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Abstract: Commercial banks' lending and deposit-taking business has declined in recent years. Deregulation and new technology have eroded banks' comparative advantages and made it easier for nonbank competitors to enter these markets. In response, banks have shifted their sales mix toward noninterest income — by selling 'nonbank' fee-based financial services such as mutual funds; by charging explicit fees for services that used to be 'bundled' together with deposit or loan products; and by adopting securitized lending practices which generate loan origination and servicing fees and reduce the need for deposit financing by moving loans off the books.

The conventional wisdom in the banking industry is that earnings from fee-based products are more stable than loan-based earnings, and that fee-based activities reduce bank risk *via* diversification. However, there are reasons to doubt this conventional wisdom *a priori*. Compared to fees from nontraditional banking products (e.g., mutual fund sales, data processing services, mortgage servicing), revenue from traditional relationship lending activities may be relatively stable, because switching costs and information costs reduce the likelihood that either the borrower or the lender will terminate the relationship. Furthermore, traditional lending business may employ relatively low amounts of operating and/or financial leverage, which will dampen the impact of fluctuations in loan-based revenue on bank earnings.

We test this conventional wisdom using data from 472 U.S. commercial banks between 1988 and 1995, and a new 'degree of total leverage' framework which conceptually links a bank's earnings volatility to fluctuations in its revenues, to the fixity of its expenses, and to its product mix. Unlike previous studies that compare earnings streams of unrelated financial firms, we observe various mixes of financial services produced and marketed jointly within commercial banks. Thus, the evidence that we present reflects the impact of production synergies (economies of scope) and marketing synergies (cross-selling) not captured in previous studies. To implement this framework, we modify standard degree of leverage estimation methods to conform with the characteristics of commercial banks.

Our results do not support the conventional wisdom. As the average bank tilts its product mix toward fee-based activities and away from traditional lending activities, we find that the bank's revenue volatility; its degree of total leverage, and the level of its earnings all increase. The first two results imply increased earnings volatility (because earnings volatility is the product of revenue volatility and the degree of total leverage) and the third result implies a possible risk premium.

These results have implications for bank regulators, who must set capital requirements at levels that balance the volatility of bank earnings against the probability of bank insolvency. These results also suggest another explanation for the shift toward fee-intensive product mixes: a belief by bank managers that increased earnings volatility will enhance shareholder value (or at least will increase the value of the managers' call options on their banks' stock). Our results have no direct implications for the expanded bank powers debate — we examine only currently permissible fee-based activities, and these activities may have demand and production characteristics different from insurance underwriting, investment banking, or real estate brokerage.

Introduction

Commercial banks' market share of loans and deposits has been in decline since the early 1980s. These trends — documented and analyzed by Boyd and Gertler (1994), Kaufman and Mote (1994), Berger, Kashyap, and Scalise (1995), Edwards and Mishkin (1995), and others — were set in motion by the elimination of decades-old regulatory restrictions that limited competition in banking product markets and geographic markets, and by advances in information technology that negated some of commercial banks' traditional comparative advantages. Banks have reacted to declining shares of their most traditional business activities by increasing the production and sale of fee-based financial services. Between 1984 and 1997, noninterest income at FDIC-insured commercial banks increased from 25 percent to 38 percent of aggregate operating income (i.e., revenues net of interest expenses).[1] Although this shift toward fee-based activities has been more pronounced at larger institutions than at smaller banks, some bank analysts believe that fee income is the key to profitability and survival for community banks.[2]

Commercial banks have long earned noninterest income by offering 'traditional' banking services such as checking, trust, and cash management. The recent increase in the importance of noninterest income has come from several sources. First, banks have expanded into less traditional fee-for-service products such as insurance and mutual fund sales, and (limited) investment banking activities. Second, banks now charge explicit fees for a number of financial services which traditionally had been bundled together with deposit accounts and which customers previously had paid for by accepting lower interest rates on deposits. For example, retail customers might receive higher interest rates on their deposits but have to pay explicit fees for visiting bank tellers,

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[1] Kaufman and Mote (1994) show that noninterest income comprised an even larger percentage of operating income at U.S. commercial banks during the 1930s and 1940s, due largely to the historically low demand for commercial loans during the Depression and war years.

[2] See DeYoung (1994) for levels and trends of noninterest income at large versus small banks. For analyst opinions regarding the importance of fee income for small bank profitability, see Anat Bird, "Industry Can't Compete Without Off-Balance-Sheet Opportunities," *American Banker*, May 25, 1995, and Karen Shaw Petrou, "New Business Lines May Be Small Banks' Salvation," *American Banker*, June 26, 1998.

and correspondent banking customers might now earn interest on their compensating balances but have to pay explicit fees for data processing services. Third, the growth of securitization in mortgage, credit card, and other loan markets has presented banks with opportunities to earn fee income from originating and servicing loans separate from interest income earned by holding loans on the books. Further expansions of fee-based activities are likely in the near future as the legal barriers between commercial banking, investment banking, and insurance industries become more blurred or disappear entirely.

The conventional wisdom among bankers, bank regulators, and bank analysts is that fee-based earnings are more stable than loan-based earnings, chiefly because they are less sensitive to movements in interest rates and to economic downturns. Furthermore, the general feeling is that adding fee-based activities to a traditional mix of banking products will reduce earnings volatility *via* diversification effects. Roger Fitzsimmons, the chairman of Firstar Corp., has stated that “there is a stability to [fee] income that we like.” Banking analyst Richard X. Bove states that “Banks that have strong fee-based business and that do not have major commitments to the loan sector can weather the storm much better than those banks that are building a loan portfolio.” Andrew Hove, twice the Acting Chairman of the FDIC, has stated that “the growth in the relative performance of noninterest income over the years reflects a diversifying industry, were risks are being spread.” If these claims are true, banks that produce broad mixes of financial services should be less risky, all else held equal, than pure financial intermediaries. By extension, these arguments imply that further expansion of bank powers — to underwrite securities and insurance, or to participate in markets ancillary to financial services such as real estate brokerage or computer sales — would reduce further the riskiness of commercial banks. With this in mind, former Comptroller of the Currency, Eugene Ludwig stated that insurance sales “is a product that marries nicely with the banking business, is low risk, and should certainly be allowed.”[3]

There are a number of reasons, however, to doubt this conventional wisdom. First, banks can

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[3] The preceding quotations appeared in, respectively, the *American Banker*, May 30, 1997; *American Banker*, May 30, 1997; *American Banker*, May 30, 1997; and *Northwestern Financial Review*, May 24, 1997.

have qualitatively different relationships with fee-based customers than with their traditional loan-based customers. Revenue from a bank's traditional lending activities is likely to be relatively stable over time, because switching costs and information costs make it costly for either borrowers or lenders to walk away from a lending relationship. Revenue from fee-based activities is more likely to fluctuate from period to period, because banks face relatively high competitive rivalry, relatively low information costs, and less stable demand in a number of these product markets (e.g., investment advice, mutual fund and insurance sales, data processing services). For example, fee income in the banking industry from mutual fund sales fell by about 50 percent in 1994, a short-run fluctuation in revenue that would be unthinkable in the lending business where, even during an economic downturn, only a small percentage of loans stop making interest payments.[4]

Second, the input mix needed to produce fee-based financial services can be quite different from that needed to produce more traditional intermediation-based products. The key here is that a high ratio of fixed-to-variable expenses increases the bank's operating leverage, which turns any given amount of volatility in revenues into an even greater amount of earnings volatility. Once a bank has established a lending relationship with a customer, increasing the amount of credit actually extended requires the bank to increase only its variable costs (interest expense), which reduces its operating leverage. In contrast, expanding the production of certain fee-based services can require the bank to hire additional fixed labor inputs, which increases its operating leverage. This point is underscored by a quotation from a Standard & Poors analyst regarding J.P. Morgan & Co.: "Over the last decade, the company's business mix has evolved, so that it has become increasingly reliant on...underwriting, advisory services, and trading. This profile has rendered earnings more volatile. The expense base has also become quite high, so that earnings could be vulnerable to revenue declines."[5]

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[4] The source of the mutual fund revenue figure is the *American Banker*, July 16, 1996. Note that from 1984 through 1997, the percentage of real estate loans held by commercial banks that were noncurrent (i.e., 90 days past due or no longer accruing) fluctuated only between 1.1 percent and 5.4 percent (source: *OCC Quarterly Journal*).

[5] *American Banker*, January 26, 1998.

Third, bank regulators do not require the bank to hold any capital against many fee-based activities (see Spong 1994, page 76), and banks that take advantage of this can increase their returns to equity. For example, a Dean Witter Reynolds analyst concluded that Mellon Bank Corp. redeemed $160 million of its in preferred stock in the aftermath of purchasing securities giant Dreyfus Corp. because the combined firms "...don't need as much capital for their fee business as they have for the spread business."[6] Although most banks will internally allocate some capital to these activities, the lack of a regulatory capital requirement suggests a higher degree of financial leverage -- and thus earnings volatility -- for these products.

Finally, there is evidence from the academic literature. Over the past two decades, a substantial number of studies have investigated whether a repeal or revamp of the Glass-Steagall Act would allow commercial banks to reduce risk by diversifying into currently nonpermissible, nontraditional financial services. Although most of these studies (which we review below) find that combining banking and nonbank activities creates the *potential* for risk-reducing diversification, these studies also find that some nonbank activities tend to increase bank risk; that the returns to diversification quickly diminish; and that any risk reduction achieved via diversification can be undone by taking other risks, such as increased financial leverage.

These observations lead us to reconsider the popularly held belief that increased fee-based activity tends to reduce the volatility of earnings at commercial banks. We test this proposition using quarterly revenue and earnings data from 472 U.S. commercial banks between 1988 and 1995, and a 'degree of total leverage' framework which conceptually links the volatility of a bank's earnings to its revenue volatility, its expense fixity, and its product mix. To our knowledge, this is the first study to use degree of leverage concepts to analyze risk at financial institutions. We devise a new empirical framework based on these theoretical concepts, and we also modify standard degree of leverage estimation techniques to make them compatible with the operational, financial, and strategic

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[6] *American Banker*, December 21, 1994.

characteristics of banks. These innovations allow us to investigate more completely than in previous studies the manner in which alterations in product mix can affect the riskiness of financial institutions. Most previous studies measure correlations between the earnings streams of pairs of financial services produced by two unrelated firms, or produced by two affiliates of a financial services holding company that are related only by common ownership. In contrast, we observe combinations of financial services that are jointly produced and marketed within the same commercial bank, and because of this we capture both cost synergies (scope economies) and revenue synergies (cross-selling) in our estimates of the impact of product mix on earnings volatility.

Our results contradict the conventional wisdom. We find evidence that commercial bank earnings grow more volatile as banks tilt their product mixes toward fee-based activities and away from traditional intermediation activities. For the average bank in our sample, both revenue volatility and the degree of total leverage increase with the share of bank revenue generated from non-deposit-related, non-trading-related, fee-based activities. These two results imply that the volatility of bank earnings increases as banks expand their fee-based activities because, as we show, earnings volatility is the multiplicative product of revenue volatility and the degree of total leverage. We also find evidence that the level of bank earnings increases as banks expand their fee-based activities, which suggests the existence of a risk premium associated with these activities.

Our findings offer some (perhaps surprising) commentary on what two decades of changes in competitive rivalry, technological advance, and business strategy in the commercial banking industry have meant for the risk profiles of commercial banks. If, as seems likely, the share of commercial bank revenues generated by fee-based activities continues to trend upward, our results imply that bank earnings will become increasingly more volatile. Although most bank shareholders could neutralize the effects of these changes on the riskiness of their portfolios by adjusting their holdings of nonbank stocks, for bank regulators and bank managers the risks are less avoidable. Bank regulators bear only the downside risk: holding capital constant, higher earnings volatility increases the probability that a bank will become insolvent. Bank managers bear both the upside and the downside risk, and in some circumstances may be attracted to especially volatile fee-based activities. Banks whose charter values have eroded over the past twenty years now have less at risk, and shareholders may now prefer higher earnings volatility in order to increase the upside probability of a large payout. Managers who own call options on their bank's stock may also prefer output mixes that generate high earnings volatility.

Although one might wish to use the results of this study to draw inferences about the wisdom of various plans to allow commercial banks full brokerage and insurance underwriting powers, any such inferences should be made with caution. On the one hand, we derive our results using an empirical framework that captures production and marketing synergies across product lines, phenomena that should be included in any benefit-cost analysis of whether banks should be allowed to produce nontraditional services internally, at arms-length through a holding company, or not at all. On the other hand, we derive our results from the revenues and earnings generated by fee-based activities that are currently permissible for commercial banks, and this set of activities for the most part excludes the securities and insurance activities central to the debate over expanded powers. Ultimately, the degree to which our results are useful in this policy debate depends on the (unobserved) degree to which the demand and production characteristics of the currently permissible fee-based activities are similar to the characteristics of the proposed expanded powers.

The remainder of the paper is organized as follows. In section 1 we present a simple model of the degree of total leverage at a multiproduct firm, and establish our research plan-of-attack. In section 2 we review the empirical literature on bank product mix and bank risk. In section 3 we describe our data set, which contains quarterly observations of revenues and earnings for 472 sample banks between 1988 and 1995. In section 4 we compute revenue volatility for each of our sample banks, and discover how revenue volatility varies across banks with different product mixes. In section 5 we modify standard leverage estimation techniques for use on commercial bank data, use these techniques to estimate the degree of total leverage for each of our sample banks, and then discover how the degree of total leverage varies across banks with different product mixes. In section 6 we combine the theoretical framework from section 1 with the empirical results from sections 4 and 5 to demonstrate the degree to which earnings at the typical commercial bank are affected when product mix shifts away from traditional lending activities and toward fee-based activities. In section 7 we summarize our main results and discuss their implications for regulatory policy, business strategy, and future research.

1. Applying a Degree of Total Leverage Framework to Multiproduct Banking Firms

The concept of *degree of total leverage* summarizes the relationship between the top of a business firm's income statement (sales revenue) and the bottom of its income statement (earnings). Consider a firm that has relatively high fixed expenses and relatively low variable expenses. We refer to such a firm as being 'highly levered' or having a high 'degree of leverage'. When sales revenues are increasing at this firm, its earnings will increase more than proportionally, because a relatively large portion of each additional revenue dollar can be retained due to the low variable expenses. Of course, this sword has two edges -- when sales revenues are decreasing at a highly levered firm, losses will occur more quickly due to its high fixed obligations. A firm's degree of total leverage (*DTL*) can be defined as the percentage change in earnings (π) that is caused by a 1 percent change in revenue (r):

$$DTL = \frac{\partial \pi}{\partial r} * \frac{r}{\pi} = \frac{\% \Delta \pi}{\% \Delta r} \quad (1)$$

In other words, *DTL* is the 'revenue elasticity of profits.' Note that *DTL* can be expressed as the product of two other leverage concepts, the degree of operating leverage and the degree of financial leverage (i.e., *DTL=DOL*DFL*). *DOL* is the elasticity of earnings before interest and taxes (EBIT) with respect to sales revenue, and reflects leverage in production. *DFL* is the elasticity of profits with respect to EBIT, and reflects the use of financial leverage. Of the two concepts, financial leverage is much more familiar in the banking industry, where financial liabilities often outnumber financial capital by 10-to-1. (Ironically, in banking the 'leverage ratio,' defined as the ratio of book equity capital to total assets, moves in the opposite direction from *DFL*.) We concentrate on *DTL* in this study because changes in bank product mix can affect both operating and financial leverage, and because accurately separating a bank's interest expenses into operating costs and financing costs is difficult.

By rearranging the terms in (1) we can show that a high degree of total leverage can amplify a given amount of revenue volatility ($\%\Delta r$) into an even greater amount of earnings volatility ($\%\Delta\pi$):

$$(2) \qquad \%\Delta\pi = DTL * \%\Delta r$$

Assuming that the firm is a price taker in output markets, this formula decomposes earnings volatility into two parts: volatility due to largely external market conditions ($\%\Delta r$) and volatility due to internal production and financing considerations (*DTL*).

Figure 1 shows how the degree of total leverage influences the relationship between bank revenues and bank earnings. In the figure, Firm I is highly levered: it has high fixed costs (low vertical intercept) and low variable costs (high slope). In contrast, Firm II is less highly levered: it has low fixed costs (high vertical intercept) and high variable costs (low slope). Thus, for a given increase or decrease in sales away from current revenue R^*, profits at Firm I vary more than do profits at Firm II. (Figure 1 assumes that increases and decreases in revenue are caused by fluctuations in quantity sold, holding sales price constant.) Although increased revenue volatility will result in increased earnings volatility regardless of the degree of total leverage, the highly levered Firm I is more likely than Firm II to suffer losses, or enjoy large increases in profits, when revenue volatility increases.

For multiple-product firms like banks, both $\%\Delta r$ and *DTL* are influenced by product mix. Multi-product firms face multiple output demand curves, some of which are more volatile than others, and as a result some product-specific revenue streams will be more volatile than others. For example, we could reasonably expect the stream of revenue from merger and acquisition financing to be more volatile than the stream of service charge revenues levied on core depositors. Thus, a bank's overall revenue volatility can vary substantially depending on its product mix or 'business strategy.' Similarly, the degree of total leverage at a multiple-product firm depends on its product mix, because not all product lines are produced with the same ratio of fixed-to-variable expenses. For example, relative to lending activities, fee-generating activities such as mortgage servicing and trust services may employ higher fixed or quasi-fixed operating expenses (office space and labor), or higher fixed financing expenses (zero required regulatory equity capital), per dollar of revenue. Hence, to the extent that both of its determinants ($\%\Delta r$ and DTL) are functions of product mix, earnings volatility ($\%\Delta\pi$) will also be a function of product mix. Thus, we could rewrite equation (2) as follows:

$$(2a) \qquad \%\Delta\pi = \sum_{j=1}^{J} DTL_j * \%\Delta r_j$$

where j is an index of J different product lines.

Commercial banks report their sales revenues separately by product line, but they do not report their earnings separately by product line. Hence, while it is possible to generate the product-specific measures of revenue volatility suggested in equation (2a), it is not possible to generate the product-specific degree of leverage measures.[7] Given this data restriction, we will take the following practical approach to revealing the relationships embedded in equation (2a). First, we use time series data on individual bank revenues and earnings to measure overall revenue volatility ($\%\Delta r$) and the degree of total leverage (DTL) for each of the banks in our sample. Second, we use cross-section regressions to estimate the degree to which different product mixes (where j = lending, investments, trading, deposit, and fee-based activities) across banks are associated with different levels of $\%\Delta r$ and DTL. Finally, we use the coefficients from those cross-section regressions to demonstrate how a shift in product mix, away from traditional lending activities and toward less traditional fee-based activities, affects earnings volatility ($\%\Delta\pi$) indirectly through its two determinants, $\%\Delta r_j$ and DTL_j, as shown in equation (2a).

We recognize that earnings volatility ($\%\Delta\pi$) is not a good measure of risk within the context of a diversified portfolio. Barefield and Comiskey (1979) found that earnings variability and systematic risk are not highly associated, but earnings *forecast errors* and systematic risk are highly associated. Litzenberger and Rao (1971) drew similar conclusions: "Clearly, earnings variability per se is not the same thing as risk. To the extent that the direction and magnitude of a change in earnings is predicted,

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[7] This can be seen by observing equation (1), in which DTL is a function of both $\%\Delta r$ and $\%\Delta\pi$. That is, estimating product-specific leverage requires product-specific observations of both revenues and earnings.

the variability will have no effect on the required rate of return." However, while this logic holds for an individual investor, it doesn't necessarily hold for bank regulators or bank managers, neither of which can diversify away the idiosyncratic risk associated with the volatility of individual bank earnings, regardless of how predictable may be those earnings.[8] Furthermore, the risk embedded in earnings volatility affects each of these parties differently. Bank regulators, who are vested with the responsibility of protecting the payments system and the insurance fund from the impact of bank failures, have to contend with a higher overall probability of bank failure when industry earnings grow more volatile. Bank managers, whose incomes and professional reputations are clearly linked to bank earnings, obviously fare poorly if their bank becomes insolvent. But some managers may have reasons to embrace high earnings volatility, e.g., managers of troubled banks that face moral hazard incentives; managers holding call options on the bank's stock; or managers attempting to bolster the stock price by increasing the probability of a large one-time dividend payout.

2. A Brief Review of the Literature on Product Mix and Bank Risk

A sizeable empirical literature analyzes the relative riskiness of commercial banks, nonbank financial institutions, and their various product lines. These studies employ a variety of methodologies to compare earnings streams across financial services industries, across individual firms from different financial services industries, and across individual banking firms with different product mixes. In general, these studies provide evidence that combining banking and nonbank activities can potentially reduce risk. However, these studies also find that the returns to diversification tend to diminish quickly; that diversifying into some nonbank activities could actually increase a bank's riskiness; and that any risk reduction achieved via diversification can be undone by taking other risks, such as increased financial leverage.

The earliest group of studies established that not all nonbank activities would reduce the risk of banking firms. Johnson and Meinster (1974), Heggestad (1975), Wall and Eisenbeis (1984), and Litan

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[8] Thus, it should not be surprising that both regulators and bankers have been champions of legislation to allow increased diversification *via* expansion into new geographic and product markets.

(1985) used IRS data to compare the aggregate earnings streams of the banking industry to the earnings streams of other financial industries (e.g., securities, insurance, real estate, leasing). Earnings in the banking industry were more volatile than some of the nonbanking industries, but less volatile than others. More importantly, banking industry earnings were positively correlated to the earnings of other financial industries, but negatively correlated to others. Finally, because the studies examined these industries over a number of different time periods prior to 1980, these results followed very little pattern across studies, which suggests that the relationships between banking earnings and nonbanking earnings are not stable across time, and that constructing a risk-minimizing portfolio of banking and nonbanking activities may be difficult.

Other studies have used firm-level data rather than industry averages. Some of these studies concluded that diversification into nonbanking activities tends to increase the riskiness of banks. Boyd and Graham (1986) examined the risk of failure at large BHCs that diversified into non-banking activities during the 1970s and early 1980s, and concluded that, in the absence of strict regulatory oversight and control, expansion into nonbanking areas can actually increase the risk of BHC failure. Sinkey and Nash (1993) found that commercial banks that specialized in credit card lending (an often-securitized type of lending that generates substantial fee income) generated higher and more volatile accounting returns, and had higher probabilities of insolvency, than commercial banks with traditional product mixes during the 1980s. Demsetz and Strahan (1995) measured diversification and risk at bank holding companies using stock return data between 1980 and 1994. They found that, although BHCs tend to become more diversified as they grow larger, this diversification does not necessarily translate into risk reduction because these firms also tend to shift into riskier mixes of activities and hold less equity. In a study of large U.S. bank holding companies, Roland (1997) found that abnormal returns from fee-based activities were less persistent (more short-lived or volatile) than abnormal returns from lending and deposit-taking. Kwan (1998) compared the accounting returns of Section 20 securities affiliates to the accounting returns of their commercial banking affiliates between 1990 and 1997, and found that the securities affiliates tended to be riskier (more volatile returns over time), but not necessarily more profitable, than the commercial banking affiliates.

Other firm-level studies have found that diversification into nonbanking activities can reduce the riskiness of banks, although these gains tended to be limited in size, scope, or practice. Boyd, Hanweck and Pithyachariyakul (1980) measured the correlations between accounting rates of return at the bank and nonbank affiliates of BHCs between 1971 and 1977. They concluded the potential for risk reduction (i.e., minimizing the probability of failure) was exhausted at relatively low levels of nonbank activities, and that most BHCs had already fully captured this potential. Eisenbeis, Harris, and Lakonishok (1984) found positive abnormal returns to the stock of banking firms announcing the formation of one-bank holding companies (OBHCs) between 1968 and 1970, a brief period during which OBHCs were permitted to engage in a wide variety of nonbanking activities. The authors found no abnormal returns to announcements of OBHC formations after 1970 regulations that limited the scope of these activities. Kwast (1989) used quarterly financial statement data to calculate the means and standard deviations associated with the securities (i.e., trading) and non-securities activities of commercial banks, and used those results to demonstrate that, between 1976 and 1985, some limited potential existed for commercial banks to reduce their return risk by diversifying further into securities activities. Gallo, Apilado, and Kolari (1996) found that high levels of mutual fund activity (mutual fund assets managed as a percentage of total BHC assets) were associated with increased profitability, but only slightly moderated risk levels, at large BHCs between 1987 and 1994.

Another group of studies posits hypothetical mergers between actual banking firms and nonbank financial firms, and then calculates the potential reduction in earnings variability based on the covariances of the two unrelated firms' earnings streams. Wall, Reichert, and Mohanty (1993) constructed synthetic portfolios based on the accounting rates of return earned by banks and by nonbank financial firms. Their results suggest that, had banks been able to diversify into small amounts of insurance, mutual fund, securities brokerage, or real estate activities, they could have experienced higher returns and lower risk between 1981 and 1989. Boyd, Graham, and Hewitt (1993) simulated mergers between bank holding companies and various nonbanking financial firms between

1971 and 1987. Their results, based on both accounting and market data, suggest that a BHC can reduce its risk by combining with a life insurance firm or with a property/casualty insurance firm, but would likely increase its risk by combining with a securities firm or with a real estate firm. Laderman (1998) applied a modified version of this simulated merger approach to financial firm data between 1970 and 1994, and concluded that by offering “modest to relatively substantial amounts” of life insurance or casualty insurance underwriting, a BHC could reduce both the standard deviation of its return on assets and also its probability of bankruptcy. Allen and Jagtiani (1999) used stock market data to construct return streams for synthetic ‘universal banks,’ each consisting of one commercial bank holding company, one securities firm, and one insurance company. They found that the universal bank’s exposure to market risk increased as the securities trading and insurance underwriting activities comprised a larger portion of the artificially constructed firm.

In this paper, we take an empirical approach that is fundamentally different from the general approach taken in the literature. We begin our analysis at the top of the income statement with revenues, rather than at the bottom of the income statement with earnings as do all of the previous studies. Furthermore, we observe product mix effects within established, integrated production processes, rather than artificially combining earnings streams generated by unrelated production and marketing processes. Hence, we will capture synergies in expenses and revenues between product lines that studies of unrelated firms cannot capture, and these synergies might enhance or detract from the diversification benefits found in those studies. For example, if a bank expands internally into a nonbank activity, it may be able to produce the new product at relatively low cost due to scope economies with its existing products. Thus, it will generate a higher ratio of return to risk than will a stand-alone producer of that product, and thus will generate larger diversification benefits than most of the existing literatures. In contrast, if the bank is cross-selling this new product only to its existing customer base, rather than diversifying to new customers, it may not capture as large a diversification benefit as that suggested by the existing literature, which combines unrelated firms with customer bases that do not perfectly overlap.

3. Data Set

Our initial data set was a balanced panel of 19,650 quarterly observations of revenues, profits, and other financial variables for 655 commercial banks over the 30 quarters between March 1988 and June 1995. All data were collected from the Reports of Condition and Income (call reports), and are expressed in June 1995 dollars. We included in the data panel only those banks that had greater than $300 million in assets as of June 1995 and whose charter existed continuously from the beginning of 1988 through the end of 1995. All of the financial statement variables are merger-adjusted — that is, in any given quarter, we set bank *i*'s revenues (or profits, assets, etc.) equal to its own revenues *plus* the revenues of the banks it acquired during that quarter or in subsequent quarters during our 30-quarter sample period. From these 655 banks, we excluded 30 banks which had poor quality data in one or more quarters.[9] In addition, we excluded 153 banks that participated in more than three mergers during the 30-quarter sample period, because multiple mergers can make the data unfit for estimating leverage. (We discuss this point in greater detail below.) These adjustments left us with a balanced panel of 14,160 quarterly observations of 472 banks.

The national economic climate varied substantially across the 30 quarters in our data set. This time period included a recession, a period of rapid recovery, and a sustained period of low economic growth. Real GDP growth ranged from -2 percent to 4 percent, accompanied by a national unemployment rate that ranged from 5 percent to 8 percent. Banks operated in a variety of interest rate environments, also. The 3-month Treasury rate fluctuated between 3 percent and 9 percent and the 3-month/10-year yield curve ranged from nearly flat to a positive 300 basis points. Thus, this data series should be long enough to capture business cycle-related volatility in sales and profits, and to test how that volatility differs across banks with different product mixes.

We expect that our calculations of revenue volatility will be positively associated with merger

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[9] We discarded 27 banks with negative quarterly sales revenues too large to be explained by quarterly losses from trading or investment activities. We discarded two banks with implausibly large deviations in reported quarterly sales revenues. We discarded one large outlying bank because its average sales revenues were two-and-a-half times those of the next largest bank.

activity. In the quarters and years following a merger some of the acquired depositors will run-off to other banks; some acquired loan accounts will not be renewed by the acquiring bank; and some branch offices will be shut-down in order to reduce fixed expenses or are divested in order to satisfy antitrust authorities. In addition to these 'actual' revenue disruptions, there are often disruptions to 'reported' revenues during the merger-quarter (the quarter during which the merger was consummated) because the acquired bank does not always file a complete, or completely accurate, quarterly call report. We take a number of precautions to control for these effects. First, we use quarterly, rather than annual, call report data because this allows us to compile a statistically meaningful sample size for each bank over a relatively short window in time (i.e., exposing each time series to fewer mergers).[10] Second, in order to capture most of the 'actual' revenue disruptions, but eliminate the 'reported' revenue disruptions, we exclude the merger-quarter from our time series calculation of revenue volatility. Third, because this adjustment reduces the number of time series observations, we exclude from our sample any bank that participated in more than three mergers during our 30-quarter sample period. Finally, we control for any remaining merger-induced revenue volatility by including a 'number of mergers' variable ($M = (0,3)$) in our main regression tests, and also by retesting all of our main results for robustness using the subsample of 250 banks that made no acquisitions during the sample period.

We expect that our estimates of the degree of total leverage will be biased toward zero for banks that participate in mergers. By merger-adjusting the data, we have combined the pre-merger revenue and profit streams of banks with potentially different business strategies, organizational structures, corporate cultures, efficiency levels, and local market conditions — and all of these phenomena can potentially influence the production process, and hence the degree of total leverage, at the pre-merger banks. Thus, for a bank that made multiple acquisitions during the sample period, the

[10] Although the quarterly call reports are likely to contain more data errors than annual call report data, we are willing to accept this reduction in quality for the large attendant benefits. Our statistical results rely on central tendencies in the data (median average and OLS regression coefficients), which should minimize the impact of these data errors. In addition, using quarterly data is consistent with the conventional time period used by financial analysts tracking quarterly movements in earnings.

quarter-to-quarter changes in revenues may have little or no systematic relationship with the quarter-to-quarter changes in profits, and if this occurs then $DTL = \partial\Delta\pi/\partial\Delta r$ will approach zero. As discussed above with regard to merger-induced revenue volatility, we attempt to mitigate this problem by excluding banks that made more than three mergers; by including a merger control variable in our regression tests; and by running robustness tests using data only from non-merging banks.

To measure product mix at bank *i*, we disaggregate total bank *i* revenues into five qualitatively different activities. *Loan revenue* is the sum of interest and fee income associated with the loans originated and/or held by the bank during quarter *t*.[11] *Investment revenue* is the interest, dividend, and capital gains(losses) from the bank's investments in marketable securities not held in the bank's trading account. *Trading revenue* is the sum of gains(losses) and fees on securities in the bank's trading account. *Deposit revenue* equals service fees charged to depositors. *Fee-based revenue* equals the revenue not included in the previous four categories, and includes fees associated with (among other items) trust services, mutual fund and insurance sales, standby letters of credit, loan commitments, credit cards, mortgage servicing, data processing, cash management, business consulting services, investment advice, correspondent banking, services provided by bank tellers, and gains(losses) from the sale of a variety of assets. These five categories capture 100 percent of bank revenue.

We use gross revenues from loans, investments, and depositor services rather than netting out interest expenses associated with these revenues. We do this for three reasons. First, allocating total interest expenses across loans, investments, and deposit accounts would require us to make arbitrary expense allocations that would be inaccurate for all banks and especially inaccurate for some banks.

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[11] We use accrual accounting figures for all revenue categories. In any given quarter, accrued loan interest revenue can exceed actual (cash) loan interest revenue because of past due interest payments. Some of these interest payments will eventually be received; aside from a potential timing difference, accrual interest will equal actual interest for these loans. Loans that continue to be past due are eventually reclassified from accruing status to nonaccruing status (or equivalently, the terms of the loan are renegotiated); when this occurs, any unpaid accrued interest is backed out of the revenue account, and accrued interest revenue declines to equal actual interest revenue. We do not subtract either loan loss provisions or charge-offs from the quarterly loan revenue figures, because provisions are based on expected, not actual, loan losses, and charge-offs are based on loan principal, not loan revenue.

These mistakes and mismatches would likely result in overstating the volatility of the resulting quarterly net revenue streams. Second, the concept of net interest revenues implies that interest expenses are strictly variable expenses. Rather than assuming this to be true, we treat deposit interest expenses like any other expense line item (i.e., as a potential mixture of fixed and variables costs) and rely on our leverage estimation technique to reflect the actual variability and/or fixity of these expenses. Third, using gross loan revenues rather than net loan revenues makes it more difficult to reject the 'conventional wisdom hypothesis' that fee-based activities are less volatile than lending activities. Net loan revenues are naturally less volatile than gross loan revenues because the interest rates paid and received by banks tend to move up and down together across time.

As reported above, our fee-based revenue variable combines noninterest revenues from many separate fee-based activities. This high level of aggregation is unavoidable given the way that noninterest revenue is reported in the call reports.[12] Aggregating across so many different types of activities is likely to create diversification effects that reduce the volatility of the fee-based revenue variable at some banks. Thus, using this highly aggregated definition of fee-based revenue may further increase the difficulty of rejecting the conventional wisdom hypothesis (see the discussion of gross loan revenue versus net loan revenue above). A potentially bigger concern is that the call report includes some credit-related fees (e.g., fees from loan commitments, standby letters of credit, loan servicing) in the "noninterest income" category. Banks earn these fees by performing activities (e.g., risk analysis) that are traditionally associated with lending, and as such these activities share some of the fixed inputs

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[12] Since 1991 the call reports have separated out "other noninterest income," which includes include a record gains(losses) from the sale of a variety of assets (e.g., loans, leases, strips, forward and futures contracts, OREO, premises and fixed assets), from the main category "noninterest income." We do not employ this slightly finer categorization here because doing so would have reduced our time series' to only 18 quarters (1991:1 to 1995:2), a shorter slice of the business cycle and a substantial reduction in the degrees of freedom in our leverage estimation equations. However, we did employ this data in an earlier version of this study that used a different empirical approach (DeYoung and Roland, 1997). In that study, we used 30 quarters of data to compute the coefficients of variation for each of the five revenue classifications used in this paper, and then repeated that exercise using 18 quarters of data for the six-way revenue categorization that included "other noninterest income." For both sets of data, we found results similar to those that we find in this paper: for the average bank, the coefficient of variation of "noninterest income" (i.e., fee-based revenue) was significantly larger (at the 1% level) than the coefficient of variation of loan revenue.

(e.g., credit analysts) used to generate loan revenues. We will keep this issue in mind when we interpret our empirical results. In particular, we recognize that an observed change in product mix that simultaneously increases our fee-based revenue variable and decreases our loan revenue variable could indicate that a bank is doing one or both of the following: shifting its overall product mix away from traditional intermediation activities and toward less traditional fee-based activities; or maintaining its role as a financial intermediary but shifting away from the traditional way of making loans (originate and hold) toward a less traditional way of making loans (originate and securitize, and perhaps retain the servicing rights). *In either case*, observing such a shift in revenue mix would indicate that the bank is moving away from the traditional commercial banking model.

Summary statistics for our 472 banks are displayed in Table 1. Over half of the sample banks made no acquisitions during the 30-quarter sample period. The 30-quarter average asset size ranged from $256 million for the smallest bank in our sample to $52 billion for the largest bank in our sample.[13] The 30-quarter averages for quarterly sales revenues and quarterly adjusted profits had similarly wide ranges. Among the many possible ways to define profits, we feel that adjusted profits (i.e., net income before taxes, extraordinary items, and loan loss provisions, but after chargeoffs and recoveries) corresponds best to theoretical degree of leverage concepts.[14] The 30-quarter average adjusted profit was negative for 23 banks, suggesting that these banks were not viable in the long-run and perhaps should be excluded from the leverage estimations (see the discussion in section 5 below).

The average (mean) bank generated 64.29 percent of its revenue from lending activities; 19.38 percent from investment activities; 10.59 percent from fee-based activities; 4.29 percent from service

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[13] Although the parameters of our sample selection process excluded banks with less than $300 million of assets in 1995, the 30-quarter average asset size can be below $300 million due to growth over time.

[14] We use pre-tax profits because leverage is a pre-tax concept. We exclude extraordinary items because they are non-recurring and hence are not systematic to either the production function or the financing function represented by the degree of total leverage. We feel that net chargeoffs (chargeoffs less recoveries) come closer to reflecting the actual patterns of cash loan revenues than do loan loss provisions. Although neither net chargeoffs nor provisions perfectly transform accounting revenues into cash flows, net chargeoffs are subject to less discretion than are provisions. Regardless, there is evidence that commercial banks use their discretion over the timing of loan provisioning to manage bank capital, not bank earnings (see Ahmed, Takeda, and Thomas 1998).

charges on deposit accounts; and 1.44 percent from trading activities. Most of these banks had a 'traditional' banking product mix: 425 banks generated the majority of their revenues from loans; 12 banks generated the majority of their revenues from investment activities; 7 banks generated the majority of their revenues from fee-based activities; and for the remaining 28 banks none of the five product lines generated over 50 percent of total revenues. The 30-quarter average for trading revenues was negative for 11 banks, and equaled zero for 164 banks.

Finally, note that we observe our data for individual banks, not for the combined affiliates of bank holding companies. We feel that our degree of leverage framework is most powerful when used to describe the relationships among the revenues, costs, and profits generated by an integrated production and marketing process. Thus, bank-level data allows us to examine the *actual* diversification effects across the relatively narrow range of financial products currently produced at commercial banks, while most of the previous literature has examined the *potential* diversification effects across a broader range of financial products produced by loosely related affiliate organizations, or by completely unrelated business firms.

4. Measuring revenue volatility

To calculate the volatility of total sales revenue at bank i, we begin by calculating the percent change in its quarter-to-quarter revenues for each quarter t:

$$\%\Delta r_{it} = \frac{r_{i,t+1} - r_{i,t}}{r_{i,t}} \qquad (3)$$

(For convenience, we will express the percentage change in both revenues and profits as a number between zero and one.) We then transform the resulting time series of quarter-to-quarter changes into a single summary measure of revenue volatility over the entire sample period:

(4) $$RV_i = std.\ dev.\ of\ \%\Delta r_i = \sqrt{\frac{\sum_{t=1}^{N}(\%\Delta r_{it} - \bar{r}_i)^2}{N}}$$

where $\bar{r}_i$ is the mean of $\%\Delta r_{it}$. Although N=29 for most of the banks in this calculation, we use fewer than 29 observations to calculate *RV* for banks that made acquisitions during our sample period. As discussed in the previous section, the merger-adjusted revenue data is poor quality during merger-quarters, so before calculating *RV* we discard any observations of $\%\Delta r_{it}$ that were generated using revenues from those quarters. In our calculations, then, N=29 for banks that made no acquisitions during the sample period; N=27 for banks that made one acquisition; N=25 for banks that made two acquisition; and N=23 for banks that made three acquisitions. Hence, we expect *RV* to be positively related to the number of mergers for two reasons: (a) post-merger revenues are naturally more volatile due to acquired depositor run-off, discontinuation of acquired lending relationships, and closing or divesting acquired branches, and (b) the denominator in *RV* is lower for banks that made acquisitions.

Note that *RV* is a growth-adjusted, inflation-adjusted, and merger-adjusted measure of revenue volatility that is scaled similarly for all banks, and is directly comparable across banks that made the same number of mergers during the sample period.[15] Tests that compare *RV* across banks that made different numbers of mergers will be made conditional on the merger variable M=(0,3). To the extent that changes in prices and quantities beyond the bank's control are largely responsible for its quarterly fluctuations in revenues, *RV* is an exogenous determinant of profit volatility.

4.1 Results for revenue volatility

Table 2 displays summary statistics for our calculations of revenue volatility. *RV*=0.0772 for the median bank in our sample, i.e., one standard deviation of revenue volatility was equivalent to about an eight percent change in this bank's quarterly revenues. Revenue volatility varied widely

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[15] *RV* is growth-adjusted because systematic growth in revenues over time is netted out in the $(\%\Delta r_{it} - \bar{r}_i)$ terms.

between the extremes of our sample (*RV*=0.0147 for the most stable bank and *RV*=0.8447 for the most unstable bank), but it varied over a much tighter range ($0.0297 \leq RV \leq 0.2677$) for the ninety percent of the banks at the center of the distribution. Revenue volatility was higher for banks that made acquisitions during the sample period. As discussed above, while some of this merger-related volatility is probably evidence of disruptions to revenue streams around the time of the merger, some of it can also be attributed to the manner in which we constructed the *RV* variable.

In Table 3A we test the degree to which the cross-sectional variation in revenue volatility displayed in Table 2 is associated with product mix. Columns [1] through [5] display the results of ordinary least squares regressions of *RV* on the five revenue shares w_j (*j* = deposit activities, lending activities, investment activities, fee-based activities, and trading activities), and on control variables for bank size (revenues and revenues^2), merger activity (*M*), and a constant term. In each of the regressions we excluded one of the five revenue shares to avoid perfect colinearity. The coefficients on the w_j variables are the estimated changes in revenue volatility that occur when one revenue share point of activity *j* is substituted for one revenue share point of the activity excluded from the regression, holding constant the revenue shares of the other three activities. A negative coefficient on w_j indicates that substitution into activity *j* has volatility-reducing diversification effects.

The regressions explain about a quarter of the variation in the dependent variable, and the specifications were significant at the 1% level (*F*=23.938). Trading activities have an unambiguous positive effect on revenue volatility, as evidenced by the significant positive coefficients on $w_{trading}$ in columns [1] through [4], and also by the significant negative coefficients on all four of the w_j variables in column [5]. Using the point estimates from column [2], moving one percentage point of revenue out of loans and into trading activities would increase revenue volatility at the average bank by 0.0124, or by about 11 percent (.0124/.1075). Bank revenues were much less sensitive to changes in the other four activities. After trading activities, fee-based activities had the most consistently positive effect on total revenue volatility. For the average bank, substituting one percentage point of fee-based revenue for loan revenue would increase revenue volatility by 0.0013, or by about 1 percent (.0013/.1075).

Deposit activities had the most stabilizing effect on bank revenues. Increasing deposit-based revenue at the expense of less loan revenue would decrease total revenue volatility by 0.0058, or by about 5 percent (-.0058/.1075). There was no significant difference between the revenue volatilities of investment activities and loan activities.

Revenue volatility declined at a decreasing rate with total sales revenue, consistent with size-related diversification effects, for banks of all sizes. This quadratic effect ‘bottomed-out’ at around $2 billion in quarterly revenues, just short of the quarterly revenues generated by the largest sample bank. Even after controlling for these size effects, revenue volatility was still positively related to merger activity. The coefficient on the merger variable *M* was positive and significant; on average, a merger increased *RV* by about 2 percentage points.

As a further test, we re-estimated the *RV* regressions for the subsample of 250 non-merging banks, and report the results in Table 3B. Although adjusted-R^2 falls to 0.1039 in these regressions, the basic results are unchanged. The revenue share coefficients for loans, investments, deposits, and fee-based activities are similar in sign, magnitude, and significance to those in the full sample regressions, and the coefficients on trading activity remain positive (but are smaller and less precise). Hence, we have a high level of confidence that our results for fee-based activities are unaffected by any merger-induced bias in the way we constructed *RV.* Interestingly, the sized-based diversification effect from Table 3A disappears for the non-merging banks in Table 3B. The asset-size and revenue-size distributions of the 250 non-merging banks and the 222 merging banks are very similar, so any size-related diversification available to one group should be available to the other. One possible explanation is that growth via acquisition, which can quickly diversify a bank’s geographic or product-line exposures, is more likely to produce diversification effects than internal growth.

On balance, the results in Tables 3A and 3B run contrary to the conventional wisdom that fee-based activities reduce the volatility of bank earnings. Notice that the rank ordering of revenue volatility across the other four activities (trading-related revenues the most volatile; deposit-related revenues the least volatile) is rather ‘orthodox,’ which increases our confidence in the ‘unorthodox’ fee-based result. However, we cannot accept of reject the ‘conventional wisdom hypothesis’ based only on this evidence — recall that the theoretical framework in equation (2a) expresses earnings volatility as the product of *two* phenomena, revenue volatility and the degree of total leverage. We now turn our attention to estimating the degree of total leverage and exploring how the degree of total leverage is related to product mix.

5. Estimating the degree of total leverage

A bank that exhibits low revenue volatility will not necessarily experience low earnings volatility. For such a bank, earnings volatility could still be high if the bank has a high degree of total leverage. A typical textbook formula for the total degree of total leverage looks like this:

$$(5) \qquad DTL = \frac{(p-v)*Q}{(p-v)*Q - \left(F + I + \frac{D_{ps}}{(1-\tau)}\right)}$$

where p is the price of a unit of output; v is variable cost per unit of output; Q is number of units sold; and F, I, and $D_{ps}/(1\text{-}\tau)$ are fixed expenditures for, respectively, operating costs, interest obligations, and the pre-tax equivalent dividend payments to preferred stockholders. Note that the denominator is pre-tax profits, while the numerator is the contribution made by sales to pre-tax profits. Thus, *DTL* can be expressed more simply:

$$(6) \qquad DTL = \frac{sales\ revenue - variable\ costs}{sales\ revenue - variable\ costs - fixed\ costs}$$

Note that equation (6) is simply a compact way to express the graphical relationships we have already displayed in Figure 1. Holding sales revenue constant, firms with high fixed operating or financing costs, but low variable operating costs, will have a relatively high degree of total leverage.

When we hold the cost structure constant but allow a firm’s sales revenue to vary, *DTL* will fluctuate over a set of well-defined ranges, depending on whether or not the firm is earning ‘break-even' profits. Figure 2 displays the theoretical values for *DTL* with respect to short-run profits, holding costs constant. When the firm is operating above break-even (where break-even revenue = variable costs + fixed costs, so that the denominator in (6) equals zero), *DTL* is strictly positive and greater than 1.0, ranging between positive infinity very near break-even and declining asymptotically toward 1.0 as profits advance. When the firm is operating below break-even but above shut-down (where shut-down revenue = variable costs, so the numerator in (6) equals zero), *DTL* is strictly negative, ranging between negative infinity very near break-even and increasing toward zero as profits decline further. Firms earning profits lower than this are not economically viable, and will shut-down.[16] Thus, the degree of total leverage has a discontinuous range of theoretically acceptable values (1.0 < *DTL* < 0).

Although textbook leverage formulae elegantly illustrate these concepts, the formulae themselves are not particularly useful in practice. To apply them, the analyst must be able to separate fixed operating costs (*F*) from variable operating costs (*vQ*). This can be a difficult and inexact task, particularly at a complicated, multi-product firm.[17] An analyst working inside the firm often resorts to arbitrary cost accounting rules to make these separations. Because the mix of fixed and variable expenses is the crucial, defining concept for the degree of total leverage, any misrepresentation of this expense mix will transmit directly into a miscalculation of *DTL*. Even if this were not a problem for inside analysts, outside analysts (like us) performing cross-sectional studies of multiple firms lack the information to make these separations accurately on their own, because the crucial cost accounting information is not necessarily included in firms' financial statements.[18]

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[16] Note that our data set may include some profit and revenue streams from banks that were not economically viable in the long-run. During our data period, bank regulators "resolved" a substantial number of insolvent banks by arranging for them to be acquired by healthy institutions. If any of those banks were acquired by the banks in our sample (as seems likely), the pre-merger profit and revenue streams of those non-viable banks will be subsumed in the merger-adjusted time series' of the acquiring sample banks.

[17] Are interest payments to core depositors fixed or variable expenses? Are loan officers, investment counselors, and/or fund salesperson fixed or variable inputs?

[18] For banks, these measurement problems are made worse by ambiguities in modeling the bank production process. Some economists have argued that only asset-based products such as loans and investments in securities should be considered outputs, because these assets represent the final stage of the process of financial

5.1 The standard degree of leverage methodology

The alternative solution is to estimate each firm's *DTL* by regressing a time series of its profits on a time series of its sales revenues. When such a regression is specified in natural logs, the estimated slope coefficient equals the 'revenue elasticity of profit,' or *DTL*. Although this approach is not without its shortcomings (as we discuss below), it obviates the need to separate fixed and variable operating expenses. This empirical approach was introduced by Mandelker and Rhee (1984) and subsequently modified by O'Brien and Vanderheiden (1987). We make additional modifications to the O'Brien and Vanderheiden method in order to accommodate the production, financing, and strategic idiosyncracies of commercial banks.

In the Mandelker and Rhee (M&R) approach, a single equation is estimated for firm *i*:

$$\ln\pi_{it} = \alpha_i + \beta_i lnr_{it} + \varepsilon_{it} \qquad (7)$$

where α is a constant term, ε is a random disturbance term with zero mean, the subscript *t* refers to time, and *ln* is the natural log operator. In this log-log specification, β is the revenue elasticity of profit, or *DTL*. However, O'Brien and Vanderheiden (O&V) demonstrate that the M&R method is biased: as firm *i* grows over time, π and *r* tend to increase in proportion to each other, and as a result the estimated elasticity β will naturally tend toward one. To correct for this bias, O&V use a two-stage approach which corrects for the growth in π and *r* in the first stage and then estimates the degree of total leverage coefficient in the second stage. The first stage regressions are:

$$\ln\pi_{it} = \ln\pi_{i0} + \gamma_{i\pi}t + \mu(\pi)_{it} \qquad (8)$$

$$lnr_{it} = lnr_{i0} + \gamma_{ir}t + \mu(r)_{it} \qquad (9)$$

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intermediation. Others have argued that banks add value in a variety of ways related or unrelated to the intermediation process, and as such bank output should include not only assets, but also transactions and liquidity services (e.g., checking) and various fee-based services (e.g., mutual fund sales, trust services, cash management, mortgage servicing, credit enhancements). See Humphrey (1990), Berger and Humphrey (1992), and Tripplet (1992) for a discussion of these issues. We note here that the time series estimation approach that we use to measure the degree of total leverage circumvents most of these issues.

where π_{i0} and r_{i0} are the initial profits and revenues for firm *i*; $\gamma_{i\pi}$ and γ_{ir} capture the growth in firm *i*'s profits and revenues over time; and the random disturbance terms $\mu(\pi)_{it}$ and $\mu(r)_{it}$ capture the growth-adjusted time series of firm *i*'s profits and revenues in natural logs. The second stage regression is:

$$\mu(\pi)_{it} = \alpha_i + \beta_i \mu(r)_{it} + \varepsilon_{it} \quad (10)$$

As in equation (7), α is a constant term, ε is a random disturbance term with zero mean, and β is the revenue elasticity of profit, or *DTL*. Both O'Brien and Vanderheiden (1987) and Dugan and Shriver (1992) have shown that this two-stage approach produces leverage estimates that are more plausible than those generated by the M&R approach.

A key assumption in both the M&R and O&V approaches is that the parameters underpinning the degree of total leverage — namely, *Q*, *p*, *v*, *F*, *I*, *D*, and τ in equation (5) — are constant for all values of *t* used in the estimations. Lord (1998) shows that leverage measures estimated using either the M&R or the O&V approaches are quite sensitive to fluctuations in these parameters. This is a particular concern to us, given that our data set covers a time period (1988-1995) during which some of these parameters were changing. For example, the level and term structure of interest rates (a key price for banks) fluctuated substantially, and many banks engaged in well-advertised efficiency efforts designed to reduce fixed costs (either in the aftermath of mergers or in order to make themselves a less attractive merger target). Although we cannot completely control for such changes, we do take a number of steps to minimize their potentially deleterious impact, which we describe below.

5.2 Modifying the standard methodology

We make three modifications to the O&V approach in order to make it more compatible with the production and financing idiosyncracies of commercial banks. First, we use both linear and nonlinear time trends in the first-stage regressions to control for the secular growth in revenues and profits. At commercial banks, revenues are a function of exogenously determined interest rate levels, and profits are a function of exogenously determined interest rate term structures. Only under extremely unusual circumstances will movements in interest rates be consistent with linear growth trends for bank revenues or bank profits — indeed, as displayed in Figures 3 and 4, quarterly revenues and profits follow a cubic time trend on average. Thus, we attempt to control simultaneously for both exogenous changes in interest rates (i.e., the parameters *p* and *v* in equation (5)), and secular growth in revenues and profits, by specifying cubic time trends in the first-stage regressions. One concern with this approach is that, if the time trend is specified too flexibly, some of the short-run quarter-to-quarter variation that we wish to capture in leverage coefficient β will be absorbed by the time trend coefficients $\gamma_{i\pi}$ and γ_{ir}. To guard against this possibility, we also estimate the first-stage regressions using the more standard, albeit less flexible, linear time trend.

Second, we include in the first-stage regressions a set of dummy variables to absorb systematic movements in revenues and profits caused by accounting treatments and/or seasonal factors. (Recall that we use quarterly observations in order to minimize the impact of mergers and acquisitions on our leverage estimates, in contrast to previous leverage studies which use annual data.) Third, because it is not unusual for an economically viable bank to occasionally record negative quarterly profits, we do not transform profits (or revenues) into natural logs prior to estimation. This allows us to retain a substantial number of banks which otherwise would have to have been discarded (the natural log of negative profits is undefined), but requires an additional transformation of the β coefficient from the second-stage regression (see below).

Making these modifications resulted in the following first stage regressions:

$$\pi_{it} = \pi_{i0} + \gamma_{i\pi 1}t + \gamma_{i\pi 2}t^2 + \gamma_{i\pi 3}t^3 + \delta_{i1}q1 + \delta_{i2}q2 + \delta_{i3}q3 + \mu(\pi)_{it} \quad (11)$$

$$r_{it} = r_{i0} + \gamma_{ir1}t + \gamma_{ir2}t^2 + \gamma_{ir3}t^3 + \delta_{i1}q1 + \delta_{i2}q2 + \delta_{i3}q3 + \mu(r)_{it} \quad (12)$$

where *q1*, *q2*, and *q3* are (0,1) dummy variables equal to 1 for observations that occur in the first, second, or third calendar quarter, respectively. Equations (11) and (12) assume the general case of a cubic time trend; imposing the restriction $\gamma_{i2}=\gamma_{i3}=0$ results in linear time trends. The second stage regression is identical to the O&V second stage regression:

$$\text{(13)} \qquad \mu(\pi)_{it} = \alpha_i + \beta_i \mu(r)_{it} + \varepsilon_{it}$$

Note, however, that the estimated β coefficient in (13) is no longer the revenue elasticity of profit *DTL*, because the profit and revenue time series' in the first stage regressions are no longer expressed in natural logs. We transform β into the appropriate elasticity measure as follows:

$$\text{(14)} \qquad DL_i = \beta_i * \left(\frac{\bar{r}_i}{\bar{\pi}_i} \right)$$

where $\bar{r}_i$ and $\bar{\pi}_i$ are the average (mean) revenues and profits for bank *i*.

We discard merger-quarter observations due to the poor quality of the merger-adjusted revenue and profit data during these quarters. Hence, we estimate equations (11), (12) and (13) using 30 quarterly observations for banks that made no acquisitions during our sample period; 29 quarterly observations for banks that made one acquisition; etc. In all of these regressions, the time variable *t* still ranges from 1 to 30, but can have up to three missing entries; although the reduced number of observations will reduce the efficiency of estimated β slightly for banks that made acquisitions, the missing quarters should not materially affect the shape of the fitted time trend. As previously mentioned, we expect that our estimates of *DTL* will be biased toward zero for banks that made acquisitions, because the merger-adjustment process may create noise that masks the leverage relationship between revenues and profits. (Note that this bias would exist even if we did not have to discard merger-quarter observations, and is independent of that adjustment.)

5.3 Estimates of the degree of total leverage

Table 4A displays summary statistics for our estimates of *DTL* using the standard linear time trend specification. Consistent with the results of previous empirical studies (Mandelker and Rhee 1984, O'Brien and Vanderheiden 1987, Dugan and Shriver 1992, and Lord 1998), our estimations generated a substantial number of very large positive and negative outliers. Because outliers influence the mean averages, the median averages are better measures of central tendency for our estimates.

Median *DTL*=0.4628 for the entire sample of 472 banks. Thus, for the average bank a 1 percent change in gross revenue would yield an estimated 0.46 percent change in adjusted profits.

Note, however, that this median value falls outside the acceptable theoretical range for *DTL*. In fact, only about a third of the *DTL* estimates fall within the theoretical range for profitable firms ($1.0<DTL<\infty$), and the large standard deviation of 22.2202 indicates that these estimates are not very precise. Furthermore, despite the fact that only about 5 percent of the banks averaged negative quarterly profits over the sample period, about 33 percent of the banks had negative estimated *DTL*. We suggest three possible explanations for the large number of low and/or negative leverage estimates. First, because we are using streams of revenues and profits over time to estimate an instantaneous phenomenon, some of the dispersion in estimated *DTL* is likely due to changes in the theoretical leverage parameters (Q, p, v, F, I, D, and τ) over time. Second, as we expected, making acquisitions during the sample period appears to bias estimated *DTL* toward zero; median *DTL* declined to 0.3153, 0.1815, and 0.0544, respectively, for banks that made one, two, and three acquisitions. In contrast, median *DTL*=0.6644 for the 250 banks that did not engage in any merger activity during the sample period, and *DTL* was greater than 1.0 for about 41 percent of the non-merging banks. Third, consistent with leverage theory, our estimates of *DTL* were more likely to be negative for unprofitable banks — when we removed from the sample the 23 banks with negative average quarterly profits, there were 20 fewer negative outliers.

But even for the subsample of profitable, non-merging banks, the linear time trend model still performs poorly: median *DTL*=0.7371 and estimated *DTL*>1.0 for only 42 percent of the banks. When we substitute the more flexible cubic time trend for the standard linear time trend, as shown in Table 4B, a much larger percentage of the *DTL* estimates fall on the theoretically ‘correct’ range. For the entire sample of 472 banks, median *DTL*=1.3817 (i.e., on average a 1 percent change in gross revenue yields a 1.38 percent change in adjusted profits) and the standard deviation, though still large, declines some to 17.2438. *DTL* is greater than 1.0 for about 56 percent of the banks, and is negative only about 26 percent of the time. As before, the estimates of *DTL* are biased downward for banks that made acquisitions, and are more likely to be negative for unprofitable banks; but in all cases the magnitudes of *DTL* produced by the cubic time trend model are more theoretically pleasing than in the linear time trend model. Estimated *DTL* was greater than 1.0 for 67 percent of the non-merging banks and for 69 percent of the profitable non-merging banks — results that compare quite favorably with the degree of leverage estimates from previous studies of nonfinancial firms[19] — and estimated *DTL* was negative for 20 percent of the non-merging banks and 16 percent of the profitable non-merging banks.

Why does the cubic time trend model produce a greater percentage of theoretically correct estimates than does the standard linear time trend model? It may be that specifying a more flexible time trend allows us to control for some of the changes in the theoretical leverage parameters (Q, p, v, F, I, D, and τ) over time, and thus produce more accurate (and somewhat more precise) estimates of *DTL*. Of course, generating more accurate point estimates of *DTL* is a Pyrrhic victory if the time trend coefficients also absorb some of the intertemporal covariation in revenues and profits that we wish to capture in the leverage coefficient. Although we favor the *DTL* estimates generated by the cubic time trend model, we will run the remainder of our degree of leverage tests using both sets of estimates.

Figure 5 plots the cubic *DTL* estimates against the average quarterly return-on-sales for the 472 sample banks, and Figure 6 repeats this for the 250 non-merging banks.[20] Banks that averaged positive quarterly profits are marked with a "+" and banks that averaged negative quarterly profits are marked with a "-". The shapes of these scatter diagrams are consistent with the expected, theoretical pattern displayed in Figure 2. So, despite a relatively large number of outlying values, the general patterns and central tendencies of our *DTL* estimates appear to be consistent with finance theory.

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[19] O'Brien and Vanderheiden (1987) estimated the degree of operating leverage for firms in a variety of nonfinancial industries, and reported leverage estimates greater than 1.0 for 73 percent of the firms in their sample. Using a similar data set, Dugan and Shriver (1992) reported operating leverage estimates greater than 1.0 for 57 percent of their sample firms.

[20] For each bank, average quarterly return-on-sales (*ROS*) equals mean quarterly adjusted profit divided by mean quarterly gross revenues. We use *ROS* rather than return-on-assets (*ROA*) because our degree of leverage model is a revenue-based concept, not an asset-based concept. We use a profitability ratio in the graph, rather than raw profits, to neutralize the effects of bank size.

5.4 The degree of total leverage and bank product-mix

Table 5 displays the results of OLS regressions that test whether the degree of total leverage is systematically related to bank product mix. *DTL* is the dependent variable in these regressions, and is estimated using the cubic time trend model. The right-hand-side of these regressions is specified identically to the right-hand-side of the revenue volatility regressions. Given the wide dispersion of *DTL*, it is not surprising that the statistical fit is low in the Table 5 regressions (adjusted-R^2 = 0.0223). However, the specification was statistically significant at the 5 percent level (F=2.537). *DTL* declines at a decreasing rate with bank revenue size, which suggests that larger banks are better able to absorb short-run variations in sales revenues; this may reflect differences in the ability of large and small banks to use hedging instruments, diversify geographically, or fully utilize fixed production capacity. The coefficient on the merger variable *M* is negative as expected, but is not statistically significant.

With one exception, a bank's degree of total leverage is not strongly related to its product mix. That exception is the revenue share of fee-based activities *relative to* the shares of loan-based and investment-based activities. Shifting one percentage point of revenue out of lending or investment activities and into fee-based activities is associated with a large increase in the degree of total leverage. Based on the results in column [2], substituting a percentage point of fee-based revenue for loan-based revenue would increase *DTL* at the median bank in our sample by 15 percent (.2029/1.3817). These results suggest that, for the average bank in our sample, a higher ratio of fixed-to-variable expenses is required to produce fee-based earnings than to produce loan-based or investment-based earnings.

In Tables 4A and 4B we saw that our estimates of *DTL* are sensitive to a number of factors, including: the technique used to control for secular growth in the estimation procedure; whether banks did or did not make acquisitions during the sample period; and whether a bank earned positive long-run profits. In addition, our estimates of *DTL* are quite noisy and include a substantial number of large positive and negative outliers. In Table 6 we perform a number of robustness tests of the basic Table 5 regression equation to see if any of these phenomena are driving our fee-based revenue share results.

Table 6 displays the results from 16 separate re-estimations of the column [2] regression from

Table 5. These 16 regressions vary across three dimensions. The even-numbered columns show regressions in which the outlying values of *DTL* have been truncated at the 5^{th} and 95^{th} percentiles of its sample distribution; these regressions test whether outlying values of *DTL* are materially affecting the coefficient estimates. Columns [9] through [16] show regressions in which the cubic time trend estimates of *DTL* have been replaced with the more standard linear time trend estimates of *DTL*; these regressions test whether our methodological innovations are driving our regression results. Finally, we test for robustness using subsamples of banks that had positive long-run profits (columns [3], [4], [11], and [12]); banks that made no acquisitions during the sample period (columns [5], [6], [13], and [14]); and profitable banks that made no acquisitions during the sample period (columns [7], [8], [15], and [16]). The first column in Table 6 is our base line regression, as it replicates the regression results shown in column [2] of Table 5.

Truncating the outlying values of the dependent variable causes the *DTL* regressions to change in several ways. (Note that this truncation still leaves plenty of variation in the dependent variable. For example, the truncated cubic time trend version of *DTL* has a median value of 1.38, and it ranges between -7.22 and 9.61.) Truncation tends to improve the statistical fit of the regressions, which suggests that the large positive and negative values of *DTL* are noise. Truncation also substantially reduces the point estimates of the revenue share coefficients (while leaving the signs and significance of these coefficients basically unchanged). For example, the re-estimated coefficients in column [2] indicate that substituting a percentage point of fee-based revenue for loan-based revenue would increase *DTL* by about 3 percent (.0399/1.3817), which seems like a more economically reasonable magnitude than the 15 percent increase indicated in our base line regression in column [1]. Finally, when we truncate *DTL* the negative coefficient on *M* becomes statistically significant, but the significant negative affect of bank size disappears. This suggests that noisy outlying values of *DTL* were preventing us from finding the expected negative merger bias so evident in the Table 4 summary statistics; and conversely that a few large outlying values of *DTL* were driving the size-based effects.[21]

Excluding the unprofitable banks from the regressions tends to increase the statistical fit (these banks are likely to have large negative values for *DTL*), while removing the banks that made acquisitions tends to reduce the statistical fit. Substituting the 'linear' version of *DTL* for the 'cubic' version of *DTL* also tends to reduce the statistical fit of the regression. In addition, the coefficient estimates in the 'linear' *DTL* regressions tend to be smaller in magnitude and less precise than those in the 'cubic' *DTL* regressions. Despite these changes, our main result remains robust — the coefficient on fee-based revenue share remains positive and statistically significant more often than any of the other coefficients in these regressions — ranging between 2.48 and 20.29 in the 'cubic' regressions and between 1.78 and 3.01 in the 'linear' regressions.

Although the regression results in Tables 5 and 6 are relatively weak in a statistical sense, they are robust in suggesting that the production and marketing of fee-based services requires a high degree of leverage relative to other banking services. Thus, they provide additional evidence contrary to the conventional wisdom about fee-based activities at commercial banks: increasing fee-based activities not only increases the volatility of a bank's revenues, it also increases its degree of total leverage, which has the effect of amplifying revenue volatility into even greater earnings volatility.

6. The effect of product mix on the level and volatility of bank earnings

In this section we use the point estimates from the previous two sections to demonstrate the degree to which, on average, a shift in product mix toward fee-based activities will increase the volatility of bank earnings. We also present evidence that, on average, banks that shift their product mix toward fee-based activities can expect to earn a higher level of earnings.

Consider a change in a bank's business strategy that de-emphasizes lending activities but increases its emphasis on fee-based activities. Assume that this shift in product mix leaves the bank's

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[21] We tried other truncations as well. Truncating *DTL* at the 1st and 99th percentiles produced point estimates virtually identical to those in Table 5. Truncating *DTL* at the 10st and 90th percentiles slightly increased the statistical fit, and produced revenue share coefficients that were slightly smaller but more precise, compared to truncating *DTL* at the 5th and 95th percentiles.

gross revenues unchanged, but alters the composition of gross revenues such that 10 percent of gross revenues is shifted from lending activities to fee-based activities. Note that this 10 percent shift is approximately equal to a one standard deviation reduction in loan revenue share, and a one standard deviation increase in fee-based revenue share, for the typical bank in our sample (see Table 1). We can use equation (2) to show how this change in product mix indirectly effects the volatility of bank earnings through its impact on revenue volatility and leverage:

$$\%\Delta\pi = DL * \%\Delta r \quad (2)$$

Prior to the change in product mix, our estimates of revenue volatility and the degree of total leverage from Table 2 and Table 4B imply the following pretax earnings volatility for the median bank:

$$\%\Delta\pi = (1.3817)*(0.0772) = 0.1067$$

That is, one standard deviation of revenue volatility, amplified by the degree of total leverage, translates into about an 11 percent change in pretax earnings.

From the *RV* regressions we know that a shift in product mix from loans to fee-based activities will increase revenue volatility. Based on the statistically significant coefficient on $w_{fee\text{-}based}$ in column [2] of Table 3A, a 10 percentage point increase in fee-based revenue share (at the expense of loan revenue share) will increase our measure of revenue volatility *RV* by 0.0127, from .0772 to .0899, or about a 16 percent increase. Similarly, we know from the *DTL* regressions that this product mix shift will increase the degree of total leverage. Based on the statistically significant coefficient on $w_{fee\text{-}based}$ in column [2] of Table 6, a 10 percentage point increase in fee-based revenue share (at the expense of loan revenue share) will increase the degree of total leverage *DTL* by 0.3997, from 1.3817 to 1.7804, or about a 29 percent increase. By combining these two effects we can see that this shift in product mix increases the implied standard deviation of pretax earnings volatility from 11 percent to 16 percent:

$$\%\Delta\pi = (1.7804)*(0.0899) = 0.1601$$

In other words, a paired one standard deviation change in fee-based and loan revenue shares translates into a 50 percent change in pretax earnings volatility (1.16*1.29=1.50). Thus, our estimates suggest the changes in product mix that increase the revenue share of fee-based activities in which banks are already permitted to participate can have a substantial impact on the volatility of their earnings.

6.1 Increased risk and increased return

Efficient risk-taking should be accompanied by increased returns. Our tests suggest that, at least for the average bank in our sample, a shift in product mix toward fee-based activities causes the volatility of bank earnings to increase. Thus, we would also expect this shift in product mix to generate higher earnings at the margin. We test this expectation by regressing bank profitability ratios on the same right-had-side specification that we used in the *RV* and *DTL* regressions.

Table 7 displays summary statistics for return on assets (*ROA*) and return on sales revenue (*ROS*). The *ROA* ratio (*ROS* ratio) is equal to mean adjusted profits divided by mean sales revenue (mean asset size), where both the numerator and the denominator are averages over the 30-quarter sample period. Although *ROS* is not a standard measure of bank profitability, we use it because the degree of total leverage is a sales revenue-based concept. (We avoid using the return-on-equity profitability ratio because it is positively related by construction to the degree of financial leverage.)

The regression tests are reported in Table 8A and 8B. Note that the coefficient on $w_{fee\text{-}based}$ is positive and significant in column [2] of both tables, which indicates that moving one percentage point of revenue out of fee-based activities and into lending activities is associated with an increase in returns to sales. These estimates suggest that substituting a percentage point of fee-based revenue for loan-based revenue would increase *ROS* at the median bank in our sample by about ½ percent (.000857/.1728), and would increase *ROA* by almost two percent (.000079/.0043). The larger impact on *ROA* is not surprising, because shifting revenue from lending activities to fee-based activities will typically cause a net reduction in bank assets.

7. Summary and implications for policy and research

Over the past two decades, noninterest income has outpaced interest income as a growth area for commercial banks. The conventional wisdom among bankers, bank analysts, and bank regulators is that, because noninterest income is more stable than interest income, this long-run change in bank product mix has reduced the volatility of bank earnings. To the extent that this is true, the typical commercial bank should be better able to weather economic downturns today than it was a decade ago. Taking this logic one step further, expanding commercial bank powers into fee-generating areas such as insurance and securities brokerage could further reduce the risk of bank failure.

We find evidence that contradicts this conventional wisdom. We analyze the quarterly movements in revenues and profits at 472 large and medium sized banks between 1988 and 1995, using a theoretical 'degree of total leverage' framework that is not typically applied to financial institutions. In this framework, the volatility of a bank's earnings stream is determined by two independent components: the bank's revenue volatility, which is determined largely by forces exogenous to the bank, and the bank's combined degree of operating and financial leverage, which reflects production and financing conditions inside the bank. When we apply this theoretical framework to our data set, we find that both components of earnings volatility increase with the share of revenues generated by fee-based activities. More specifically, when the median bank in our sample reduces its interest revenue from traditional originate-and-hold lending activities, and replaces it by increasing its noninterest income from (perhaps credit-related) fee-for-service activities, the bank's earnings are likely to become more volatile. This occurs for two reasons: the bank's stream of revenues becomes less stable, and the bank takes on a higher degree of total leverage, which amplifies the revenue instability. We also find that this shift in product mix from lending activities to fee-based activities is accompanied by an increase in profitability, at least partially compensating banks for the increase in volatility.

Although these results are unorthodox, they follow naturally from the different demand and production characteristics of these two types of banking products. Traditional bank lending is a relationship business — it is costly for borrowers and/or lenders to walk away from lending relationships because of switching costs and information costs — so revenues from lending business are likely to be stable over time. Once the lending relationship is established and the fixed costs of credit evaluation have been incurred, the ongoing production costs are mostly variable (interest) costs, which reduces operating leverage. Furthermore, the bank must hold some equity capital against outstanding loan balances, which reduces financial leverage. In contrast, bank-customer relationships are likely to be less stable in many fee-based activities (e.g., investment advice, mutual fund and insurance sales, data processing) in which information costs are low and competitive rivalry is high, and the degree of leverage associated with these activities may be large due to relatively high fixed-to-variable operating cost ratios and relatively low (or zero) regulatory capital requirements.

Although our main results are unorthodox, we find very plausible and orthodox results for banks' non-fee-based activities. For example, we find that an increased reliance on trading activities increases the volatility of overall bank revenues, and that increased reliance on charging fees to depositors reduces the volatility of overall bank revenues. We also find that increased reliance on lending activities and investment activities — both intermediation-based activities which should have similar production processes and similar sensitivities to changes in interest rates — have statistically similar impacts on bank revenue volatility and on banks' degree of total bank leverage. These plausible results increase the confidence that we have in our innovative empirical framework and in the unorthodox fee-based results that this framework generates.

7.1 Implications of our results

Our results have implications for regulatory policy, business strategy, and future research studies. Our main result suggests that increased reliance on fee-based activities can, at least under some circumstances, make bank earnings more volatile. While diversified investors can neutralize much of this risk in their portfolios, bank depositors (and the insurance fund) bear a portion of this risk, particularly at larger banks. Should our results prove to be robust to future testing, bank regulators may want to consider the appropriate role of capital requirements for fee-based activities. We do not believe, however, that our results should be used to comment on the current debate over expanded powers for banks. The activities at the heart of the expanded powers debate (securities brokerage and insurance activities) are primarily fee-based activities, but the demand and production characteristics of these activities may differ from those of the fee-based activities included in this study. Furthermore, to the extent that banking firms participated in these activities during the time period encompassed by our study, some of these activities would have been located in nonbank holding company affiliates, not in the banking affiliate. The degree to which our results are useful in this policy debate ultimately depends on the degree of similarity between the characteristics of the currently permissible fee-based activities and the proposed expanded powers.

Our results are at odds with the numerous public pronouncements (see the Introduction to this paper for examples) by banks and bank regulators that expansion into fee-based activities banks stabilizes bank earnings streams. If fee-based activities do not stabilize earnings, then why have banks increased these activities relative to their more traditional lines of business? One plausible explanation is that the value of bank charters fell in the 1980s and 1990s as banks lost market share in their core products (loans and deposits) due to technological change and increased competition, and with less charter value at risk, banks sought out ways to increase the volatility of their earnings. This explanation is rooted in the concept of equity as a call option on the value of the firm's assets, and is consistent with research on financial institutions by Marcus (1984) and Keeley (1990).[22] Importantly, this explanation also fits the facts at hand. During our sample period, banks faced increased competition from nonbank financial institutions, and responded by shifting into highly levered product lines (i.e., fee-based activities) that generated relatively volatile earning streams.

We generate these earnings volatility results using a 'degree of total leverage' approach not generally applied to banking firms. This approach allows us to measure the marginal contribution to

[22] Black and Scholes (1973) point out that, for levered firms like banks, higher earnings volatility enhances equity value because it increases the probability of a positive payout to shareholders. (This is similar to higher share price volatility increasing the probability that the price of the associated call option exceeds its strike price.) Marcus (1984) developed a theoretical model showing that banks are more likely to adopt high-risk strategies when the value of their charter is low. Keeley (1990) generated empirical evidence that increases in competition are associated with reductions in bank charter values, and that reduced charter values are associated with increases in bank default risk due to higher levels of asset risk and financial leverage.

earnings volatility of products and services that are already being produced by banks, and thus our estimates reflect the effects of production synergies (economies of scope), marketing synergies (cross-selling), and portfolio synergies (diversification effects). This approach also allows us to roughly decompose earnings volatility into demand-side (revenue volatility) and supply-side (operating and financial leverage) sources. We encourage other researchers to test this approach for robustness, to expand upon it, and to improve it.

In addition, we make a number of modifications to the standard leverage estimation framework. While we designed these modifications with the operational, financial, and strategic characteristics of commercial banks in mind, our modified approach could also be useful in the estimation of the degree of total leverage for non-financial firms. Unlike the standard methodology, our estimation framework accepts firms that are economically viable in the long-run but that suffer negative profits in the short-run. Also, our non-linear adjustment for growth might be useful for estimating the degree of leverage at firms in the early growth phase of their industry or product life cycles (e.g., high technology firms during the 1980s and 1990s). We encourage others to test these modifications for robustness on nonfinancial firm data.

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Table 1

Summary statistics for 472 U.S. commercial banks. For each of these banks, we observed quarterly values of the variables in the left-hand column (except *M*) over the 30 quarters from 1988:1 to 1995:2, and then calculated the 30-quarter means of those variables for each bank. Each row in this table displays a set of statistics that describe the distribution of those mean values. These data are merger-adjusted and expressed in millions of 1995 dollars. Adjusted profits = net income + taxes + extraordinary items + loan loss provisions - net chargeoffs. Loan share = revenue from loans divided by total bank revenue. (Fee-based share, investment share, etc. are similarly calculated.) *M* = the number of acquisitions made by each bank during the sample period.

	N	mean	std. dev.	median	min	max
mean quarterly revenue	472	$65.39	$170.32	$20.56	$5.85	$2,307.06
mean quarterly adjusted profits	472	$9.95	$21.53	$3.24	($7.51)	$234.49
mean asset size	472	$2,193.37	$4,049.39	$797.29	$256.61	$52,676.45
number of acquisitions (*M*)	472	0.758	0.963	0	0	3
revenue shares:						
mean loan share (w_{loans})	472	0.6429	0.1295	0.6646	0.0000	0.9743
mean fee-based share ($w_{fee\text{-}based}$)	472	0.1059	0.1007	0.0753	0.0001	0.9996
mean investment share (w_{invest})	472	0.1938	0.1195	0.1804	0.0001	0.9410
mean trading share ($w_{trading}$)	472	0.0144	0.0300	0.0011	-0.0084	0.3502
mean deposit share ($w_{deposits}$)	472	0.0429	0.0250	0.0409	0.0000	0.1539

Table 2

Revenue volatility (*RV*) for 472 U.S. commercial banks. For each of these banks, we calculated *RV* (the standard deviation of quarter-to-quarter percent change in revenue) using equations (3) and (4) and quarterly values of total sales revenue over the 30 quarters from 1988:1 to 1995:2. Each row in this table displays a set of statistics that describe the distribution of those bank-specific values of *RV*. All data are merger-adjusted. *RV* is calculated using 29 quarterly changes in revenue for banks that made no acquisitions during the sample period; 27 quarterly changes in revenue for banks that made one acquisition during the sample period; etc.

	N	**mean**	**std. dev.**	**minimum**	**median**	**maximum**		
all banks	472	0.1075	0.0921	0.0147	0.0772	0.8447		
0 acquisitions	250	0.0855	0.0759	0.0147	0.0599	0.5476		
1 acquisition	125	0.1172	0.0928	0.2239	0.0940	0.8447		
2 acquisitions	58	0.1580	0.1176	0.0363	0.1114	0.4844		
3 acquisitions	39	0.1419	0.1000	0.0291	0.1239	0.4058		
	N	**1st %**	**5th %**	**10th %**	**median**	**90th %**	**95th %**	**99th %**
all banks	472	0.0240	0.0297	0.0349	0.0772	0.2238	0.2677	0.4669

Table 3A

OLS regressions for 472 U.S. commercial banks. The dependent variable is revenue volatility (*RV*). Estimated regression coefficients are reported in the cells, where ***, **, and * indicate a significant difference from zero at the 1, 5, and 10 percent levels. Multiplying the coefficients on the w_j variables (i.e., the share of a bank's total sales revenue that it generates from activity *j*) by 0.01 gives an estimate of the change in *RV* when one percent of a bank's revenue is moved into activity *j* and out of the activity that is excluded from the regression.

	[1]	[2]	[3]	[4]	[5]
intercept	-0.4858 ***	0.0967 ***	0.1062 ***	0.2241 ***	1.3416 ***
number of mergers (*M*)	0.0199 ***	0.0199 ***	0.0199 ***	0.0199 ***	0.0199 ***
revenue ($ billions)	-0.2193 ***	-0.2193 ***	-0.2193 ***	-0.2193 ***	-0.2193 ***
revenue^2 ($ billions)	0.0512 *	0.0512 *	0.0512 *	0.0512 *	0.0512 *
$w_{deposits}$		-0.5826 ***	-0.5921 ***	-0.7099 ***	-1.8274 ***
w_{loans}	0.5826 ***		-0.0095	-0.1273 ***	-1.2448 ***
$w_{investments}$	0.5921 ***	0.0095		-0.1178 ***	-1.2353 ***
$w_{fee\text{-}based}$	0.7099 ***	0.1273 ***	0.1178 ***		-1.1175 ***
$w_{trading}$	1.8274 ***	1.2448 ***	1.2353 ***	1.1175 ***	
R^2	0.2652	0.2652	0.2652	0.2652	0.2652
adjusted-R^2	0.2541	0.2541	0.2541	0.2541	0.2541
F	23.938 ***	23.938 ***	23.938 ***	23.938 ***	23.938 ***
N	472	472	472	472	472

Table 3B

OLS regressions *for the subsample of 250 banks that did not make any acquisitions during the sample period*. The dependent variable is revenue volatility (*RV*). Estimated regression coefficients are reported in the cells, where ***, **, and * indicate a significant difference from zero at the 1, 5, and 10 percent levels. Multiplying the coefficients on the w_j variables (i.e., the share of a bank's total sales revenue that it generates from activity *j*) by 0.01 gives an estimate of the change in *RV* when one percent of a bank's revenue is moved into activity *j* and out of the activity that is excluded from the regression.

	[1]	[2]	[3]	[4]	[5]
intercept	-0.5099 ***	0.0825 ***	0.1232 ***	0.2308 ***	0.5066 **
revenue ($ billions)	-0.0312	-0.0312	-0.0312	-0.0312	-0.0312
$revenue^2$ ($ billions)	-0.0194	-0.0194	-0.0194	-0.0194	-0.0194
$w_{deposits}$		-0.5923 ***	-0.6330 ***	-0.7406 ***	-1.0164 ***
w_{loans}	0.5923 ***		-0.0407	-0.1483 ***	-0.4241 *
$w_{investments}$	0.6330 ***	0.0407		-0.1076 **	-0.3834 *
$w_{fee\text{-}based}$	0.7406 ***	0.1483 ***	0.1076 **		-0.2758
$w_{trading}$	1.0164 ***	0.4241 *	0.3834 *	0.2758	
R^2	0.1255	0.1255	0.1255	0.1255	0.1255
adjusted-R^2	0.1039	0.1039	0.1039	0.1039	0.1039
F	5.811 ***	5.811 ***	5.811 ***	5.811 ***	5.811 ***
N	250	250	250	250	250

Table 4A

Degree of total leverage (*DTL*) for 472 U.S. commercial banks. For each of these banks, we calculated *DTL* (the revenue elasticity of profits) using equations (11) through (14) and quarterly values of total sales revenues and adjusted profits over the 30 quarters from 1988:1 to 1995:2. *We use a linear time trend in equations (11) and (12).* Each row in this table displays a set of statistics that describe the distribution of the bank-specific values of *DTL*. All data are merger-adjusted. *DTL* is calculated using 30 observations for banks that made no acquisitions during the sample period; 29 observations for banks that made one acquisitions during the sample period; etc. "Profits > 0" refers to banks with positive average quarterly merger-adjusted profits over the 30 quarters in our time series.

	N	**mean**	**std. dev.**	**minimum**	**median**	**maximum**	**% > 1.0**	**% < 0**
all banks	472	-0.4247	22.2202	-375.8240	0.4628	219.4800	34.32%	32.63%
0 acquisitions	250	1.2878	15.7879	-100.3290	0.6644	219.4800	40.80%	26.80%
1 acquisition	125	-3.5277	36.4822	-375.8240	0.3153	30.1327	32.00%	38.40%
2 acquisitions	58	-0.4526	5.6353	-36.4797	0.1815	10.7385	24.14%	37.93%
3 acquisitions	39	-1.4156	6.6146	-37.6937	0.0544	2.5726	15.38%	43.59%
profits > 0	449	1.2717	11.8363	-100.9080	0.4822	219.4800	35.41%	29.84%
0 acquisitions and profits > 0	238	2.1274	14.4775	-7.2545	0.7371	219.4800	42.02%	23.95%
	N	**1st %**	**5th %**	**10th %**	**median**	**90th %**	**95th %**	**99th %**
all banks	472	-37.6937	-4.2116	-1.4825	0.4628	3.1868	5.4787	21.3309
profits > 0	449	-6.1359	-1.8086	-0.9654	0.4822	3.2501	5.3526	20.2074
0 acquisitions	250	-19.6169	-3.1426	-1.3871	0.6644	3.6856	5.8325	12.4393
0 acquisitions and profits > 0	238	-5.8299	-1.5374	-0.9639	0.7371	3.7056	5.8867	12.4393

Table 4B

Degree of total leverage (*DTL*) for 472 U.S. commercial banks. For each of these banks, we calculated *DTL* (the revenue elasticity of profits) using equations (11) through (14) and quarterly values of total sales revenues and adjusted profits over the 30 quarters from 1988:1 to 1995:2. *We use a cubic time trend in equations (11) and (12).* Each row in this table displays a set of statistics that describe the distribution of the bank-specific values of *DTL*. All data are merger-adjusted. *DTL* is calculated using 30 observations for banks that made no acquisitions during the sample period; 29 observations for banks that made one acquisitions during the sample period; etc. "Profits > 0" refers to banks with positive average quarterly merger-adjusted profits over the 30 quarters in our time series.

	N	**mean**	**std. dev.**	**minimum**	**median**	**maximum**	**% > 1.0**	**% < 0**
all banks	472	0.3087	17.2438	-214.4444	1.3817	63.3016	56.36%	25.85%
0 acquisitions	250	1.7674	9.8166	-96.0150	1.8822	60.9262	66.80%	19.60%
1 acquisition	125	-1.9394	29.0429	-214.4444	1.0034	63.3016	50.40%	29.60%
2 acquisitions	58	0.1446	8.5951	-55.2394	0.3825	12.2977	41.38%	36.21%
3 acquisitions	39	-1.5927	12.5079	-68.5510	0.3515	13.4739	30.77%	38.46%
profits > 0	449	2.2037	7.9092	-91.0823	1.4948	63.3016	58.57%	22.72%
0 acquisitions and profits > 0	238	2.9278	6.0295	-8.9404	1.9417	60.9262	69.33%	16.39%
	N	**1st %**	**5th %**	**10th %**	**median**	**90th %**	**95th %**	**99th %**
all banks	472	-68.5510	-7.2194	-1.4405	1.3817	5.8018	9.6067	34.4415
profits > 0	449	-8.7275	-1.6796	-0.8653	1.4948	5.8018	9.6067	34.4415
0 acquisitions	250	-26.882	-4.1514	-1.2129	1.8822	6.1275	9.7352	43.1045
0 acquisitions and profits > 0	238	-4.5016	-1.4405	-0.6387	1.9417	6.1242	9.8381	43.1045

Table 5

OLS regressions for 472 U.S. commercial banks. The dependent variable is the degree of total leverage (*DTL*), *estimated using a cubic time trend.* Estimated regression coefficients are reported in the cells, where ***, **, and * indicate a significant difference from zero at the 1, 5, and 10 percent levels. Multiplying the coefficients on the w_j variables (i.e., the share of a bank's total sales revenue that it generates from activity *j*) by 0.01 gives an estimate of the change in *DTL* when one percent of a bank's revenue is moved into activity *j* and out of the activity that is excluded from the regression.

	[1]	[2]	[3]	[4]	[5]
intercept	-0.4858 ***	0.0967 ***	2.4527 ***	0.2241 ***	1.3416 ***
number of mergers (*M*)	-1.0881	-1.0881	-1.0881	-1.0881	-1.0881
revenue ($ billions)	-40.2457 ***	-40.2457 ***	-40.2457 ***	-40.2457 ***	-40.2457 ***
revenue^2 ($ billions)	19.0847 ***	19.0847 ***	19.0847 ***	19.0847 ***	19.0847 ***
$w_{deposits}$		-19.1453	-20.5352	-39.4339	-51.8377
w_{loans}	19.1453		-1.3899	-20.2887 **	-32.6924
$w_{investments}$	20.5352	1.3899		-18.8988 **	-31.3025
$w_{fee\text{-}based}$	39.4339	20.2887 **	18.8988 **		-12.4037
$w_{trading}$	51.8377	32.6924	31.3025	12.4037	
R^2	0.0369	0.0369	0.0369	0.0369	0.0369
adjusted-R^2	0.0223	0.0223	0.0223	0.0223	0.0223
F	2.537 **	2.537 **	2.537 **	2.537 **	2.537 **
N	472	472	472	472	472

Table 6

OLS regressions for 472 U.S. commercial banks. The dependent variable is the degree of total leverage (*DTL*). The table tests the regression in column [2] of Table 5 for robustness across three different dimensions: subsample selection; cubic versus linear time trend specification of the dependent variable; and whether the dependent variable was truncated at the 5th and 95th percentiles of its sample distribution. Estimated regression coefficients are reported in the cells, where ***, **, and * indicate a significant difference from zero at the 1, 5, and 10 percent levels. Multiplying the coefficients on the w_j variables (i.e., the share of a bank's total sales revenue that it generates from activity *j*) by 0.01 gives an estimate of the change in *DTL* when one percent of a bank's revenue is moved into activity *j* and out of the activity that is excluded from the regression. *M* is the number of acquisitions made by the bank during the sample period. Revenues are in billions of 1995 dollars.

	[1]	[2]	[3]	[4]	[5]	[6]
time trend	cubic	cubic	cubic	cubic	cubic	cubic
truncation	none	5th and 95th	none	5th and 95th	none	5th and 95th
subsample	all banks	all banks	banks with profits>0	banks with profits>0	non-merging banks	non-merging banks
intercept	1.0627	1.4855 ***	3.7185 ***	2.1493 ***	-0.3762	1.8773 ***
M	-1.0881	-0.4159 **	-0.5334	-0.3550 ***	--	--
revenue	-40.2457 ***	1.0224	-9.9658 *	1.4735	-3.3487	-0.5594
revenue^2	19.0847 ***	0.8327	5.4578 *	0.6704	-0.6199	-0.3660
$w_{deposits}$	-19.1453	-4.4184	-25.6484 *	-2.9069	5.4856	-2.6502
w_{loans}	--	--	--	--	--	--
$w_{investments}$	1.3899	0.3538	3.6815	-0.3683	1.8263	-0.2001
$w_{fee\text{-}based}$	20.2887 **	3.9926 ***	10.6689 ***	2.4826 *	13.8777 **	3.1261 *
$w_{trading}$	32.6924	-3.5553	2.8759	-7.0841	32.2941	12.8054
R^2	0.0369	0.0525	0.0457	0.0666	0.0301	0.0279
adjusted-R^2	0.0223	0.0382	0.0305	0.0518	0.0061	0.0039
F	2.537 **	3.672 ***	3.015 **	4.498 ***	1.255	1.161
N	472	472	449	449	250	250

Table 6 — continued

	[7]	[8]	[9]	[10]	[11]	[12]
time trend	cubic	cubic	linear	linear	linear	linear
truncation	none	5th and 95th	none	5th and 95th	none	5th and 95th
subsample	non-merging and profits>0	non-merging and profits>0	all banks	all banks	banks with profits>0	banks with profits>0
intercept	3.0338 ***	2.3936 ***	1.4059	0.3605	4.2212 **	0.9479 ***
M	--	--	-1.3242	-0.3499 ***	-0.8232	-0.2843 ***
revenue	-10.3400 *	-1.7642	-33.9698 **	0.5088	-11.8698	0.4839
revenue^2	2.6163	0.0866	14.7510 *	-0.0092	4.6049	-0.0345
$w_{deposits}$	-10.4838	-3.3717	-25.2061	0.1155	-38.0388 *	-2.8399
w_{loans}	--	--	--	--	--	--
$w_{investments}$	-2.4388	-0.5683	-0.1176	0.5127	-5.4427	-0.3184
$w_{fee\text{-}based}$	9.8714 ***	2.4535	11.3527	3.0149 ***	5.5368	2.2709 ***
$w_{trading}$	35.0506 *	14.4076 *	55.8559	3.9014	27.5733	2.9131
R^2	0.0648	0.0304	0.0185	0.0523	0.0246	0.0619
adjusted-R^2	0.0405	0.0052	0.0037	0.0380	0.0091	0.0470
F	2.666 **	1.206	1.249	3.661 ***	1.590	4.158 ***
N	238	238	472	472	449	449

Table 6 — continued

	[13]	[14]	[15]	[16]
time trend	linear	linear	linear	linear
truncation	none	5^{th} and 95^{th}	none	5^{th} and 95^{th}
subsample	non-merging banks	non-merging banks	non-merging and profits>0	non-merging and profits>0
intercept	0.7748	0.4359	1.0019 ***	1.0387 ***
M	--	--	--	--
revenue	-11.6087	-0.6100	-1.2839	-1.9568
$revenue^2$	-1.1314	1.0389	1.2088	1.5594
$w_{deposits}$	-7.3174	0.3102	-3.7238	-4.1822
w_{loans}	--	--	--	--
$w_{investments}$	-0.3624	0.6269	-0.0891	0.0216
$w_{fee\text{-}based}$	9.0754	3.0118 **	1.7804 **	2.6193 **
$w_{trading}$	91.5885 *	2.2059	0.5099	3.6312
R^2	0.0180	0.0413	0.0430	0.0514
adjusted-R^2	-0.0062	0.0176	0.0182	0.0268
F	0.744	1.750	1.730	2.086 **
N	250	250	238	238

Table 7

Profitability Ratios for 472 U.S. commercial banks. Return on Assets (*ROA*) is equal to mean quarterly adjusted profits divided by mean quarterly assets over the 30 quarters from 1988:1 to 1995:2. Return on Sales Revenues (*ROS*) is equal to mean quarterly adjusted profits divided by mean quarterly sales revenue. The numerator and the denominator in both *ROA* and *ROS* are the quarterly averages for each sample bank from 1988:1 to 1995:2. Each row in this table displays a set of statistics that describe the distribution of the bank-specific values of *ROA* and *ROS*. All data are merger-adjusted.

	N	**mean**	**std. dev.**	**minimum**	**median**	**maximum**		
ROA	472	0.0043	0.0030	-0.0081	0.0043	0.0266		
ROS	472	0.1612	0.0822	-0.2153	0.1728	0.5750		
	N	**1st %**	**5th %**	**10th %**	**median**	**90th %**	**95th %**	**99th %**
ROA	472	-0.0021	0.0001	0.0014	0.0043	0.0064	0.0089	0.0188
ROS	472	-0.0881	0.0025	0.0025	0.1728	0.2438	0.2656	0.3529

Table 8A

OLS regressions for 472 U.S. commercial banks. Dependent variable is return on assets (*ROA*). Estimated regression coefficients are reported in the cells, where ***, **, and * indicate a significant difference from zero at the 1, 5, and 10 percent levels. Multiplying the coefficients on the w_j variables (i.e., the share of a bank's total sales revenue that it generates from activity *j*) by 0.01 gives an estimate of the change in *ROA* when one percent of a bank's revenue is moved into activity *j* and out of the activity that is excluded from the regression.

	[1]	[2]	[3]	[4]	[5]
intercept	-0.0154 ***	0.0047 ***	0.0028 ***	0.0126 ***	-0.0039
number of mergers (*M*)	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
revenue ($ billions)	0.0065 ***	0.0065 ***	0.0065 ***	0.0065 ***	0.0065 ***
$revenue^2$ ($ billions)	-0.0031 ***	-0.0031 ***	-0.0031 ***	-0.0031 ***	-0.0031 ***
$w_{deposits}$		-0.0200 ***	-0.0181 ***	-0.0279 ***	-0.0115 *
w_{loans}	0.0200 ***		0.0019 **	-0.0079 ***	0.0086 *
$w_{investments}$	0.0181 ***	-0.0019 **		-0.0098 ***	0.0066
$w_{fee\text{-}based}$	0.0279 ***	0.0079 ***	0.0098 ***		0.0165 ***
$w_{trading}$	0.0115 *	-0.0086 *	-0.0066	-0.0165 ***	
R^2	0.2153	0.2153	0.2153	0.2153	0.2153
adjusted-R^2	0.2035	0.2035	0.2035	0.2035	0.2035
F	18.187 ***	18.187 ***	18.187 ***	18.187 ***	18.187 ***
N	472	472	472	472	472

Table 8B

OLS regressions for 472 U.S. commercial banks. Dependent variable is return on assets (*ROS*). Estimated regression coefficients are reported in the cells, where ***, **, and * indicate a significant difference from zero at the 1, 5, and 10 percent levels. Multiplying the coefficients on the w_j variables (i.e., the share of a bank's total sales revenue that it generates from activity *j*) by 0.01 gives an estimate of the change in *ROS* when one percent of a bank's revenue is moved into activity *j* and out of the activity that is excluded from the regression.

	[1]	[2]	[3]	[4]	[5]
intercept	-0.1188	0.1552 ***	0.2314 ***	0.2409 ***	-0.1229
number of mergers (*M*)	-0.0058	-0.0058	-0.0058	-0.0058	-0.0058
revenue ($ billions)	0.0568	0.0568	0.0568	0.0568	0.0568
revenue^2 ($ billions)	-0.0413	-0.0413	-0.0413	-0.0413	-0.0413
$w_{deposits}$		-0.2740 *	-0.3502 **	-0.3597 **	0.0040
w_{loans}	0.2740 *		-0.0762 **	-0.0857 **	0.2781 **
$w_{investments}$	0.3502 **	0.0762 **		-0.0095	0.3542 **
$w_{fee\text{-}based}$	0.3597 **	0.0857 **	0.0095		0.3638 ***
$w_{trading}$	-0.0040	-0.2781 **	-0.3542 **	-0.3638 ***	
R^2	0.0563	0.0563	0.0563	0.0563	0.0563
adjusted-R^2	0.0421	0.0421	0.0421	0.0421	0.0421
F	3.957 ***	3.957 ***	3.957 ***	3.957 ***	3.957 ***
N	472	472	472	472	472

Figure 1

Firm I has high fixed costs and low variable costs.
Firm II has low fixed costs and high variable costs.

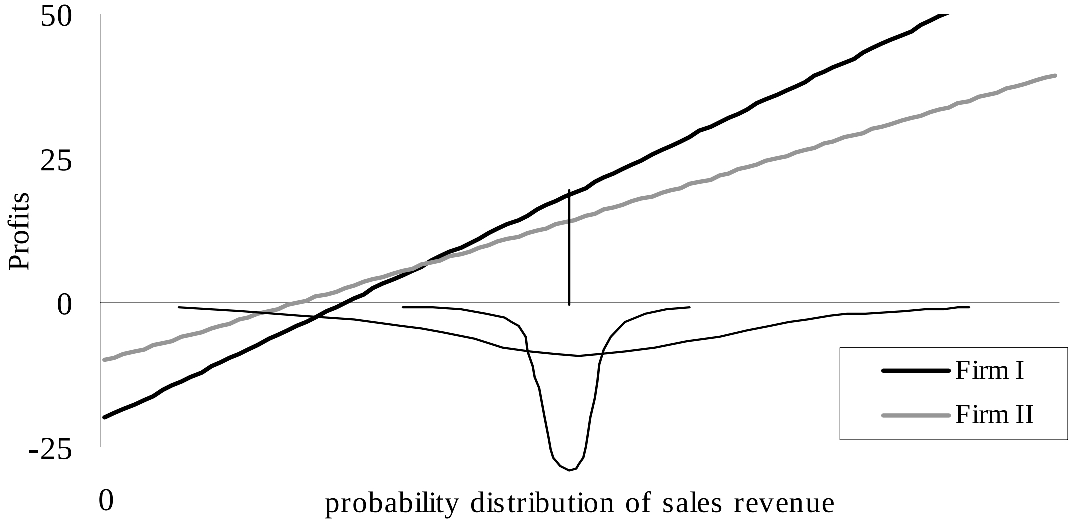

Figure 2

Theoretical Plot of DTL

(Break-even profits = 0; Shut-down profits = -1)

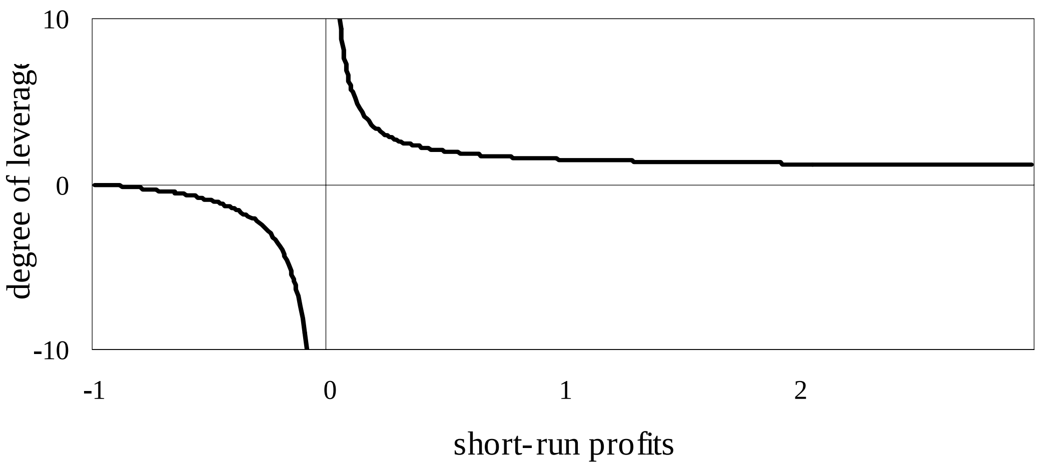

Figure 3
Mean Revenue by Quarter for 472 Sample Banks

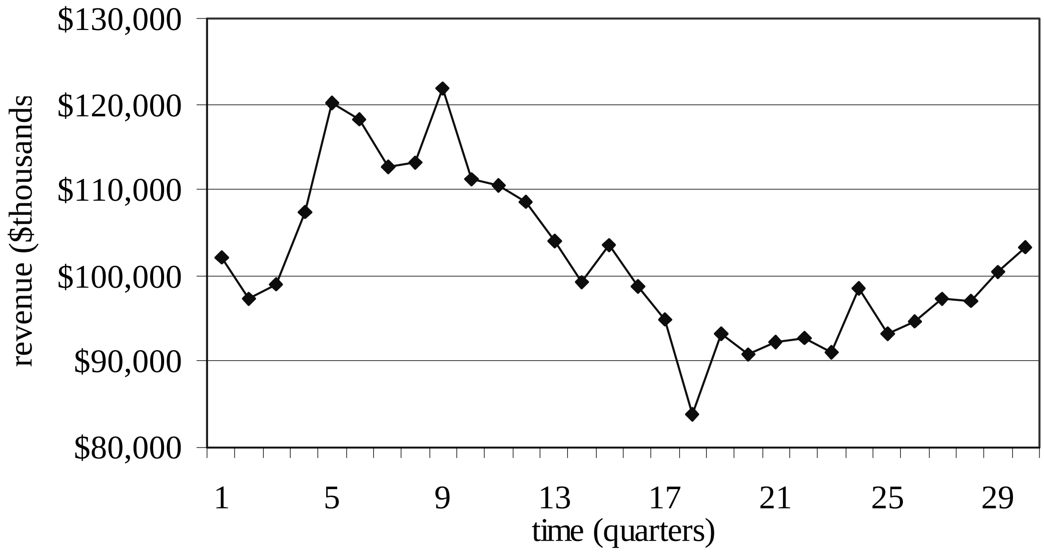

Figure 4
Mean Profits by Quarter for 472 Sample Banks

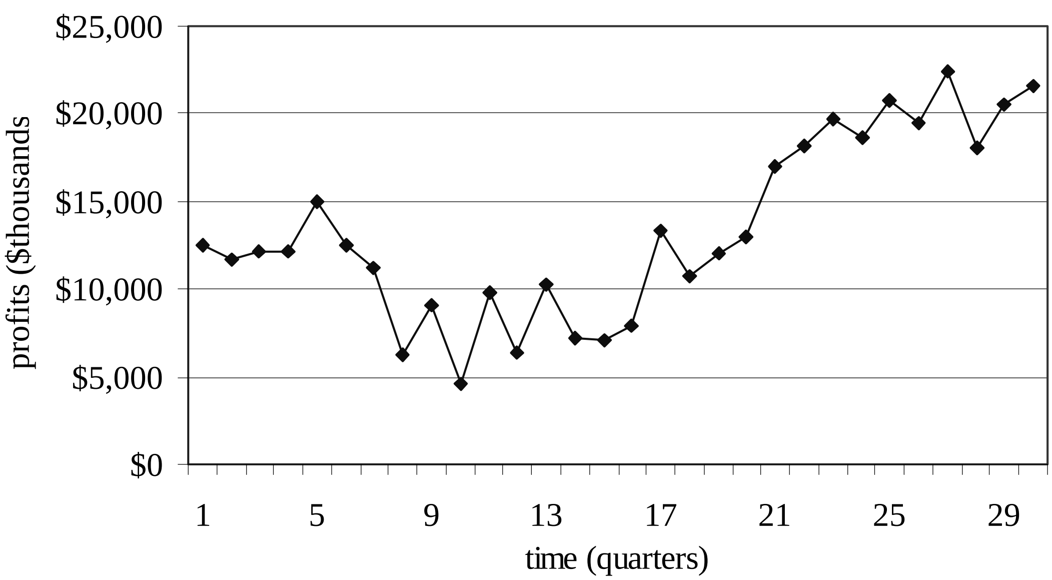

Figure 5

Degree of Total Leverage for 472 Sample Banks

(Time trend specification is cubic.)

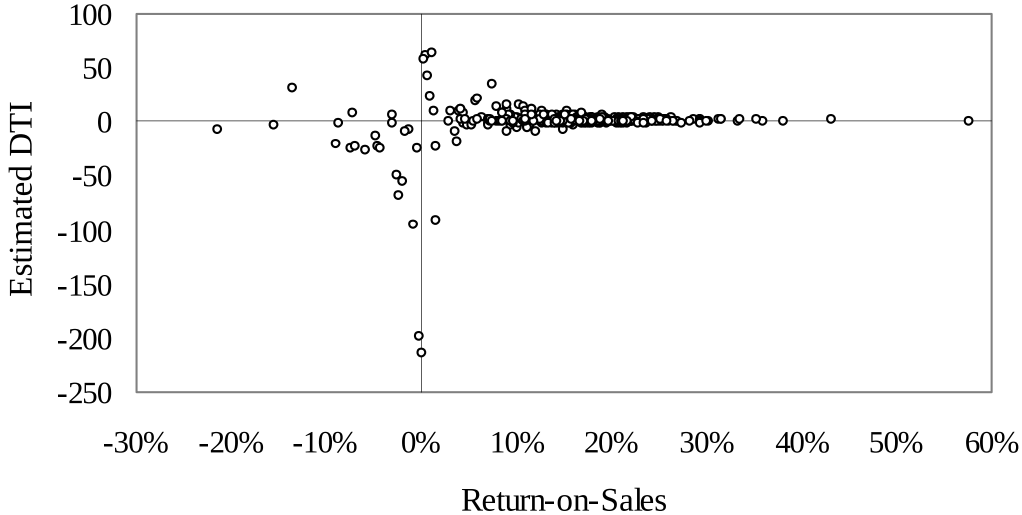

Figure 6

Degree of Total Leverage for 250 Non-Merging Banks

(Time trend specification is cubic)