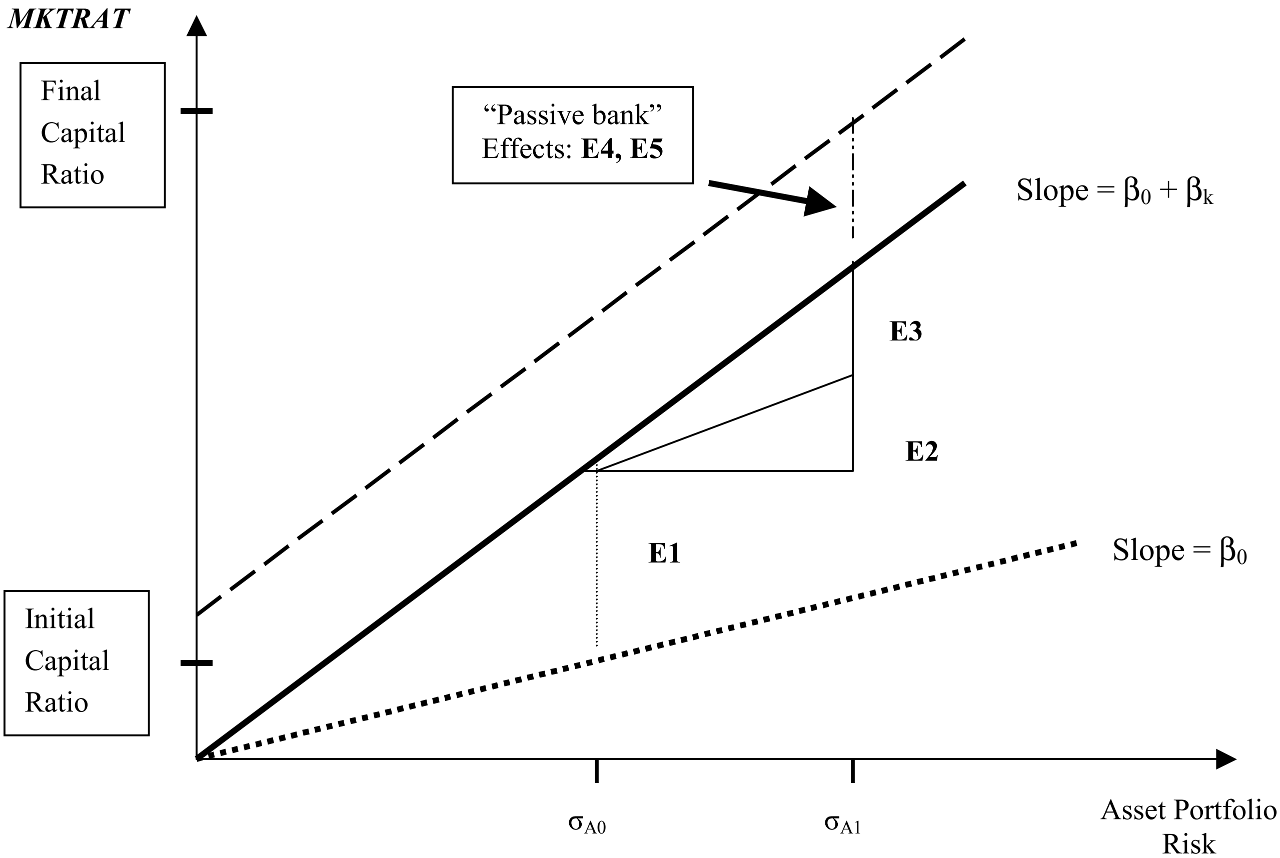


Figure 8B: Changes in Outstanding Capital Instruments, "Large" Banks
(% of prior yearend common + preferred equity)
Common
Preferred
SND
Mkt Cap Ratio
8%
6%
4%
2%
0%
-2%
25%
15%
5%
-5%
1987
1989
1991
1993
1995
1997
1999



"Market Discipline" Effect = E1 + E2 + E3.

"Passive Bank" effects occur as shifts in the original schedule, independent of asset risk.

Figure 9