

Studies

**Bank Mergers and
Shareholder Wealth:
Evidence from 1995's
Megamerger Deals**

Thomas F. Siems
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**Does Greater Mortgage
Activity Lead to Greater
Interest Rate Risk?
Evidence from Bank
Holding Companies**

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Bank Mergers and Shareholder Wealth: Evidence from 1995's Megamerger Deals

Thomas F. Siems

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In 1995, the value of U.S. bank mergers and acquisitions reached a record \$73 billion, with consolidation among the largest banks surging. Using an event study methodology and data from the largest bank mergers of 1995, Thomas F. Siems finds that acquiring banks in mergers with the highest percentage of office overlaps received significant positive and higher abnormal returns than banks in mergers with fewer office overlaps. However, Siems finds no evidence that acquiring banks in mergers resulting in the largest increases in market concentration received higher abnormal returns. These results suggest that as the banking industry continues to consolidate, expected cost reductions and efficiency improvements, as opposed to potential gains in market power, are rewarded in the financial market at the merger announcement date.

Does Greater Mortgage Activity Lead to Greater Interest Rate Risk? Evidence from Bank Holding Companies

Kenneth J. Robinson and Kelly Klemme

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Mortgage activity has gained importance over the past fifteen years as a greater mix of mortgage lenders and products has become available. Developments in the mortgage secondary market have been instrumental in increasing the liquidity and safety of mortgage lending activity, as well as providing greater avenues to hedge the risks associated with mortgage activity.

In an effort to determine if greater mortgage activity is associated with greater interest rate risk, Kenneth Robinson and Kelly Klemme analyze a sample of publicly traded bank holding companies (BHCs). Using BHC stock returns, the authors derive estimates of the extent of interest rate risk based on BHCs' involvement in mortgage-related activity. The results suggest that the stock returns of those BHCs more involved in mortgage activity are more sensitive to changes in the spread between long-term and short-term interest rates.

Bank Mergers and Shareholder Wealth: Evidence from 1995's Megamerger Deals

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It appears that banks in in-market mergers receive higher returns because of potential cost reductions and synergistic gains as opposed to potential market power gains.

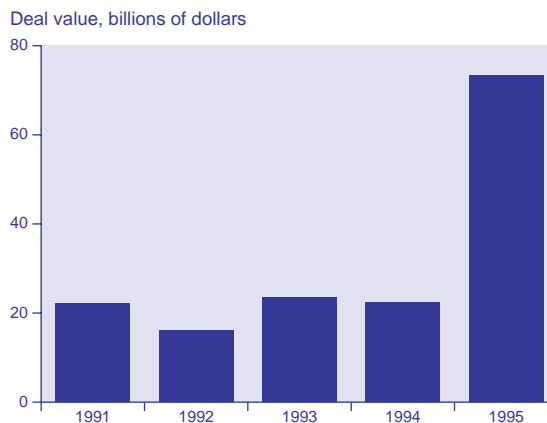
In 1995, the value of U.S. bank mergers and acquisitions exceeded \$73 billion, far surpassing the value of deals in previous years and more than tripling 1994's total (*Chart 1*). Consolidation among the largest banks (those with more than \$10 billion in assets) reached a record level, with 14.7 percent of all large U.S. banks agreeing to sell or merge. This contrasts sharply with consolidation among the nation's smallest banks (those with less than \$500 million in assets), only 3.7 percent of which agreed to merge, the lowest level since 1991.¹

This tremendous surge in merger activity among the nation's largest banks has renewed interest in the great banking battlefield. Today, there are approximately 50 percent fewer U.S. banking organizations than there were in 1986, with most of the consolidation resulting from mergers and acquisitions. Many banking analysts and industry scholars expect this consolidation trend to continue as banks attempt to transform themselves into institutions that successfully compete with other financial services retailers.

It is widely believed that banks on the prowl for mergers are attempting to pick up new customers, expand into new markets, cut overhead, exploit economies of scale, reduce overcapacity, and extend their product offerings into mutual funds, derivatives, and other financial products.² The argument is that the easiest and most efficient way to cut costs, compete effectively against new entrants, and diversify revenue sources is to merge.

By merging with competitors in the same markets (so-called in-market mergers), bankers typically promise to cut overall expenses by consolidating operations, eliminating duplication, and exploiting economies of scale in activities with high fixed costs. In-market mergers also

Chart 1
U.S. Bank Mergers and Acquisitions, 1991–95



DATA SOURCE: SNL Securities Inc.

¹ These data are from SNL Securities (1996).

² See, for example, *The Economist* (1995), Grant (1995), and Holland and Melcher (1995).

present opportunities to create regional banking giants that can gain greater market control. Alternatively, by merging with banks that operate in predominately different markets (cross-market mergers), bankers hope to reduce overall risks through geographic and product diversification, as well as cut costs where appropriate through consolidated operations.

This article empirically investigates banking's megamerger deals in 1995 from the financial market's perspective to shed some light on these various motivations for bank mergers. What are the apparent incentives for 1995's megamerger bank deals? Overall, are bank mergers creating wealth, and how are the gains/losses from mergers distributed between shareholders of acquiring banks and target banks? Can changes in shareholder wealth be explained? Are there differences in abnormal returns received by banks in in-market mergers and those engaged in cross-market mergers?

This article addresses these questions using an event study methodology to assess the financial market's expectations as to the overall performance results from nineteen bank megamerger announcements in 1995. Stock returns of acquiring banks and target banks are analyzed relative to a portfolio of stocks that represent the market. Differences in returns are analyzed on days leading up to and following the "event" date—in this case, the merger announcement date—to determine whether shareholder returns differ significantly from the general market return for stocks.

Using this methodology, differences in returns for acquiring and target banks—ranked and classified by the extent of office overlap and degree of increased market concentration resulting from the merger—can also be assessed. This allows for comparisons of abnormal returns from banks engaged in predominately in-market mergers and those in cross-market mergers. Using these classifications reveals key differences in how the financial markets assess the attractiveness of mergers.

Overall, acquiring bank shareholders experienced significant negative cumulative average abnormal returns over the three-day event period from the day before the merger announcement to the day following the announcement, whereas target bank shareholders experienced significant positive cumulative average abnormal returns. When mergers are ranked and grouped by their extent of office overlap, however, acquiring banks in mergers that result in the five highest office overlap percentages received significant *positive* average abnormal re-

turns. This contrasts with the significant *negative* average abnormal returns received by banks in mergers with the five highest increases in market concentration.

The results provide evidence that, at the merger announcement date, mergers with higher office overlap percentages generate greater shareholder wealth than those with fewer or no office overlaps. Moreover, I find that this preference may have more to do with potential synergistic gains and cost reduction opportunities than with the potential to reduce price competition and gain market power. It is important to note, however, that these conclusions are based on a limited sample and I have not investigated all competing hypotheses.

Why merge?

Why are banks interested in merging with other financial institutions? What motivates a bank to acquire another bank? This article examines five hypotheses for why banks merge.³

Manager utility maximization. The *manager-utility-maximization hypothesis* suggests that factors other than maximizing shareholder value motivate mergers. These factors include management's level of compensation, job security, and span of control. In this view, managers act to maximize their own utilities, rather than those of the owners, or shareholders, of the firm. If investors perceive that managers are pursuing a merger solely in management's own interests, the price of the acquiring bank's shares should drop to reflect expected losses from an unprofitable investment. Taken to the extreme, the manager-utility-maximization hypothesis predicts no aggregate wealth creation, or even a drop in wealth, because of the acquiring bank management's selfish motives. The gains realized by target bank shareholders should equal the losses suffered by the acquiring bank's shareholders, plus any expenses incurred to account for the transfer.

Hubris. Another behavioral explanation is the *hubris hypothesis*, which suggests that managers believe they can uncover "bargains." They persist in the belief that their own valuation of the target bank is correct, even when confronted with objective information that shows the target's true economic value is lower, as reflected in its market valuation. Here, the acquiring bank winds up paying too much for the target institution. Thus, under the hubris hypothesis, the stock price of the acquiring bank could be expected to fall and that of the target bank to rise at the merger announcement date. Further, a merger under these circumstances should sim-

³ Interested readers are directed to Hawawini and Swary (1990) for more on these hypotheses and for additional hypotheses on the motivations for bank mergers. For the most valued characteristics in target banks, see Hunter and Wall (1989).

ply transfer wealth from acquiring bank shareholders to target bank shareholders and not result in any net aggregate wealth creation. Because of the similar stock price predictions of this hypothesis and the manager-utility-maximization hypothesis, it is difficult to distinguish empirically between the two.

Synergy. The *synergy hypothesis* suggests that the acquiring bank can effectively generate synergies via economies of scale and scope by reducing costs and eliminating redundancies and duplication. All else being equal, lower costs mean increased profits and higher stock prices for both acquiring bank shareholders and target bank shareholders. Expected synergistic gains should create positive net aggregate wealth. While a better test of the synergy hypothesis would be to study the postmerger efficiency effects of bank mergers, the event study methodology can be used to test whether investors believe the merging partners' promises to cut costs and increase internal efficiencies.

Diversification. The *diversification hypothesis* suggests that the combined firm can create diversification gains and hedge risk exposures either geographically or through offering a greater selection of products and services. In a principal-agent relationship, shareholders should benefit from gains in diversification. Thus, shareholders of both acquiring banks and target banks should experience stock price gains from mergers that result in risk-reducing diversification.

Market power. Finally, the *market power hypothesis* suggests that the acquiring bank can succeed in reducing price competition in the market by acquiring some of its competitors (see Stigler 1964). One approach used by researchers to test this hypothesis is to examine the price reaction of competitors in the same market as the merged institutions (see Eckbo 1983 and Stillman 1983). If a merger creates market power, competitors in the same market should also experience a rise in their share prices as a result of higher product prices and lower monitoring costs. Another approach to testing the market power hypothesis is to examine the relationship between a merger's increased market concentration and abnormal returns received by acquiring bank and target bank shareholders. Large increases in market concentration associated with high abnormal returns would tend to support the market power hypothesis.

Table 1 summarizes the predicted stock price movements for both acquiring banks and target banks under each of the hypotheses presented. Also included are references to studies that have empirically tested each hypothesis.

Table 1
Stock Price Predictions at Merger Announcement

Hypothesis	Acquiring banks	Target banks	Selected references
Manager-utility-maximization	–	+	Amihud and Lev (1981) Born, Eisenbeis, and Harris (1988) Sushka and Bendeck (1988)
Hubris	–	+	Roll (1986, 1988) Bradley, Desai, and Kim (1988)
Synergy	+	+	Jensen and Ruback (1983) Bradley, Desai, and Kim (1988) Hawawini and Swary (1990)
Diversification	+	+	Jensen and Meckling (1976) Amihud, Dodd, and Weinstein (1986) Saunders, Strock, and Travlos (1990)
Market power	+	+	Eckbo (1983) Stillman (1983) Boyd and Graham (1991)

Findings from previous bank merger event studies

Rhoades (1994) provides a comprehensive and well-organized summary of bank merger performance studies published during 1980–93. Of the thirty-nine studies published during this period, twenty-one used the event study methodology, while nineteen took the operating performance approach (one study used both methodologies).⁴

Rhoades concludes that the main findings of the event studies are not consistent. For acquiring banks, seven studies find that a merger announcement had a significant negative influence on the returns to shareholders, seven other studies find no significant effect on the acquiring bank's stock returns, three studies find positive returns, and four studies conclude with mixed findings. Only nine studies analyze the merger's effect on the target bank's stock returns. Of these, eight studies find a significant positive abnormal return to target bank shareholders, and one study finds no abnormal returns.

Thus, previous merger-announcement event studies have generally found positive abnormal returns for target bank shareholders, but the returns to shareholders of the acquiring banks are too inconsistent to draw any conclusions. It is also important to note two shortcomings of event studies. First, event studies reflect expectations about many varied factors surrounding merger proposals. As a result, they should not be used to draw conclusions about whether mergers result in efficiency gains.⁵ Second, event studies use short-term stock price movements that may reflect investor speculation. Conse-

⁴ Operating performance studies observe the financial performance of the combined firm following a merger and allow the researcher to focus on evaluating costs and efficiencies. Interested readers are directed to Rhoades (1993) and Peristiani (1993) for applications in the banking industry.

⁵ Operating performance studies in banking, on the other hand, generally conclude that bank mergers do not tend to result in efficiency gains. See, for example, DeYoung (1993), Srinivasan and Wall (1992), and Berger and Humphrey (1992).

Table 2
1995 U.S. Bank Megamergers

Acquiring bank	Target bank	Deal value (millions)	Announcement date
First Union Corp.	Coral Gables Fedcorp	\$513.8	1/03/95
National Australia Bank	Michigan National Corp.	1,517.9	2/05/95
Fleet Financial Group	Shawmut National	3,635.2	2/21/95
PNC Bank Corp.	Chemical Bank		
	New Jersey holdings	504.0	3/08/95
US Bancorp	West One Bancorp	1,448.5	5/08/95
Union Bank	BanCal Tri-State	1,006.4	5/19/95
Charter One Financial	FirstFed Michigan	555.8	5/30/95
First Union Corp.	First Fidelity Bancorp	5,395.0	6/19/95
NationsBank Corp.	CSF Holdings	516.0	7/05/95
PNC Bank Corp.	Midlantic Corp.	3,043.2	7/10/95
First Chicago Corp.	NBD Bancorp	5,107.0	7/12/95
Banc One Corp.	Premier Bancorp	696.0	7/19/95
First Bank System	FirsTier Financial	712.8	8/07/95
Boatmen's Bancshares	Fourth Financial	1,179.8	8/25/95
National City Corp.	Integra Financial	2,081.7	8/28/95
Chemical Banking Corp.	Chase Manhattan Corp.	11,358.4	8/28/95
NationsBank Corp.	Bank South Corp.	1,589.8	9/05/95
UJB Financial	Summit Bancorp	1,124.1	9/11/95
Republic New York	Brooklyn Bancorp	529.6	9/24/95
CoreStates Financial	Meridian Bancorp	3,192.5	10/10/95
Wells Fargo Corp.	First Interstate	11,600.0	10/18/95
Regions Financial	First National Bancorp	648.1	10/23/95
Bank of Boston	BayBanks	2,058.4	12/12/95
Fleet Financial Group	National Westminster	3,260.0	12/19/95

SOURCES: SNL Securities; Bloomberg Business News.

⁶ Megamerger deals are defined here as those mergers with deal values that exceeded \$500 million.

⁷ While SNL Securities reports that there were twenty-four megamerger deals in the banking industry in 1995, the following five deals were eliminated from this analysis for the following reasons: (1) Stock price data were unavailable for NBD Bancorp in the \$5.1 billion deal with First Chicago; (2) U.S. stock price data were unavailable for National Westminster (a British bank) in the \$3.3 billion deal with Fleet Financial; (3) the \$1 billion deal between Union Bank and BanCal Tri-State was the result of two Japanese banks merging; (4) the \$700 million acquisition of Premier Bancorp by Banc One came as no surprise to investors because of an option that Banc One had received in 1991 to acquire Premier under certain conditions, thereby making the deal a foregone conclusion; and (5) PNC Bank's \$500 million acquisition of Chemical Bank's New Jersey holdings involved the sale of eighty-three branches and was not really a merger.

⁸ Peterson (1989) provides a review of the present state of knowledge and practice with respect to event study methodology. Armitage (1995) also outlines widely used methods for estimating abnormal returns and tests of significance. Fama, Fisher, Jensen, and Roll (1969) is considered the earliest and most influential event study to examine abnormal returns around the announcement of stock splits. I closely follow the approach outlined in Wall and Gup (1989).

⁹ The office overlap measures were calculated by summing, over the shared markets, the smallest office total of either the acquiring bank or the target bank and then dividing that quantity by the total number of offices of the acquiring bank.

¹⁰ The office overlap measure and this separation of mergers seems consistent with the literature. For example, in an operating performance study intended to examine mergers most likely to result in efficiency gains, Rhoades (1993) defines horizontal (in-market) mergers as those that have partners with "overlapping operations in terms of having any offices located in the same market, where market is defined as a Metropolitan Statistical Area (MSA) or non-MSA county."

quently, short-run abnormal stock returns should not be used to evaluate the actual performance effects of mergers. They can, however, be used to assess the financial market's expectations for future performance and may help explain why the bank merger trend continues.

Methodology to identify abnormal returns

Table 2 lists twenty-four bank megamergers in 1995, arranged by merger announcement date.⁶ Five mergers were eliminated from the sample for various reasons, leaving nineteen deals to analyze.⁷ Some descriptive statistics for both acquiring banks and target banks are given in Table 3. As expected, acquiring banks are significantly larger, in terms of total assets, than target banks. Moreover, target banks have greater variability in measures of profitability, capital strength, and asset quality.

Overall, I am interested in whether shareholders of the acquiring and target banks involved in 1995's megamerger deals received any abnormal returns on their stock holdings at, or near, the merger announcement date. More specifically, I am interested in whether the data support any of the five hypotheses outlined above.

To assess these motivations to merge, I rank the mergers by office overlap and market

concentration measures and group the banks into quartiles. Doing so enables me to test for significant differences in abnormal returns between, say, the top quartile (that is, the banks from mergers ranked in the top five of the given measure) and the rest of the sample population. For example, I can test whether banks in mergers with a higher percentage of office overlaps or greater market concentration received abnormal returns significantly different from banks in mergers with fewer office overlaps or smaller increases in market concentration. To identify abnormal returns to shareholders, I follow the methodology used in most event studies (see the box entitled "Event Study Methodology").⁸

To test the synergy and diversification hypotheses, I classify mergers by ranking and group them by their extent of office overlap.⁹ The office overlap measure provides some indication of the potential cost savings and synergistic gains that could be realized by closing offices and eliminating redundancies and duplicative efforts. Mergers that result in a higher percentage of office overlaps should have greater opportunities for synergistic gains.¹⁰ Mergers with fewer overlaps, while having fewer opportunities for cost savings, should have greater opportunities for geographic diversification gains by extend-

Table 3
1995 Megamergers: Descriptive Statistics

	Acquiring banks		Target banks	
	Mean (Standard deviation)	Median (Low:High)	Mean (Standard deviation)	Median (Low:High)
Total assets (millions of dollars)	\$60,575 (54,337)	\$42,849 (6,116:171,423)	\$18,651 (26,892)	\$8,727 (2,381:114,038)
Return on assets	1.13 (.27)	1.11 (.72:1.63)	1.09 (.65)	1.14 (-1.15:2.02)
Equity/ total assets	7.16 (.77)	7.01 (5.69:8.68)	8.06 (1.74)	7.89 (5.23:12.71)
Nonperforming assets/ gross assets	.95 (.39)	1.02 (.22:1.77)	1.35 (1.77)	.94 (.19:8.32)
Total loans/ deposits	86.76 (15.74)	89.20 (37.82:103.80)	80.24 (12.69)	78.14 (55.16:115.45)
Volatile liabilities/ total assets	25.23 (11.17)	20.38 (11.04:47.45)	17.60 (11.01)	15.04 (5.45:49.10)

NOTE: All data are as of December 31, 1994. National Australia Bank is excluded from these figures because it had no U.S. depository institution subsidiaries as of December 31, 1994.

DATA SOURCES: NIC (the Federal Reserve's National Information Center for Systemwide Structure and Financial Information); Office of Thrift Supervision, Thrift Financial Report.

ing their market. In other words, in-market mergers—that is, mergers with more office overlaps—offer greater opportunities for extensive cost savings through the elimination of redundant branches, consolidation of back-office operations, and synergies realized through a streamlined organization that understands its market. On the other hand, cross-market mergers—those with fewer or no office overlaps—offer fewer prospects for cost savings, but they do provide an opportunity for the combined entity to expand its product base, geographically diversify, and accelerate earnings growth through added lines of business to a larger customer base. These are very different approaches. In-market mergers emphasize cost-cutting, whereas cross-market mergers emphasize diversity and growth. In-market mergers search for increased efficiencies by reducing inputs relative to outputs, whereas cross-market mergers seek increased efficiencies by expanding the rate of output growth faster than the rate of input growth. In-market mergers create regional banking giants that have the potential for greater market control, whereas cross-market mergers permit an institution to establish a footing in a new geographic area.

Thus, for mergers expected to result in extensive cost savings and synergistic gains, the synergy hypothesis postulates that those banks in mergers with more office overlaps should receive positive average abnormal returns. For mergers expected to produce risk-reducing ben-

efits and enhanced revenue growth through geographic diversification, the diversification hypothesis theorizes that those banks in mergers with fewer office overlaps should receive positive average abnormal returns.¹¹

However, because it is possible that mergers with more office overlaps (and a correspondingly higher percentage of deposit overlaps) presumably have greater opportunities to reduce price competition and gain market power by earning monopoly rents, it seems feasible that investors might value in-market mergers more than cross-market mergers.¹² To test the market power hypothesis, I again rank and group mergers but this time use a measure to capture the merger's increase in market concentration—the change in the Herfindahl–Hirschman Index (HHI).¹³ This quantity is used by the Department of Justice to measure market concentration and evaluate the potential anticompetitive effects of mergers. If a merger is expected to generate market power, banks in mergers with the greatest increases in market concentration could be expected to have positive average abnormal returns.

Shareholder returns

What were the incentives for the bank megamergers of 1995? And do different rankings and groupings of merged banks by the office overlap and market concentration measures shed any light on the various motivations to merge?

Overall results. Table 4 presents a summary of the abnormal returns for both acquiring banks

¹¹ The wealth effects of bank mergers may vary cross-sectionally, depending on factors specific to individual mergers. To analyze merger-specific factors, I could regress the abnormal returns on several explanatory variables. However, to sufficiently investigate the contribution of each factor, more merger data are needed.

¹² See Boyd and Graham (1991).

¹³ The HHI is calculated by summing the squares of the market share of each firm, using total deposits as the proxy for market share. The change in the weighted-average HHI was calculated as follows: (1) For each market, the acquiring bank's HHI was multiplied by the percentage of its deposits in that market divided by its total deposits; (2) the same computation was made for the target bank; (3) the quantities from steps 1 and 2 were then summed by weighing each quantity by each bank's share of total deposits of the combined institution to arrive at the premerger HHI; and (4) the change in the weighted-average HHI was then computed by comparing the postmerger HHI (that is, what the HHI would be if the two banks were combined) with the quantity arrived at in step 3.

Table 4
**Average Abnormal Stock Returns
 For Nineteen Megamergers in 1995**

Event period	Acquiring banks	Target banks
Day before announcement	.09% (.428)	.82%* (2.068)
Day of merger announcement	-1.59%*** (-5.214)	11.99%*** (35.884)
Day after announcement	-.47%* (-1.930)	.23% (.488)
Day before announcement to day of announcement	-1.49%*** (-3.384)	12.81%*** (26.836)
Day before announcement to day after announcement	-1.96%*** (-3.877)	13.04%*** (22.193)

NOTE: *t* statistics in parentheses.

- *** Significant at the .01 level.
- ** Significant at the .05 level.
- * Significant at the .10 level.

and target banks in 1995's megamerger deals. Average abnormal returns for five event periods are reported (the day before the merger announcement, the day of the announcement, the day following the announcement, cumulative returns from the day before the announcement to the day of the announcement, and cumulative returns from the day before the announcement to the day following the announcement). Also reported are the *t* statistics (to test whether the returns are significantly different from zero).

For all mergers taken together, the merger announcements were generally associated with negative average abnormal returns to acquiring bank shareholders and positive average abnormal returns to shareholders of target bank stocks. Most noteworthy is the cumulative average abnormal returns received over the three-day event period from the day before the merger announcement to the day following the announcement. For acquiring banks, the cumulative average abnormal return during this event period was -1.96 percent, with eleven of the nineteen stocks receiving negative returns. For target banks, the cumulative average abnormal return was +13.04 percent, with eighteen of the nineteen stocks receiving positive returns. Abnormal returns to shareholders of both acquiring banks and target banks are significantly different from zero at the 0.01 level.

The finding of significant negative average abnormal returns to acquiring banks and signifi-

cant positive average abnormal returns to target banks is consistent with a number of previous bank merger event studies.¹⁴ For the group of nineteen bank megamergers, the overall results align best with the predictions of the manager-utility-maximization hypothesis and the hubris hypothesis. That is, acquiring banks received negative average abnormal returns because management was either attempting to maximize its own utility, and not that of its shareholders, or it simply paid too much for the target institutions. However, because acquiring banks received a positive three-day average abnormal return in eight of the nineteen mergers, it seems feasible that other hypotheses may be true as well, especially when banks are grouped and analyzed according to the extent of office overlap and degree of increased market concentration.

Office overlap results. Table 5 shows the three-day event period cumulative average abnormal returns for both acquiring banks and target banks, ranked and grouped in quartiles by the extent of office overlap. Panel A shows that the cumulative average abnormal return for acquiring banks engaged in mergers with the five highest office overlaps was +2.80 percent, which is significantly different from zero at the 0.05 level. This contrasts with the fourteen remaining acquiring banks in mergers with fewer office overlaps. These banks received a cumulative average abnormal return of -3.66 percent, which is significantly different from zero at the 0.01 level. Moreover, the difference in abnormal returns between these two groups of banks is statistically significant at the 0.01 level.

But the difference in abnormal returns between acquiring banks in mergers with a higher percentage of office overlaps and those with fewer office overlaps is not significant when the banks are grouped according to the other two cutoffs (for example, top ten versus bottom nine and top fourteen versus bottom five). When including more banks in the higher office overlap groups (and thereby fewer in the lower office overlap groups), no significant differences in acquiring bank stock returns between the groups are detected.

For target banks, panel B of Table 5 displays the three-day event period cumulative average abnormal returns grouped in quartiles by the extent of office overlap. Target banks involved in mergers with more office overlaps consistently had higher positive cumulative average abnormal returns. Most notable here is the significant difference in cumulative average abnormal returns for the target banks in the fourteen mergers with the highest percentage of

¹⁴ See Cornett and Tehranian (1992), Hawawini and Swary (1990), Hannan and Wolken (1989), Baradwaj, Fraser, and Furtado (1990), and Trifts and Scanlon (1987) for studies that have found significant negative abnormal returns for acquiring banks and significant positive abnormal returns for target banks.

Table 5

Three-day Event Period Cumulative Average Abnormal Returns, Ranked by Percentage of Office Overlaps

Panel A: Acquiring bank returns

Office overlap	Abnormal return	Office overlap	Abnormal return	Difference in abnormal returns
Top 5	2.80%** (3.631)	Bottom 14	-3.66%*** (-6.687)	6.46%*** (12.451)
Top 10	-2.20%** (-2.400)	Bottom 9	-1.69%** (-3.104)	-.51% (1.086)
Top 14	-2.10%*** (-3.227)	Bottom 5	-1.58%* (-2.158)	-.52% (.340)

Panel B: Target bank returns

Office overlap	Abnormal return	Office overlap	Abnormal return	Difference in abnormal returns
Top 5	13.82%*** (13.663)	Bottom 14	12.76%*** (17.689)	1.06%*** (4.945)
Top 10	13.79%*** (18.730)	Bottom 9	12.20%*** (12.503)	1.59%*** (6.812)
Top 14	15.21%*** (21.699)	Bottom 5	6.95%*** (6.952)	8.26%*** (9.243)

NOTE: *t* statistics in parentheses.

*** Significant at the .01 level.

** Significant at the .05 level.

* Significant at the .10 level.

office overlaps (+15.21 percent) and the target banks in mergers with the five fewest office overlaps (+6.95 percent).

These results tend to support the synergy hypothesis in that, as the banking industry consolidates, greater emphasis is being placed on banks' lowering input costs and gaining internal efficiencies via in-market mergers, yet still maintaining strong market share. Most noteworthy is the significant *positive* average abnormal returns received by the acquiring banks in the top five mergers ranked by office overlap. Shareholders appear to receive greater value for banks in mergers with the highest percentage of office overlaps (that is, the top quartile), where both acquiring banks and target banks received positive average abnormal returns significantly higher than the rest of the sample population.

Furthermore, because acquiring banks in mergers with fewer office overlaps always received negative average abnormal returns, I find no evidence to support the diversification hypothesis. This could be because the geographic and revenue diversification gains typically sought through cross-market mergers seem to be easier and less costly for all banks to obtain through

technological innovations that allow customers to do their banking via computers and telephones, without the need for costly brick and mortar structures.

Market concentration results. My interest here is whether shareholders receive more value for in-market mergers than for cross-market mergers because of the greater likelihood that in-market mergers can gain market power and earn monopoly rents. Table 6 shows the three-day event period cumulative average abnormal returns for banks ranked and grouped in quartiles according to each merger's increase in market concentration, as measured by change in the weighted-average HHI.

For acquiring banks, none of the groups with higher increases in market concentration received cumulative average abnormal returns that were positive or significantly greater than the abnormal returns received by banks in mergers with lower increases in market concentration. Acquiring banks in mergers with the five highest increases in market concentration received a cumulative average abnormal return of -2.87 percent, significantly different from zero at the 0.10 level but not significantly different from the -1.64

Table 6

Three-day Event Period Cumulative Average Abnormal Returns, Ranked by Market Concentration

Panel A: Acquiring bank returns

Change in HHI	Abnormal return	Change in HHI	Abnormal return	Difference in abnormal returns
Top 5	-2.87%* (-2.692)	Bottom 14	-1.64%** (-2.908)	-1.23% (-1.500)
Top 10	-2.40%** (-2.701)	Bottom 9	-1.47%** (-2.787)	-.93% (.292)
Top 14	-2.10%*** (-3.227)	Bottom 5	-1.58%* (-2.158)	-.52% (.340)

Panel B: Target bank returns

Change in HHI	Abnormal return	Change in HHI	Abnormal return	Difference in abnormal returns
Top 5	15.37%*** (13.609)	Bottom 14	12.20%*** (17.721)	3.17%*** (4.436)
Top 10	14.58%*** (19.301)	Bottom 9	11.32%*** (11.901)	3.26%*** (8.326)
Top 14	15.21%*** (21.699)	Bottom 5	6.95%*** (6.952)	8.26%*** (9.243)

NOTE: *t* statistics in parentheses.

*** Significant at the .01 level.

** Significant at the .05 level.

* Significant at the .10 level.

percent cumulative average abnormal return received by the rest of the acquiring banks.¹⁵

For target banks, I find significantly higher and positive average abnormal returns for banks in mergers with greater increases in market concentration. The difference in abnormal returns is especially pronounced between target banks engaged in mergers with the five lowest increases in market concentration and the rest of the target banks. The fourteen banks in mergers with the highest increases in market concentration received a cumulative average abnormal return of +15.21 percent, whereas the target banks in mergers with the five lowest increases in market concentration received a cumulative average abnormal return of +6.95 percent. Interestingly, this grouping is the same as that generated by the office overlap measure in Table 5.

To further examine the relationship between abnormal returns and market concentration, Chart 2 plots the three-day event period cumulative average abnormal returns received by acquiring bank shareholders and target bank shareholders, respectively, against the change in the weighted-average HHI. No significant rela-

tionships between abnormal returns and market concentration levels seem to exist, and the correlation coefficients of the tested relationships are only +0.067 for acquiring banks and +0.216 for target banks.

Thus, the most noteworthy finding here is that the cumulative average abnormal returns for acquiring banks in mergers with the five largest increases in market concentration was *negative* and significantly different from zero at the 0.10 level, whereas the average abnormal returns for acquiring banks in mergers with the five highest office overlaps was significantly *positive*. Given the negative average abnormal returns for all groups of acquiring banks ranked by market concentration, I find no evidence to support the market power hypothesis.

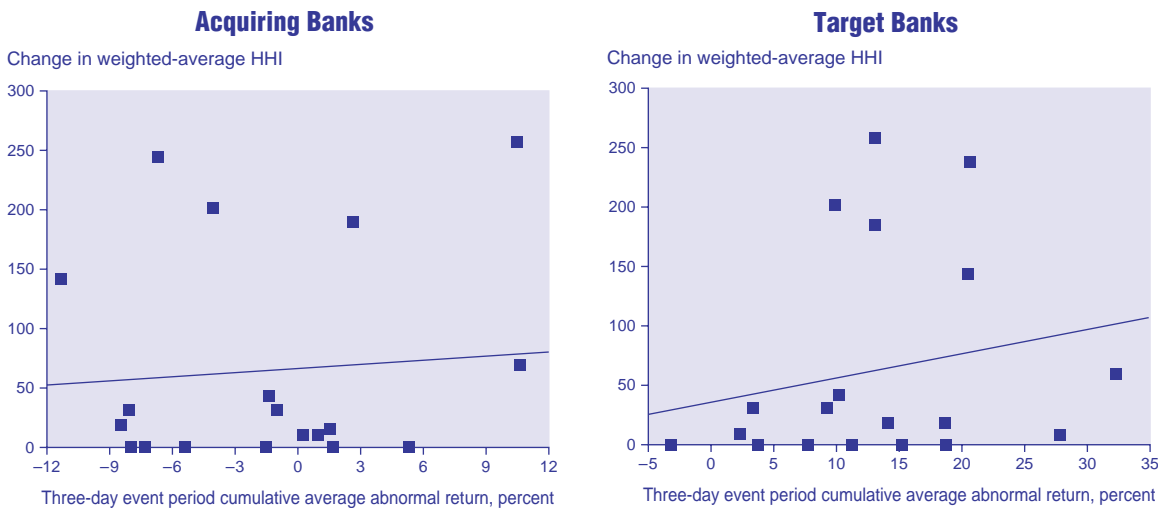
Conclusions

For 1995's bank megamergers, banks in mergers with a higher percentage of office overlaps earned higher returns than banks in mergers with fewer office overlaps. Whereas the total sample of nineteen acquiring banks produced significant *negative* average abnormal returns, acquiring banks in mergers with the five highest

¹⁵ This result seems consistent with James and Wier (1987), who find that the achievement of market power is not an important source of observed positive abnormal returns to acquiring banks.

Chart 2

Relationships Between Abnormal Returns and Market Concentration



DATA SOURCES: Bloomberg Business News; NIC; Federal Deposit Insurance Corp., Summary of Deposits.

percentages of office overlaps (the top quartile) received significant *positive* average abnormal returns. This contrasts with acquiring banks in mergers with the five greatest increases in market concentration, which received significant *negative* average abnormal returns.

These results suggest that as the banking industry continues to consolidate, expected cost reductions and efficiency improvements theorized under the synergy hypothesis for in-market mergers are rewarded in the financial markets at the merger announcement date. Moreover, I find no evidence that banks in mergers resulting in large increases in market concentration lead to significant positive abnormal returns, leading me to reject the market power hypothesis.

The results for the full sample of banks are consistent with the predictions of the manager-utility-maximization hypothesis and the hubris hypothesis, which postulate that acquiring bank stock prices fall if management is perceived as looking out for its own interests or believed to be paying too much for the target institution and target bank stock prices rise as its shares are bid up by the acquiring institution.

Of course, other factors could influence the stock prices of acquiring banks and target banks around the merger announcement date that are not controlled for in this study. For example, I have limited this merger analysis to using market measures, but there could be corporate control issues distorting the returns near the merger announcement date that remain masked. Further, my conclusions are based on an analysis of a limited number of observations.

Nevertheless, it appears that banks in in-market mergers receive higher returns because of potential cost reductions and synergistic gains as opposed to potential market power gains. By separating banks into groups based on the extent of office overlap and increased market concentration, I find evidence to support the synergy hypothesis and reject the market power and diversification hypotheses as possible explanations for bank mergers. For the full sample of banks and for banks in mergers with fewer office overlaps, I find evidence to support the manager-utility-maximization hypothesis and the hubris hypothesis that acquiring banks overbid for targets, leading to negative announcement-period returns.

Event Study Methodology

For each security j , the following stochastic process model is used to calculate abnormal returns:

$$(1) \quad AR_{jt} = R_{jt} - (\alpha_j + \beta_j R_{mt}),$$

where

- AR_{jt} = abnormal return for bank stock j at time t ,
- R_{jt} = actual return for bank stock j at time t ,
- α_j = ordinary least squares (OLS) estimate of the intercept of the market model regression,
- R_{mt} = return to the market at time t as approximated by the NYSE Composite Index,¹ and
- β_j = OLS estimate of the slope of the coefficient in the market model regression.

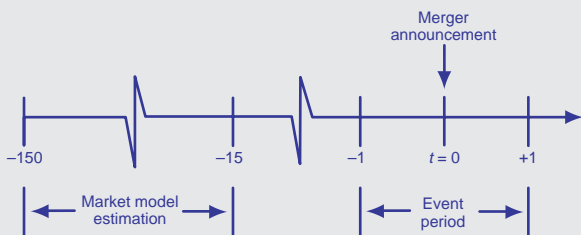
The parameters α_j and β_j are estimated from the market model as follows:

$$(2) \quad R_{jt} = \alpha_j + \beta_j R_{mt} + e_{jt},$$

where R_{jt} , α_j , R_{mt} , and β_j are as defined above, and e_{jt} is the residual. Daily returns for R_{jt} and R_{mt} are computed from daily stock price data and index values reported by Bloomberg Business News over the period from $t = -150$ to $t = -15$ relative to the merger announcement date at $t = 0$.² Equation 2 is estimated using ordinary least squares.

The resulting estimated values for α_j and β_j are then substituted into equation 1 with data for R_{jt} and R_{mt} to calculate the abnormal returns for each bank stock (AR_{jt}) for several periods immediately before and after the merger announcement date.³ Abnormal returns are computed for the day before the merger announcement ($t = -1$), the day of the announcement ($t = 0$), and the day following the announcement ($t = +1$). Cumulative average abnormal returns are also produced for the periods from $t = -1$ to $t = 0$ and from $t = -1$ to $t = +1$. These calculations indicate whether the stock returns to the acquiring banks or target banks are abnormal as compared with those expected from normal market movements. Chart A.1 displays a time line that shows the market model estimation period, the event date, and the periods used to compute abnormal returns.

Chart A.1
Event Study Time Line



As discussed in Hawawini and Swary (1990), the market model shown in equation 2 breaks down the total return on bank stock j into two components: a market component that reflects general market movements and a firm-specific component that reflects price variations caused by firm-specific events. Deducting $[\alpha_j + \beta_j R_{mt}]$ from R_{jt} (as shown in equation 1) neutralizes the effect of general market movements but does not neutralize firm-specific price variations caused by events other than the merger announcement.

To neutralize these firm-specific price variations, the cross-sectional average of the abnormal returns for the total sample of bank stocks for each period is computed. For a sample of n bank stocks, the mean abnormal return for each day t is computed as

$$(3) \quad MAR_t = \frac{1}{n} \sum_{j=1}^n AR_{jt},$$

where $t = -1, 0, +1$. The cross-sectional average neutralizes firm-specific price variations that are unrelated to the merger announcements because each announcement did not occur at the same point in time for the n banks in the sample. Hence, the expected value of MAR_t is zero in the absence of abnormal returns due to merger announcements.

The final calculation of abnormal returns is to compute cumulative average abnormal returns from day $t = -1$ to $t = 0$ and from day $t = -1$ to $t = +1$ using the formula

$$(4) \quad CAR(-1, t_1) = \sum_{t=-1}^{t_1} MAR_t,$$

where $t_1 = \{0, +1\}$, and $CAR(-1, t_1)$ is the cumulative average abnormal return for the sample of n bank stocks over the event period interval from $t = -1$ to $t = t_1$. The expected value of CAR is zero in the absence of abnormal performance.

To test the significance of MAR_t , the average standardized abnormal return is estimated using the following statistic, as described in Dodd and Warner (1983):

$$(5) \quad SAR_t = \frac{1}{n} \sum_{j=1}^n \frac{AR_{jt}}{s_{jt}},$$

where s_{jt} is the estimated standard deviation of the abnormal returns for bank stock j in event period t and is computed by

$$(6) \quad s_{jt} = \sqrt{s_j^2 \left[1 + \frac{1}{T} + \frac{(R_{mt} - \bar{R}_m)^2}{\sum_{k=1}^T (R_{mk} - \bar{R}_m)^2} \right]},$$

where

- s_j^2 = residual variance for security j from the market model regression,
- T = number of days in the estimation period (135),
- R_{mt} = rate of return on the market index for day t of the event period,
- \bar{R}_m = mean rate of return on the market index during the estimation period, and
- R_{mk} = rate of return on the market index for day k of the estimation period.

As shown in equation 6, the standard error of the forecast for the event period, s_{jt} , involves a slight adjustment from the standard error of the estimate, s_j . This adjustment reflects the deviations of the independent variables in the estimation period from the values employed in the original regression and are typically close to 1 (see Peterson 1989).

Assuming cross-sectional independence, SAR_t approaches a normal distribution and the test statistic is unit normal:

$$(7) \quad t \text{ stat.} = \sqrt{n} SAR_t.$$

This test statistic is used to test the hypothesis that the average abnormal returns for a given sample of bank stocks (MAR_t) are significantly different from zero at various significance levels for each of the event periods $t = -1, 0, +1$.

A similar test statistic is employed to test the hypothesis that the cumulative average abnormal returns (CAR) are significantly different from zero. In this case, the relevant test statistic must be modified to fit the particular interval over which the returns are calculated, as follows:

$$(8) \quad t \text{ stat.} = \sqrt{\frac{n}{(t_1+2)}} \sum_{t=-1}^{t_1} SAR_t,$$

where $t_1 = \{0,+1\}$ to compute cumulative average abnormal returns over the two-day event period from $t = -1$ to $t = 0$ and the three-day event period from $t = -1$ to $t = +1$.

To test whether abnormal returns between two different groups of stocks are statistically different from each other, I use the following test statistic, as outlined in Hawawini and Swary (1990):

$$(9) \quad t \text{ stat.} = \frac{(CAR_1 - CAR_2)}{\sqrt{\frac{1}{t-2} \sum_{t=1}^T (Z_t - Z)^2}},$$

where

CAR_1 = cumulative average abnormal return for one group of stocks,

CAR_2 = cumulative average abnormal return for another group of stocks,

T = number of days in the estimation period (135),

Z_t = difference in returns between CAR_1 and CAR_2 at time t , and

Z = average difference in returns between CAR_1 and CAR_2 over the estimation period.

¹ The NYSE Composite Index is a capitalization-weighted index that includes all companies listed on the New York Stock Exchange.

² Peterson (1989) reports that estimation periods generally range from 100 to 300 days for daily studies. Lengthening the estimation period involves a trade-off between greater precision of estimation of α , and β , and these coefficients becoming out of date (see Armitage 1995).

³ The merger announcement date is the date the merger was announced by Bloomberg Business News, which corresponds to merger dates reported by SNL Securities. For most mergers analyzed in this article, a sharp stock price increase or decrease accompanied the merger announcement. However, it is important to note that rumors of mergers and insider information may distort somewhat the abnormal returns immediately surrounding the merger announcement date. Armitage (1995) reports that short event windows are commonly used if the event date can be determined with precision, and Dyckman, Philbrick, and Stephan (1984) find that cumulative average abnormal returns are preferable to choosing one day at random as the event date. Hence, I also analyze two-day and three-day event windows.

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Does Greater Mortgage Activity Lead to Greater Interest Rate Risk? Evidence from Bank Holding Companies

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Our results provide some evidence that mortgage activity is associated with greater sensitivity to interest rate movements, especially when considering changes in the yield spread.

The nation's mortgage markets have undergone major structural changes over the past fifteen years. The mix of lenders that offer mortgage credit today looks much different than in the early 1980s, and the array of mortgage products also has become much wider and more varied. Furthermore, the emergence of a secondary market and the securitization of mortgage loans have significantly enhanced liquidity and safety. Along with these advances in the provision of mortgage credit, though, some fundamentals of the mortgage business remain unchanged. Like any other line of business, potential risks are associated with mortgage lending activity. Prepayment risk and interest rate risk represent the main types of risks to mortgage-market participants, while credit risk has been substantially mitigated by the provision of government guarantees or private mortgage insurance.

Prepayment risk is the risk that all or a portion of a mortgage loan will be paid off before maturity. Prepayments, which shorten the actual life of a mortgage loan from its stated maturity, are an expected cost of the mortgage business. Movements in interest rates, which are often difficult to predict, are important factors affecting prepayments. Increases in interest rates cause prepayments to slow as borrowers choose to retain their below-market loans, while decreases in interest rates hasten the pace of prepayments as borrowers refinance their above-market loans. The advent and development of the mortgage secondary and derivatives markets, however, have given mortgage-market participants opportunities to hedge prepayment risk.

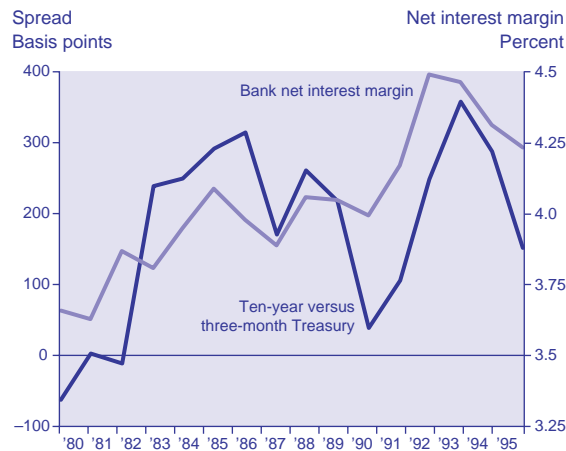
Interest rate risk is present when changes in interest rates affect profitability. The conventional wisdom is that financial intermediaries are susceptible to interest rate risk. Traditionally, intermediaries are viewed as institutions that borrow short and lend long.¹ Because of this mismatch in maturity structure, changes in interest rates could change the market value of financial intermediaries' outstanding assets and liabilities, but not necessarily in equal or offsetting ways. For instance, if interest rates increase, then the rate paid on deposit liabilities might adjust faster than the rate earned on various earning assets, exerting a negative effect on profitability. In contrast, decreases in interest rates would have a positive effect.²

Changes in the levels of interest rates, though, are not the only source of interest rate risk. Some recent evidence indicates that movements in the spread between long-term and short-term interest rates are also important influences. Chart 1 shows movements in banks' net

¹ Flannery (1983, 1981), however, finds some evidence that the portfolios of bank holding companies may be long-funded.

² A mismatch in the asset-liability maturity structure is not the only source of interest rate risk. If unanticipated increases in interest rates affect the rate at which market participants discount the present value of lenders' future profit streams, then interest rate risk would be present.

Chart 1
**Bank Net Interest Margin
 Versus Interest Rate Spread**



DATA SOURCES: Reports of Condition and Income; CITIBASE.

interest margin and the yield spread between ten-year and three-month Treasury securities. Throughout most of the past fifteen years, but especially since 1990, there appears to be a fairly close relationship between the interest margin and yield spread. When the yield spread widens such that long-term rates are high relative to short-term rates, intermediaries may shift into more long-term assets in a desire to increase current profits.³ If so, then increases in the spread would tend to exert a positive effect on intermediaries' financial condition. As with the case of prepayment risk, opportunities also exist to hedge exposure to interest rate risk.

Numerous studies have investigated the extent of banking organizations' exposure to movements in interest rates.⁴ Many of these studies measure interest rate risk by estimating how sensitive bank holding company (BHC) stock prices are to interest rate movements. The focus of this article is the degree of interest rate risk that arises from bank holding company involvement in mortgage activity. Certain characteristics of mortgage activity might actually lead to greater interest rate risk for those BHCs that pursue more of this type of activity. If so, it would be useful to try to judge the extent of this exposure to interest rate risk. The sections that follow describe some of the characteristics related to mortgage activity and their connection to interest rate risk in more detail. Then, some background on the evolution of the mortgage industry is provided, followed by a description of the technique used to estimate the extent of interest rate risk. The final sections provide an assessment of the empirical results, along with some caveats and conclusions.

Mortgage activity and interest rate risk

Mortgage activity can be defined broadly as the origination and/or servicing of loans secured by mortgages on real property. In addition to holding mortgages in their portfolios or purchasing mortgage loans from other lenders, organizations involved in mortgage activity could also temporarily hold mortgages for later sale in the secondary market and could invest in mortgage-related securities.

The steps involved in the origination and sale of a typical mortgage are illustrated in Chart 2. Mortgage origination begins when a loan application is taken and a rate commitment is agreed upon, and ends when the loan is made. In the interim, the loan is considered to be in the "pipeline," during which time documentation is gathered and the applicant's credit is analyzed. After closing, mortgage loans may be either held by the originator or packaged and sold in the secondary market. When mortgage lenders originate and sell residential real estate loans in the secondary market, these sales could be sold outright or *under recourse*, which means that the buyer has the right to return the security to the seller if unforeseen credit risks develop or other negotiated warranties and representations are breached. Mortgage originators will often retain the right to service the loans they sell in the secondary market for a fee. Servicing entails the collection of monthly payments from the borrowers, collection and maintenance of escrow accounts, and the remittance of principal and interest payments to the ultimate investors. Servicers of mortgages can also sell their so-called servicing rights to others who might purchase these servicing rights to diversify both their product mix and the geographic distribution of their portfolios.

Like the other types of activities undertaken by financial intermediaries, mortgage lending exposes them to interest rate risk. In fact, it could be the case that greater mortgage activity makes financial intermediaries even more sensitive to changes in interest rates. The borrow-short-and-lend-long view of financial intermediaries might be particularly relevant for mortgage originators because mortgages generally represent relatively long-term assets. Chart 3 provides some idea of the possible asset-liability structure that might exist with mortgage activity. This chart shows the portfolio allocations of long-term assets and long-term deposits for a sample of publicly traded bank holding companies.⁵ As a proxy for mortgage activity, these banking organizations are divided into two groups based on the percentage of their assets

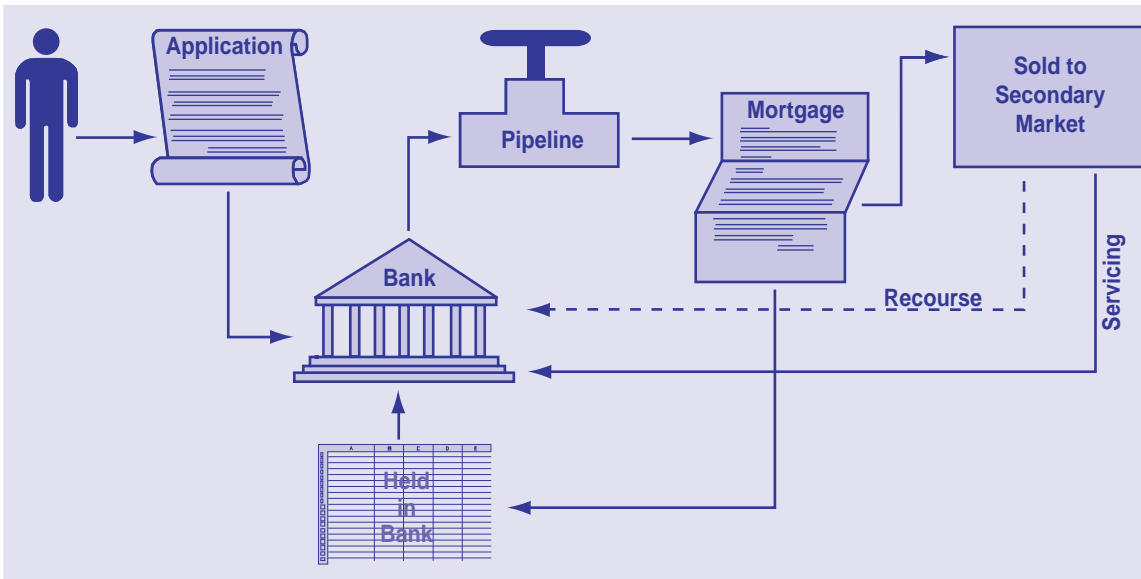
³ See Short, Gunther, and Moore (1993). Robinson (1995) provides evidence of the importance of the yield spread in affecting banking organizations' market values.

⁴ See Flannery and James (1984); Aharony, Saunders, and Swary (1986); Sweeney and Warga (1986); Saunders and Yourougou (1990); Yourougou (1990); and Houpt and Embersit (1991).

⁵ These are the same bank holding companies utilized later in the empirical estimations of interest rate risk.

Chart 2

The Mortgage Origination Process



in loans secured by one- to four-family properties—those in the upper 40 percent and those in the lower 60 percent. From Chart 3, both groups of BHCs have fairly similar deposit maturity structures, with long-term time deposits accounting for about one-fourth of total time deposits. Differences exist on the asset side, however. Those BHCs with a greater portfolio concentration in residential mortgage activity have a greater percentage of long-term assets, as might be expected. With the asset–liability structure exhibited in Chart 3, the profitability of those BHCs in the upper 40 percent could be more adversely affected by an increase in interest rates because a greater proportion of their asset portfolio would reprice more slowly than those BHCs in the lower 60 percent.

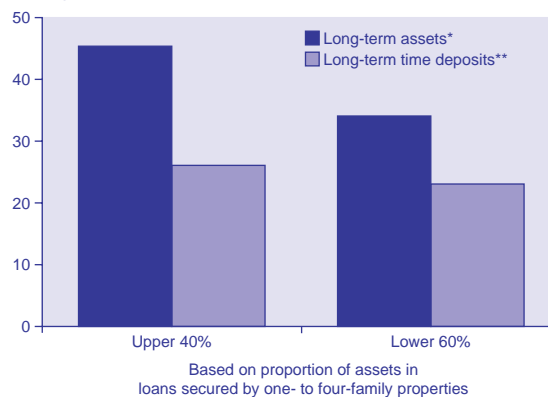
Interest rate risk is also present even before the mortgage loan closes. The cost of funding mortgage loans before their sale or delivery to permanent investors could increase significantly if interest rates increase. When interest rates rise, mortgage lenders could experience losses on the sale of mortgage loans to permanent investors because of rates that were locked in forty-five to sixty days earlier in the pipeline.⁶ If mortgage lenders choose to hold onto the loans they originate, then they would also be exposed to the usual risk that any long-term investment will lose value if interest rates increase.

The effects of changes in the yield spread might be especially important for mortgage activity, given the expanded array of mortgage products now offered. The increased availability

since the mid-1980s of adjustable rate mortgages (ARMs) and shorter term mortgages, such as those with a five- or seven-year balloon payment that are priced off the short end of the yield curve, have made changes in the spread more important. For example, beginning in 1992, short-term rates fell sharply relative to long-term rates, and the yield curve was historically steep. By the end of 1994, the production of conventional thirty-year mortgages had increased by about one-third, while the production of balloon mortgages more than doubled, and the produc-

Chart 3
Asset–Liability Structure

Average, 1983–95



* Proportion of total loans and debt securities maturing or repricing in more than one year.

** Proportion of time deposits with a maturity or repricing frequency of more than one year.

DATA SOURCE: Reports of Condition and Income.

⁶ Even after the mortgage loan is made, delays may occur in the sale of the loan to the secondary market. These delays would also expose the lender to interest rate risk.

tion of fifteen-year mortgage loans tripled. In addition, the market share of ARMs went from an average of 20 percent in 1992 to 39 percent in 1994. The wider availability and increased popularity of ARMs and shorter term mortgages priced off the short end of the yield curve may make increases in the spread an important factor that boosts the profitability of mortgage lenders when the yield spread widens.⁷ Thus, while decreases in interest rates are generally viewed positively by the mortgage industry, a decline in short-term rates relative to long-term rates may be an increasingly important factor in the profitability of mortgage lending.

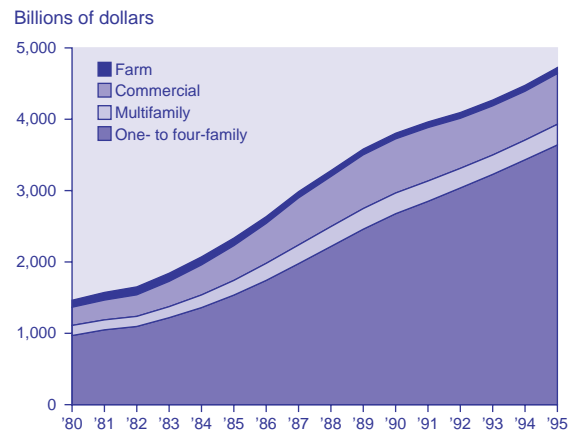
Finally, the revenue generated from mortgage servicing activity could be adversely affected by changes in interest rates. In this particular activity, decreases in interest rates could exert downward pressure on profitability. When interest rates decline, prepayments increase. These prepayments shorten the life of the mortgage loans and reduce the expected revenue stream from servicing activity.⁸

However, differences in portfolio structure, the length of the mortgage pipeline, or the increased use of shorter maturity mortgage products do not necessarily imply that financial intermediaries would be vulnerable to movements in interest rates. Opportunities to hedge interest rate risk are available through the use of such financial products as futures, options, and swaps. When financial intermediaries employ hedging strategies, they attempt to protect the market value of their assets and liabilities from the effects of changes in interest rates. Innovations in the nation's mortgage markets that have emerged over the past fifteen years have provided an expanding array of hedging opportunities that help mitigate exposure to interest rate risk.⁹ A look at some developments in the mortgage credit market over the past fifteen years shows both how important mortgage lending activity has become and how innovations to manage risk have evolved.

The mortgage industry: Some background

Mortgage credit has grown steadily and now represents the largest single type of private debt outstanding. Chart 4 shows that the total amount of mortgage debt outstanding has increased from \$1.5 trillion in 1980 to \$4.7 trillion in 1995. Total mortgage debt outstanding now accounts for about half of all total private nonfinancial debt. As Chart 4 indicates, most outstanding mortgage debt is on one- to four-family homes; multifamily, commercial, and farm mortgages account for much smaller shares of the total.

Chart 4
Total Mortgage Debt Outstanding by Loan Type



DATA SOURCE: Mortgage Bankers Association.

One of the most significant developments in the nation's housing finance market has been the emergence of a large secondary market for existing mortgage debt. Primary mortgage lenders are able to offer a wider variety of home mortgages because of this secondary market and to specialize in different aspects of mortgage activities, including loan originations, servicing, and financing. This secondary market also has enhanced the liquidity of mortgage activity and provided greater opportunities to hedge the risks associated with mortgage lending. The federal government played an active role in the development of the secondary mortgage market through the creation of *government sponsored enterprises* (GSEs), which are institutions that securitize and guarantee loans. The GSEs most important to the residential mortgage market are the Federal National Mortgage Association (FNMA), or Fannie Mae, and the Federal Home Loan Mortgage Corporation (FHLMC), or Freddie Mac.

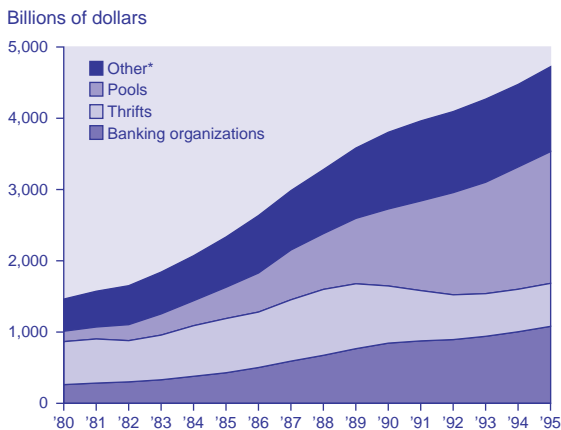
Mortgage securitizations represent the pooling and repackaging of mortgage loans into securities for sale. Since these securities are backed by mortgages, they are known as *mortgage-backed securities*. As indicated in Chart 5, at year-end 1995, about 40 percent of all mortgage loans outstanding were held in secondary market mortgage pools, with banking organizations, thrifts, and various mortgage-related entities (including GSEs themselves) accounting for the remainder. Securitization of mortgages began in 1970 when the Government National Mortgage Association (GNMA), or Ginnie Mae, developed the pass-through mortgage-backed security that guaranteed the timely pay-

⁷ See Schorin and Gordon (1995) and Inside Mortgage Finance Publications, Inc. (1996).

⁸ This revenue effect from prepayment risk could be offset, though, by the increase in overall mortgage lending activity generated by declines in interest rates.

⁹ See Giarla (1995).

Chart 5
Total Mortgage Debt Outstanding by Holder Type



* Includes GSEs, life insurance companies, mortgage companies, and real estate investment trusts.

DATA SOURCE: Mortgage Bankers Association.

ment of interest and principal on bundles of standardized mortgages.¹⁰ Normally, the underlying mortgages backing the security are similar with respect to loan type (such as fully amortizing with a level payment), maturity, and interest rate so that cash flows can be projected as if the pool were a single mortgage.

In most cases, the originators of a mortgage-backed security (such as mortgage companies, banks, or thrifts) obtain the guarantee of one of the federally sponsored agencies. In addition, a significant amount of mortgages is directly purchased, pooled, and securitized by the agencies themselves. A much smaller volume of mortgages is securitized directly by private issuers. Chart 6 shows the volume of mortgage-backed securities outstanding that are guaranteed by GNMA, FNMA, FHLMC, and also those issued by private conduits. Growth in this market has been explosive: from approximately \$111 billion in mortgage-backed securities outstanding in 1980 to about \$1.8 trillion by 1995. Securitizations have enhanced the flow of mortgage credit, facilitated the integration of the residential mortgage market into the nation's capital markets, and provided greater avenues to hedge the risks associated with mortgage lending.¹¹

The CMO

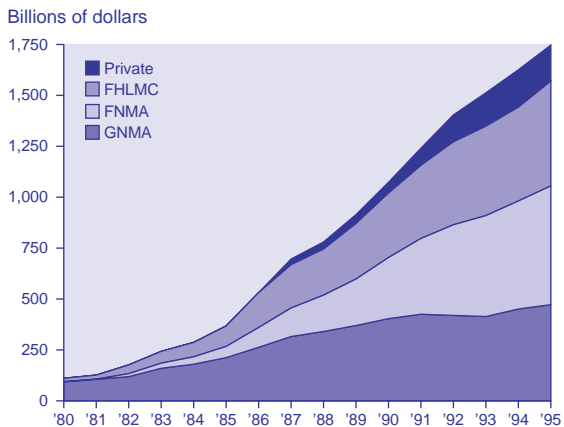
As discussed earlier, one of the risks associated with mortgage activity is prepayment risk, or the possibility that mortgage borrowers will choose to pay off their mortgages before the maturity date. When interest rates decline sharply, as in the early 1990s, borrowers often choose to

refinance their outstanding mortgages, although the rate at which they choose to do this is often difficult to predict. This tendency has important implications for mortgage-backed securities because the principal on individual mortgages in the pool can be prepaid without any penalty at any time before the stated maturity of the security. Recognizing this risk, in 1983 FHLMC issued a special type of mortgage-backed security known as the *collateralized mortgage obligation*, or CMO.

The purpose of CMOs is to provide investors with a choice of bonds that would prepay either earlier or later than the average life of most mortgages. A CMO is a multi-tranche bond backed by a pool of fixed-rate mortgages in which the cash flows are channeled into two or more groups of securities with different yields and maturities. In this way, total prepayment risk is divided among classes of bonds, or tranches.¹² The attraction of CMOs is that the interest and principal cash flows are reallocated in ways that satisfy different investors' preferences regarding payment streams. CMOs, some with as many as twenty or more tranches, have proved to be very popular in the secondary market, with the total amount outstanding increasing from \$4.6 billion in 1983 to \$582 billion at the end of 1995.¹³

Mortgage-backed securities, as a group, can be vulnerable to interest rate movements. Increases in interest rates can adversely affect the value of these securities. And, because mortgage lending activity declines, the volume of mortgage-backed securities will also tend to fall off. Both of these developments can have a depressing effect on the secondary market for

Chart 6
Mortgage-Backed Securities Outstanding



DATA SOURCES: Mortgage Bankers Association; Inside Mortgage Finance Publications, Inc., *The Mortgage Market Statistical Annual for 1996*.

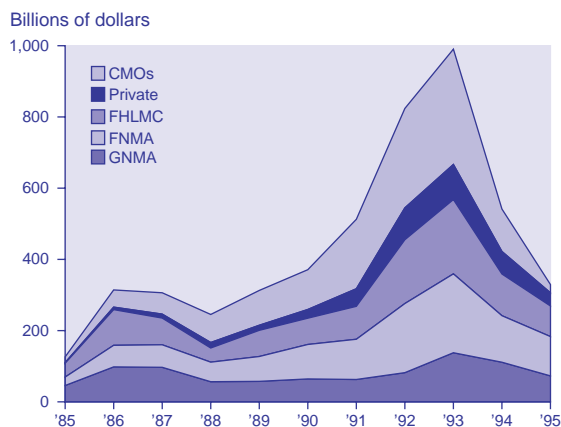
¹⁰ GNMA is not a government-sponsored enterprise but instead is a government agency that is part of the Department of Housing and Urban Development. As such, its guarantees carry an explicit full faith and credit guarantee from the federal government.

¹¹ See Giarla (1995) and Breeden (1995).

¹² Real Estate Mortgage Investment Conduits (REMICs) are similar to CMOs with the exception of some differences in tax and regulatory characteristics. See Ames (1995) for a discussion of REMICs.

¹³ See Inside Mortgage Finance Publications, Inc. (1996). A number of new types of CMOs have evolved to meet particular investors' needs, including such instruments as Planned Amortization Classes (PACs) and Targeted Amortization Classes (TACs) that are structured to provide additional protection from prepayment volatility. See Ames (1995).

Chart 7
New Mortgage-Backed Security Issues



DATA SOURCES: Mortgage Bankers Association; Inside Mortgage Finance Publications, Inc., *The Mortgage Market Statistical Annual for 1996*.

mortgages. The run-up in interest rates in 1994 offers an example. Chart 7 shows new issues of mortgage-backed securities, including CMOs, since 1985. Lower interest rates in the early 1990s generated a sharp increase in mortgage activity and a concomitant rise in new issues of mortgage-backed securities. As interest rates increased in 1994, however, new issues of mortgage-backed securities declined sharply. By 1995 mortgage-backed security issues were down more than 50 percent from their 1993 peak, while new CMO issues were off by almost 93 percent.¹⁴

The mortgage secondary market has increased liquidity and provided greater safety for mortgage lenders. Credit risk has been greatly reduced by the emergence of GSEs, and prepayment risk can be more easily managed thanks to the CMO. Movements in interest rates can have a significant impact on activity in the secondary mortgage market, reflecting, in part, the effect of interest rates on lending activity. Interest rate movements can also be potentially important factors affecting primary mortgage lenders. An examination of BHC mortgage activities can yield insight into the role of interest rate risk in mortgage lending.

Why bank holding companies?

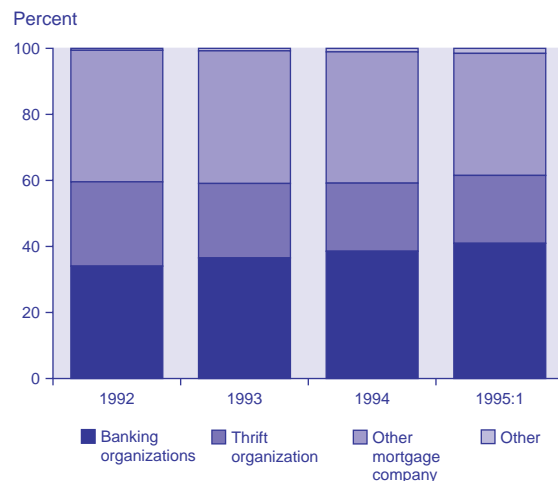
Concentrating on bank holding companies is a useful first step in analyzing whether interest rate risk is greater for those organizations that are more heavily involved in mortgages. While by no means the only player in the provision of mortgage credit, bank holding companies do represent a significant and growing component of the nation's mortgage market. Moreover, because of the Federal Reserve's oversight respon-

sibilities for banking organizations, some consistent data with which to judge the magnitude and extent of BHC participation in mortgage activity are available. Data are less readily available for other important mortgage lenders, such as mortgage companies and other publicly and privately held nondepository institutions.¹⁵

Unfortunately, no clear-cut, concise measure of the extent of bank holding companies' mortgage activities is available. The structure of mortgage banking operations differs across individual bank holding companies, and the type and extent of the mortgage-related data depend on each institution's individual structure. The data that are available, though, indicate that BHC involvement in the mortgage banking market is important and growing.

Chart 8 shows market share measures of BHCs relative to other major players in the mortgage industry, based on origination volume over the past few years. As of first-quarter 1995, BHCs accounted for about 40 percent of the total volume of mortgage originations, indicating that limiting the analysis of interest rate risk associated with mortgage activity only to bank holding companies can still capture a significant portion of the nation's mortgage market. Moreover, banking organizations' share of mortgage originations has been growing over the past few years, as indicated by Chart 8. The *American Banker's* 1995 rankings of the top one hundred mortgage originators show that banking organizations accounted for half the total number of originations of this group, compared with 44 percent in 1994.

Chart 8
Share of Origination Volume By Type of Ownership



DATA SOURCE: Mortgage Bankers Association.

¹⁴ For more on the secondary market for mortgages, see Ames (1995) and Lowell (1995).

¹⁵ While thrifts have been an important player in the nation's mortgage markets in the past, their share of one- to four-family mortgage originations has declined from more than 40 percent in 1983 to about 15 percent in the third quarter of 1995. In the most recent ranking undertaken by the *American Banker* and SNL Securities, no thrift was among the top ten mortgage originators in 1995. Moreover, the number of publicly traded thrift institutions was insufficient to carry out the empirical analysis used here.

Table 1
Mortgage Activity Classification Measures

Mortgage activity classification measure	Time period	Source	Mean (percentage)		
			Number of BHCs	Upper 40%	Lower 60%
Loans secured by one- to four-family residential properties (bank subsidiaries only)	1983:1–95:3	Report of Condition and Income	88	18	12
Loans secured by first liens on one- to four-family residential properties	1991:1–95:3	FR Y-9C	94	16	7
Loans secured by first and junior liens on one- to four-family residential properties	1990:4–95:3	FR Y-9C	94	18	8
Assets sold with recourse ^a	1990:4–95:3	FR Y-9C	84	1	.01
One- to four- family servicing volume	1992:1–95:3	FR Y-9C	93	42	22
Mortgage servicing rights	1986:4–95:3	FR Y-9C	83	.2	.01

a = outstanding principal balance of mortgages transferred with recourse to FNMA and FHLMC.

All variables are expressed as a percentage of consolidated BHC assets, except for one- to four-family bank loans, which are expressed as a percentage of total consolidated bank subsidiary assets.

Using the stock market to judge interest rate risk

Numerous studies have used the response of stock prices to interest rate movements in an effort to estimate the extent of interest rate risk at particular companies.¹⁶ In this approach, the so-called *market model* is used to judge how stock returns respond to changes in interest rates. The market model assumes that all stock prices are affected by general economic conditions, which implies that a fairly close relationship should exist between an individual security's return and the return on a marketwide index of stocks. This relationship is referred to as a stock's *beta*. When looking at interest rate risk, the market model is augmented to include terms to represent changes in interest rates or in the yield spread. If these terms exert a statistically significant influence on the individual security's return, then the stock market views these firms to be vulnerable to movements in interest rates or to changes in the spread between long-term and short-term interest rates.

To determine whether interest rate risk might be greater for those bank holding companies that pursue more mortgage-related activities, we estimate the response of BHC stock returns to interest rate movements. If increases in interest rates adversely affect profitability, then this effect should be reflected in declines in BHC stock returns when interest rates increase. If increases in the yield spread are also important, then increases in the spread should be associated with increases in BHC stock returns. And if mortgage activity leads to increased interest rate risk, then the more heavily a BHC is involved in

mortgage activities, the greater these effects should be. Three different interest rate measures are used. We estimate the effect of changes in short-term interest rates on BHC stock returns, and how changes in long-term rates and changes in the spread between long-term and short-term rates affect BHC stock returns.

The data

Estimating the extent of interest rate risk using the market model requires data on stock returns for BHCs. These data are available quarterly from *Compustat*. Before obtaining estimates of whether interest rate risk is heightened by mortgage activity, we first must define and measure this type of activity. These measures of mortgage activity can be used to classify BHCs according to the extent of their involvement in mortgages and then to test whether greater mortgage activity plays a role in increasing interest rate risk at bank holding companies.

In an effort to classify BHCs according to their mortgage activity, a total of six different mortgage activity measures can be identified based on consolidated reports filed with federal supervisory agencies. These variables, along with the time period over which each is used, the source of the mortgage activity measure, and the number of BHCs used in the estimation, are listed in Table 1.¹⁷ Also in Table 1 are the mean values of each of these measures for two groups of BHCs—those in the upper 40 percent of the sample in terms of the mortgage activity measure and those in the lower 60 percent. The upper 40 percent represents those organizations that are assumed to be more heavily involved in

¹⁶ See Chance and Lane (1980); Flannery and James (1984); Aharoni, Saunders, and Swary (1986); Sweeney and Warga (1986); Saunders and Yourougou (1990); and Yourougou (1990).

¹⁷ BHC regulatory reports do not contain data on mortgage originations. Because some of the BHCs' mortgage-related data are incomplete or missing, only those BHCs that reported data over the entire time periods shown in Table 1 are used in the estimations.

mortgage activity. These different mortgage activity measures vary considerably in their importance. Mortgage servicing rights and assets sold with recourse represent relatively small components of total assets, on average, compared with the other measures. Each of these different mortgage measures is used to divide the sample into two groups when estimating the market model in an effort to judge whether mortgage activity plays a role in how BHCs respond to changes in interest rates.

The different measures in Table 1 represent a broad spectrum of activity that can take place in the nation's mortgage markets. Loans secured by one- to four-family residential properties (bank subsidiaries only) are mortgage loans held by commercial banks and include home equity lines of credit. The next two mortgage variables are similar but represent mortgage loans held either by a bank or by a nonbank subsidiary of a BHC and do not include home equity lines of credit. Assets sold with recourse represent the dollar amount of mortgages sold to Fannie Mae and Freddie Mac with recourse. This variable can be thought of as being a rough proxy for originations, although as Table 1 indicates, assets sold with recourse are a relatively small component for these BHCs. Servicing volume is an off-balance-sheet item indicating the outstanding principal balance of mortgage loans serviced for others, while mortgage servicing rights represent a source of fee income, as discussed above. If interest rate risk is present, then for the first five variables used to classify BHCs, stock returns should be adversely affected by increases in interest rates, while the stock market should view increases in the spread favorably. For those BHCs classified based on mortgage servicing rights, the stock market could view decreases in interest rates unfavorably because lower rates increase the likelihood of prepayments, which could exert a negative effect on profitability.

The period used for the estimation depends on the particular mortgage classification measure chosen, as indicated in Table 1, with bank loans secured by one- to four-family properties offering the earliest beginning date of the first quarter of 1983. The estimates run through the third quarter of 1995. The only restrictions on the sample are that the banking organizations must have reported stock price data for a minimum of five consecutive years.

Data for banking organizations' stock prices and dividends are for the last trading day of the quarter and are adjusted for dividend and stock splits. The market index used is Standard &

Poor's stock price index and dividend index based on the last trading day of the quarter. Three different interest rate measures are used to detect whether interest rate risk is present. These include changes in the three-month Treasury bill rate (*TBILL*) and the ten-year Treasury bond rate (*TBOND*), both as of the last trading day of the quarter, and are intended to capture the importance of both short-run and long-run changes in interest rates, respectively, on BHC stock returns. The third interest rate measure is *SPREAD*, defined as (*TBOND*-*TBILL*), which is intended to capture the effects of changes in the yield spread on BHCs' stock returns.

The results

Table 2 presents the market model estimates for BHCs based on their proportion of assets in loans secured by one- to four-family properties.¹⁸ This series has the most extensive history of the mortgage-related data available, and it represents a fairly direct measure of mortgage lending activity. Table 2 contains results of estimating the market model for two groups of BHCs—the upper 40 percent in terms of loans secured by one- to four-family properties and the lower 60 percent. If this mortgage activity leads to increased exposure to interest rate movements, then this increase should be revealed in statistically significant differences in the responses of stock returns to interest rate changes between these two groups of bank holding companies.

From Table 2, the first set of estimates shows the results when using changes in *TBILL*, the second set of estimates shows the results when using changes in *TBOND*, and the third set of results utilizes changes in *SPREAD*.¹⁹ The *t* statistics that are reported at the bottom of the table are used to test whether the interest rate coefficients are statistically different across the two groups of BHCs. A statistically significant *t* statistic indicates significant differences in the responses of BHC stock returns to interest rate changes between the two groups of BHCs.

The results in Table 2 indicate the presence of interest rate risk but do not point conclusively to mortgage activity leading to greater risk. From Table 2, the betas are all statistically significant and close to 1. The estimated interest rate coefficients indicate that the stock returns for both groups of BHCs react negatively to changes in short-term rates. However, as indicated by the *t* statistic, there is no statistically significant difference in this response between BHCs that are more active in mortgage activity versus those that are less active.

¹⁸ To assess whether a single augmented market model applies to all BHCs, we employ *F* tests. For all the interest rate variables, these tests are insignificant at the 5-percent level, indicating that the data can be pooled and a single equation estimated. Fixed-effects models are also estimated using individual bank dummy variables. The qualitative results are the same as those reported in the text.

¹⁹ Changes in the interest rate series are used as proxies for unanticipated interest rate movements. The Box-Ljung *Q* statistic indicates that changes in *TBILL*, *TBOND*, and *SPREAD* are white noise series and, thus, are suitable for use as proxies for unanticipated changes in these series.

Table 2

Estimates of Interest Rate Risk

(BHCs Classified Using Loans Secured by One- to Four-Family Residential Properties—Bank Subsidiaries Only)

	Interest Rate Measure					
	<i>TBILL</i>		<i>TBOND</i>		<i>SPREAD</i>	
	Upper 40%	Lower 60%	Upper 40%	Lower 60%	Upper 40%	Lower 60%
Constant	.1272** (.0283)	.0213** (.0468)	.1247** (.0284)	.1334** (.0180)	.1180** (.0283)	.1335** (.0183)
Beta	1.3396** (.0942)	1.0864** (.0468)	1.3895** (.1013)	1.0052** (.0493)	1.4572** (.0971)	1.0690** (.0507)
Interest Rate	-.0891* (.0412)	-.0975** (.0223)	.0190 (.0421)	-.1101** (.0220)	.1479** (.0483)	-.0189 (.0256)
	<i>t</i> = .19		<i>t</i> = 2.84**		<i>t</i> = 3.24**	

* = Statistically significant at the 5-percent level.

** = Statistically significant at the 1-percent level.

NOTES: Standard errors are in parentheses. The model estimated is

$$RETURN_{it} = \alpha_i + \beta_i^* MARKET_t + \zeta_i^* INTEREST RATE_t + \epsilon_{it}$$

where $RETURN_{it}$ is defined as the (annualized) rate of return on bank i 's stock in time period t ; $MARKET$ is the rate of return on a broad market index of stocks at time t ; $INTEREST RATE$ is a measure of the change in interest rates from $t-1$ to t , (measured as percentage points), and ϵ_{it} is an error term to capture all other factors. $CONSTANT$ is the estimate derived for α , $BETA$ is the estimate derived for β , and $INTEREST RATE$ is the estimate of ζ . The t statistic is the test for differences across the interest rate coefficients.

Regarding movements in long-term rates, the coefficients on *TBOND* indicate that the stock returns for BHCs in the upper 40 percent are not significantly affected by changes in long-term rates, while the stock returns for those BHCs in the lower 60 percent of the sample react negatively to increases in long-term rates. And the t statistic indicates a statistically significant difference between the two groups of BHCs in their response to changes in long-term interest rates.

The coefficients on the interest rate spread variable show that for those BHCs with a greater portfolio allocation in loans secured by one- to four-family properties, increases in the spread are viewed favorably by the stock market (and conversely, reductions in the spread lead to lower stock returns). The spread variable is statistically insignificant for the BHCs in the lower 60 percent, and the t statistic indicates that these different responses to the spread variable are statistically significant.

From these results, the evidence is mixed that greater mortgage activity leads to greater interest rate risk. When considering long-term rates, those BHCs with a smaller proportion of mortgage activity are exposed to changes in long-term rates, while the spread variable indicates greater exposure for those BHCs more involved in mortgage activity.²⁰

As an indicator of the robustness of these results, Table 3 presents estimates of the interest rate coefficients from the market model that are

derived when classifying the BHCs using the five other mortgage measures identified in Table 1.²¹ For these models only the coefficients on *TBILL* and *SPREAD* are reported.²²

From Table 3, increases in *TBILL* are associated with decreases in BHC stock returns for all the mortgage measures, although the coefficients are not statistically significant in all the models estimated. Those BHCs in the upper 40 percent show statistically significant negative coefficients on *TBILL* in four of the five models estimated, while those BHCs in the lower 60 percent show a negative and significant coefficient only when using servicing rights as the mortgage variable. The t statistics indicate that these coefficients are significantly different only when BHCs are classified based on one- to four-family servicing volume. The signs on the interest rate coefficients when classifying BHCs by mortgage servicing rights are the opposite of what might be expected because, as discussed above, decreases in interest rates hasten prepayments, contributing to lower profitability from servicing mortgages. However, this result could reflect two factors. First, the grouping of BHCs based on servicing rights is largely the same grouping of BHCs when using another mortgage activity measure, and this overlap would result in the negative interest rate coefficients. Second, mortgage servicing rights, as revealed in Table 1, are relatively small components of BHCs' consolidated assets.²³

²⁰ Neither the constant terms nor the betas are significantly different across the two groups of BHCs, regardless of which interest rate term is used.

²¹ It should be kept in mind that these classifications are not unique. That is, the BHCs that show up in the top 40 percent when using loans secured by one- to four-family residential properties as the classification criterion could be substantially the same as those classified in the top 40 percent using another measure. The market model cannot distinguish across these mortgage activity measures but can only reveal evidence regarding interest rate risk differences based on a classification of the BHCs. For example, almost two-thirds of those observations on BHCs that are in the top 40 percent when using loans secured by one- to four-family properties are also in the top 40 percent when using loans secured by first and junior liens. One way of assessing the interest rate risk exposure that might be associated with each mortgage activity measure would be to include a dummy variable for each of these five measures. However, to encompass the five different measures of mortgage activity, the estimation of such a model would begin in 1992, leaving relatively few time series observations from which to derive statistical inferences.

²² Only these coefficients are reported because they each exert an independent effect on BHC stock returns. That is, *TBOND* appears to be proxying for the effects of the yield spread because when *TBOND* is included separately in the estimation equations, it is, at times, statistically significant. However, when *TBOND* is also included with *SPREAD* in the estimations, in all but one model *TBOND* is statistically insignificant, while the yield spread remains significant. The exception is the model using the mortgage variable one- to four-family servicing volume, where *TBOND* remains significant in the presence of *SPREAD* in the estimation equation.

²³ See the discussion in footnote 21. In fact, when using mortgage servicing rights to rank the BHCs, more than three-fourths of the observations in the top 40 percent are the same observations in the top 40 percent when using servicing volume as the mortgage activity measure.

Table 3

Interest Rate Risk Estimates From the Market Model(Various Mortgage Activity Classification Measures Using *TBILL* and *SPREAD*)

Mortgage activity classification measure	<i>TBILL</i>		<i>SPREAD</i>	
	Upper 40%	Lower 60%	Upper 40%	Lower 60%
First liens one- to four-family	-.1681*	-.0675 <i>t</i> = .87	.3278**	.4556** <i>t</i> = 1.08
Total liens one- to four-family	-.1851**	-.0226 <i>t</i> = 1.39	.3393**	.4521** <i>t</i> = .96
Assets sold with recourse	-.0584	-.1044 <i>t</i> = .41	.5776**	.3041** <i>t</i> = 2.33*
One- to four-family servicing volume	-.3328**	-.1190 <i>t</i> = 1.71†	.5125**	.3886** <i>t</i> = 2.80**
Mortgage servicing rights	-.1153**	-.0773* <i>t</i> = .65	.2636**	-.0537 <i>t</i> = 4.56**

† = Statistically significant at the 10-percent level.

* = Statistically significant at the 5-percent level.

** = Statistically significant at the 1-percent level.

NOTES: See notes to Table 2.

Regarding the spread variable, increases in the yield spread are associated with increases in BHC stock returns for those banking organizations in the upper 40 percent for all the mortgage activity measures. Increases in *SPREAD* are also associated with increases in stock returns for those BHCs in the lower 60 percent in all of the models estimated, with the exception of those BHCs classified based on mortgage servicing rights, where the spread variable is not significant. The *t* statistics in Table 3 indicate that the stock return response associated with changes in the spread variable is also greater for those banking organizations more involved in mortgage activity when that activity is measured as assets sold with recourse, one- to four-family servicing volume, and mortgage servicing rights. When combined with the results from Table 2, these results provide some evidence that mortgage activity is associated with greater sensitivity to interest rate movements, especially when considering changes in the yield spread.²⁴

How big is interest rate risk?

The estimates derived from the market model reveal that interest rate movements do exert statistically significant effects on the total stock returns of BHCs. With some important caveats, these same results can also be used to judge how large these interest rate effects are. Looking back at Table 2, the estimated interest rate coefficient on *TBILL* for the upper 40 per-

cent of BHCs is -0.0891 . From this estimate, a 100-basis-point increase in *TBILL* reduces the market value of BHCs by almost 9 percent. For the *SPREAD* variable, the coefficient of 0.1479 for the upper 40 percent of BHCs implies that a 100-basis-point increase in the yield spread increases BHCs' market value by about 15 percent. While these results appear to be fairly important, they are based on assumptions of relatively large interest rate movements that are assumed to take place over the span of one quarter. In the period under analysis here, the largest short-term interest rate movement over a single quarter was 88 basis points, while in only two quarters did movement in the spread variable amount to more than 100 basis points. And the time periods over which many of these estimates are obtained are relatively short. If mortgage-related data were available with a longer history, then different results might be obtained. Moreover, this interpretation of the effect of changes in interest rates on BHCs' market value is based on holding all other factors constant. That is, the estimated effect on the market value of BHCs from changes in interest rates assumes no changes have occurred in the overall stock market index. Finally, some care should always be taken in applying a strict structural interpretation to the coefficients of a regression equation. While widely accepted and utilized, the market model undoubtedly fails to capture all the potential influences on stock returns, which could affect the estimated values reported in the tables.

The results from Tables 2 and 3 provide some evidence that interest rate risk is greater at those BHCs with a greater concentration of mortgage activity, especially when considering changes in the spread variable. These results can be compared with previous attempts to judge the magnitude of interest rate risk at banks and thrifts using variations on the market model. Because thrifts tend to specialize in mortgage activity, they might be expected to be more exposed to changes in interest rates than banks, in the same way that BHCs that are more involved in mortgage-related activity are more exposed to interest rate risk. Several studies that utilize the market model have been undertaken to examine the relative interest rate risk exposure among banks, thrifts, and nonfinancial firms. These analyses use data mostly from the late 1970s and early 1980s, a time of considerable interest rate volatility. Estimates from Flannery and James (1984) indicate that the stock prices of thrifts were about four times as sensitive to both short-term and long-term interest rate movements as was a

²⁴ Because mortgage activities can be carried out in a number of different structures within the holding company, how the mortgage variables are calculated might affect the results. To judge what role differences in BHC structure might play in the results, the same mortgage variables were also constructed using only bank-level data (with the exception of loans secured by one- to four-family residential properties (bank subsidiaries only), which is already measured at the bank level). This step provides some idea of the importance of using consolidated versus bank-level data. Using bank-level data from bank call reports provides the same results, with one exception. The exception occurs with the market model using total liens on one- to four-family properties, where the coefficient on *TBILL* is negative and significant for the upper 40 percent of BHCs in Table 3, but this coefficient is insignificant when using only bank-level data.

sample of BHC stock prices. In Yourougou (1990), both banks and thrifts are combined into a portfolio that Yourougou refers to as financial firms. He finds that these firms' stock prices were about five times as sensitive to changes in intermediate-term (three-year) interest rates as a sample of industrial firms. Finally, estimates from Saunders and Yourougou (1990) also are derived using the market model. In their approach, the market model includes not only changes in the level of interest rates, but also the volatility of interest rates. Although the volatility measure was mostly statistically insignificant, thrifts' stock prices were roughly one-and-a-half times as sensitive to both short-term and long-term changes in interest rates than were bank stocks. And the stock prices of commercial (or nonfinancial) firms exhibited mostly statistically insignificant responses to interest rate changes.²⁵ Overall, financial firms are more exposed to interest rate risk than nonfinancial firms, and results in both this article and previous studies indicate that those financial firms that are more active in mortgage-related activity are more sensitive to changes in interest rates.

Conclusions

Mortgage lending activity has accelerated over the past fifteen years. With this growth has come major structural changes in both the types of products offered and the types of lenders participating in the mortgage markets. The emergence of a strong and active secondary market has helped improve the flow of mortgage credit and provide greater liquidity and safety to mortgage lenders. Credit risk and prepayment risk have been reduced accordingly. However, exposure to movements in interest rates remains a potential source of risk that might be even greater for mortgage activity despite opportunities to hedge. In estimating whether BHCs' mortgage activities increase their exposure to interest rate risk, we examine data from a sample of BHC stock returns. A look at how the stock market reacts to interest rate changes yields some evidence that the stock returns of those BHCs more involved in mortgage activity are more sensitive to changes in the spread between long- and short-term interest rates.

Some caveats should be kept in mind when assessing these conclusions. The most important is that consistent mortgage activity measures are difficult to come by. And most of those that are available have a limited history. From these results, though, it appears that those bank holding companies that pursue greater mortgage activity may have some increased exposure to

changes in interest rates, and that these effects could be significant in periods of substantial movements in interest rates.

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²⁵ The results discussed for Yourougou (1990) and Saunders and Yourougou (1990) are based on estimates after the October 1979 change in Federal Reserve operating procedures. The previous studies of the effects of interest rate changes on stock prices did not make use of an interest rate spread variable.

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