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Bank Risk and Revenue Diversification: An Assessment of Using Equity Returns

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Abstract

This paper examines equity returns for all publicly-traded bank holding companies (BHCs) from 1997 to 2004 to identify size-related diversification effects, the determinants of firm-specific risk, and the evolution of the driving risk factors for U.S. banks. The results indicate that size-related diversification benefits exist, but the strategic choices of large BHCs tend to offset these gains as risk rises with increased leverage, more commercial and industrial lending, and a greater reliance on noninterest income. Newly available regulatory data on the components of other noninterest income like securitization and loan sales are informative predictors of firm-specific risk, which highlight the value of increasing financial transparency to reduce the opacity of complex financial institutions. Finally, in the years since the Gramm-Leach-Bliley Act, the locus of risk has shifted off of the balance sheet and onto the income statement as investors identify the potential risks of evolving and expanding bank activities.

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I. Introduction

The combination of regulatory reform, product market innovation, and technological change has dramatically altered U.S. commercial banks. They have become bigger, operate in more markets, offer more products, and exhibit a more diversified stream of revenue. Qualifying financial holding companies, for example, can now engage in a broad range of financial activities like securities underwriting, insurance underwriting, and merchant banking, and income from activities that generate noninterest income accounts for over 40% of net operating revenue for the industry.[1] This increased scope has clearly made banks broader and more complex, but has it made them safer?[2]

This paper uses equity market data to evaluate the risk of U.S. bank holding companies (BHCs) with a focus on the evolving sources of revenue.[3] In particular, I address three questions relating to BHC risk, size, and diversification. One, is there evidence of size-related diversification gains? Two, which operating strategies, measured by balance sheet and income statement variation, are the most important determinants of risk? Three, has the relative importance of these factors changed over time as the regulatory and operating landscape evolved? These questions are fundamentally related to the safety and soundness of the institutions in this rapidly evolving industry.

The empirical work begins with a standard market model that links firm-specific returns to market returns, and other controls, for all publicly-traded BHCs from 1997 to 2004. This provides estimates of total risk (unconditional variance of equity market returns) and idiosyncratic risk (variance of market model residuals), which are both useful indicators of BHC risk. Total risk is a relevant measure from the perspective of regulators, managers, investors in a world of imperfect capital markets, and borrowers, all of whom care about bankruptcy costs and loss of value from severed banking relationships. Idiosyncratic risk is useful from the perspective of an outside investor who holds a well-diversified portfolio, and for gauging the extent of diversification within a BHC.

To identify size-related diversification benefits, I follow Barnea and Logue (1973) and Demsetz and Strahan (1997) and compare various equity market-based indicators to BHC size. The results show that large BHCs have similar mean returns to smaller BHCs and returns that are equally volatile due to a combination of higher systematic risk (e.g., higher "beta's" and adjusted-R^2's in the market model) and lower idiosyncratic risk. There is an important non-linearity, however, as both total and idiosyncratic risk first fall and then rise with BHC asset size. The trough is near $4B in total assets for total risk and $19B for idiosyncratic risk. The initial decline in idiosyncratic risk with size is consistent with size-related

[1]DeYoung and Rice (2004a) provide a detailed study of the sources of bank revenue over the last two decades.
[2]See Geithner (2004) for a broad discussion of the evolution of U.S. banking, increased complexity, and risk implications.

diversification gains, but the subsequent increase suggests other factors are important. These might include diminishing returns in the ability to diversify, e.g., increased complexity or agency costs that raise firm-specific risk, or differences in operational focus as large BHCs choose to engage in activities that are fundamentally more risky than smaller BHCs and offset diversification gains.

To identify BHC activities and operating strategies that the market judges most risky, I compare idiosyncratic risk to details of the balance sheet and income statement. In particular, I examine whether risk is linked to exposure in specific lending markets (real estate, commercial and industrial, consumer, and other) and to concentration in different types of noninterest-generating activities (those that generate fiduciary income, service charges, trading revenue, and other noninterest income). Looking at details of both the balance sheet and the income statement provides a broader view of the relative risks of banking operations and strategic choices and allows identification of risks for the wide set of activities in which U.S. BHCs now engage.

For the full period of 1997-2004, commercial and industrial lending, consumer lending, noninterest income, and revenue concentration are all positively linked to idiosyncratic risk. These factors are typically positively correlated with BHC size, which supports the interpretation of Demsetz and Strahan (1997) that large BHCs engage in riskier activities because of their diversification advantage. Evidence of a non-linear link between risk and size even after conditioning on these variables, however, suggests that this is not the whole story and some combination of increased complexity and agency costs may limit diversification gains for the largest BHCs. This has implications for merger and acquisition strategies that might be relying on diversification to generate additional gains and risk reduction, or for regulatory actions that might incorporate potential diversification effects.

In terms of specific risk factors, neither consumer lending nor noninterest income were identified as particularly risky in earlier work, which suggests that the changing nature of these businesses have made them more risky. For example, the subprime market has become an increasingly important segment of the consumer lending market, while noninterest income has steadily increased in size and shifted in composition. This type of evidence of the market's ability to monitor and identify the evolving risks of financial institutions seems a necessary condition for the growing role of market discipline in the regulatory and supervisory process, e.g., market discipline is the third pillar of the new regulatory framework (Basel Committee on Bank Supervision (1999)).[4]

To better understand the specific risk factors associated within noninterest income, I utilize new data collected by the Federal Reserve on the components of "other noninterest income." These data were

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[3]Data are for U.S. bank holding companies (BHCs) and financial holding companies (FHCs) and I use the term BHC to refer to both for ease of exposition.

[4]Flannery (1998) discusses regulatory issues surrounding market discipline and reviews the earlier literature.

incorporated into the FR Y-9C reporting forms for BHCs in 2001 after passage of the Gramm-Leach-Bliley Act (GLBA) of 1999 and identify a range of banking activities. Beginning in March 2001, for example, U.S. BHCs were required to report the revenue associated with investment banking, venture capital, loan servicing, securitization, and various types of asset sales, and the results show that these data provide useful information about idiosyncratic risk. Larger streams of revenue from loan sales, other noninterest income, sale of other assets, and net securitization income are all significantly linked with idiosyncratic risk for 2002-2004. The information in this relatively new data shows the market's ability to identify evolving risks, highlights the benefits of increased transparency, and supports the conclusion of Flannery et al. (2004, pg. 453) that government regulation and supervision can reduce the opacity of complex financial firms to outsiders.

Finally, I estimate risk/characteristic regressions with time-varying parameters to identify the variables that are becoming relatively more or less informative. Both a restrictive approach that looks at the pre- and post-GLBA period and a fully flexible analysis show a shift in the locus of risk off of the balance sheet and onto the income statement. In particular, the composition of the loan portfolio is a significant determinant of risk only in the early part of the sample, while the composition of net operating revenue is more important in the latter part of the sample. Because this shift seems to have occurred around 2000 with the passage of GLBA, one interpretation is that the expansion of banking powers led equity market investors to become more cognizant of the risks associated with new and evolving activities and looked off of the balance sheet to identify them. Of course, the post-2000 period was also different for other reasons like the 2000 equity market downturn and 2001 recession, improved credit risk management tools, and increased overall stability, so this interpretation remains tentative.

These results paint a picture of evolving risks for the U.S. banking industry, but not necessarily higher risks. That is, while the market-identified risk factors have shifted and the income statement has become a better determinant of risk, there has not been an obvious trend in either total risk or idiosyncratic risk over this period.[5] Indeed, the U.S. economy as a whole appears more stable and aggregate volatility has declined. This suggests that while the equity market has identified new risk factors, competing forces managed to keep total risk in check. Likely candidates are regulatory, debt-holder, and shareholder pressures that prevent excess risk-taking.

II. Literature Review

Risk, size and diversification are intertwined aspects of firm performance that have received considerable attention. This is manifest in the large literature on the "diversification discount," interest in

[5]The results of Campbell et al. (2001) show rising idiosyncratic risk over a much larger time (1962-1997), but the shorter nature of this panel makes it difficult to draw firm conclusions.

the link between size and performance, and studies that attempt to identify the dominant risk factors across industries. This section discusses several of the most relevant papers. Recent surveys from the banking perspective can be found in Reichert and Wall (2000), DeYoung and Roland (2001), and Stiroh (2004b), while Roll (1998) reviews the literature on market model estimation.

Evidence based on bank accounting data suggests little evidence of diversification. DeYoung and Roland (2001) show that fee-based activities are associated with increased revenue volatility, higher leverage, and increased earnings volatility, while Stiroh (2004a, 2004b) finds that a greater reliance on noninterest income, particularly trading revenue, is associated with more volatile returns and lower risk-adjusted profits. DeYoung and Rice (2004b) identify a variety of banking strategies and show clear risk/return trade-offs that may make several strategies viable, e.g., high risk and high return in corporate banking vs. low risk and low return in community banking. Stiroh and Rumble (forthcoming) argue that diversification benefits exist for BHCs that expand into non-interest generating activities, but these gains are typically more than offset by increased exposure to more volatile activities so risk-adjusted performance suffers. That is, the increased share of volatile activities outweighs the traditional diversification effect via the covariance. In terms of diversification of lending activities, Acharya et al. (2002) report that diversification of loans does not typically improve performance or reduce risk, while Morgan and Samolyk (2003) examine geographic diversification and report that a broader presence is not associated with greater returns (ROE or ROA) or reduced risk and Pilloff and Rhoades (2000) show that geographically diversified banks do not have a net competitive advantage.

Studies of banks using equity market data offer a mixed picture. On the positive side, Santomero and Chung (1992) and Saunders and Walter (1994) find reduced risk, measured as less volatile market returns, for diversified firms, while Templeton and Severiens (1992) examine a small set of BHCs from 1979 to 1986 and find that diversification (as measured by the share of market value not attributed to bank assets) is associated with lower variance of shareholder returns. Kwan (1998) compares the returns of Section 20 subsidiaries to their commercial bank affiliates and concludes that Section 20 subsidiaries are typically more risky and not necessarily more profitable than the commercial banks. Nonetheless, Kwan (1998) concludes that some diversification benefits do exist for commercial banks because of the low return correlation between securities and bank subsidiaries. Finally, Hillon et al. (2002) report that the establishment of Section 20 Subsidiaries, which were used to undertake investment banking operations, are associated with increased return on assets, but no change in firm risk.

On the negative side of diversification, Kwast (1989) reports limited diversification benefits from expansion of bank securities powers, while Rosen at al. (1989) report limited diversification from real estate activities. Demsetz and Strahan (1997) conclude that size-related diversification benefits exist for U.S. banks, but they are offset by increased exposure to commercial and industrial (C&I) loans and lower

capital ratios. Delong (2001) finds that diversifying mergers – by activity and/or geography – do not create market value at the time of merger announcement. DeYoung and Rice (2004b) also use equity returns and show that evidence that alternative banking strategies represent different points on the risk/return frontier. Stiroh (2005) uses a simple portfolio framework to show that activities that generate noninterest income do not raise average market returns, but do make both unconditional (total) and conditional (idiosyncratic) returns more volatile. The intuition is that a shift into new activities affects the portfolio variance by changing the weights on the components and by introducing a diversifying covariance. Contrary to some priors, the data suggests that higher weight on relatively volatile noninterest activities outweighs the diversification benefits.[6]

This paper builds on the earlier work in several important ways. Relative to the studies that focused on accounting data to measure risk and performance, there are clear reasons to prefer a market-based assessment of risk and return. To the extent BHCs have choices in how economic activities are reported, market-based data will provide a clearer view on the risk impact of changes in strategic focus. For example, a bank may offer a lower interest rate but charge a higher fee on a loan, which would change the revenue stream but not have real economic affects. Similarly, if accounting data are manipulated, e.g., to generate a smoother revenue stream, or if different revenue streams are subject to different accounting treatments, e.g., the trading portfolio is marked-to-market on a daily basis which may induce excess volatility in noninterest income, then accounting returns may be misleading indicator of risk and performance. In all cases, a market-based measure of risk should distinguish real changes from accounting ones. Finally, the market data provide a more forward-looking perspective on the expected returns of new activities, while accounting data are necessarily backward-looking and reflect actual performance.

Relative to the other studies of market data, this paper extends both the breadth and the coverage of earlier analysis. Kwast (1989), Rosen et al. (1989), and Templeton and Severiens (1992), for example, examine firms in the 1970's and early 1980's, while Demsetz and Strahan (1997) examined 150 large BHCs in the 1980's and 1990's. More recent studies by Hillon et al. (2002) examined only 40 BHCs that established Section 20 subsidiaries from 1987 to 1997. In these cases, BHCs were still heavily constrained in terms of the types of less traditional banking activities that they could undertake. DeYoung and Rice (2004b) use data for about 150 banking companies from 1993 to 2003. By looking at a complete sample of all publicly-traded BHCs with more recent data after the passage of GLBA and the expansion of banking powers, this study contributes to our understanding of how deregulation and revenue diversification affect the risk of U.S. commercial banks.

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[6]See DeYoung and Rice (2004a, pg. 43) for a discussion of the beliefs of some market participants about the need

III. Data

Balance sheet and income statement data for bank holding companies (BHCs) are from the "Consolidated Financial Statements for Bank Holding Companies," known as the Y-9C Reports. Data are for all top-tiered BHCs that operated between 1996 and 2003. All data were deflated with the CPI.

Equity market data are obtained from the University of Chicago's Center for Research in Security Prices (CRSP) data for publicly-traded bank holding companies (BHCs) that operated between 1997 and 2004. Publicly-traded BHCs were identified as those institutions that appeared both in the Y-9C regulatory database and in CRSP, where the firms were linked based on the CUSIP-identifier available from Compustat.

Firm-specific returns are on a daily basis, adjusted for stock splits and dividend reinvestment by CRSP. These daily returns are transformed into a weekly return as the cumulative return over the week. For each BHC/year observation, I calculate the mean return, $R_{i,t}$, and variances of returns, $\sigma^2_{i,t}$, as the average of the weekly returns in the year and the variance of those returns, where a week must have three trading days for inclusion.[7] I include only those BHCs with at least thirty weekly observations. For each BHC, I also obtained the shares outstanding and the trading volume. These data were matched with the accounting data from the prior year's Y-9C report, i.e., the BHC accounting data from 2000 were linked with equity market data from 2001. Throughout the paper, the observation year refers to the equity market data period and not the regulatory data period unless explicitly mentioned.

Returns for the market as a whole are the CRSP equally-weighed portfolio of stocks trading on the NYSE, AMEX, and NASDAQ stocks. I calculated the mean and variances of market returns, $R_{M,T}$ and $\sigma^2_{M,t}$, respectively, in the same way as for individual BHCs.

Interest rate data are taken from Bloomberg. These variables include the yield on 3-month Treasury bills, the yield on 10-year Treasury bonds, and the Moody's Baa-rated corporate bond yield. These data were matched with the equity market data and included in the market model.

IV. Measuring Diversification and Risk with Equity Market Data

Barnea and Logue (1973) present a straightforward framework for using equity market data to infer the degree of internal diversification based on standard portfolio theory. Consider the simplest world where the return of an individual firm, $R_{i,t}$, depends on the return of the market, $R_{M,t}$, and an idiosyncratic component, $\varepsilon_{i,t}$, as:

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for and benefits of diversification into fee-based activities

[7] One concern is that the bank return process may have auto-regressive, conditional heteroskedasticity (ARCH). This is not a major concern here, however, because the focus is not on forecasting volatility, but rather on correlating average, unconditional volatility with lagged explanatory variables that describe BHC strategies.

$$(1)\quad R_{i,t} = \alpha_i + \beta_m R_{m,t} + \varepsilon_{i,t}$$

The independence of the residuals implies that the variance of returns can be decomposed as:

$$(2)\quad \sigma_i^2 = \beta_M^2 \sigma_M^2 + \sigma_{\varepsilon,i}^2$$

where σ^2 reflects the variance of the subscripted variable.

Following convention, I refer to the variance of returns, σ_i^2, as "total" risk and the variance of the market model residuals, $\sigma_{\varepsilon,i}^2$, as "idiosyncratic" or "firm-specific" risk. Both measures are relevant indicators of risk for different purposes. Total risk is important for regulators, managers, and borrowers that are concerned with the probability of default and the associated bankruptcy costs. This can be seen in Merton-type portfolio models of credit risk, developed by Merton (1974) and implemented in KMV risk models, which are driven by assumptions about total asset return volatility and estimated using total equity return volatility. While asset return volatility, and the estimated default frequency (EDF), are likely to be more accurate indicators of bankruptcy risk, equity market volatility provides a timely and relatively transparent indicator of total risk.

In addition, risk-adverse managers may care about total risk if a large portion of their wealth is tied up in the firm's equity (Stulz (1984)) and if they can't diversify their skills or human capital (Cummins et al. (1998)). From the borrower's perspective, bankruptcy and total volatility hurts borrowers if valuable, intangible banking relationships are severed (Slovin et al. (1993)) or if internal capital market frictions reduce lending and the efficient allocation of scarce capital resources (Houston et al. (1997)).

From the perspective of shareholders, textbook finance theory that firms should not manage risk due to the ability of investors to hold a well-diversified portfolio may not be tenable for several reasons. Froot, Scharfstein, and Stein (1993) and Froot and Stein (1998) highlight the importance of nonlinear costs of external funds, non-traded risks, costs of financial distress, and the convexity in the corporate tax code. As a consequence, shareholders, particularly of financial institutions, will care about total risk and the volatility of revenues.

The first term of Equation (2) represents systematic risk factors common to all firms, while the second represents the idiosyncratic component. Barnea and Logue (1973) argue that diversification within a firm will reduce the idiosyncratic risk, so that the systematic factors will be the main determinants of risk for diversified firms. There are two ways to quantify this. One, internal diversification implies that the variance of the residuals from an estimate of Equation (2) will be smaller as the portfolio of activities broadens. Two, internal diversification implies that the portion of overall variation explained by the systematic factors should increase, which is measured by a higher coefficient

of determination (R^2) in the market model estimate. The variance of the residuals is a theoretically superior indicator because it is independent of the "beta" in Equation (2), although R^2 is superior on a practical level because it is more interpretable and directly comparable across firms.

Demsetz and Strahan (1997) build on these insights and estimate a richer market model that includes other variables that likely influence BHC share prices. These variables include changes in short-term yields, changes in the slope of the yield curve, and changes in credit quality premium. I estimate the same market model:

$$(3) \quad R_{i,t} = \alpha_i + \beta_m R_{m,t} + \beta_Y \Delta YIELD_t + \beta_T \Delta TERM_t + \beta_Q \Delta QUALITY_t + \varepsilon_{i,t}$$

where $YIELD_t$ is the yield on a three-month Treasury Bill, $TERM_t$ is the spread between 30-year and three-month Treasury rates, and $QUALITY_t$ is the spread between the Moody's Baa-rated corporate bonds and 30-year Treasury rates. All changes are over the week and thus represent the innovations in interest rate environment that likely affect bank returns. For the rest of the paper, the term "beta" refers to $\hat{\beta}_M$, the estimated coefficient on market returns.

Equation (3) is estimated using weekly data for each BHC for each year. That is, a separate market model regression is estimated for each BHC in each year. To be included in this sample, a BHC must have at least 30 weekly observations, which left 3,198 BHC observations from 1997 to 2004 with between 30 and 52 weekly observations.

Table 1 summarizes the results by year. The first three columns report the raw return and volatility data (number of observations, average returns, and standard deviation of returns), while the next three columns report the market model estimates (betas, adjusted-R^2's, and standard deviations of the market model residuals). All variables are the medians for the observations in a given year. The top panel includes all 3,198 BHC observations, while the bottom panel includes only large BHCs with assets greater than $10B (measured in 2003 dollars). I also report significance tests for the equality of the medians for the large BHCs and other BHCs.[8]

In terms of overall returns, the first column shows considerable fluctuation in returns over time. Not surprisingly, 1998, 1999 and 2000 were particularly bad years for BHCs with weekly returns near or below zero, while 1997, 2001 and 2003 were much stronger. These returns are quite similar in magnitude to Demsetz and Strahan (1997), who also showed considerable differences over time and reported a range in weekly returns from -0.85% in 1990 to 0.88% in 1999. The largest BHCs, on average, earned similar returns to the smaller BHCs, e.g., they earned significantly higher returns in 1998 and 2000, significantly lower returns in 2001, 2002, and 2003, and similar returns in 1997, 1999, and 2004.

Returns were most volatile during the heavy turbulence associated with the LTCM and Russian bond default in 1998, the NASDAQ decline in 2000, and the recession in 2001, but have trended toward lower volatility in recent years. Volatility was significantly higher for large BHCs than smaller BHC volatility in two years (1999 and 2000) and significantly lower only in two years (2003 and 2004). It is interesting to note that large BHCs showed more volatility in the periods of high market volatility, which reflect their relatively large betas. Finally, there is no obvious trend in equity market volatility for these BHCs. That is, the series moves over time, but the fluctuations are driven by specific events like the Russian bond default in 1998, NASDAQ decline in 2000, and recession in 2001 and do not seem reflect a secular trend. This pattern is similar to Flannery and Rangan (2004) who show that the derived asset volatility of the 100 largest U.S. banks rose through the late 1990s and peaked in 1998 and 2000.

To provide an alternative perspective on volatility over time, Figure 1 plots the mean and standard deviation of weekly returns of the SNL Bank Index from 1988 through 2004. This index is a capitalization-weighted index of all bank stocks traded on the NYSE, NASDAQ, and AMEX exchanges that is maintained by SNL Securities. The data are quite similar to those reported in Table 1 and indicate no secular increase in equity market volatility, but rather a series of specific shocks that led to temporarily higher volatility from 1998 to 2001, and a decline since then. The relative stability of equity market volatility suggests some external pressures are limiting excess risk-taking. Regulators, debt-holders, and equity-holders, for example, can play a disciplining role if total volatility grows beyond acceptable ranges.

The median beta for all BHCs fluctuated between 0.15 in 2000 when volatility was quite high to 0.70 in 1998. In all years, the median beta was significantly larger for the large BHCs. This is reasonable as the small BHCs are more likely to be affected by local economic events and idiosyncratic factors, while large BHCs are tied to aggregate market events. Similarly, large BHCs always have higher adjusted-R^2s than smaller BHCs. This is consistent with the idea of internal diversification as the market model explains a larger percentage of return variation and the idiosyncratic portion is relatively less important. The standard deviation of the residuals from the market model, however, is not always smaller for the large BHCs. While this counters the notion of diversification, it likely represents the very different set of activities in which large BHCs engage and their closer link to the market as a whole.

Table 2 presents additional analysis of the links between the market model estimates and bank size by reporting the correlation between various market measures and bank size (measured by the lagged log of total assets) for each year. Column 1 shows little overall link between average returns and size: the correlation is negative and significant in four years, positive and significant in two years, and insignificant

[8]Tests of the equality of medians are the Wilcoxon rank-sum test for unmatched data.

in two years. For total return volatility, there is a positive and significant correlation in one year (2000), and a negative and significant correlation in three years (1997, 2003, and 2004).

Figures 2 and 3 present this information in a different way by plotting a simple scatter of average returns and the total volatility of returns vs. BHC size. All variables are scaled by the annual mean to remove time trends and common shocks in a given year. Figure 2 shows no obvious relationship between returns and size, although the slope of a simple regression line is negative and significant (coef=-0.012, robust s.e. = 0.005, adjusted-R^2=0.002). Figure 3 also indicates no obvious relationship between risk and size (coef=0.022, robust s.e.=0.178, adjusted-R^2=0.000). While these simple regressions show little link between size and return or volatility, although non-linearity may be an important part of the story and this is further addressed in the subsequent econometric work.

The third column in Table 2 shows a strong positive correlation between size and the BHC's beta. Again, this is not particularly surprising and shows that the largest BHCs are most closely linked to the market. The fourth column shows a strong positive correlation between size and the adjusted-R^2 from the market model, as in Demsetz and Strahan (1997), and suggests diversification benefits for the largest BHCs. As large BHCs broaden internal operations and diversify their product lines and geographic reach, idiosyncratic risk declines and the market accounts for more of the volatility of returns.

The final column in Table 2 also provides evidence of diversification benefits as BHC size and the variance of the market model residuals are negatively and significantly correlated in six of the eight years. Figure 4 plots idiosyncratic risk versus size for the full sample and shows a significant, negative link (coef=-0.603, robust s.e.=0.153, adjusted-R^2=0.004), although again it appears that a nonlinear relation exists. The less obvious link with total risk suggests other factors may offset these apparent diversification benefits.

These results paint an interesting picture of the equity market's measures of risk, return, and size-related diversification for U.S. BHCs. Large BHCs earn slightly lower returns and have similar total risk due to a combination of higher systematic risk and lower idiosyncratic risk. While the combination of higher systematic risk but no higher returns suggests an inefficient set of activities for the large BHCs, there is also evidence of internal diversification benefits for large BHCs. This puzzle could reflect the very different set of activities undertaken by large and small BHCs, which is the focus of Section VI, or could simply reflect a bad draw where returns were unexpectedly low. That is, strategic choices are made with respect to expected returns and risk, while these results are for actual return and risk.

V. BHC Size and Risk

a) Specifications and Data

This section further explores the size/risk relationship for U.S. BHCs using regression and non-parametric methods to compare size to both total risk and the idiosyncratic component. Demsetz and

Strahan (1997), for example, found evidence that large BHCs enjoy diversification benefits, measured by lower idiosyncratic risk, but these benefits did not translate into reduced total risk. This work extends those results to the more recent period and documents important non-linearities in the size/risk relationship that have implications for regulators, investors, and bank borrowers.

The most straightforward way to examine the size/risk relationship is through simple regressions like those described above in the discussion of Figures 3 and 4, so I estimate variants of the following regressions for various set of BHCs:

$$(4)\quad \sigma^2_{i,t} = \alpha_i + \beta_1 \ln\left(A_{i,t-1}\right) + \beta_2 \left(\ln\left(A_{i,t-1}\right)\right)^2 + \sum_t \delta_t YR_t + \varepsilon_{i,t}$$

where the dependent variable is either the total risk of the BHC, $\sigma^2_{i,t}$, or the idiosyncratic component, $\sigma^2_{\varepsilon,i,t}$, $A_{i,t-1}$ is total assets from the prior year, and YR_t is a year dummy variable.

Note that I do not include BHC fixed effect here for several reasons. One, the focus is on size differences in the cross-sectional sense, rather than marginal changes in size for individual firms. Two, the widespread consolidation of banking over the last decade makes the interpretation of a fixed, unobservable component impractical for many of the largest institutions that have steadily merged and evolved over this period. Three, many of the income statement variables used in subsequent analysis are quite noisy on an annual basis, which makes within identification difficult and imprecise. As a result, I simply pool the annual cross-sections and treat each BHC/year separately.

b) Results

Results are reported in Table 3 with the top panel using total risk ($\sigma^2_{i,t}$, the unconditional variance of market returns) as the dependent variable and the bottom panel using idiosyncratic risk ($\sigma^2_{\varepsilon,i,t}$, the variance of the market model residuals) as the dependent variable. All regressions are pooled cross-sections with market data from 1997 to 2004. Standard errors are corrected for heteroskedasticity. Some regressions include size linearly, while others also include a squared term to allow for a non-linear relationship.

The first column reports the simple regressions that include only bank size and year dummy variables.[9] As shown in Figures 3 and 4, there is no significant linear relationship between size and total risk, but a significant negative link with idiosyncratic risk. This implies that the greater systematic risk of large BHCs, i.e., their larger betas, is offset by the internal diversification gains that reduce idiosyncratic risk.

[9]Note that these regressions do not exactly match those reported for Figures 3 and 4 due to differences in how the year effects were removed.

The second column includes squared assets and a clear, non-linear relationship emerges. In both cases, the regressions imply a U-shaped relationship as risk falls and then rises with BHC size. The data indicate that the trough of this relationship occurs at an asset size of about $4B for the total risk regressions and $18B for the idiosyncratic risk regressions. Given the highly skewed size distribution of U.S. BHCs with a few large firms and many small firms (the sample has median assets of $1B and mean assets of $13.5B), this implies that most BHCs remain on the favorable side of the curve where risk is falling with size but most of the assets are on the unfavorable side. For total risk, for example, 78% of the observations have assets below the trough, but these BHCs have only about 6% of the total assets. For idiosyncratic risk, the 90% of observations below the trough hold 14% of the total assets.

In terms of diversification, this suggests there are benefits for smaller BHCs, but they dissipate as the BHCs grow. One potential explanation is that diminishing returns to diversification may set in at the very largest sizes due to increased complexity, difficulty of oversight and risk management, or greater scope for agency problems that lead to excessive risk-taking. An alternative explanation is that large BHCs are engaging in a different set of activities that increases idiosyncratic risk and offsets any size-related diversification. This is examined further in the following section.

One concern with quadratic specifications, however, is that they can be heavily influenced by outliers and Figures 3 and 4 do show some very small BHCs with highly volatile returns. As a robustness test, I winsorized total risk and idiosyncratic risk at the 5^{th} and 95^{th} percentiles and reestimated Equation (4) with the transformed data.[10] The third column reports results and shows the same statistically significant non-linear relationship, although the shape of the curve is somewhat flatter.

As a second robustness test, the linear regressions were estimated for a set of small BHCs and large BHCs, where the cut-off was $10B as in Table 1. These results are reported in columns 4 and 5 and support the non-linear interpretation. For total risk, there is no relationship with size for the smaller BHCs, but a significant increase with size for the large BHCs. For idiosyncratic risk, the negative link with size suggests diversification benefits for the smaller BHCs, but increased idiosyncratic risk for the largest BHCs. Thus, both total and idiosyncratic risk seem to increase with size for the largest BHCs.

One can also perform an even less parametric comparison by calculating average risk for BHCs of different size classes. To do this, I sorted the BHCs by size and created 20 cohorts with about 160 BHCs in each and simply averaged the measures of total and idiosyncratic risk. The means for each cohort are plotted in Figure 5 and show the same patterns as indicated by the regressions with high total

[10]Winsorizing limits the influence of extreme values by replacing values above (below) a certain percentile with the value from that percentile, e.g., all values above the 95^{th} percentile in the distribution are set equal to the value of the 95^{th} percentile. In contrast to dropping outliers, this has the advantage retaining potentially informative data.

and idiosyncratic risk for both the smallest BHCs (assets below $300) and then rising total and idiosyncratic risk for the largest BHCs (assets greater than around $10B).

These results show a non-linear relationship between BHC size and both total and idiosyncratic risk. This implies that size-related declines in idiosyncratic risk are exhausted or offset for the very large BHCs. This could reflect decreasing returns in the ability to diversify, increased management difficulties at large organizations due to greater complexity, or changes in the set of activities that tend to increase return volatility and idiosyncratic risk, and thereby offset diversification gains. For those interested in the total risk of the BHC, this suggests that the largest BHC are engaging in a different set of activities that lead to more volatility in returns and higher risk. For example, large BHCs tend to hold less capital and are more leveraged, and engage in more risky lending, which could offset any diversification benefits and lead to higher total risk.

VI. Determinants of BHC Risk

The previous section shows that risk is systematically linked to BHC size and this section explores the BHC-specific factors that drive risk. Demsetz and Strahan (1997), for example, showed that balance sheet indicators of risk like the leverage ratio and concentration in commercial and industrial (C&I) lending were important determinants of idiosyncratic risk. In contrast, revenue sources, measured by the ratio of noninterest income to net interest income, were typically insignificant. In recent years, however, BHCs have shifted heavily into activities that generate fees, service charges, and other forms of noninterest income and it is useful to examine the current importance of these factors. Stiroh (2004b) and DeYoung and Rice (2004), for example, show that revenue from these activities are relatively volatile, and DeYoung and Roldand (2001) argue that this volatility reflects the low switching cost of fee-based activities compared to relationship-based lending, higher operating leverage due to greater reliance on fixed inputs like labor, and higher financial leverage due to little or no capital requirements.

a) Specifications and Data

To examine these factors that determine BHC risk, I augment the idiosyncratic risk regressions in Equation (4) with a set of lagged explanatory variables, **X**, that describe both the BHC's balance sheet and its income statement. I focus on the idiosyncratic risk regressions to identify the factors that might be offsetting the diversification benefits identified earlier, although total risk regressions are similar. The idiosyncratic risk regressions are:

$$(5)\quad \sigma^2_{\varepsilon,i,t} = \alpha_i + \beta_1 \ln\left(A_{i,t-1}\right) + \beta_2 \left(\ln\left(A_{i,t-1}\right)\right)^2 + \theta' \mathbf{X}_{i,t-1} + \sum_t \delta_t YR_t + \varepsilon_{i,t}$$

The following balance sheet characteristics are included in **X**: the ratio of loans to assets; the breakdown of loans into major categories (real estate, commercial and industrial (C&I), consumer, and other); loan concentration; the ratio of deposits to assets; and the ratio of equity to assets. The first two

sets of variables measure asset composition both between loans and other assets and within the loan portfolio.[11] These variables capture the risk associated with lending in general and specific lending businesses. Loan concentration is measured via a Herfindahl-Hirshman Index (HHI) of the four loan shares where a higher value indicates greater loan concentration. Liability composition is measured by the ratio of deposits to assets to provide some indicator of funding choices and the impact of shifting from other liabilities toward deposits.[12] The equity to assets ratios is included to control for the degree of financial leverage. This is quite important because higher leverage raises equity volatility for a given level of underlying asset volatility.

To examine the importance of income statement characteristics, two breakdowns of net operating revenue are examined. In the simple case, the "two-part revenue breakdown," net operating revenue is decomposed into two parts: net interest income and noninterest income. As discussed earlier, noninterest income has been growing steadily and other recent research has shown this to be linked with accounting-based measures of risk. In the two-part revenue breakdown specifications, **X** includes only the noninterest share, defined as the ratio of noninterest income to net operating revenue, and revenue concentration, calculated as the HHI of these two revenue shares. The noninterest share will capture risk associated with different types of revenue-generating activities, while the revenue HHI will capture the impact of revenue concentration. Net interest income is the omitted revenue type, so the coefficient on the noninterest share represents the impact on risk from a one percent shift out net interest income and into noninterest income.

The second specification, the "five-part revenue breakdown," includes a more detailed breakdown of noninterest income into five components: net interest income and the four major categories of noninterest income (fiduciary income, service charges, trading revenue, and other noninterest income). Fiduciary income includes revenue related to the bank's fiduciary operations, e.g., administering investments for others. Service charges include revenue directly related to deposit accounts like ATM or check usage fees. Trading revenue is primarily income from trading cash instruments, off-balance contracts, and mark-to-market changes in the carrying value of assets and liabilities. Fees and other income include all other fees, e.g., loan commitment fees, safe deposit boxes, commissions, and land rental fees. This is the most detailed breakdown of noninterest income that is possible from the Y-9C reports for the full period 1997 to 2004, although more detail is available for a later sub-period and discussed in the following section. In the empirical work, net interest income is the omitted variable, so

[11]Note that the loan shares sum to one, so one share must be dropped. Real estate lending is the largest component, so this is the excluded share and the coefficients on the other shares can be interpreted as the impact of a 1% shift our of real estate lending into the other activity.

[12]Demsetz and Strahan (1997) included a more detailed description of the liability structure, but these were universally insignificant and are not included here.

each coefficient measures the impact of a shift out of net interest income and into that activity. I also include the HHI from the five shares to measure revenue concentration. Details on these revenue categories are in the Appendix

A final variable included in the **X** vector is turnover, which measures the trading frequency of the BHC's equity. Turnover is defined as the total trading volume divided by the average shares outstanding. While there is obviously some endogeneity that limits the interpretation, this is meant to capture the impact of other factors not included in the regression that affect the volatility of the stock. That is, turnover proxies for the flow of new information about the stock and the stock's liquidity, which may be linked with size.

Table 4 reports summary statistics of the income statement and balance sheet characteristics for the main sample of 3,198 BHC observations from 1997 to 2004. The sample includes a wide range of BHCs with total assets (all measured in 2003 dollars) ranging from $128 million to $1.26 trillion. The median asset size is $1 billion and the mean is $13.5 billion, which reflects the very skewed size distribution of U.S. BHCs. All of the variables show considerable variation, which is helpful in identifying the link with risk. In particular, the noninterest share varies from 0.02 to 0.98, which shows the enormous range of focus among U.S. BHCs. Similarly, all of the components of noninterest income vary widely.[13]

b) Primary Results for 1997-2004

Table 5 present estimates of the basic idiosyncratic risk regression in Equation (5). The first two columns use the two-part revenue breakdown of net operating revenue into noninterest income and net interest income, while the third and fourth columns use the five-part revenue breakdown. In both cases, estimates are reported with assets included linearly and with a squared term. In terms of interpretation, the coefficients on the loan share indicate the impact of a one percent shift in lending out of real estate loans (the omitted category) into that category, while the coefficients on the revenue shares indicate the impact of a one percent shift of revenue out of net interest income (the omitted category) into that category.

The estimates show a negative relationship with size and evidence of the non-linearity in the five-part breakdown, which controls for more variation in BHCs' operating strategies and exposures (column 4). These results imply diminishing returns to diversification, so that BHCs do not enjoy size-related gains over the entire size range, even after controlling for other differences on the balance sheet and income statement.

[13]The negative shares for some revenue components indicate losses in those areas. There are relatively few of these observations and the results are robust to dropping them.

On the balance sheet, large exposures to C&I lending are consistently linked with higher idiosyncratic risk and the loan shares are jointly significant in all regressions. The finding that C&I lending is particularly risky is quite common, e.g., Demsetz and Strahan (1997), Cebenoyan and Strahan (2004), and Stiroh and Rumble (forthcoming). Higher equity ratios are consistently linked with less risk and this can be interpreted as one of the gain from diversification, i.e., large BHCs can operate with less capital and more leverage precisely because of their internal diversification.

Both consumer lending and the deposit to asset ratio are significantly linked to risk in the two-part revenue breakdown, but not in the five-part breakdown. This likely reflects the correlation between these balance sheet measures and service charges, which are explicitly controlled for in the five-part breakdown, as both are indicators of retail banking focus. For example, the simple correlation of the service charge share with the consumer loan share is a significant 0.18 and with the deposit asset share is a significant 0.25. Nonetheless, the importance of consumer lending as a risk factor is less widely documented than C&I lending and could reflect the increased scope of these activities into the sub-prime market. Han et al. (2004), for example, report that sub-prime mortgage market has increased nearly five-fold from 1994 to 2001.

In terms of the income statement, the noninterest income share in the two-part revenue breakdown is quite large and highly significant (columns 1 and 2). In economic terms, a one-standard deviation increase in the noninterest share is associated with an increase in idiosyncratic risk of 2.9, which is relatively large compared to the mean value of 16.0. Revenue concentration is positive in both the two-part regressions as a more diversified revenue stream lowers idiosyncratic risk.

The significance of the revenue component differs from the early work of Demsetz and Strahan (1997), who found that the revenue breakdown was significant in only one of their four specifications. This difference likely reflects the growing importance and attention placed on these activities as BHCs expand their operations, e.g., noninterest income accounted for only 29% of net operating revenue from noninterest sources in 1987 compared to nearly 44% in 2003. Moreover, the composition has shifted in recent years, which changes the risk implications.

To identify the specific sources of risk within noninterest activities, columns 3 and 4 decompose noninterest income into the four components – fiduciary income, service charges, trading revenue, and other noninterest income. These variables are jointly significant and thus provide useful information about BHC risk and the individual coefficients show that reliance on other noninterest income in particular drive BHC-specific risk. On one hand, this is unsatisfactory because this is a catch-all income statement item that includes many revenue streams and thus does not identify precisely which activities are most risky. On the other hand, it is supportive of the notion that opacity of operations is risky. Morgan (2003), for example, shows that the ratings agencies disagree more about banks than other firms

and concludes that this is because banks are relatively obscure to outside investors. This finding is similar as relatively opaque and undefined activities drive idiosyncratic risk. Revenue concentration in this more detailed specification is also systematically linked with idiosyncratic risk and shows the benefits of a diversified revenue stream.

c) Robustness Tests for 1997-2004

The regressions reported in Table 5 are of course reduced-form regressions, so one must be careful when drawing causal inferences. That is, even though the explanatory variables are lagged relative to the risk measures, alternative explanations are possible. To rule out the most likely of these alternatives, Table 6 reports several robustness tests that either examine specific sub-samples or transform the data. In all cases, the specification use the five-part revenue breakdown with assets entered linearly and as a quadratic as in Table 5, column 4.

One concern is that the results are driven by outliers, e.g., the few BHCs with very large idiosyncratic risk measures shown in Figure 4. Column 1 of Table 6 uses the winsorized sample as described above. The relative risk of C&I lending, components of net operating revenue, higher leverage, and a concentrated revenue stream appear robust. The conditional size relationship, however, is no longer apparent.

A second concern is that these results may reflect a reverse causality as poor-performing BHCs enter into risk activities like trading to try and recapture profitability and/or solvency. If overall health and market volatility have a persistent component, then simply lagging the explanatory variables will not be sufficient. To examine this hypothesis, column 2 reports estimates for the sub-sample of profitable BHC (positive net income in the prior year) and column 3 reports estimates for only the sub-sample of BHCs with healthy capital (defined as a leverage ratio above 6%, about the 10^{th} percentile of the sample). In both cases, the estimates are qualitatively unchanged – C&I lending, other noninterest income, and revenue HHI remain significantly linked to idiosyncratic risk, although size is no longer conditionally important. These results were not driven by poorly-performing BHCs with negative earnings or low equity capital ratios.

A third concern is that the results reflect consolidation or rapid growth, e.g., BHCs that merge or acquire other institutions may be more likely to both have large exposure in noninterest and more risk. While the flexible size specification will control for this to the extent that these are size-related effects, e.g., large BHCs tend to acquire and have more noninterest income, I can also limit the sample to those BHCs that have not been directly involved in these activities. To do this, I restrict the sample to BHCs that have loan growth in the prior year below the 95^{th} percentile or above the 5^{th} percentile. Again, the results remain qualitatively unchanged and indicate that rapid growth is not driving the results. Note also that size is now marginally linked negatively to risk, as expected from the diversification view.

A final concern is that the income statement variables are too variable to adequately reflect the BHCs' strategic choices. For example, any unexpected shock to either net interest income or noninterest income would move it away from the long-term average and could give a misleading indicator of the BHCs' long-term strategic choices. To evaluate this concern, column 5 of Table 6 reports estimates where all explanatory variables are three-year trailing averages, which likely raises the signal to noise ratio of the income statement variables. Again, the results are quite similar and suggest a robust, negative relationship between a BHC's income statement and idiosyncratic risk.

An alternative way to examine the robustness of these results is to suppress the information in the magnitude of the revenue shares and simply look at whether the BHC has any revenue in a particular category. This loses some information in terms of the relative intensities, but provides a cleaner indicator of whether a BHC is involved in a particular type of activity. For example, trading is quite volatile and a BHC with a substantial trading operation could still have a trading share close to zero if it suffers offsetting gains and losses in different activities.

To implement this approach, I construct a dummy variable for each of the four components of noninterest income that is set equal to 1 if the revenue in the prior year is non-zero and set equal to 0 otherwise. Because these dummies are not perfectly collinear, I also include the overall noninterest share to capture overall differences in revenue focus.

Results in the first column of Table 7 are with BHC size as a linear term only, while the second column includes a squared term. The findings are broadly similar and show some evidence of a non-linear relationship between risk and size (p-value=0.15 for the square of assets), the risk of C&I lending, and the risk of activities that generate noninterest income in general. In terms of the revenue dummy variables, both specifications show that BHCs with active trading portfolios or with other noninterest income tend to have higher idiosyncratic risk, while BHCs with service charges have lower risk. The trading result, in particular, seem reasonable and is consistent with Morgan and Stiroh (2001), who found that trading risk is reflected in spreads on bank bonds.

d) Extended Results for 2002 to 2004

The results for the full period 1997 to 2004 highlight other noninterest income as the most risky component of a BHC's income statement. As mentioned earlier, this is a broad category that includes many different revenue streams. Beginning in 2001, however, BHCs were required to provide additional information about revenue streams and the new Y-9C regulatory reports included a much more detailed breakdown of other noninterest income. This section examines these new data and highlights the role that increased data can have on increasing the transparency of large, complex financial institutions. This is important because regulators and supervisors are increasingly turning to market measures as a way to both identify potential and prevent risk-taking. Broadly defined "market discipline," for example, is a key

component of the Basel II supervisory framework and examining whether the market incorporates this new information is an important step in understanding the potential usefulness of market discipline.

Other noninterest income is now broken down into twelve new categories – investment banking (including advisory, brokerage, and underwriting fees and commissions), venture capital revenue, net servicing fees, net securitization income, underwriting income from insurance, income from other insurance activities, net gains on sales of loans and leases, net gains on sales of other real estate owned (OREO), net gain on other assets excluding securities, and other noninterest income. Most of these variables became mandatory reporting items in March 2001, but the insurance variables were not reported until March 2003. Because the equity data run through 2004 and the BHC characteristics are lagged one year, this data is available only for one year of this sample. As a result, I can decompose other noninterest income into eight components – investment banking, venture capital, net servicing, net securitization, sale of loans, sale of OREO, sale of other assets, and other noninterest income. Details are available in the Appendix.

Table 8 reports summary statistics of these income statement variables for the 1,227 observations with Y-9C data from 2001-2003. Focusing on the breakdown of other noninterest income, the largest components are other noninterest income, sale of loans, and investment banking revenue. Venture capital revenue, on average, is negative, which is likely due to the weak equity market in 2001 and 2002. Again, there is considerable variation across BHCs, which is useful for identifying the cross-sectional correlations.

Regressions using the sample 1,227 BHCs with idiosyncratic risk for 2002-2004 and BHC financials for 2001-2003 are reported in Table 9. This sample differs from that used in the earlier tables, so the first two columns report regressions results with the two-part and five-part revenue breakdown to provide a benchmark.

Asset size remains negatively linked with idiosyncratic risk, although the non-linearity is now apparent as risk rises for the largest BHCs even after controlling for balance sheet and income statement items. The loan shares, in contrast, are no longer significant, either jointly or individually, for the later period. Results for the income statement variables are similar and show that noninterest income and revenue concentration are associated with more idiosyncratic risk. In addition, three of the four noninterest components are significantly linked with risk, a marked difference from the results for the full period. This apparent shift in risk factors from the balance sheet to the income statement in the later sample suggests a fundamental shift in BHC risk and is addressed in detail in the following section.

The results in column 3 decompose other noninterest income into the eight available components and show that they contain useful information about idiosyncratic risk. Four of the eight components are statistically significant (other noninterest income, sale of other assets, sale of loans, net securitization) are

highly significant, two are not quite significant (venture capital and net servicing have p-values=0.13), and the eight components show a high degree of joint significance. The loan and asset sale variables may indicate financial distress as BHCs sell under-performing assets.

While some of these activities are very traditional in nature, the additional information clearly has some value for identifying idiosyncratic risk. Moreover, this suggests that the increase in financial transparency mandated by regulators has been observed and incorporated by the equity markets into perceptions of firm-specific risk. This supports the belief embedded in recent regulatory reform proposals like the Basel II capital reforms that increased transparency and market information are useful for identifying and evaluating risk of large, complex financial institutions and provides a concrete example of the conclusion by Flannery et al. (2004) that government regulation and supervision can reduce the opacity of complex BHCs.

VII. The Evolution of BHC Risk

The previous section shows that both balance sheet and income statement variables determine idiosyncratic risk for U.S. BHCs and the final goal is to understand how the relative importance of these factors has evolved in recent years. Demsetz and Strahan (1997), for example, found little evidence that revenue streams were associated with idiosyncratic risk in the 1980s and early 1990s, while these results show that revenue streams are quite important in recent years.

This section presents formal tests of whether income statement variables have become more important determinants of idiosyncratic risk for BHCs. The working hypothesis is that the steady increase in less traditional banking activities that generate noninterest income and the expansion of banking powers under Gramm-Leach-Bliley Act (GLBA) of 1999 has shifted the locus of risk off of the balance sheet and onto the income statement. Because many of these business lines like trading, underwriting, or venture capital investments are not associated with large balance sheet positions, investors may now play greater focus on the income statement as indicators of these activities.[14]

While GLBA was a major event for U.S BHCs, there were obviously other factors that have changed the operating and risk environment of BHCs. At the macroeconomic level, 2001 was a recession year and while U.S. BHCs fared remarkably well, there were undoubtedly effects on their operations and risk. At the micro-level, banks have also greatly improved their risk management tools over this period, particularly for credit risk through more accurate risk-based pricing and increased use of credit derivatives, so one might expect to see changes in these correlations.[15] In either case, however, a useful

[14]Furlong (2000) provides a description of the expansion of banking powers under GLBA and Boyd and Gertler (1994) provide an early discussion of the declining information of a bank's balance sheet.
[15]See Schuermann (2004) for the case for improved credit risk management.

first step is to identify whether change in risk factors did in fact occur and whether the market recognized this shift.

The most straightforward means to address the changing significance of balance sheet and income statement items is to incorporate time-varying coefficients into the idiosyncratic risk regressions, and I do this in two ways. First, I split the sample in 2000 and allow all coefficients for the period 1997-2000 to differ from those for 2001-2004. 2000 is a natural break-point because GLBA was passed in November 1999 and went into effect in March 2000. Recall that the BHC balance sheet and income statement variables are lagged one year relative to the equity market data, so this means that the first portion of the sample is pre-GLBA and the second part is post-GLBA. Of course, BHCs were shifting focus and expanding the range of operations before GLBA and other factors are relevant, so I also examine idiosyncratic with a series of separate cross-section regressions for each year. This allows complete flexibility in the coefficients and does not impose any arbitrary restrictions on the pattern over time.

The first test uses the base risk regressions in Table 5, but includes interactions terms that allow the coefficients to vary over time. I create a dummy variable, *D*, that equals one for years 1997-2000 and zero for years 2001-2004 and interacted this with all right-hand side variables in Equation (5) as:

$$\sigma^2_{\varepsilon,i,t} = \alpha_i + \beta_1 \ln\left(A_{i,t-1}\right) + \beta_2 \left(\ln\left(A_{i,t-1}\right)\right)^2 + \theta' \mathbf{X}_{i,t-1} + D_t\left(\beta_1 \ln\left(A_{i,t-1}\right) + \beta_2 \left(\ln\left(A_{i,t-1}\right)\right)^2 + \theta' \mathbf{X}_{i,t-1}\right) + \sum_t \delta_t YR_t + \varepsilon_{i,t} \quad (6)$$

where all right-hand side variables are defined as above.

Table 10 reports results with the two-part revenue breakdown in columns 1 through 3 and the five-part revenue breakdown in columns 4 through 6.[16] A single regression is run for each specification and the first column reports the pre-2001 impact (the un-interacted coefficients), the second column reports the post-2000 impact (the sum of the un-interacted coefficient and the interacted coefficients), and the third column reports the difference between the two (the interacted coefficients). The bottom of table reports the joint significance of the loan shares and the revenue shares, for each period as well as the difference between periods.

In both specifications, loan shares are jointly significant for 1997-2000, but jointly insignificant for 2001-2004. For example, the p-value associated with the F-test of the null hypothesis that all four loan share are jointly zero is 0.002 for 1997-2000 and 0.318 for 2001-2004 for the two-part revenue breakdown and 0.002 for 1997-2000 and 0.693 for 2001-2004 for the five-part revenue breakdown. In both specifications, the changes in the loan share coefficients are jointly significant and the coefficient on

C&I lending falls dramatically in size and in statistical significance. This implies that the composition of the lending portfolio has become a less important determinant of idiosyncratic risk since 2000.

In contrast, the revenue variables have tended to become larger and more significant over time. In the two-part revenue breakdown regression, for example, the coefficient on the noninterest share rises from 14.6 to 22.8, while in the five-part revenue breakdown fiduciary income, service charges, and trading income all increased by a statistically significant amount indicating a tighter link with idiosyncratic risk in the post-2000 period. Other noninterest income is large and statistically significant in both periods. The changes in these revenue shares are also jointly significant in the five-part revenue breakdown. In both specifications, the revenue concentration variable increases in size and statistical significance as investors apparently became more concerned about revenue concentration.

As a final observation, the U-shaped pattern between BHC size and idiosyncratic risk seems to be driven by the early part of the sample when equity markets were relatively volatile. Overall market volatility has declined in recent years and the largest BHCs, with the highest beta, saw the biggest declines in the banking industry. Table 1, for example, shows that the median standard deviation of equity market returns was significantly lower for the large BHCs only in 2003 and 2004, and this relative stability for the large BHCs is manifest in the flatter size/risk relationship.

The second approach examines the risk regressions on an annual basis to look for trends in significance. I estimated both the two-part and the five-part revenue breakdown regressions for each year separately without any restrictions over time. Rather than report all of the coefficients from each annual regressions, I focus on the joint significance of the loan shares and the revenue shares, which indicates the trend of their relative importance as risk drivers.

Figures 6 and 7 plot the joint significance of the loan shares and the revenue shares for each year, measured by the p-value associated with the null hypothesis that the shares are jointly significant, from the two-part and five-part regressions, respectively.[17] While there are some differences, both plots show a similar picture – the revenue shares are becoming more significant through 2003, while the loan shares are becoming less significant – that is consistent with Table 10. In particular, the loan shares seem to lose their link with idiosyncratic risk after 2000.

The significance of the revenue shares for 2004 are obviously different from those of 2001 through 2003 and this also likely reflects the increased stability of bank equities in 2004. As mentioned earlier, large BHC, which are most heavily involved in activities that generate noninterest income, saw decreased volatility (both in an absolute and in a cross-sectional sense in 2004), which makes it more

[16]Note that I cannot examine the twelve-part revenue breakdown because these data are only available for 2001 and 2002 financials.

difficult to identify the impact of the noninterest revenue shares. It will be interesting to examine this relationship in future years when overall market volatility is higher.

Taken together, these results indicate a shift in the determinants of BHC risk away from the balance sheet and toward the income statement. Around 2000 when GLBA was introduced and BHCs were allowed to expand operations into new activities and raise revenue shares on existing ones, idiosyncratic risk become more highly associated with differences across BHCs in their revenue sources. A likely interpretation is that the equity market became relatively concerned about these new activities and this concern was manifest in equity market volatility. As with the earlier results, this supports the growing belief in the ability of market participants to monitor and discipline large, complex financial institutions.

As a final point, it is interesting to recall that there is no clear trend in total risk even as the equity market was recognizing the increased risk associated with the income statement. Table 1 and Figure 1, for example, suggest that both total risk and idiosyncratic risk have no secular trend and annual differences seem to be dominated by year-specific events. This suggests that other pressures have kept total risk in check and merely shifted it among activities. For example, regulators, debt-holders, and equity-holders all influence the risk-taking of BHCs and prevent BHC risk from rising to unacceptable levels.

VIII. Conclusions

This paper examines the determinants of risk for U.S. bank holding companies and draws three main sets of conclusions. First, I find evidence of size-related diversification benefits, but the relationship appears non-linear, which could reflect the increased complexity of the largest BHCs, management difficulties and agency problems associated with scale, or from diminishing returns in the ability to diversify. Thus, already large BHCs should not necessarily expect continued diversification gains from either internal growth or through mergers and acquisitions. Of course, size-related benefits could still come from scale and scope economies or from differences in regulatory treatment, e.g., a too-big-to-fail subsidy, but size-related diversification benefits do not appear to be a compelling motivation for continued growth of the very largest BHCs.

Second, idiosyncratic risk is closely linked to BHCs' strategic choices, as captured by cross-sectional differences in the balance sheet and the income statement. Newly available information about BHC's revenue flows in particular seems to be a useful predictor of subsequent risk. While some of these activities like servicing and securitization are very traditional in nature, the fact that the market

[17]In the two-part revenue case, the test statistic is simply the p-value from the t-test associated with the null hypothesis that the noninterest share is zero.

incorporates these data supports regulators' and many economists' belief in disclosure and market discipline as a way to better understand and control complex financial institutions, a belief which is now embedded as the third pillar of the new Basel regulatory framework.

Third, the locus of risk has shifted off of the balance sheet and onto the income statement. As BHCs steadily expand into new activities and transform old ones, equity market investors are following these changes and identifying the risk via the associated revenue streams. An obvious implication is that BHC regulators and supervisors should also follow the risk and devote more attention on these activities that the equity market has identified as relatively risky. This might include, for example, relatively more attention on market risk measures compared to credit risk measures.

Data Appendix

Balance sheet and income state data for bank holding companies (BHC) are from the "Consolidated Financial Statements for Bank Holding Companies," also known as the Y-9C Reports. Data are for all top-tiered BHCs that operated between 1996 and 2003 at both the quarterly and annual frequency. All data were deflated with the CPI and transformed into 2003 dollars. For each BHC, the Y-9C includes a unique code that identifies the BHC over time. In cases of mergers and acquisitions, the acquiring BHC's code is maintained and the target drops from the sample.

The decomposition of the income statement available on the Y-9C changes over time. For the full sample 1996-2003, I use the most detailed available data that includes four components of noninterest income – income from fiduciary activities, service charges on deposit accounts, trading revenue, and other noninterest income. For each of these variables, I present the Y-9C code, the start data, and a brief description

- Income from Fiduciary Activities (BHCK4070; 06/30/1981) – includes gross income from services rendered by the bank's trust department or by any of its consolidated subsidiaries acting in any fiduciary capacity. Beginning 03/31/02, commissions and fees on the sales of annuities by these entities are also included, if executed in a fiduciary capacity.
- Service Charges on Deposit Accounts (BHCK4483; 06/30/1981) – includes total amount of service charges on depositor accounts in domestic offices. This includes minimum deposit charges, charges based on number of checks drawn, and other service charges, commissions and fees related to payment stop orders, check certification, bill collection, safety deposit boxes, sale of insurance policies, letters of credit, etc.
- Trading Revenue (BHCKA220; 03/31/1996) – includes the net gain (loss) from trading cash instruments and off-balance sheet derivative contracts (including commodity contracts) that has been recognized during the calendar year-to-date. Also included are the revaluation adjustments to the carrying value of certain assets and liabilities and derivative contracts due to marking to market.
- Other Noninterest Income (BHCK4078; 03/31/1996) – includes all other noninterest income such as data procession, net gain on assets (other than securities or trading assets), real estate rents, and certain income in common stock investments, etc.

Beginning in with the Y-9C reports of March 2001, additional detail was required and other noninterest was decomposed into:

- Investment Banking, Advisory, Brokerage, and Underwriting Fees and Commissions (BHCKB490; 03/31/2001) – includes fees and commissions from securities brokerage

activities, the sale and servicing of mutual funds, the purchase and sale of securities and money market instruments where the bank is acting as agent for other banks or customers, and from the lending of securities owned by the bank or its customers. Commissions and fees from the sale of annuities to bank customers by the bank's securities brokerage subsidiaries are also included.

- Venture Capital Revenue (BHCKB491; 03/31/2001) – involves the providing of funds, technical and management assistance to start-up or high risk companies, with the primary objective of capital growth. Included are venture capital revenue market value adjustments, interest, dividends, gains and losses on venture capital investments.
- Net Servicing Fees (BHCKB492; 03/31/2001) – includes income from servicing real estate mortgages, credit cards, and other financial assets held by others. Beginning 03/31/02, impairments recognized on servicing assets, as well as increases in servicing liabilities are also included.
- Net Securitization Income (BHCKB493; 03/31/2001) – includes net gains (losses) on assets sold in securitization transactions. Included are fees (other than servicing fees) earned from the bank's securitization transactions, and unrealized losses on loans and leases held for sale in securitization transactions.
- Insurance and Reinsurance Underwriting Income (BHCKC386; 03/31/2003) – includes earned premiums from (1) life and health insurance, and (2) property and casualty insurance, by bank subsidiaries engaged in underwriting and re-insurance activities.
- Income from Other Insurance and Reinsurance Activities (BHCKC387; 03/31/2003) – includes income from insurance product sales and referrals, such as service charges, commissions, and fees earned from insurance sales, and fees earned from customer referrals for insurance products and annuities to insurance companies and agencies external to the consolidated bank.
- Net Gains on Sales of Loans (BHCK8560; 03/31/1994) – the amount of net gains (losses) on sales and other disposals of loans and leases, including unrealized losses on loans and leases held for sale.
- Net Gains on Other Real Estate Owned (BHCK8561; 03/31/1994) – the amount of net gains (losses) on sales and other disposals of real estate owned, increases and decreases in the valuation allowance for foreclosed real estate, and write downs of other real estate owned subsequent to acquisition charged to expense.
- Net Gains (Losses) on Sales of Other Assets (excluding Securities) (BHCKB496; 03/31/2001) – includes net gains (losses) on sales and other disposals of premises and fixed

assets, personal property acquired for debts previously contracted, and coins, art, and other similar assets.

- Other Non-interest Income (BHCKB497; 03/31/2001) – includes all operating income of the bank for the calendar year-to-date not required to be reported elsewhere in Schedule RI. Forms of Non-interest income include service charges for the sale of bank drafts, income from the sale of checks, and interchange fees from credit card transactions, among others.

Note that “Insurance and Reinsurance Underwriting Income” and “Income from Other Insurance and Reinsurance Activities” were not required reporting items until March 2003, and thus were not included in the current analysis.

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Table 1: Estimation of Market Model of Bank Returns

$$R_{i,t}=\alpha+\beta R_{M,t}+\delta X+\varepsilon_{i,t}$$

Results are from estimation of market model of weekly firm-specific returns regressed on weekly market returns, weekly change in yield, weekly change in term spread, and weekly change in credit quality spread. Each regression is estimated with at least 30 weekly return observations for a bank holding company (BHC) in a given year. Reported are the median average weekly return over all BHCs in a year; the median standard deviation of the weekly returns; the median "beta" from the market model; the median adjusted-R^2 from the market model; and the median standard deviation of the residual from the market model. All BHC sample includes all BHCs. Large BHC sample includes subset of BHCs with assets in the previous year greater than $10B (2003 dollars). Significance of tests of equality of medians between large and small BHCs (assets less than $10B (2003 dollars)) are reported next to results for large BHCs.

Year	No. Obs.	Mean of Weekly Returns (%)	Std Dev of Weekly Returns (%)	Beta	Adjusted-R^2	Std Dev of Residual (%)
			All BHCs			
1997	374	1.05	3.56	0.44	0.04	3.31
1998	362	-0.01	4.50	0.70	0.21	3.76
1999	396	-0.14	4.05	0.41	0.02	3.82
2000	418	0.11	5.05	0.15	0.00	4.77
2001	421	0.60	4.32	0.36	0.09	3.87
2002	414	0.42	3.66	0.56	0.06	3.33
2003	422	0.65	3.19	0.49	0.09	2.87
2004	391	0.32	2.92	0.49	0.10	2.56
			Large BHCs			
1997	58	1.02	3.51	0.88 ***	0.25 ***	2.97 ***
1998	56	0.16 ***	4.69	0.94 ***	0.41 ***	3.44 **
1999	53	-0.16	4.31 **	0.72 ***	0.07 ***	3.96 *
2000	57	0.54 ***	6.35 ***	0.33 ***	0.03 ***	6.00 ***
2001	52	0.22 ***	4.18	0.46 ***	0.20 ***	3.51
2002	50	0.04 ***	3.65	0.92 ***	0.27 ***	2.94 *
2003	51	0.54 **	2.63 ***	0.79 ***	0.37 ***	2.03 ***
2004	54	0.32	2.37 ***	0.56 ***	0.17 ***	2.01 ***

***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

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Table 2: Correlation of BHC Market Performance Measures with Lagged Size

$Corr(X_t, Size_{t-1})$

Correlations between bank holding company (BHC) size and risk measures for each year. BHC size is the log of assets from the previous year. X includes: Mean of Weakly Returns (average weekly return during the year); Variance of Weekly Returns (variance of the weekly equity returns during the year); Beta (coefficient on market returns from the market model described in Table 1); Adjusted-R^2 (adjusted-R^2 from the market model described in Table 1); Variance of Market Model Residuals (variance of the residuals from the Market Model descriped in Table 1). Significance of correlation is reported next to each measure.

Year	No. Obs.	Mean of Weekly Returns	Variance of Weekly Returns	Beta	Adjusted-R^2	Variance of Market Model Residuals
1997	374	-0.09 *	-0.12 **	0.47 ***	0.69 ***	-0.25 ***
1998	362	0.17 ***	0.05	0.50 ***	0.56 ***	-0.15 ***
1999	396	0.01	-0.03	0.40 ***	0.29 ***	-0.05
2000	418	0.30 ***	0.19 ***	0.36 ***	0.18 ***	0.17 ***
2001	421	-0.27 ***	-0.05	0.21 ***	0.44 ***	-0.10 **
2002	414	-0.42 ***	0.04	0.52 ***	0.73 ***	-0.08 *
2003	422	-0.16 ***	-0.14 ***	0.55 ***	0.75 ***	-0.26 ***
2004	391	0.06	-0.18 ***	0.38 ***	0.47 ***	-0.23 ***

***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

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Table 3: Simple Risk Regressions

$$\sigma^2_{i,t}=\beta_1 \ln(A_{i,t-1})+\beta_2 \ln(A_{i,t-1})^2+\delta_t YR_t+\varepsilon_{i,t}$$

OLS regressions of total risk and idiosyncratic risk on bank size and year dummy variables (not reported) for 1997 to 2004. Total risk is variance of weekly equity market returns. Idiosyncratic risk is the variance of residuals from the market model described in Table 1. Balance sheet measures are from the end of the prior year. Winsorized samples replace values of the dependent variable above (below) the 95th (5th) percentile with the value from that percentile. Small BHCs have assets below $10B (2003 dollars) and Large BHCs have assets greater than $10B (2003 dollars). Robust standard errors are reported in parentheses.

	Full Sample	**Full Sample**	**Winsorized**	**Small BHCs**	**Large BHCs**
		Total Risk			
ln(Assets)	0.022	-7.256**	-3.193*	-0.475	1.727***
	(0.178)	(2.857)	(1.646)	(0.394)	(0.407)
$\ln(\text{Assets})^2$		0.238***	0.117**		
		(0.090)	(0.053)		
No. Obs.	3,198	3,198	3,198	2,767	431
Adjusted-R^2	0.12	0.12	0.20	0.10	0.58
		Idiosyncratic Risk			
ln(Assets)	-0.607***	-7.110***	-2.829**	-1.151***	0.692**
	(0.152)	(2.380)	(1.311)	(0.331)	(0.276)
$\ln(\text{Assets})^2$		0.212***	0.085**		
		(0.074)	(0.042)		
No. Obs.	3,198	3,198	3,198	2,767	431
Adjusted-R^2	0.13	0.13	0.21	0.10	0.67

***, **, * indicate statistical significance at the 1% , 5%, and 10% level, respectively.

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Table 4: Summary Statistics for Idiosyncratic Risk and BHC Characteristics

Sample includes 3,198 bank holding companies (BHCs) in the main sample used in the regressions reported in Tables 5 to 8. Variance of residual is from the market model described in Table 1. BHC financial characteristics are from Y-9C reports. All financial characteristics are in 2003 dollars.

Name	Mean	Std Dev	Min	Max
Dependent Variable				
Variance of Residuals	15.95	15.85	0.33	290.39
Independent Variables				
Assets ($m)	13,458	67,668	128	1,264,032
Ln(Assets)	14.3	1.6	11.8	21.0
Deposits/Assets	0.70	0.11	0.02	0.91
Equity/Assets	0.09	0.04	0.02	0.76
Loans/Assets	0.64	0.12	0.01	0.93
RE Loans/Loans	0.67	0.18	0.00	1.00
C&I Loans/Loans	0.18	0.13	0.00	1.00
Consumer Loans/Loans	0.11	0.10	0.00	0.97
Other Loans/Loans	0.05	0.08	0.00	0.99
Loan HHI	0.56	0.17	0.26	1.00
Noninterest Income/Net Operating Revenue	0.24	0.14	0.02	0.98
Revenue HHI (2-part revenue breakdown)	0.68	0.10	0.50	0.97
Fiduciary Income/Noninterest Income	0.10	0.15	-0.39	0.99
Service Charges/Noninterest Income	0.37	0.19	0.00	1.55
TradingRevenue /Noninterest Income	0.01	0.07	-2.57	0.55
Other Noninterest Income/Noninterest Income	0.52	0.20	-0.11	2.02
Revenue HHI (5-part revenue breakdown)	0.64	0.13	0.25	0.96

Table 5: Idiosyncratic Risk Regressions

$$\sigma^2_{i,t}=\beta_1 \ln(A_{i,t-1})+\beta_2 \ln(A_{i,t-1})^2+\theta X_{i,t-1}+\delta_t YR_t+\varepsilon_{i,t}$$

OLS regressions of idiosyncratic risk on bank characteristics and year dummy variables (not reported) for 1997-2004. Balance sheet measures are from the end of the previous year and income statement variables are from the full previous year. Jt Sig of Loan Shares reports p-value associated with F-test of joint significance of loan shares. Jt Sig of Revenue Shares reports p-value associated with F-test of joint significance of revenue shares. Robust standard errors are reported in parentheses.

	Two-Part Revenue Breakdown		**Five-Part Revenue Breakdown**	
ln(Assets)	-1.937***	-4.514*	-1.571***	-5.402**
	(0.299)	(2.333)	(0.283)	(2.448)
$\ln(\text{Assets})^2$		0.085		0.127*
		(0.072)		(0.076)
Loan/Assets	2.100	1.925	-0.686	-0.982
	(2.786)	(2.792)	(2.864)	(2.879)
C&I Loans/Loans	20.171***	20.040***	18.143***	17.974***
	(4.868)	(4.849)	(4.914)	(4.892)
Consumer Loans/Loans	7.762**	7.909**	4.674	4.759
	(3.339)	(3.360)	(3.456)	(3.470)
Other Loans/Loons	1.611	1.165	6.454	5.737
	(5.137)	(5.252)	(4.288)	(4.402)
Loan HHI	8.411**	8.510**	5.211	5.289
	(3.390)	(3.404)	(3.383)	(3.393)
Nonint Inc/Net Op Rev	20.603***	20.248***		
	(4.315)	(4.288)		
Revenue HHI (2-component)	12.608**	12.265**		
	(5.213)	(5.214)		
Fiduciary Income/Net Op Rev			4.236	4.824
			(4.784)	(4.841)
Service Charges/Net Op Rev			7.566	7.667
			(8.871)	(8.907)
Trading Revenue/Net Op Rev			-8.747	-14.637
			(10.235)	(11.052)
Other Nonint Inc/Net Op Rev			28.577***	28.413***
			(5.004)	(4.986)
Revenue HHI (5-component)			13.711***	13.773***
			(4.876)	(4.888)
Deposits/Assets	-9.297**	-9.103**	-5.425	-5.201
	(4.151)	(4.147)	(4.027)	(4.025)
Ln(Equity/Assets)	-10.639***	-10.644***	-11.403***	-11.483***
	(2.355)	(2.357)	(2.364)	(2.382)
Turnover	0.217***	0.215***	0.213***	0.213***
	(0.073)	(0.073)	(0.065)	(0.065)
Jt Sig of Loan Shares	0.000	0.000	0.001	0.001
Jt Sig of Revenue Shares			0.000	0.000
No. Obs.	3,198	3,198	3,198	3,198
Adjusted-R^2	0.20	0.20	0.21	0.21

***, **, * indicate statistical significance at the 1% , 5%, and 10% level, respectively.

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Table 6: Robustness Tests for Idiosyncratic Risk Regressions

$$\sigma^2_{i,t}=\beta_1 \ln(A_{i,t-1})+\beta_2 \ln(A_{i,t-1})^2+\theta X_{i,t-1}+\delta_t YR_t+\varepsilon_{i,t}$$

OLS regressions of idiosyncratic risk on bank characteristics and year dummy variables (not reported) for 1997-2004. Balance sheet measures are from the end of the previous year and income statement variables are for the full previous year. Winsor sample replaces observations with values above (below) the 95th (5th) percentile with the value of that percentile. Profitable sample include only BHCs with positive profit in previous year. Well-capitalized has an equity ratio greater than 6%. Non-jumping sample drops observations with loan growth above 95th percentile or below 5th percentile. 3-year average sample uses the three-period average for all right-hand side variables. Jt Sig of Loan Shares reports p-value associated with F-test of joint significance of loan shares. Jt Sig of Revenue Shares reports p-value associated with F-test of joint significance of revenue shares. Robust standard errors are reported in parentheses.

	Winsor	Profitable	Well-Capitalized	Non-Jumping	3-Year Average
ln(Assets)	-1.175	-1.227	-3.626	-4.910*	-5.407*
	(1.335)	(1.942)	(2.304)	(2.655)	(2.992)
$\ln(\text{Assets})^2$	0.013	0.003	0.072	0.112	0.113
	(0.044)	(0.061)	(0.071)	(0.083)	(0.091)
Loan/Assets	0.764	0.386	1.125	-1.896	2.310
	(1.417)	(2.613)	(2.792)	(2.879)	(4.304)
C&I Loans/Loans	9.163***	10.867***	12.391***	19.661***	20.329***
	(2.130)	(3.462)	(3.559)	(5.313)	(7.676)
Consumer Loans/Loans	2.081	1.592	1.905	6.466*	3.094
	(2.064)	(2.910)	(3.026)	(3.631)	(5.607)
Other Loans/Loons	5.606**	6.029	4.161	5.676	5.196
	(2.588)	(3.822)	(4.252)	(4.843)	(5.719)
Loan HHI	2.448	2.298	3.238	5.446	3.156
	(1.899)	(2.949)	(3.107)	(3.600)	(4.977)
Fiduciary Income/Net Op Rev	4.376	4.965	6.036	2.009	10.897
	(3.189)	(4.613)	(4.880)	(4.573)	(9.877)
Service Charges/Net Op Rev	4.561	6.372	10.454	3.219	16.658
	(5.689)	(8.118)	(8.484)	(8.764)	(16.167)
Trading Revenue/Net Op Rev	0.438	-0.974	14.562	-15.689	0.558
	(8.066)	(9.891)	(13.446)	(12.656)	(18.190)
Other Nonint Inc/Net Op Rev	18.685***	25.943***	27.731***	23.739***	34.335***
	(2.320)	(4.563)	(4.738)	(4.754)	(9.730)
Revenue HHI (5-component)	8.965***	12.705***	12.105***	11.214**	18.580**
	(2.572)	(3.916)	(4.268)	(4.763)	(8.450)
Deposits/Assets	-1.99	-6.186*	-6.183	-3.959	-10.748**
	(1.893)	(3.763)	(4.072)	(4.099)	(4.955)
Ln(Equity/Assets)	-5.486***	-6.442***	-8.226***	-11.453***	-10.539***
	(0.606)	(0.949)	(1.159)	(2.637)	(1.614)
Turnover	0.128***	0.177***	0.213***	0.267***	0.585***
	(0.047)	(0.058)	(0.056)	(0.089)	(0.158)
Jt Sig of Loan Shares	0.009	0.002	0.001	0.001	0.003
Jt Sig of Revenue Shares	0.000	0.000	0.000	0.000	0.000
No. Obs.	2,878	3,141	2,982	2,878	2,146
Adjusted-R^2	0.21	0.22	0.20	0.20	0.24

***, **, * indicate statistical significance at the 1% , 5%, and 10% level, respectively.

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Table 7: Idiosyncratic Risk Regressions with Revenue Dummies

$$\sigma^2_{i,t}=\beta_1 \ln(A_{i,t-1})+\beta_2 \ln(A_{i,t-1})^2+\theta X_{i,t-1}+\delta_t YR_t+\varepsilon_{i,t}$$

OLS regressions of idiosyncratic risk on bank characteristics and year dummy variables (not reported) for 1997-2004. Balance sheet measures are from the end of the previous year and income statement variables are from the full previous year. Revenue dummies equal 1 if value if non-zero; equal 0 otherwise. Jt Sig of Loan Shares reports p-value associated with F-test of joint significance of loan shares. Jt Sig of Revenue Dummies reports p-value associated with F-test of joint significance of revenue dummies. Robust standard errors are reported in parentheses.

ln(Assets)	-1.929***	-5.487**
	(0.342)	(2.627)
$\ln(\text{Assets})^2$		0.117
		(0.081)
Loan/Assets	2.797	2.680
	(2.762)	(2.769)
C&I Loans/Loans	17.921***	17.811***
	(4.797)	(4.779)
Consumer Loans/Loans	4.911	4.862
	(3.415)	(3.410)
Other Loans/Loons	-3.177	-4.335
	(4.492)	(4.662)
Loan HHI	4.853	4.995
	(3.510)	(3.529)
Nonint Inc/Net Op Rev	27.391***	27.390***
	(5.133)	(5.131)
Fiduciary Income Dummy	-0.194	0.051
	(0.865)	(0.938)
Service Charges Dummy	-9.798*	-10.723*
	(5.442)	(5.484)
Trading Revenue Dummy	1.852**	1.756**
	(0.790)	(0.789)
Other Nonint Dummy	14.864***	15.015***
	(2.825)	(2.874)
Revenue HHI (5-component)	19.798***	20.197***
	(5.453)	(5.541)
Deposits/Assets	-7.514*	-7.143*
	(4.036)	(4.051)
Ln(Equity/Assets)	-11.070***	-11.145***
	(2.462)	(2.487)
Turnover	0.213***	0.212***
	(0.067)	(0.067)
Jt Sig of Loan Shares	0.000	0.000
Jt Sig of Revenue Dummies	0.000	0.000
No. Obs.	3,198	3,198
Adjusted-R^2	0.20	0.20

***, **, * indicate statistical significance at the 1% , 5%, and 10% level, respectively.

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Table 8: Summary Statistics BHC Revenue Streams

Sample includes 1,227 bank holding companies (BHCs) in the main sample used in the regressions reported in Table 9 for 2001, 2002, and 2003. All figures are shares of net operating revenue, in percentages.

Name	Mean	Std Dev	Min	Max
Noninterest Income	25.86	13.85	3.41	98.44
Fiduciary Income	2.69	6.52	0.00	67.97
Service Charges	7.76	4.08	0.00	29.27
Trading Revenue	0.31	1.70	-8.39	23.96
Other Noninterest Income	15.10	12.58	-0.47	95.81
Investment Banking	1.60	5.48	-0.14	94.66
Venture Capital	-0.06	0.63	-11.76	3.32
Net Servicing Fees	0.52	2.42	-32.28	16.45
Net Securitization Income	0.33	3.27	-1.79	55.59
Sale of Loans	3.40	7.41	-14.72	80.33
Sale of Other Real Estate Owned	-0.02	0.51	-11.80	4.05
Sale of Other Assets	0.28	3.58	-4.96	80.40
Other Noninterest Income	8.61	7.87	-1.49	95.57

Table 9: Idiosyncratic Risk Regressions with Twelve-Part Revenue Breakdown

$$\sigma^2_{i,t}=\beta_1 \ln(A_{i,t-1})+\beta_2 \ln(A_{i,t-1})^2+\theta X_{i,t-1}+\delta_t YR_t+\varepsilon_{i,t}$$

OLS regressions of idiosyncratic risk on bank characteristics and year dummy variables (not reported) for 2002, 2003, and 2004. Balance sheet measures are from the end of the previous year and income statement variables are for the full previous year. Jt Sig of Loan Shares reports p-value associated with F-test of joint significance of loan shares. Jt Sig of Revenue Shares reports p-value associated with F-test of joint significance of revenue shares. Jt Sig of Noninterest components reports p-value associated with F-test of joint significance of the eight noninterest revenue shares. Robust standard errors are reported in parentheses.

ln(Assets)	-6.415**	-6.777**	-7.091**
	(2.696)	(2.730)	(2.805)
ln(Assets)^2	0.128	0.148*	0.162*
	(0.079)	(0.080)	(0.083)
Loan/Assets	4.655	3.874	2.230
	(3.512)	(3.544)	(3.087)
C&I Loans/Loans	4.784	5.205	5.208
	(5.422)	(5.657)	(5.480)
Consumer Loans/Loans	2.703	1.299	2.196
	(3.580)	(3.741)	(4.191)
Other Loans/Loons	-3.833	-0.418	0.724
	(6.314)	(7.713)	(7.119)
Loan HHI	-2.801	-2.909	-4.023
	(3.607)	(3.754)	(3.892)
Nonint Inc/Net Op Rev	15.718***		
	(6.113)		
Revenue HHI (2-component)	20.068***		
	(5.948)		
Fiduciary Income/Net Op Rev		16.858**	17.837**
		(8.609)	(7.711)
Service Charges/Net Op Rev		24.179*	26.740**
		(13.178)	(12.886)
Trading Revenue/Net Op Rev		15.502	24.309
		(13.916)	(14.799)
Other Nonint Inc/Net Op Rev		21.097***	
		(7.460)	
Revenue HHI (5-component)		21.967***	
		(6.733)	
Investment Banking			5.375
			(4.574)
Venture Capital			-38.101
			(25.462)
Net Servicing			36.651
			(24.250)
Net Securitization			25.754***
			(7.844)
Sale of Loans			33.745**
			(13.753)
Sale of OREO			-40.402
			(124.484)
Sale of Other Assets			19.567**
			(8.014)
Other Nonint Inc			27.076***
			(6.312)
Revenue HHI (12-component)			25.076***
			(6.261)
Deposits/Assets	-12.358**	-10.468**	-10.371**
	(5.094)	(4.884)	(4.686)
Ln(Equity/Assets)	-7.448***	-7.762***	-7.053***
	(2.048)	(2.116)	(2.026)
Turnover	1.230***	1.142***	1.103***
	(0.220)	(0.218)	(0.217)
Jt Sig of Loan Shares	0.156	0.532	0.604
Jt Sig of Revenue Shares		0.046	0.000
Jt Sig of Noninterest Components			0.000
No. Obs.	1,227	1,227	1,227
Adjusted-R^2	0.17	0.17	0.18

***, **, * indicate statistical significance at the 1% , 5%, and 10% level, respectively.

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Table 10: Comparison of Idiosyncratic Risk Regression Parameters over Time

$$\sigma^2_{i,t}=\beta_1 \ln(A_{i,t-1})+\beta_2 \ln(A_{i,t-1})^2+\theta X_{i,t-1}+D_t*(\beta_1 \ln(A_{i,t-1})+\beta_2 \ln(A_{i,t-1})^2+\theta X_{i,t-1})+\delta_t YR_t+\varepsilon_{i,t}$$

OLS regressions of idiosyncratic risk on bank characteristics, post-2000 dummy variable interactions, and year dummy variables (not reported) for 1997-2004. Balance sheet measures are from the end of the previous year income statement variables are from the full previous year. Jt Sig of Loan Shares reports p-value associated with F-test of joint significance of loan shares for each period. Jt Sig of Revenue Shares reports p-value associated with F-test of joint significance of revenue shares for each period. Difference reports the difference between the estimated coefficients for the two periods. Robust standard errors are reported in parentheses.

	Two-Part Revenue Breakdown			Five-Part Revenue Breakdown		
	1997-2000	**2001-2004**	**Difference**	**1997-2000**	**2001-2004**	**Difference**
ln(Assets)	-7.542**	-6.844**	0.698	-8.854**	-6.919**	1.935
	(3.706)	(3.145)	(4.860)	(3.716)	(3.266)	(4.947)
$\ln(\text{Assets})^2$	0.202*	0.125	-0.077	0.257**	0.138	-0.119
	(0.117)	(0.093)	(0.150)	(0.117)	(0.098)	(0.153)
Loan/Assets	-0.522	4.515	5.037	-5.276	2.807	8.083
	(3.340)	(4.345)	(5.480)	(3.538)	(4.494)	(5.720)
C&I Loans/Loans	25.204***	4.975	-20.230**	21.242***	4.711	-16.531**
	(6.949)	(4.532)	(8.296)	(6.905)	(4.690)	(8.346)
Consumer Loans/Loans	8.296*	5.061	-3.235	3.174	3.591	0.417
	(4.915)	(3.287)	(5.913)	(4.976)	(3.444)	(6.051)
Other Loans/Loons	1.464	-1.079	-2.543	1.202	4.925	3.723
	(7.554)	(8.003)	(11.005)	(6.331)	(7.096)	(9.510)
Loan HHI	10.144**	0.457	-9.686	4.059	-0.379	-4.438
	(5.181)	(3.869)	(6.466)	(5.044)	(3.878)	(6.362)
Nonint Inc/Net Op Rev	14.621***	22.735***	8.114			
	(5.376)	(6.780)	(8.653)			
Revenue HHI (2-component)	1.404	19.015**	17.611*			
	(7.248)	(7.529)	(10.451)			
Fiduciary Income/Net Op Rev				-7.274	12.519	19.794*
				(6.004)	(8.238)	(10.194)
Service Charges/Net Op Rev				-16.636	23.697*	40.333**
				(14.674)	(12.888)	(19.530)
Trading Revenue/Net Op Rev				-35.011**	16.807	51.818**
				(16.055)	(15.204)	(22.112)
Other Nonint Income/Net Op Rev				24.611***	28.889***	4.277
				(5.683)	(8.103)	(9.898)
Revenue HHI (5-component)				2.816	19.818***	17.002*
				(6.589)	(7.372)	(9.888)
Deposits/Assets	-2.690	-12.504**	-9.814	0.881	-9.342	-10.223
	(5.389)	(5.980)	(8.050)	(5.325)	(5.839)	(7.903)
Ln(Equity/Assets)	-8.941***	-11.439***	-2.499	-10.155***	-11.818***	-1.663
	(2.004)	(4.120)	(4.582)	(2.016)	(4.127)	(4.593)
Turnover	0.102*	1.467***	1.364***	0.107**	1.378***	1.271***
	(0.060)	(0.246)	(0.253)	(0.053)	(0.243)	(0.248)
Jt Sig of Loan Shares	0.002	0.318	0.047	0.002	0.693	0.057
Jt Sig of Revenue Shares	0.007	0.001	0.349	0.000	0.001	0.020
No. Obs.		3,198			3,198	
Adjusted-R^2		0.21			0.22	

***, **, * indicate statistical significance at the 1% , 5%, and 10% level, respectively.

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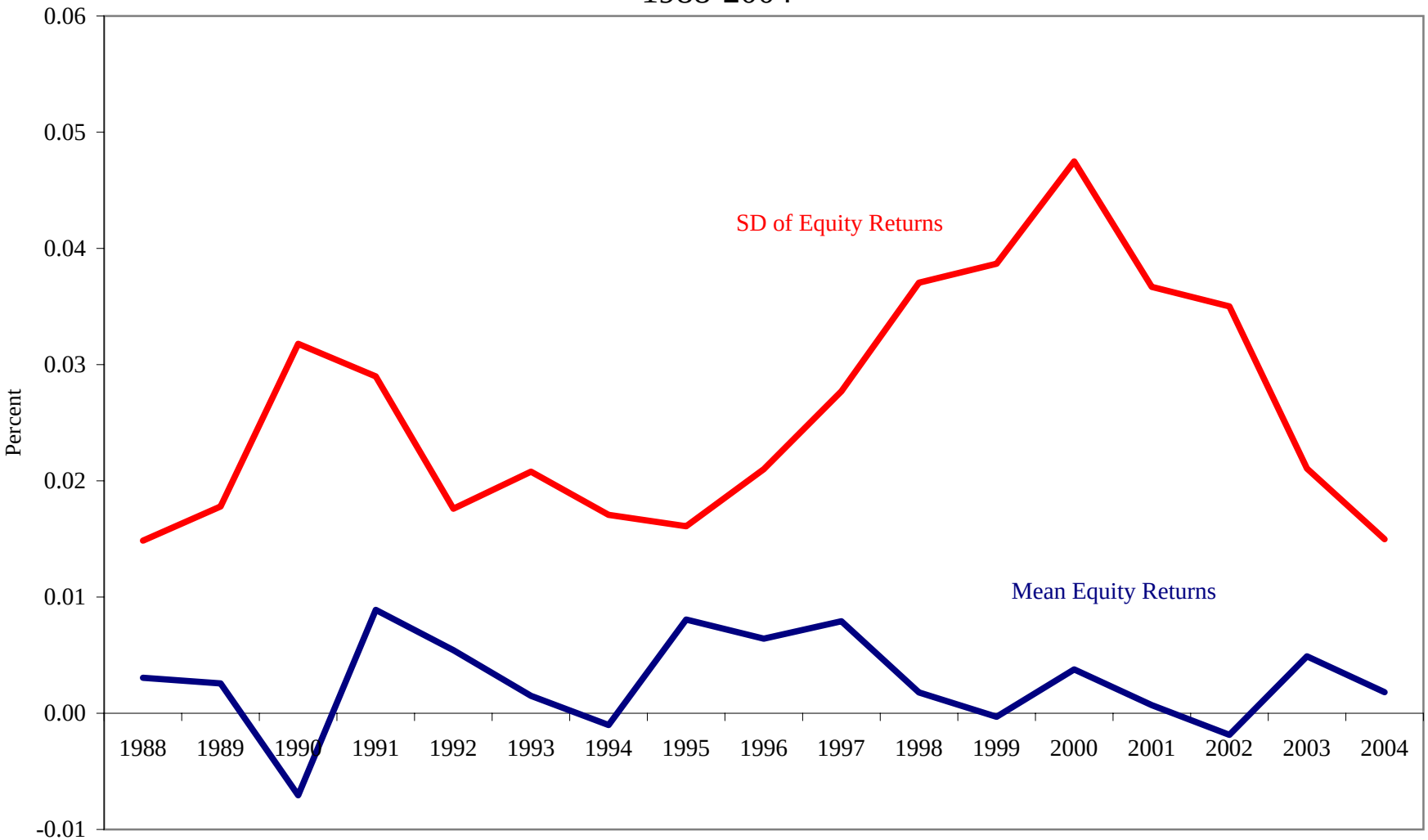
Figure 1: Bank Risk and Return

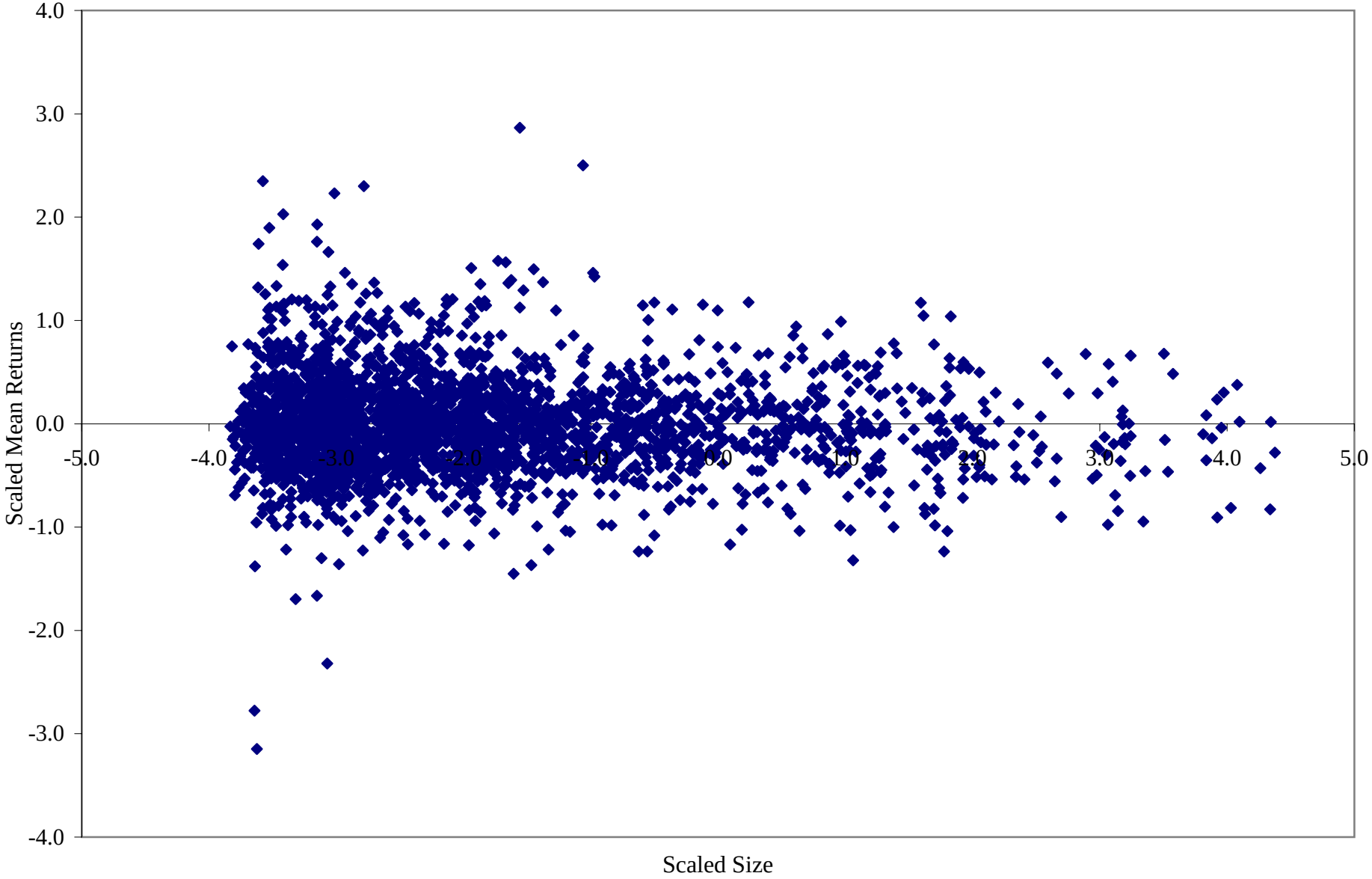
1988-2004



Note: Data are from SNL Bank Index, a capitalization-weighted index of all banks traded on the NYSE, NASDAQ, and AMEX. Mean Equity Returns is average of weekly returns in a given year. SD of Equity Returns is standard deviation of weekly returns in a given year.

Figure 2: Mean Return vs. BHC Size

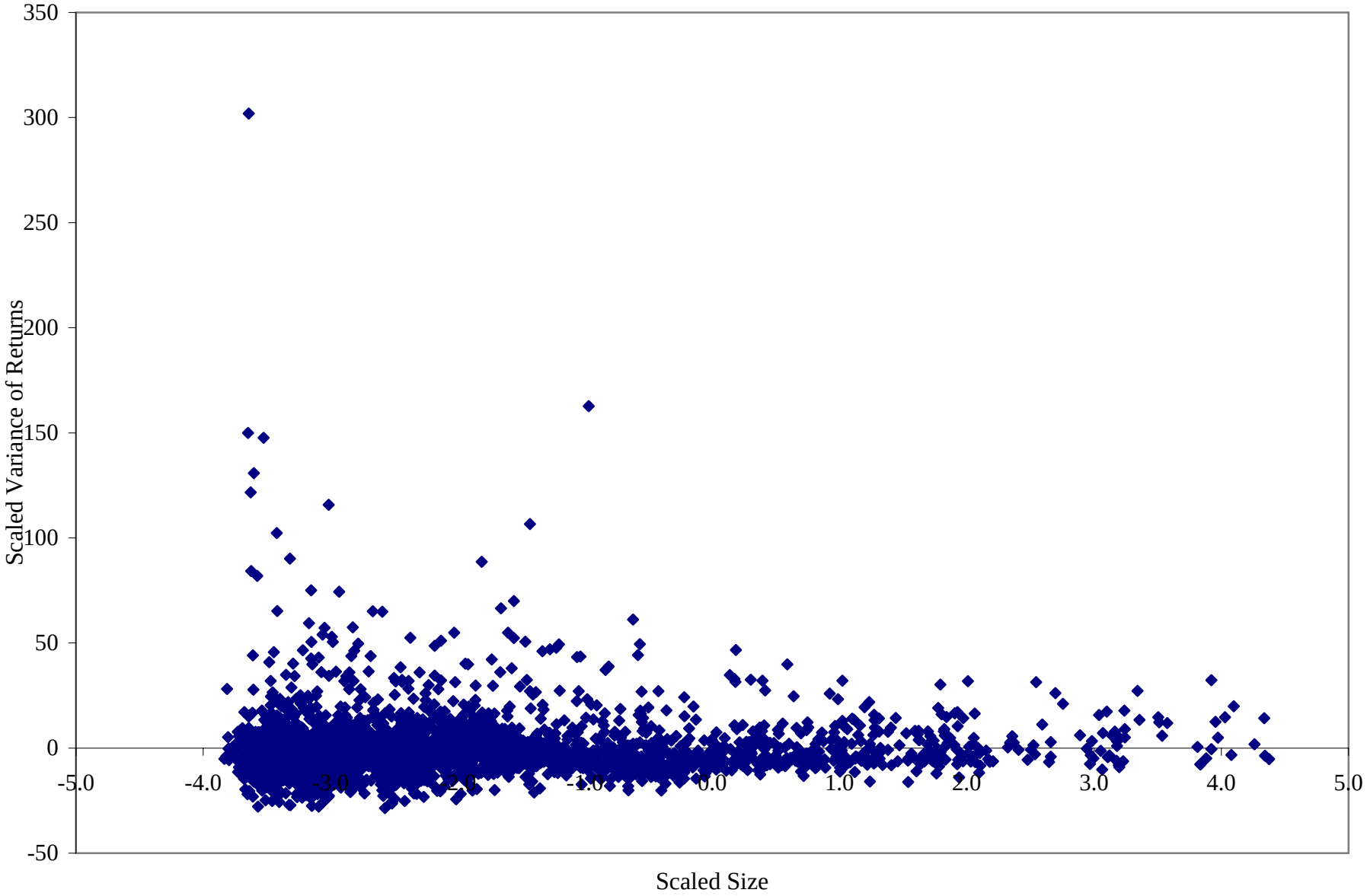
1997-2004



Note: Mean return is the average of weekly equity market returns. Size is the log of assets from the prior year. All variables are scaled by the year mean.

Figure 3: Total Risk vs. BHC Size

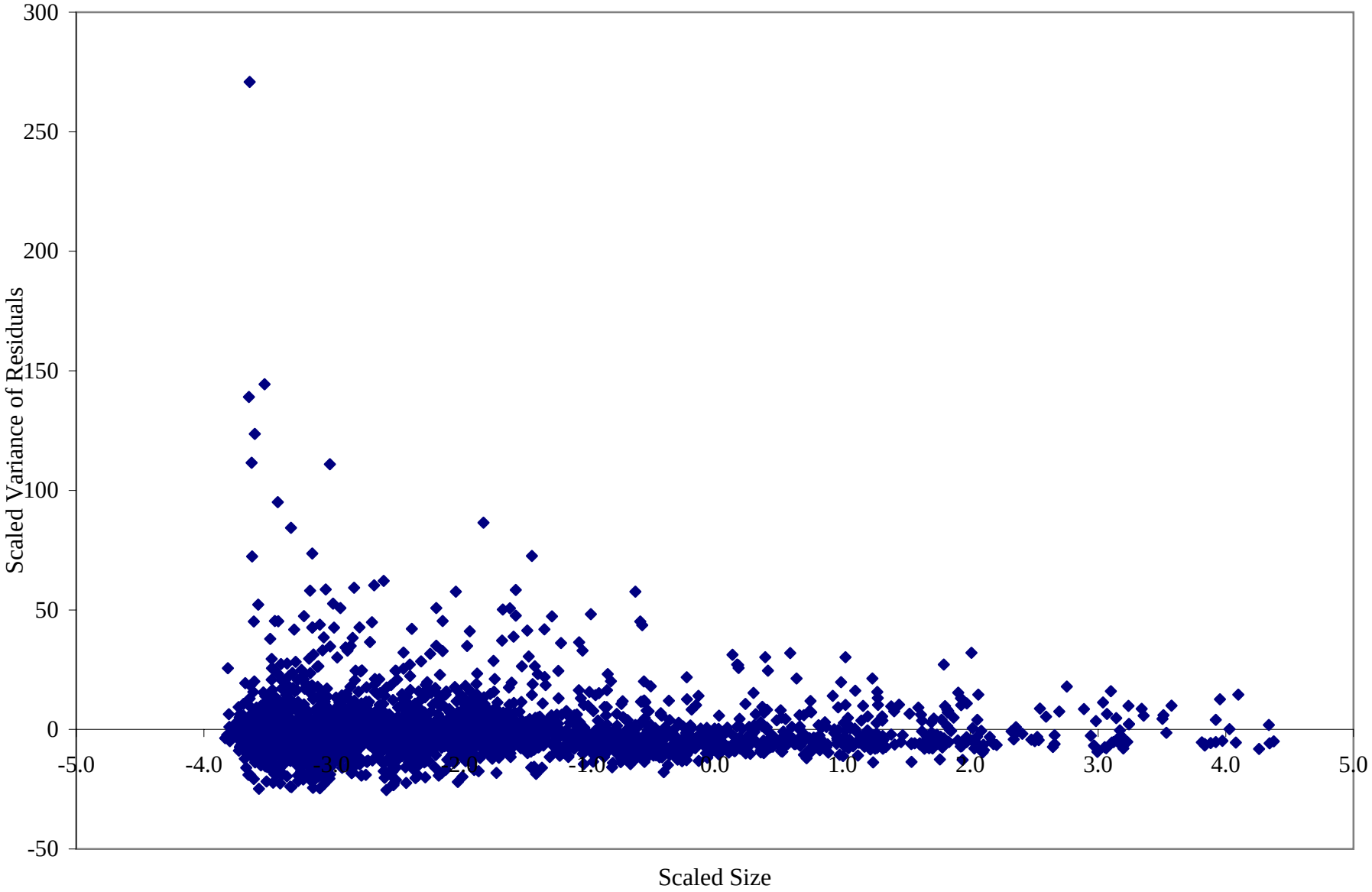
1997-2004



Note: Total risk is measured as the total variance of weekly equity market returns. Size is the log of assets from the prior year. All variables are scaled by the year mean.

Figure 4: Idiosyncratic Risk vs. BHC Size

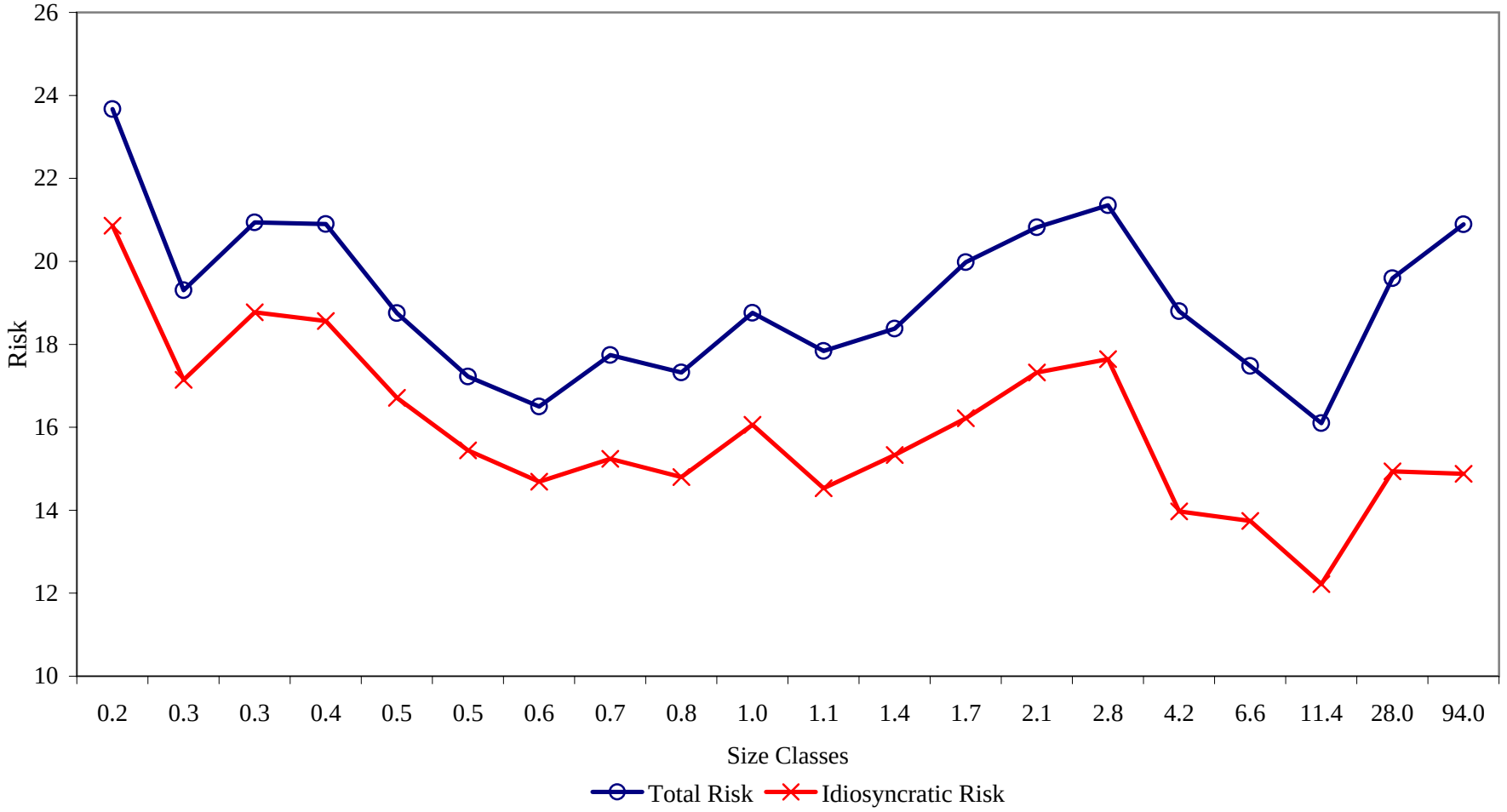
1997-2004



Note: Idiosyncratic risk is measured as the variance of the residuals from the market model described in Table 1. Size is the log of assets from the prior year. All variables are scaled by the year mean.

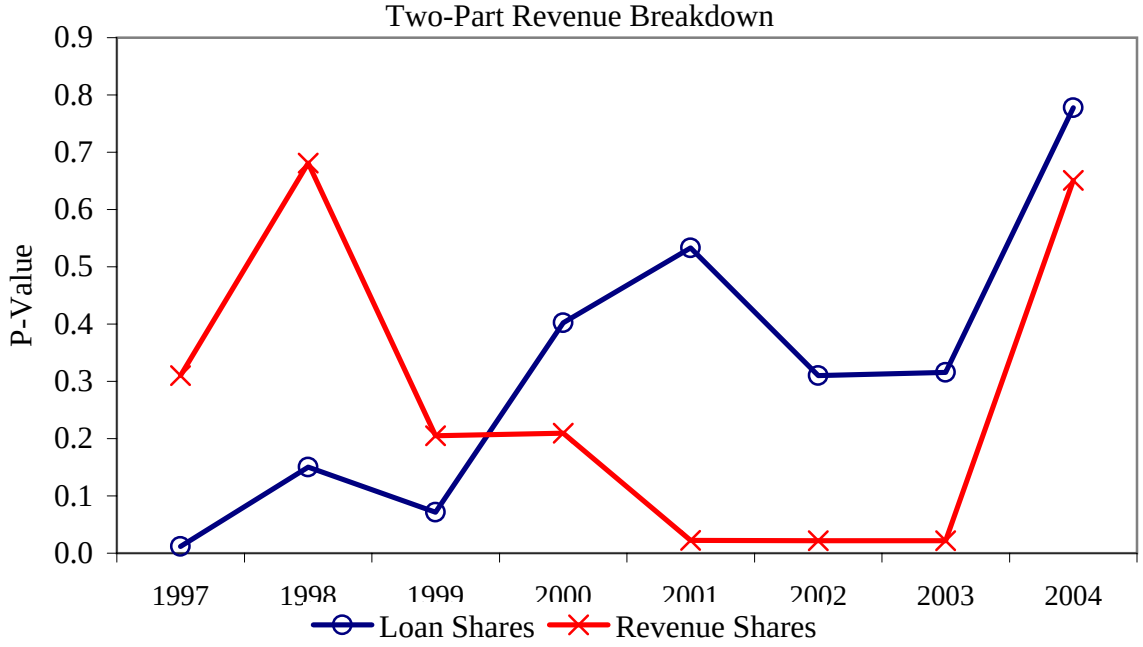
Figure 5: Total and Idiosyncratic Risk by Size Percentile

1997-2004



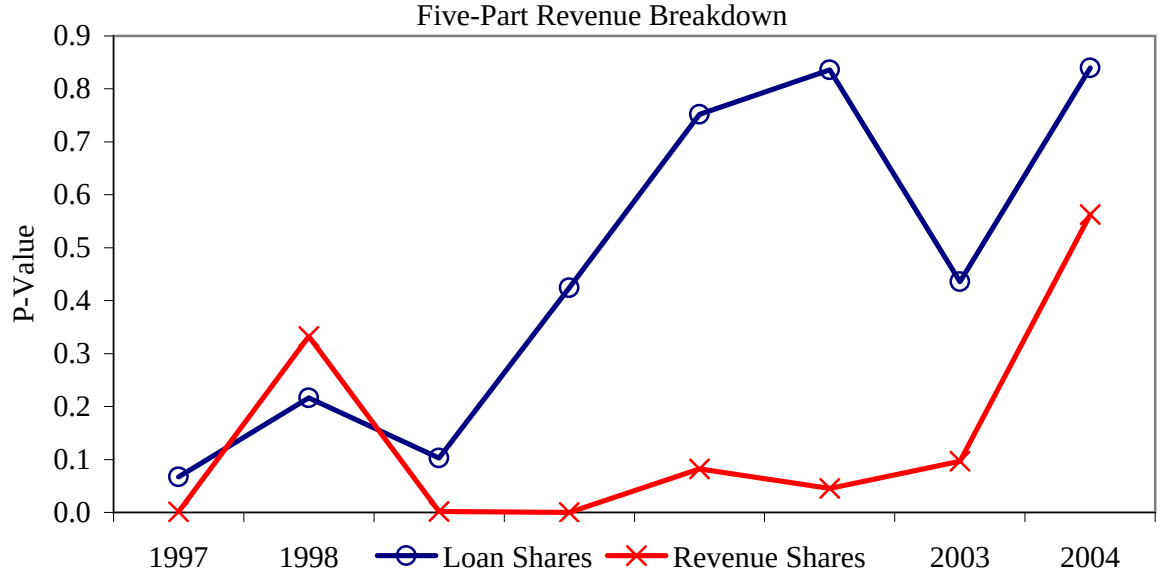
Note: Total risk is the variance of weekly equity market returns. Idiosyncratic risk is the variance of the residuals from the market model described in Table 1. Size classes contain an equal number of BHCs, sorted on the log of assets from the prior year, with median assets for each size class shown. Risk measures are means for all BHCs in a size class.

Figure 6: Significance of Loan and Revenue Shares over Time
Two-Part Revenue Breakdown



Note: P-values for Loan Shares are from the test of the joint significance of the three loan shares and p-values for Revenue Share are the p-values from the significance test of the noninterest share. All estimates are from an annual regression based on the specification in Table 5, column 2.

Figure 7: Significance of Loan and Revenue Shares over Time
Five-Part Revenue Breakdown



Note: P-values for Loan Shares are from the test of the joint significance of the three loan shares and p-values for Revenue Share are the p-values from the significance test of the four noninterest shares. All estimates are from an annual regression based on the specification in Table 5, column 4.