

**“WILL THE ADOPTION OF BASEL II ENCOURAGE  
INCREASED BANK MERGER ACTIVITY?  
EVIDENCE FROM THE UNITED STATES”**

*by*  
*Timothy H. Hannan and Steven J. Pilloff*

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## **Abstract**

This study presents two tests of the hypothesis that adoption of an internal ratings-based approach to determining minimum capital requirements, proposed as part of the Basel II capital accord, would cause adopting banking organizations to increase their acquisition activity. The study employs U.S. data and focuses on the advanced internal ratings-based approach, as proposed for banking organizations in the United States. The first test estimates the relationship between excess regulatory capital and subsequent merger activity, including organization and time fixed effects, while the second test employs a “difference in difference” analysis of the change in merger activity that occurred the last time U.S. regulatory capital standards were changed. Estimated coefficients and observed differences have signs consistent with the hypothesis, but results are either statistically insignificant or imply differences that are small in magnitude.



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## **I. Introduction**

The Basel II capital accord is expected to change fundamentally the way that the minimum regulatory capital requirements of many banking organizations throughout the world are determined. One of the key elements of this accord is the anticipated introduction of two internal ratings-based (IRB) approaches to regulatory capital requirements. These differ substantially from the Basel I approach and the proposed standardized approach under Basel II in that a banking organization's internal assessments of key risk considerations serve as primary inputs in the calculation of minimum capital requirements. Because these IRB approaches are based on banks' internal assessments using systems validated by supervisors, they offer the benefit of more risk-sensitive regulatory capital requirements.

Two IRB approaches have been proposed. The foundation IRB (F-IRB) approach allows banks to use internal assessments for some risk components and requires them to use regulatory prescribed values for others. The advanced IRB (A-IRB) approach permits banks to use more of their own internal risk assessments. Both IRB approaches will require banks to employ sophisticated risk-measurement techniques that involve a statistical and quantitative assessment of risk, but the demands and complexity of the A-IRB approach are greater than those of the F-IRB approach.

Under the current proposal for banking organizations in the United States, organizations with total banking (and thrift) assets of at least \$250 billion or at least \$10 billion in on-balance-sheet foreign exposure – about ten large organizations based on current balance sheets – would be required to adopt A-IRB.<sup>1</sup> Other banking organizations may also choose to adopt A-IRB, provided they have developed the necessary infrastructure to measure and manage risk. While any bank may “opt in” if it meets regulatory standards, only a few of the largest U.S. banking organizations initially are expected to have in place the infrastructure required to employ such techniques, implying that the A-IRB approach likely will be used at the outset only by a small group of the largest banking organizations. If banks that do not adopt the A-IRB approach continue to be subject to regulatory capital rules based on Basel I, the result would be a bifurcated system in which the largest banking

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<sup>1</sup> See Board of Governors of the Federal Reserve System (September 2003).

organizations would be subject to the more risk-sensitive and flexible method of determining minimum regulatory capital requirements. It is anticipated that a number of larger banking organizations will join the initial set relatively soon after the implementation date.

In Europe, the application of Basel II is expected to involve more alternatives, as banks will likely have the option of adopting the F-IRB, A-IRB, or standardized approach.<sup>2</sup> Because F-IRB requires fewer internally generated inputs, the option of using this methodology should make it possible for less complex banks to implement an IRB approach to capital requirements. European banks that opt not to adopt an IRB approach will be able to use the standardized approach, which is simpler and less risk sensitive than either of the IRB approaches.

While adoption of an IRB approach may raise the regulatory capital requirements for some IRB banks, it is likely to result in somewhat lower minimum regulatory capital requirements, on average, for the banking organizations that will avail themselves of these approaches, relative to the minimum regulatory capital requirements applied to the majority of banks that initially will not.<sup>3</sup> Concerns have been raised that this disparity would provide an undue competitive advantage to the initial adopters, many of which will be very large banking organizations. Concerns have also been raised that both the excess regulatory capital that would be created at IRB organizations as a result of reduced capital requirements and the aforementioned competitive advantage associated with those reduced requirements would fuel their acquisitions of non-adopting banking organizations. Such concerns have not been the subject of empirical examination. In this paper, we bring data to bear on the second of these concerns: that banking organizations that adopt IRB will aggressively acquire other banking organizations.<sup>4</sup>

While this issue is relevant to the implementation of Basel II in Europe and elsewhere throughout the world, we restrict our focus in this paper to potential effects on merger activity of the implementation of Basel II in the United

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<sup>2</sup> See Commission of the European Communities (2004).

<sup>3</sup> See "International Convergence of Capital Measurement and Capital Standards: A Revised Framework," which was issued by the Basel Committee on Banking Supervision, Bank for International Settlements, in June 2004.

<sup>4</sup> Berger (2004) examines the potential competitive effects of Basel II in the United States on banks in credit markets for small and medium size enterprises.

States, where a bifurcated system is expected to develop with a relatively few very large banks adopting A-IRB and many, smaller banks not adopting A-IRB. There are two primary consequences of adopting an IRB approach to capital requirements that suggest to some observers that IRB banking organizations would increase acquisition activity. Arguments based on these consequences may be usefully designated as “excess regulatory capital” and “relative capital advantage” arguments.

“Excess regulatory capital” arguments assert that merger activity would increase as a result of the excess regulatory capital that would be created by the lower capital requirements stemming from adoption of IRB, and this could fuel acquisitions for a number of different reasons. For example, in the United States, a bank holding company (BHC) desiring to engage in a certain acquisition may be deterred under current capital requirements, because the merger might cause the combined entity to violate existing capital standards. However, a reduction in regulatory requirements and a consequent increase in excess regulatory capital might encourage the acquisition by significantly reducing the likelihood of the combined BHC failing to meet the new, more lenient capital standards.

Another example of an “excess regulatory capital” argument is that, with an increase in excess regulatory capital, adopters could increase their return on equity (ROE) by increasing the amount of earning assets against which a given amount of capital is held (or reducing capital held against a given amount of earning assets). Increased ROE may in turn raise bank valuation, which could facilitate an increase in acquisition activity.

The focus of “relative capital advantage” arguments is on the difference in the capital standards applied to IRB and other banking organizations, maintaining that lower capital requirements for organizations operating under IRB, relative to those operating under existing standards, would result in increased acquisition activity. Specifically, in the U.S. context, some have alleged that A-IRB BHCs would have an incentive to acquire banks not subject to A-IRB capital standards because target banks would be worth more to A-IRB BHCs than to current owners. Different valuations would exist because A-IRB BHCs are expected to face regulatory capital requirements that would be lower than those of the banking organizations that they might acquire. Consequently, A-IRB BHCs could acquire non-adopters and increase the return on equity associated with the acquired assets by either increasing

income-earning assets without adding capital or holding less capital against the newly acquired assets.<sup>5</sup>

Both “excess regulatory capital” and “relative capital advantage” arguments rely on the assumption that current regulatory capital requirements are “binding” in the sense that banking organizations are restricted from doing what they would otherwise do in the absence of current minimum capital regulations. Regulatory capital requirements would not be binding if market-based considerations dictated higher levels of capital than those imposed by regulation, or if, as some have argued, “capital arbitrage” techniques currently employed by some larger banking organizations allow them largely to avoid, with minor costs, the constricting effects of existing minimum regulatory capital requirements.<sup>6</sup> However, much of the extensive discussion of the risk implications of Basel II presumes that, at least during crucial periods, capital requirements can be binding and thus influence bank behavior regarding risk.<sup>7</sup>

Ultimately, the question of whether adoption of the Basel II capital accord will result in a substantial increase in merger activity by banking organizations using an IRB approach must be assessed by examining relevant data. The best approach, were it available, would be to examine the results of previous reductions in regulatory capital requirements that applied to some banking organizations but not to others, and assess whether substantial relative increases in the acquisition activity of those granted the reduction occurred as a result of the change. Since no such reduction in capital requirements has taken place in recent decades in the United States, which is the focus of this study, we must assess the issue by pursuing less definitive, but nonetheless informative, approaches.

Specifically, we conduct two different types of tests on U.S. banking data. The first type of test uses recent data on merger activity and BHC capital ratios to determine if, all else equal, large banking organizations with greater

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<sup>5</sup> Although other arguments for a positive relationship between IRB status and acquisition activity can be made, we believe that the primary reasons that acquisition activity may be affected by IRB depend on “excess regulatory capital” and the “relative capital advantage.” An example of an alternative explanation is that the market values the improved ability to measure and manage risk associated with adopting IRB, thereby raising the valuation of IRB organizations and enabling them to increase their acquisition activity. In addition, the costs and benefits associated with an IRB approach could influence decisions by banks not using an IRB approach to merge with each other. This study does not examine the effect of IRB on mergers of this type.

<sup>6</sup> See Jones (2002) for a detailed discussion.

<sup>7</sup> See in particular Danielsson, et. al. (2001).

excess regulatory capital exhibit a greater tendency to subsequently acquire other banks. Such a finding would be consistent with the argument that allowing large banking organizations to operate under lower capital requirements (and thereby increase excess regulatory capital) would result in expanded acquisition activity on their parts. This approach, however, is subject to several sources of potential endogeneity bias, only some of which are eliminated by the fixed-effects statistical procedure that we employ.

In part for this reason, we also conduct a test based on observations of what happened the last time that capital standards in the United States changed substantially for banks. It is argued that the advent of “prompt corrective action” (PCA) standards, instituted in the early 1990s, increased capital requirements for banks, a change that was in the opposite direction of the reduction of regulatory minimum capital requirements that is expected to occur, on average, for BHCs that adopt the A-IRB approach.<sup>8</sup> Taking a sample of large BHCs that did not appear to be constrained by the capital requirements in effect before the advent of PCA, and, further, would not have been constrained under the pre-PCA capital standards after the adoption of PCA, we compare the change (from the period before to the period after PCA) in merger activity exhibited by those BHCs that did and did not become capital constrained after more stringent regulatory capital standards became relevant. A finding that BHCs constrained by the advent of PCA standards reduced their merger activity by more (or increased it by less) than those not so constrained would be supportive of the hypothesis that relaxation of regulatory capital requirements (as anticipated, on average, for banking organizations that adopt an IRB approach) would result in greater merger activity by IRB organizations.

Our tests are more relevant to the “excess regulatory capital” arguments for increased merger activity by IRB banking organizations than for “relative capital advantage” arguments. However, as discussed below, a number of studies have been conducted that are not supportive of “relative capital advantage” arguments. The results of this literature almost uniformly reject the hypothesis that acquirers seek to purchase more highly capitalized targets – a finding that is not consistent with the notion that acquirers prefer targets with greater potential for ROE improvement from increased leverage.

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<sup>8</sup> Although the capital standards of “prompt corrective action” are relevant for banking institutions, not bank holding companies, the amount of capital held by bank holding companies should be affected by the “prompt corrective action” standards.

The plan of the paper is as follows. Section II discusses the literature relevant to the relationship between bank merger activity and capitalization. Section III describes the proposed empirical tests, section IV describes the samples, data, and variables, and section V presents empirical results. A final section summarizes and concludes. To preview results, we do not find convincing evidence that past levels of excess regulatory capital or past changes in capital requirements have had a substantial effect on merger activity. Results of the two tests suggest relationships that are in the direction consistent with the concern that a reduction in minimum capital requirements for banking organizations that adopt IRB would result in increased merger activity on their part, but, with a few exceptions, results are not statistically significant. When results are statistically significant, relevant magnitudes are found to be quite small.

## II. Relevant Literature

A very large literature has addressed the question of why banking organizations acquire other banking institutions.<sup>9</sup> Several reasons that banks merge have emerged from this literature, and these same reasons are also commonly cited by bankers and other industry analysts.<sup>10</sup> Specifically, the prospects for increased efficiency and gains from diversification are frequently cited as key determinants of acquisition activity, and studies in both Europe and the United States have investigated whether these benefits are in fact realized as a result of mergers.<sup>11</sup> Interestingly, capital is rarely cited as an important issue in the question of why banks merge. Indeed, few studies have sought to investigate the role of capital, especially that of the acquirer's capitalization relative to regulatory requirements. The scarcity of such studies likely reflects the belief that such considerations play a minor role at best in explaining mergers in the banking industry.

The only study that we know of to investigate the acquiring institution's capitalization as a determinant of merger activity was conducted by O'Keefe (1996), who found that acquirers in the large sample of banks that he investigated had significantly lower equity capitalization rates than their nonacquiring peers. Because it suggests that better capitalized banks are less likely to acquire other banks, this finding does not support "excess regulatory capital" arguments that banking organizations, holding increased excess regulatory capital as a result of reductions in minimum regulatory capital requirements, would increase the rate at which they acquire other banking organizations. O'Keefe's sample, however, is not restricted to the very large bank holding companies of concern in this study, so this finding may have limited relevance to the behavior of the BHCs that adopt an IRB approach.

Several studies report evidence relevant to "relative capital advantage" arguments, which our empirical tests do not address very directly. These arguments, as noted above, assert that, with lower capital requirements than

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<sup>9</sup> For comprehensive reviews, see Berger, Demsetz, and Strahan (1999), Dermine (1999), and Group of Ten (2001), available at [www.bis.org](http://www.bis.org).

<sup>10</sup> Of particular importance to the U.S. banking industry, relaxation of longstanding interstate banking restrictions is widely believed to have sparked extensive consolidation of an industry that was decentralized for over one hundred years.

<sup>11</sup> See, for example, Altunbas, Molyneux, and Thornton (1996), Vander Venet (1996), Akhavein, Berger, and Humphrey (1997), and Amel et. al. (2004).

those of their potential targets, banking organizations employing an IRB approach would have an incentive to acquire these better capitalized targets and increase the return on equity associated with target assets by reducing the capital held against those assets. An implication of this argument for past merger behavior is that acquirers should have found more highly capitalized banks relatively more attractive as acquisition targets.

A fairly large number of studies report results that contradict this implication. We know of at least six studies – Hannan and Rhoades (1987), Amel and Rhoades (1989), O’Keefe (1996), Moore (1997), Wheelock and Wilson (2000), and Akhigbe, Madura, and Whyte (2004) – that sought to determine the characteristics of banking organizations that make them more likely to be a target in a future bank acquisition and that also included the bank’s capitalization as a potential determinant. Using various time periods and various samples, five of these six studies find that more highly capitalized banks are less likely, not more likely, to be acquired, all else equal. The sixth study, by Akhigbe, Madura, and Whyte (2004), finds that more capitalized banks are more likely to be acquired, but it differs from the other cited studies in that the sample of targets employed is restricted to relatively large, publicly traded banking organizations. Although the reason for the more common finding of an inverse relationship between target capital ratios and likelihood of acquisition is not clear, the finding is clearly not consistent with the “relative capital advantage” argument.

Another study, by Houston, James, and Ryngaert (2001), addresses in a different way the role of capital as a motivation for bank mergers. As a part of their study, the authors obtained from both managers and analysts opinions and, in some cases, estimates of the sources of expected merger-related gains. Of the 41 mergers on which such information could be obtained, capital structure benefits were noted in only five cases. In four of these cases, analysts noted that the merger might enable the combined bank to free up excess capital, a benefit that would be consistent with “relative capital advantage” arguments. However, because capital is cited in such a small share of the acquisitions in their analysis, their findings seem to suggest that capital has not played a major role in explaining why banks make acquisitions.



### III. Empirical Tests

**Test 1.** Our first test requires estimation of the relationship between BHC capitalization and subsequent BHC merger activity in the United States, using data obtained for recent years. The rationale for this test rests on the presumption that some banking organizations in the recent past have, for whatever reason, found themselves in the position of having capital in excess of the level that they would hold because of regulatory capital requirements, while other banking organizations have found themselves with no such excess and thus may have been constrained by regulatory capital requirements.

The level of capital that BHCs feel bound to maintain because of regulatory requirements may include some additional “cushion” above the required regulatory minimums. Such cushions may be maintained for protection against poor performance or other unanticipated events, and the size of this cushion may differ from one BHC to another, depending on the BHC’s risk and other factors.<sup>12</sup>

With this in mind, we seek in this test to determine if BHCs that find themselves with excess regulatory capital exhibit a greater subsequent tendency to acquire other banking organizations than do BHCs that are more constrained by regulatory requirements. The finding of a positive relationship between observed capital ratios and merger activity or the finding of a discreet increase in merger activity at some level of capitalization representing a plausible critical level, would be consistent with the predictions of “excess regulatory capital” arguments that relaxation of capital constraints leads to more merger activity.<sup>13</sup>

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<sup>12</sup> There is ample evidence that most BHCs choose to maintain some kind of cushion or buffer above minimum regulatory requirements and that its size depends on portfolio characteristics and other factors. See, for example, Hancock and Wilcox (2002).

<sup>13</sup> An increase in capital could lead to less, rather than more, merger activity if BHCs with low capital ratios engage in greater acquisition activity than better capitalized BHCs. This could occur because weakly capitalized organizations may purchase highly capitalized targets to increase the capitalization of the combined entity, relative to the pre-merger acquirer. If raising capital levels is a motivation for some mergers, then test results will reflect these mergers, which could obscure the effect of acquisition activity that was conducted for reasons consistent with “excess regulatory capital” arguments. To the extent that such differing types of mergers take place, we believe that results that reflect the average mix of these different types of mergers are the most relevant for understanding the potential effects of IRB.

A point that bears emphasizing, however, is that if the level of capitalization required by the market were greater than that dictated by regulation, or, equivalently, if capital arbitrage allowed BHCs to circumvent regulatory capital requirements with little cost, then there would be little reason to expect a relationship between excess regulatory capital and merger activity.

We can test for this hypothesized relationship by estimating the following relationships:

$$M^i = \beta_0 + \beta_1(K/A)^i + \beta_2X + \varepsilon_i, \text{ and} \quad (1)$$

$$M^i = \alpha_0 + \alpha_1KA1 + \alpha_2KA2 + \dots + \alpha_nKA_n + \alpha_{n+1}X + \mu_i, \quad (2)$$

where  $M^i$  denotes the level of merger activity of BHC<sub>*i*</sub>,  $(K/A)^i$  denotes its capital asset ratio, and  $KA1, KA2, \dots, KA_n$  denote binary variables that receive values of 1 if  $(K/A)^i$  is in a defined range of values and zero otherwise. Equation (1) imposes a linear relationship between  $M^i$  and  $(K/A)^i$ , while equation (2) allows the relationship to vary across different ranges of  $(K/A)^i$  but not to vary within those ranges. The vector  $X$  denotes other explanatory variables that may influence observed merger activity, and  $\varepsilon_i$  and  $\mu_i$  denote error terms. Finding that  $\beta_1 > 0$  in estimations of (1) would be consistent with the hypothesis that merger activity increases with capitalization (and equivalently, excess regulatory capital), and finding that coefficients on  $KA1, KA2, \dots, KA_n$  are positive and increasing in magnitude as capitalization increases would also be consistent with the hypothesis.

If, as noted above, different BHCs set different cushions above the regulatory minimum, estimates of (2) could not be used to identify some critical level of capital below which BHCs are constrained. Under these circumstances, a given binary variable might correctly classify one BHC as not being bound by regulatory requirements, while incorrectly classifying another BHC that was, because of a higher cushion, in fact constrained by such requirements.

Biased estimates attributable to various forms of endogeneity are an important concern in assessing the results of estimations of (1) and (2). Any unobservable characteristic of BHCs that influences both the propensity of a BHC to acquire other banking organizations and its capitalization would impart a bias to the relevant coefficients. To reduce, but unfortunately not eliminate, this possibility, explanatory variables are calculated either for the year prior to that for which merger activity is measured, or, in the case of balance sheet variables, at the beginning of the year for which merger activity

is measured. More importantly, (1) and (2) are estimated using panel datasets consisting of annual observations of large BHCs over two time periods: The first, from 1998 to 2002, is designed to obtain the benefits of panel data estimation using only the most recent (and relevant) five years of available data. A second and longer period, from 1993 to 2002, is also used, since it allows for more annual observations of merger activity and capitalization.

Reported estimations incorporate both year and BHC fixed effects. This approach, in essence, controls for all BHC-specific characteristics that do not vary over time and for all time-specific characteristics that do not vary across BHCs. The inclusion of BHC fixed effects in particular eliminates potential sources of spurious correlation that might arise in comparing one BHC with another.

Spurious correlations in the form of endogeneity bias may result, however, if a time varying unobserved variable influences both a BHC's merger activity and its level of capital (or excess capital) over time in a way different from its effect on other BHCs in the sample. This type of correlation would exist, for example, if BHCs intent on making acquisitions first increase capital levels. The existence of such a correlation between merger activity and measures of capital would bias upward estimates of the coefficients on measures of capital (or excess regulatory capital), resulting in estimates that would overstate the actual expected change in merger activity that would accompany a change in capital requirements.<sup>14</sup>

**Test 2.** The second test that we conduct should not be as vulnerable to endogeneity bias but requires that we go back considerably in time to assess the impact on merger activity of a previous change in capital requirements. Specifically, we look at the effect on merger activity attributable to the adoption of more restrictive capital standards in the United States. Passed into law in December 1991 and fully implemented at the end of 1992, the "prompt corrective action" (PCA) provisions of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991, by all accounts, increased capital adequacy requirements for commercial banks and made more certain that failure to meet them would result in sanctions.

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<sup>14</sup> Another example might be an improvement in a local economy that resulted in an increase in both the merger activity and excess capital of BHCs located in the relevant area but that had no or less influence on BHCs not located in the area. This would impart a positive bias to the coefficients of the measures of excess capital in the regressions reported below. To control for this possibility, we include a measure of local economic health in the analysis.

In this second test, our strategy, roughly stated, is to examine the change in merger activity exhibited by large BHCs before and after PCA provisions became relevant. We restrict the sample to those BHCs that met the pre-PCA capital requirements both before and after the PCA standards became relevant. These conditions are imposed to determine whether BHCs that became constrained only because of the new capital requirements (and not for other reasons that may entail endogeneity bias) decreased their merger activity by more (or increased it by less) than those BHCs that were not constrained by the new requirements.

A positive answer to the question of whether constrained BHCs decreased their acquisition activity relative to unconstrained BHCs would be consistent with the hypothesis that “binding” or constraining capital requirements reduce merger activity. More relevant to the question at hand, it would be consistent with the hypothesis that relaxation of regulatory capital requirements, to the extent that they are binding or constraining, would result in an increase in merger activity.

A more formal derivation of the test is presented as follows: Suppose that before the advent of PCA, the relationship between the merger activity of a typical, large BHC and its capitalization can be expressed as:

$$M_i^b = \beta_0^b + \beta_1 KADUM^b + \beta_2 X^b + \varepsilon_i^b, \quad (3)$$

where the superscript “b” denotes that the variable or coefficient pertains to the period before PCA,  $KADUM^b$  is a binary variable that receives the value of one if capitalization was less than the level at which regulatory capital requirements in that period became binding or constraining, and zero otherwise, and  $\varepsilon_i^b$  denotes the error term. The major feature of this specification is that it allows a discrete difference in merger activity for BHCs that do and do not face binding capital constraints.

We posit the same relationship after PCA, expressed as:

$$M_i^a = \beta_0^a + \beta_1 KADUM^a + \beta_2 X^a + \varepsilon_i^a, \quad (4)$$

where the superscript “a” refers to the period after adoption of PCA standards, with all variables defined as in (3).

Note that coefficients are presumed to be the same in (3) and (4), consistent with the underlying “natural experiment” rationale for the test, which is that

only regulatory capital requirements, and not underlying relationships between acquisition activity and explanatory variables changed between periods. There appears to be little reason to expect changes in regulatory minimums to affect these underlying relationships between merger activity and its determinants. Importantly,  $KADUM^a$  is a binary variable that receives the value of one if capitalization is less than the critical value of capitalization under PCA. If this critical value is higher than that which was relevant in the earlier period, then we will observe some BHCs for which  $KADUM^b=0$  and  $KADUM^a=1$ , despite little or no change in capitalization. In other words, there will be some BHCs that were not constrained before the introduction of PCA standards, but became constrained as a result of that introduction.

Subtracting (3) from (4) yields:

$$M_i^a - M_i^b = (\beta_0^a - \beta_0^b) + \beta_1(KADUM^a - KADUM^b) + \beta_2(X^a - X^b) + (\varepsilon_i^a - \varepsilon_i^b), \quad (5)$$

If determinants of merger activity other than those associated with a binding capital requirement are either invariant over time, (in which case  $X^a = X^b$ ) or, as with variables reflecting the macroeconomic environment, the same across BHCs over the time period, then the term  $\beta_2(X^a - X^b)$  in (5) is either zero or subsumed into the constant term. Under these conditions, only  $\beta_1$ ,  $KADUM^a$ , and  $KADUM^b$  explain differences between the two groups of BHCs in the change in merger activity before and after PCA. It follows that  $(KADUM^a - KADUM^b) = 1$  for the case of a BHC that was not constrained by capital requirements before PCA but was constrained afterwards, and that the term  $(KADUM^a - KADUM^b) = 0$  for BHCs that were not constrained in either period.

If  $\beta_1 < 0$ , which is implied if constrained BHCs engage in less merger activity than unconstrained ones, then we have the simple prediction that, of those BHCs believed to be unconstrained by capital requirements prior to PCA ( $KADUM^b = 0$ ), the BHCs that became constrained after the change to tougher capital standards ( $KADUM^a = 1$ ) should have experienced a greater reduction (or smaller increase) in merger activity than those BHCs that remained unconstrained after the change ( $KADUM^a = 0$ ). This prediction follows because the only remaining term (except for the constant) in (5), given these assumptions, is:  $\beta_1(KADUM^a - KADUM^b)$ , and, with  $\beta_1 < 0$ , this term is negative for banking organizations constrained by PCA and zero for those that are not.

Under the assumptions discussed above, this prediction may be tested with a straightforward comparison of the change in merger activity across the two groups. This test has the benefit of focusing on the effect of an actual past change in capital standards, and it offers well known advantages associated with this “difference in difference” methodology. Among these advantages, all of the numerous differences in BHCs that might influence merger activity and that do not change over the comparison period “cancel out.” Further, because the changes in merger activity for the two groups are calculated for the same time period, the effects of macroeconomic and other changes over time (as long as they influence the two groups equally) are fully controlled for. While these simplifying assumptions appear reasonable, tests based on full estimations of (5) are also conducted.

#### **IV. Samples, Data, and Key Variables**

Samples employed in the analysis consist of the largest U.S. BHCs (based on total assets as of mid-year 2003) that operated throughout the period under investigation. Two successively larger samples of BHCs that operated between year-end 1991 and mid-year 2003 are used in test 1 (panel data analysis). The more restrictive sample includes the ten U.S. banking organizations that are expected to be required to adopt A-IRB status under the current proposals. These organizations are referred to as the mandatory A-IRB BHCs. The first sample also includes the nine other U.S. BHCs with total assets of at least \$50 billion as of mid-year 2003, since they are considered most likely to adopt voluntarily the A-IRB approach in the initial implementation phase. The second and larger sample includes the ten mandatory A-IRB BHCs plus all other U.S. BHCs with total assets of at least \$15 billion as of mid-year 2003. This results in a sample of 38 BHCs and includes a large number of banking organizations that are likely to eventually adopt A-IRB. Analysis is conducted on both samples over two different time periods: a shorter and more recent one covering the years 1998–2002 and a longer one covering the years 1993–2002.

The samples used in test 2 (the natural experiment) are the same as those used in test 1, except that BHCs must have operated between year-end 1986 and mid-year 2003. This requirement causes two BHCs to be dropped because they were not operating during the early part of the period. For reasons discussed below, the years 1987 to 1989 serve as the pre-PCA period, while 1991 and 1992 serve as the post-PCA period.

Merger data were obtained from two sources. The SNL Financial Bank Mergers and Acquisitions Database was the primary source for data on deals that were completed after December 31, 1989. The SNL database includes the vast majority of acquisitions of banks (banks and bank holding companies) and thrifts (savings banks, savings and loan associations, and thrift holding companies) that took place during the period, which includes all of the time covered by test 1 (panel study) and the latter part of test 2 (natural experiment).

The SNL database is not used before 1990 because it is not very comprehensive for deals that took place during that time. Therefore, data for this earlier period were collected from another source. Mergers that took

place in 1987, 1988, or 1989 – the pre-PCA years needed for test 2 – were identified from a database created by staff at the Federal Reserve Board from Federal Reserve Bulletins and reports provided by the Federal Deposit Insurance Corporation (FDIC) and Office of the Comptroller of the Currency (OCC) <sup>15</sup> This database includes only acquisitions in which each party was either a commercial bank or a BHC that operated a commercial bank. Deals involving a thrift as the acquirer or target were not included. Therefore, to maintain consistency, mergers involving savings banks or savings and loan associations that took place after the adoption of PCA are dropped from the group of mergers identified on the SNL database. This requirement has little effect on the set of mergers included in the analysis.

We construct two variables that measure merger activity. The first is the annual number of mergers completed during the relevant period by a BHC. This variable measures the frequency with which a BHC pursued consolidation, not the size of acquisitions. It can be constructed for all years in our analysis and therefore is used for both test 1 and test 2.

A second merger variable that incorporates the size of the targets acquired by a BHC is also used for test 1. Data on the amount of banking assets acquired are available for all years included in test 1 and are used to construct a measure of the relative magnitude of acquisition activity that was conducted by each BHC in the sample. Specifically, the aggregate amount of banking assets acquired in a given year is divided by the BHC's asset level at the start of the year. By dividing by the BHC's total assets, we account for the size of that banking organization.

Capital ratios are constructed with data from the Y-9C report, which is filed quarterly by each BHC with the Federal Reserve Board and contains extensive accounting information on the organization. Creating variables that measure the extent to which BHCs faced capital constraints involves several challenges. First, during the full time period for which data are required (1986–2002), two distinct sets of capital requirements were in effect. Therefore, the capital ratios that are constructed must be those that were relevant at the time.

Capital requirements during the late-1980s predated the implementation of Basel I and its associated risk-based capital rules. At the time, BHCs had to

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<sup>15</sup> This database was the primary source for two extensive studies of bank merger activity in the United States. See Rhoades (2000) and Rhoades (1996).



satisfy two requirements. First, the ratio of primary capital to assets had to be at least 5.5 percent and the ratio of total capital to assets had to be at least 6 percent.<sup>16</sup> We create variables that measure both the primary and total capital ratios that are consistent with these regulatory requirements.

The original Basel capital accord, or Basel I, was approved in 1988 and fully implemented by 1992. This accord established a new set of capital requirements that attempted to take risk into account. More specifically, less capital had to be held against assets that were considered safer, such as residential mortgages and inter-bank loans, as well as government and agency securities. In the United States, BHCs had to satisfy two risk-based capital requirements and one leverage requirement. The ratio of tier 1 capital to risk-weighted assets had to be at least 4 percent, the ratio of total capital to risk-weighted assets had to be at least 8 percent, and tier 1 capital to average tangible assets had to be at least 4 percent. For each year that the Basel I requirements were in effect, we construct variables that correspond to each of these three capital ratios.

Legal limits represent the lowest level of capital that a BHC can maintain before violating regulatory requirements. However, as mentioned, BHCs are likely to prefer to hold a capital buffer above those regulatory limits for a variety of reasons. First, there are tangible benefits to being considered well or strongly capitalized. During the 1990s, the implementation of PCA standards meant that banks that maintained capital ratios below certain thresholds faced increased regulatory intervention despite the fact that their capital ratios exceeded regulatory minimums. Although PCA does not directly apply to BHCs, it is relevant, because it applies to their bank subsidiaries. To be considered well-capitalized under the requirements of PCA, a bank must have a ratio of tier 1 capital to risk-weighted assets of at least 6 percent, a ratio of total capital to risk-weighted assets of at least 10 percent, and tier 1 capital to average tangible assets of at least 5 percent.

In the late 1980s, prior to Basel I rules, the Federal Reserve Board had established that 7 percent was an important level for the total capital ratio.

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<sup>16</sup> Primary capital for a bank holding company consists of common stock, perpetual preferred stock, surplus (excluding surplus relating to limited-life perpetual stock), undivided profits, contingency and other capital reserves, mandatory convertible instruments, allowance for possible loan and lease losses (exclusive of allocated transfer risk reserves), minority interest in equity accounts of consolidated subsidiaries, and perpetual debt instruments. Total capital consists of primary and secondary capital. This latter component includes limited-life preferred stock, as well as bank subordinated notes and debentures and unsecured long-term debt of the parent company and its non-bank subsidiaries.

BHCs with total capital that exceeded 7 percent of assets were considered adequately capitalized and faced less intense monitoring and a lower likelihood of supervisory actions than BHCs with ratios below 7 percent, but above 6 percent, the required minimum.

Another reason that BHCs may want to hold capital above Basel I or even the PCA regulatory limits is for protection against downturns in the business cycle and unanticipated events. Additional capital may also be desirable because it would provide BHCs with flexibility that could be used to pursue potentially profitable opportunities such as acquisitions or other types of expansion. Moreover, a buffer may be desirable so that losses do not restrict the BHC's ability to engage in certain businesses. Of course, still another reason that BHCs may maintain capital ratios that exceed regulatory minimums is that the level of capital dictated by the market may exceed the level that would be held because of regulatory requirements.

To make the relationship between excess regulatory capital and merger activity more explicit, measures of BHC capitalization are expressed in terms of excess regulatory capital, which is calculated as actual capital ratios less some critical level based on regulatory requirements or standards. The critical levels chosen for this purpose will be those that must be exceeded to be considered strongly capitalized. More specifically, we use the three ratios required for a bank to be considered-well capitalized under PCA (tier 1 capital to risk-weighted assets of 6 percent, total capital to risk-weighted assets of 10 percent, and tier 1 capital to average tangible assets of 5 percent) for analysis of the years since 1990 and the total capital ratio level (7 percent of assets) required to avoid additional scrutiny in the late 1980s. Although no level for a strong level of the primary capital ratio was defined by the regulator prior to 1991, we use 6.5 percent (the regulatory minimum of 5.5 percent plus 1 percentage point) as an estimate for a primary capital ratio that would be considered a sign of a strong BHC. Table 1 presents a summary of the various capital ratios, requirements, and variables that are relevant for different time periods.

For each BHC, we construct a variable that measures the overall constraint faced by the BHC by taking the minimum of all the measures of excess regulatory capital that were relevant during the year. Because BHCs must satisfy all the capital requirements in effect at a given time, the ratio that reflects the weakest, or most binding, actual capital position is the one that is likely to be most relevant for the BHC. We recognize that simply taking the lowest value is imprecise. For example, ratios are based on different

numerators, and, in recent years, different denominators. Nonetheless, we believe that the magnitude of the smallest excess capital measure provides a reasonable proxy for the extent of capital constraints faced by a BHC. For test 1, we measure excess capital at the beginning of each year under investigation (1993–2002 or 1998–2002), and for test 2, we measure it at the beginning of 1987 for the pre-PCA period and at the beginning of 1991 for the post-PCA period.

In short, we take the smallest difference between each of the capital ratios from among the relevant set of regulatory ratios and the value required to be considered strongly capitalized. While not adjusted for individual levels of BHC risk and risk tolerance or for idiosyncratic needs to meet capital requirements, we nonetheless believe that our measure of excess regulatory capital roughly captures the degree to which a BHC faced regulatory capital constraints.



## V. Results

The two tests that we conduct provide a thorough and rigorous examination of the question of whether changes in regulatory capital requirements might be expected to influence merger activity.

**Test 1.** In the first type of test conducted, we estimate, for two different samples of BHCs and for two different time periods, the relationship between a BHC's merger activity and its excess capital, defined as the minimum of the difference between each of three actual capital ratio measures and that level of those ratios required to be considered strongly capitalized. Table 2 provides definitions of the independent variables used in these estimations.

Because many of the BHCs in the sample made no acquisitions during at least some of the years in which they are observed, each of the two dependent variables used to measure annual merger activity (the number of acquisitions and the ratio of banking assets acquired to the assets of the acquirer) receive the value of zero for many observations. Because of the well-known violation of OLS assumptions that this entails, other estimation procedures must be used. Since the number of annual acquisitions made by a BHC is a count of the number of occurrences of an event, we use negative binomial maximum-likelihood regression when this variable is employed to measure merger activity.<sup>17</sup> Since the ratio of acquired banking assets to the assets of the acquirer may be thought of as a continuous variable that is censored at zero, we use Tobit maximum-likelihood regressions when this variable is employed to measure merger activity.

Each reported regression includes as an explanatory variable the BHC's expense ratio (*expense ratio*), calculated for the previous year as total noninterest expenses divided by the sum of total noninterest income and net interest income. This rough, but widely used, measure of a BHC's efficiency is included as an explanatory variable because it is often asserted that greater efficiency is associated with greater acquisition activity, as more efficient firms frequently acquire less efficient ones.<sup>18</sup> A negative and significant

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<sup>17</sup> Because assumptions underlying the more common Poisson maximum-likelihood regressions could be rejected, this more general estimation procedure was chosen. See chapter 19 of Wooldridge (2002) for an extensive discussion on these regression models.

<sup>18</sup> Akhavein, Berger, and Humphrey (1997) and Vander Venet (1996) report evidence consistent with this.

coefficient on this variable would be consistent with this hypothesis, because more efficient firms have lower values of this expense ratio.

To account for differences in the economic conditions in which BHCs in the sample operate, we employ the annual change in housing prices, collected from a weighted repeat sales index (the House Price Index) produced by the Office of Federal Housing Enterprise Oversight. Price changes are measured at the state level and over the same year as merger activity. For BHCs with banking assets in more than one state, a weighted average of these state-specific measures is used, with each state's share of the BHC's total deposits used as the weights.<sup>19</sup>

For each type of estimation, results using two different functional forms are presented, conforming to specifications (1) and (2) above. The first employs as an explanatory variable *excregcap*, which is a continuous measure of excess regulatory capital, measured, as described above, as the minimum difference between each of the three observed capital ratios and that level of each ratio required to be considered well capitalized under PCA. The second replaces this variable with two binary variables indicating different ranges of *excregcap* observed for the BHC. The variable *excregcap(1-2)* indicates that the BHC's excess regulatory capital, measured as described above, is between 1 percentage point and 2 percentage points, while *excregcap(>2)* is similarly defined for BHCs that have excess regulatory capital of at least 2 percentage points. BHC and year combinations in which the minimum capital differential is less than 1 percentage point represent the omitted category.

Tables 3 and 4 report regression results obtained for the 1998–2002 period, and tables 5 and 6 report the results of equivalent estimations conducted for the longer 1993–2002 period. All reported regressions include year fixed effects (reported only in tables 3 and 4 for reasons of space) and BHC fixed effects (not reported in any tables for reasons of space). Tables 3 through 6 each presents four different estimations, organized into two pairs. The first pair reports the results of negative binomial maximum-likelihood regressions when the number of acquisitions serves as the dependent variable, while the second pair present the results of Tobit maximum-likelihood regressions when the ratio of acquired banking assets to assets of the acquirer serves as the dependent variable.

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<sup>19</sup> We also account for local economic conditions by including a variable that measures the average unemployment rate in the state or states in which a BHC operates. Results (not reported) using this variable are the same as those obtained using the annual change in housing prices.

Consider first table 3, which presents results obtained for the period 1998–2002 for a sample consisting of the ten mandatory A-IRB BHCs and the nine other BHCs with total assets of at least \$50 billion as of mid-year 2003. This sample may be the most immediately relevant to the Basel II proposal, since it is composed specifically of those BHCs whose regulatory capital requirements would be the most likely to be directly affected by the proposal. Of the nineteen BHCs in this group, four are excluded from these estimations because they made no acquisitions during the period.<sup>20</sup>

The finding of positive and statistically significant coefficients on the measures of excess regulatory capital would be consistent with the hypothesis that greater excess regulatory capital enabled or induced BHCs to increase acquisition activity. However, the coefficients reported in 3 are not statistically significant. Indeed the coefficients on *excregcap*, the continuous measure of excess regulatory capital, are negative and insignificant. The coefficients on the binary variable *excregcap(1–2)* are positive when either the number of mergers or the ratio of assets acquired to total assets is used to measure merger activity, and the coefficient on *excregcap(>2)* is positive when the ratios of assets acquired to total assets is used, but these coefficients are also not statistically significant, both individually and jointly, with either measure of merger activity.

The coefficients on *exratio* are negative, consistent with the hypothesis that less efficient BHCs (i.e., those with higher expense ratios) are less likely to acquire other banking organizations, but they are not statistically significant. The coefficients on *hpchange*, the change in housing prices during the year, are positive, as might be expected if a better state economy is associated with a greater tendency for BHCs to acquire other banking institutions, but they are also not statistically significant. The coefficients on the year binary variables are negative and, in most cases, statistically significant, reflecting the fact that 1998, the year representing the omitted category, saw a greater amount of merger activity than later years in the period.

Our inability to find a statistically significant relationship between merger activity and excess regulatory capital may reflect the possibility that the level of capitalization required by the market is, for the most part, greater than that required by regulation, with no relationship between regulatory requirements and merger activity the result. However, this lack of statistical significance

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<sup>20</sup> These observations are dropped, because the fixed-effects statistical model that is used in the empirical analysis requires that, for a given BHC, acquisition activity exhibit some variation over time.

may also reflect the small size of the sample, chosen to contain only those BHCs that are the most likely to be required to adopt or the most likely to adopt voluntarily the A-IRB approach.

Table 4 reports the results of the same regressions, run on a larger sample obtained by lowering the size threshold from \$50 billion to \$15 billion in total consolidated assets as of mid-year 2003. The result is an increase in the number of BHCs in the analysis from 15 to 33 and an increase in the number of year-BHC observations from 75 to 165. For this larger sample, the coefficients on all measures of excess regulatory capital are positive, consistent with the hypothesis that excess regulatory capital induces or enables BHCs to engage in more acquisition activity, but again, none are statistically significant. The estimated coefficients on *excregcap(1-2)* and *excregcap (>2)* are jointly insignificant as well.

The coefficients on *expense ratio* are negative, consistent with the hypothesis that less efficient banking organizations exhibit less of a tendency to acquire other organizations, and these coefficients are highly significant when the ratio of assets acquired to total assets is used as the measure of merger activity. The coefficients on *hpchange* are not statistically significant, while the coefficients of the year binary variables are all negative and, in most cases, highly significant, reflecting the general decline in merger activity occurring after 1998.

Tables 5 and 6 report estimates for regressions equivalent to those reported in tables 3 and 4, except that they employ panel data sets that extend from 1993 to 2002 instead of from 1998 to 2002.<sup>21</sup> Table 5 reports these results for a sample consisting only of BHCs with greater than \$50 billion in consolidated assets (which includes all mandatory A-IRB BHCs). Again, all coefficients on variables that measure the degree of excess regulatory capital are positive, but not statistically significant. The coefficients on the two binary excess capital variables are also jointly insignificant.

The coefficients on *expratio* are all negative and, for this sample, highly significant in every case, consistent with the hypothesis that more efficient banking organizations exhibit a greater tendency to acquire other banking organizations. The coefficients on *hpchange* are not statistically significant.

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<sup>21</sup> Note that the samples analyzed over the 1993-2002 period contain more BHCs than the samples analyzed over the shorter 1998-2002 period, because, for this longer panel, fewer BHCs were omitted as a result of making no acquisitions during the period. Only two BHCs made no acquisitions between 1993 and 2002.



Year fixed effects in the case of this longer panel are not shown for reasons of space.

Table 6 reports the results of equivalent regressions when the sample is expanded to include BHCs with greater than \$15 billion in consolidated assets as of mid-year 2003.

Because of the many years and BHCs included as observations, this sample is the largest of those for which results are reported, and here, we do find statistically significant positive coefficients on the measures of excess regulatory capital when the number of mergers is the measure of merger activity, but not when the ratio of acquired assets to total assets is used as the measure. In this latter case, the coefficients on the binary capital variables are not jointly significant either. Also in the case of this sample, the coefficients on *expense ratio* are negative and statistically significant in most cases, while the coefficients on *hpchange* are not significant.

Summarizing the results reported in tables 3 through 6, we find that coefficients on measures of excess regulatory capital are generally positive, consistent with the hypothesis that excess regulatory capital induces or enables BHCs to increase their level of merger activity, but in most cases are statistically insignificant. Indeed, such coefficients are statistically significant only when the largest sample is employed, and then only for the case in which merger activity is measured by the number of annual acquisitions.

Despite these generally weak regression results, it is still possible that the relationship between excess regulatory capital and BHC merger activity is quantitatively important, based on the magnitude of estimated coefficients. To address this issue, we estimate the likely range of the quantitative impact of adoption of the A-IRB approach on merger activity by combining coefficient estimates with estimates of changes in excess regulatory capital that might result from adoption of A-IRB.

The Third Quantitative Impact Study (QIS 3) was conducted by the Basel Committee on Banking Supervision to understand the possible effects that the Basel II proposals (as of late 2002) might have on capital levels across participating banks.<sup>22</sup> Based on data for 22 U.S. BHCs, the QIS 3 estimated that adoption of A-IRB would, by reducing certain risk weights, lead to an

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<sup>22</sup> The evolution of the Basel proposal, of course, implies that the QIS 3 may not be a good indicator of the effect of the present proposal. Another quantitative impact study is underway and is expected to be completed in 2005.

average reduction in total risk-weighted assets (RWA) of 6 percent. This change would have the effect of raising the ratios of tier 1 to RWA and total capital to RWA. A change in RWA has no effect on the leverage ratio (total capital to average tangible assets), because the denominator is not based on RWA.

We calculate the three relevant regulatory capital ratios – tier 1 capital to RWA, total capital to RWA, and tier 1 capital to average tangible assets – for each of the 38 BHCs in the sample using data from June 30, 2003. We also estimate the value of those ratios under the A-IRB approach by assuming that RWA would be 6 percent lower than the level reported as of that date. Then, for both sets of the three ratios, we compute the difference between each of the ratios and the minimum needed to be considered well capitalized under PCA standards (see table 1). Next, for both the standard and A-IRB approach, we take the minimum of the three differences. Finally, we subtract the excess capital figure computed under current capital rules from the excess capital figure obtained under the A-IRB approach to get an estimate of the change in excess regulatory capital (expressed as a ratio) that a BHC would experience with the adoption of the A-IRB approach. It should be noted that this final figure will be 0 if the BHC were constrained by the leverage ratio under both capital approaches, since the leverage ratio would be unaffected by adoption of A-IRB.

On average, we find (using QIS 3 results) that adoption of A-IRB would result in an increase in a BHC's excess regulatory capital (expressed as a ratio) of 0.31 percentage points. However, it should be noted that this estimate assumes that every BHC in the sample experienced an identical change in risk-weighted assets equal to the average. In actuality, however, the change in risk-weighted assets following adoption of A-IRB should vary across BHCs. Although not accounting for this variation should affect our estimates of the change in excess regulatory capital, the results of the exercise should not be substantially influenced, because we are estimating the likely range of changes in merger activity, which is rather general.

In order to assess the economic meaning of an increase in excess regulatory capital of 0.31 percentage points, we employ the regression coefficient on *excregcap*, as well as previous levels of BHC merger activity.<sup>23</sup> Calculations of the range of likely changes in acquisition activity are based on the smallest

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<sup>23</sup> We do not examine the change in merger activity implied by coefficients on *excregcap(1-2)* and *excregcap(>2)* because we estimate that the values of these binary variables following adoption of A-IRB would change for very few BHCs in our sample.

and largest estimated coefficients on *excregcap*, because they generate the most extreme changes in merger activity that can be predicted from regression results.

The largest coefficient estimated for the number of deals is 0.19 (table 4), and it implies that the average number of mergers conducted by a BHC would increase by 6.1 percent, given an increase in excess regulatory capital of 0.31 percentage points.<sup>24</sup> The smallest coefficient estimate is – 0.087 (table 3) and it corresponds to a decrease in the number of acquisitions of 2.7 percent. These percent increases translate into very modest projected changes in merger activity. The average BHC in the full sample of 38 banks conducted 1.74 deals per year between 1993 and 2002, which is greater than the 1998–2002 average for the full sample or any of the averages for the smaller sample of very large BHCs. Given this average number of deals, a 6.1 percent increase would mean an increase in the average annual number of mergers of only 0.1 acquisitions per large BHC, and a 2.7 percent decrease would mean 0.05 fewer acquisitions per year for each large BHC.

With respect to the ratio of acquired banking assets to total BHC assets, the largest coefficient is 0.049 (table 4) and the smallest one is – 0.022 (table 3). Respectively, these estimates imply changes in the average value of acquired assets to acquirer assets of 1.5 percentage points and – 0.7 percentage points following a 0.31 percentage point jump in excess regulatory capital.<sup>25</sup>

Several caveats suggest that these estimated changes in BHC merger activity that would follow adoption of the A-IRB approach should be viewed as rough, back-of-the-envelope calculations. First, the analysis is static and does not take into account the effect of portfolio changes that could accompany adoption. If BHCs increase the relative share of their assets held in categories that would receive lower risk weights, then the increase in excess regulatory capital could be greater than the estimate of 0.31 percentage points. Second, the data used to estimate changes in RWA are based on QIS 3, which analyzed the effect of the Basel II proposal that was current at the time of the study (late 2002/early 2003). The regulatory capital rules that are ultimately adopted are likely to differ from those used in QIS 3. Finally, we have noted that the estimated change in excess regulatory capital incorporated in this analysis is

<sup>24</sup> For the negative binomial regression, the percentage increase in the number of mergers for a given change in excess capital ( $\Delta\text{excregcap}$ ) can be computed as  $(100 \times e^{\beta(\Delta\text{excregcap})} - 100)$ , which in this case equals  $100 \times e^{(0.19)(0.31)} - 100$ .

<sup>25</sup> The percentage point increase in the ratio of acquired assets to acquirer assets for a given change in excess capital ( $\Delta\text{excregcap}$ ) can be computed simply as  $100 \times \beta \times \Delta\text{excregcap}$ .

based on the average change in risk-weighted assets and does not take into account the wide range of possible changes that individual BHCs may experience.

In summary, our estimates suggest that the likely change in the number of acquisitions in the United States that would follow adoption of the A-IRB capital approach would fall within a narrow range, and that the number of acquisitions would be unlikely to change much following adoption. This result is especially notable because the only significant results obtained in test 1 are for the case in which acquisition activity is measured by the number of deals. Estimates of the change in the ratio of acquired assets to BHC assets includes more extreme values and the likely range is therefore larger. However, all of these estimates are based on statistically insignificant coefficients.

**Test 2.** Tables 7 and 8 present the results of t-tests that analyze the effect on merger activity of generally tighter capital requirements brought about by the adoption of PCA capital standards. In these two tables, merger activity before PCA is measured as the average number of mergers per year during the period 1987–1989. Merger activity after the time that the requirements of PCA should have been foreseen, assumed to be the beginning of 1991, is measured as the average number of mergers per year for the period 1991–1992.<sup>26</sup>

Only BHCs judged to be relatively unconstrained by the capital requirements in effect prior to the advent of PCA (the “old standards”) are included in the comparisons. Such BHCs are defined as those that met the requirement for being “strongly capitalized” (primary capital ratio of at least 6.5 percent and total capital ratio of at least 7 percent) as of December 31, 1986, the start of our pre-PCA period. In addition, we require that the primary capital and total capital ratios of sample BHCs as of December 31, 1990, the start of our post-PCA period, also exceed 6.5 percent and 7 percent, respectively. Requiring sample BHCs to be well-capitalized under the “old standards” at the start of both periods increases the likelihood that the change in acquisition activity undertaken by a BHC over the analysis period is affected largely by

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<sup>26</sup> Although PCA was enacted in December 1991 and fully implemented at the end of 1992, we believe that 1991–92, which took place before PCA became legally binding, is the appropriate period to use as the time that PCA standards first became relevant. The data show that in 1991 sample BHCs with less excess regulatory capital, as measured with the ratios relevant under PCA, increased their excess regulatory capital by more than sample BHCs with greater excess regulatory capital measured with those ratios. This behavior suggests that the standards that would become legally effective at the end of 1992 were already affecting BHCs in 1991. Nonetheless, the results of the analysis are similar if 1992–93 is used as the post-PCA period.

the new PCA standards, and is not heavily influenced by any underlying weakness in the BHC's capital position that would have affected merger activity even if standards had not been increased.

BHCs are split into two groups – those that became constrained by the “new standards” introduced by PCA and those that remained unconstrained under these standards. In the post-PCA period, a BHC is classified as constrained if it fails to meet any of the requirements for being well capitalized under PCA (see table 1) as of December 31, 1990. BHCs that meet all three of these requirements are counted as unconstrained after the change to the new capital regime. Clearly, other definitions of what constitutes a binding capital constraint are possible, and we discuss below the results of tests that employ alternative definitions.

Table 7 reports the results of this test for the sample of sixteen mandatory A-IRB BHCs and other BHCs with consolidated assets greater than \$50 billion (as of mid-year 2003) that met the definition of being unconstrained under the “old standards” as of year-end 1986 and year-end 1990. The first row indicates that for those BHCs that became constrained by PCA capital standards (nine BHCs), mergers per year declined from an average of 1.63 during the period 1987–1989 to .61 during the 1991–1992 period. The second row indicates that for the group of BHCs judged not to have become constrained by PCA standards (seven BHCs), mergers actually increased slightly, from 1.33 per year during the 1987–1989 period to 1.50 per year in the period 1991–1992. Perhaps the most relevant number reported in table 7 is the “difference in difference” reported in the third column of the third row. This figure shows that BHCs that became constrained participated in 1.19 fewer mergers per year, on average, than would have been the case had they not become constrained, assuming their merger activity changed after the introduction of PCA in the same way as the group that remained unconstrained. Although the difference between the two groups of BHCs is clearly consistent with the hypothesis that the imposition of binding capital requirements would cause merger activity to decline, the t-statistic calculated for this difference, and reported in the third column of the fourth row, is only  $-1.46$ , indicating that this difference is not statistically significant at levels traditionally employed to reject null hypotheses (in this case that there is no difference between the two groups).

Table 8 reports the results of an equivalent test conducted using a larger sample obtained by including those BHCs that had at least \$15 billion in consolidated assets as of mid-year 2003. In this sample, those BHCs that

became constrained by the requirements of PCA (eleven BHCs) reduced the number of acquisitions that they made annually from 1.48 in the period 1987–1989 to .54 in the 1991–1992 period. The seventeen BHCs in the sample that did not become constrained by the requirements of the new capital standard also exhibited a reduction in average annual acquisitions, from 1.08 in the earlier period to .76 in the later period. The “difference in difference” of  $-.63$  indicates that BHCs that became constrained by PCA participated, on average, in .63 fewer mergers per year than would have been the case had they exhibited the same change as did those BHCs that did not become constrained. The t-statistic of  $-1.18$  registered for this difference indicates that for this sample as well, this difference is not statistically significant.

The results obtained in test 2 appear to be robust, as we conducted a number of alternative analyses and obtained consistent findings. The results of these additional analyses are discussed, but not reported. Results obtained using higher standards to differentiate whether a BHC is classified as capital constrained or not under the new PCA standards indicate no significant differences in the change in merger activity of the two groups of BHCs. In one of these alternative tests, we classified a BHC as constrained if any of its relevant capital ratios were less than the PCA standard plus 0.5 percentage points, and in another alternative, we used the PCA standard plus 1 percentage point to distinguish between constrained and unconstrained BHCs. Results were similar to those reported in tables 7 and 8, which present results based on PCA standards (with no additional cushion) as the level used to classify BHCs.

We also conducted analyses on an expanded sample of 54 BHCs that operated between December 31, 1986 and December 31, 1993 and that held assets of at least \$5 billion as of December 31, 1986. Of these organizations, 45 were unconstrained under the “old standards.” Results based on this group also fail to reject the hypothesis of no difference in the change in acquisition activity between those BHCs that became constrained by PCA standards and those that did not. Further, regression analyses that control for other variables that might influence the observed change in a BHC’s merger activity, as derived in (5) above, were conducted and found to yield similar, statistically insignificant results. Finally, as noted (see footnote 22), results are similar when the post-PCA period is defined as 1992 and 1993, although more BHCs are unconstrained by PCA standards in this later period.

## VI. Summary and Conclusion

This paper examines empirically the question of whether the internal ratings-based (IRB) approaches employed by certain large banking organizations to determine their regulatory capital requirements, as provided for in the proposed Basel II capital accord, would be likely to lead those banking organizations to increase their acquisition activity. Although the empirical analysis in this study focuses on the United States, where the advanced IRB approach will be implemented by a relatively small number of large banking organizations, the results and discussion are relevant for any country that permits banking organizations to use any internal ratings-based approach to determine capital requirements.

Concerns that acquisition activity would increase following adoption of IRB by a relatively small number of banking organizations stem from two consequences of using an IRB approach. Arguments based on these consequences can be usefully designated as “excess regulatory capital” and “relative capital advantage” arguments. “Excess regulatory capital” arguments focus on the additional excess regulatory capital that would result from a reduction in an IRB adopter’s capital requirements as the driver of greater acquisition activity. Arguments based on the “relative capital advantage” cite the disparity in capital requirements that would exist between banking organizations using the IRB approach and those that would not as the force fueling merger activity.

Because we cannot examine the effects of past reductions in capital requirements in the United States, which is the focus of this study, that affect some organizations but not others, we conduct two less definitive, but nonetheless informative, tests. The first uses recent data to determine whether large banking organizations in the United States with greater excess regulatory capital exhibited a greater tendency to subsequently acquire other banking organizations. The second examines whether the generally higher capital requirements resulting from adoption of “prompt corrective action” standards in the United States in the early 1990s (the last time capital requirements were substantially changed) resulted in a relative reduction in merger activity on the part of those large banking organizations most severely affected by the policy.

Both of these tests are most relevant to “excess regulatory capital” arguments for increased acquisition activity. Of relevance to “relative capital advantage” arguments, however, we note that a substantial number of studies do not support a major implication of the arguments.

On the whole, we do not find convincing evidence either that past changes in excess regulatory capital or that past changes in capital standards had substantial effects on merger activity in the United States. Estimated coefficients and observed differences have signs consistent with the concern that a reduction in regulatory capital requirements for large banking organizations would result in increased merger activity on their part. However, results of the two tests are, with a few exceptions, statistically insignificant, and, in cases where results are statistically significant, quantitative magnitudes are small. Overall, we do not find strong evidence that adoption of IRB under Basel II will lead to a substantial increase in merger activity.



## Appendix

**Table 1**

**Capital Measures for U.S. banks**

	Relevant years	Regulatory minimum	Minimum for „strongly“ capitalized	Source of definition for „strongly“ capitalized
Primary capital to total assets*	1987–1989	5.5 %	6.5 %	Same mark-up that is used with total capital
Total capital to total assets*	1987–1989	6.0 %	7.0 %	Top total capital zone established in Federal Reserve System regulations
Tier 1 capital to risk-weighted assets	1990–2002	4.0 %	6.0 %	Prompt corrective action standards
Total capital to risk-weighted assets	1990–2002	8.0 %	10.0 %	Prompt corrective action standards
Tier 1 capital to total assets	1990–2002	4.0 %	5.0 %	Prompt corrective action standards

\* The ratios of primary capital to total assets and total capital to total assets are also computed for 1990 in order to identify bank holding companies that were affected by the advent of prompt corrective action standards, but that did not experience a substantial weakening in capitalization under the standards relevant before prompt corrective action.

**Table 2**  
**Regression Variable Definitions**

<b>Variable</b>	<b>Definition</b>
excregcap	The “excess capital” exhibited by the BHC at the beginning of the year for which merger activity is observed. Since, for the periods examined, specified values of three different types of capital ratios had to be exceeded to be considered well capitalized, this variable measures the smallest of the differences between the observed BHC’s capital ratio and that level required to be considered well capitalized under prompt corrective action.
excregcap(1–2)	A binary variable indicating that excregcap is between 1 and 2 percentage points above the regulatory minimum required to be considered well capitalized.
excregcap(>2)	A binary variable indicating that excregcap is 2 or more percentage points above the regulatory minimum to be considered well capitalized.
expense ratio	The “expense ratio” exhibited by the BHC during the year previous to the year for which merger activity is observed, defined as BHC noninterest expenses, divided by the sum of noninterest income and the difference between interest income and interest expenses.
hpchange	Weighted average of the percent change in housing prices in the states in which each BHC operates, with BHC-specific state deposit shares used to calculate the weights.

Table 3

<b>The Relationship Between Merger Activity and “Excess Regulatory Capital” for Mandatory A-IRB BHCs and other U. S. BHCs with Assets over \$50 Billion as of June 30, 2003, Panel Data Estimation for the Period 1998–2002, with Year and BHC Fixed Effects</b>				
Dependent variable	Number of Mergers	Number of Mergers	Ratio of Assets Acquired to Total Assets	Ratio of Assets Acquired to Total Assets
exregcap	-.087 (-.23)		-.022 (-.24)	
exregcap (1–2)		.31 (.80)		.10 (1.03)
exregcap (>2)		.13 (.16)		-.025 (-.13)
expense ratio	-.039 (-1.03)	-.036 (-.94)	-.018 (-1.67)	-.017 (-1.53)
hpchange	.082 (.58)	.10 (.71)	.017 (.37)	.021 (.46)
Year 1999	-.44 (-.98)	-.33 (-.69)	-.35** (-2.68)	-.35** (-2.70)
Year 2000	-.87 (-1.52)	-.75 (-1.31)	-.48** (-2.68)	-.47** (-2.79)
Year 2001	-1.05+ (-1.77)	-.92+ (-1.64)	-.33+ (-1.93)	-.33+ (-1.95)
Year 2002	-1.52* (-2.57)	-1.45* (-2.46)	-.47** (-2.75)	-.47** (-2.79)
Estimation procedure:	Neg. Binomial regression	Neg. Binomial regression	Tobit regression	Tobit regression
no. of obs.	75	75	75	75
no. of BHCs	15	15	15	15

Note: t-statistics in parentheses. +, \*, and \*\* indicate significance at the 10, 5, and 1 percent levels, respectively. Four of nineteen BHCs are omitted from the analysis because they made no acquisitions during the time period.

Table 4

<b>The Relationship Between Merger Activity and “Excess Regulatory Capital” for Mandatory A-IRB BHCs and other U. S. BHCs with Assets over \$15 Billion as of June 30, 2003, Panel Data Estimation for the Period 1998–2002, with Year and BHC Fixed Effects</b>				
Dependent variable	Number of Mergers	Number of Mergers	Ratio of Assets Acquired to Total Assets	Ratio of Assets Acquired to Total Assets
exregcap	.19 (.99)		.049 (1.09)	
exregcap (1–2)		.31 (1.17)		.069 (.95)
exregcap (>2)		.42 (1.03)		.095 (.89)
expense ratio	–.026 (–1.13)	–.031 (–1.32)	–.016** (–2.68)	–.017** (–2.75)
hpchange	.089 (1.04)	.10 (1.20)	–.034 (–1.26)	–.033 (–1.23)
Year 1999	–.65* (–2.46)	–.62* (–2.28)	–.18* (–2.31)	–.18* (–2.30)
Year 2000	–1.06** (–2.95)	–1.12** (–3.26)	–.16 (–1.52)	–.17 (–1.61)
Year 2001	–1.20** (–3.06)	–1.25** (–3.36)	–.15 (–1.37)	–.17 (–1.52)
Year 2002	–1.63** (–4.46)	–1.66** (–4.69)	–.31** (–3.10)	–.32** (–3.22)
Estimation procedure:	Neg. Binomial regression	Neg. Binomial regression	Tobit regression	Tobit regression
no. of obs.	165	165	165	165
no. of BHCs	33	33	33	33

Note: t-statistics in parentheses. . +, \*, and \*\* indicate significance at the 10, 5, and 1 percent levels, respectively. Five of thirty-eight BHCs are omitted from the analysis because they made no acquisitions during the time period.

Table 5

<b>The Relationship Between Merger Activity and “Excess Regulatory Capital” for Mandatory A-IRB BHCs and other U. S. BHCs with more than \$50 Billion in Assets as of June 30, 2003, Panel Data Estimation for the Period 1993–2002, with Year and BHC Fixed Effects</b>				
Dependent variable	Number of Mergers	Number of Mergers	Ratio of Assets Acquired to Total Assets	Ratio of Assets Acquired to Total Assets
exregcap	.035 (0.24)		.021 (.54)	
exregcap (1–2)		.31 (1.46)		.095 (1.57)
exregcap (>2)		.48 (1.55)		.11 (1.34)
expense ratio	–.044* (–2.21)	–.050* (–2.51)	–.013* (–2.47)	–.013* (–2.51)
hpchange	–.067 (–1.15)	–.050 (–1.40)	–.0044 (–.33)	–.0042 (–.32)
(Year fixed effects not shown)				
Estimation procedure:	Neg. Binomial regression	Neg. Binomial regression	Tobit regression	Tobit regression
No. of obs.	170	170	170	170
No. of BHCs	17	17	17	17

Note: t-statistics in parentheses. . +, \*, and \*\* indicate significance at the 10, 5, and 1 percent levels, respectively. Two of nineteen BHCs are omitted from the analysis because they made no acquisitions during the time period.

**Table 6**

<b>The Relationship Between Merger Activity and “Excess Regulatory Capital” for Mandatory A-IRB BHCs and other U. S. BHCs with more than \$15 Billion in Assets as of June 30, 2003, Panel Data Estimation for the Period 1993–2002, with Year and BHC Fixed Effects</b>				
Dependent variable	Number of Mergers	Number of Mergers	Ratio of Assets Acquired to Total Assets	Ratio of Assets Acquired to Total Assets
exregcap	.14+ (1.91)		.033 (1.43)	
exregcap (1–2)		.42* (2.32)		.065 (1.38)
exregcap (>2)		.57* (2.49)		.082 (1.39)
expense ratio	–.018 (–1.52)	–.021+ (–1.79)	–.0077* (–2.51)	–.0080* (–2.62)
hpchange	–.031 (–.98)	–.031 (–.98)	–.01 (–1.30)	–.01 (–1.25)
(Year fixed effects not shown)				
Estimation procedure:	Neg. Binomial regression	Neg. Binomial regression	Tobit regression	Tobit regression
No. of obs.	360	360	360	360
No. of BHCs	36	36	36	36

Note: t-statistics in parentheses. . +, \*, and \*\* indicate significance at the 10, 5, and 1 percent levels, respectively. Two of thirty-eight BHCs are omitted from the analysis because they made no acquisitions during the time period.

Table 7

<b>Yearly Averages of the Number of Mergers Before and After “Prompt Corrective Action” and the Change from Before to After “Prompt Corrective Action” for Mandatory A-IRB BHCs and other U.S. BHCs with greater than \$50 Billion in Assets as of June 30, 2003</b>			
	(1)	(2)	(3)
	Average number of mergers per year, 1987–1989	Average number of mergers per year, 1991–1992	Change between the two periods
(a) BHCs not constrained before but constrained after “prompt corrective action” (9 obs)	1.63	.61	–1.02
(b) BHCs not constrained in either period (7 obs)	1.33	1.50	.17
(c) Difference between the groups, (a) – (b)	.30	–.89	–1.19
(d) t-statistic for the difference in (c) <sup>1</sup>	.54	–1.35	–1.46

<sup>1</sup> Assumes unequal variance. Differences may reflect rounding error.

**Table 8**

<b>Yearly Averages of the Number of Mergers Before and After “Prompt Corrective Action” and the Change from Before to After “Prompt Corrective Action” for Mandatory A-IRB BHCs and other U.S. BHCs with greater than \$15 Billion in Assets as of June 30, 2003</b>			
	(1)	(2)	(3)
	Average number of mergers per year, 1987–1989	Average number of mergers per year, 1991–1992	Change between the two periods
(a) BHCs not constrained before but constrained after “prompt corrective action” (11 obs)	1.48	.54	–.94
(b) BHCs not constrained in either period (17 obs)	1.08	.76	–.31
(c) Difference between the groups, (a) – (b)	.41	–.22	–.63
(d) t-statistic for the difference in (c) <sup>1</sup>	.91	–.64	–1.18

<sup>1</sup> Assumes unequal variance. Differences may reflect rounding error.



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