The Sensitivity of Bank Net Interest Margins and Profitability to Credit, Interest-Rate, and Term-Structure Shocks Across Bank Product Specializations

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Abstract

This paper presents a dynamic model of bank behavior that explains net interest margin changes for different groups of banks in response to credit, interest-rate, and term-structure shocks. Using quarterly data from 1986 to 2003, we find that banks with different product-line specializations and asset sizes respond in predictable yet fundamentally dissimilar ways to these shocks. Banks in most bank groups are sensitive in varying degrees to credit, interest-rate, and term-structure shocks. Large and more diversified banks seem to be less sensitive to interest-rate and term-structure shocks, but more sensitive to credit shocks. We also find that the composition of assets and liabilities, in terms of their repricing frequencies, helps amplify or moderate the effects of changes and volatility in short-term interest rates on bank net interest margins, depending on the direction of the repricing mismatch. We also analyze subsample periods that represent different legislative, regulatory, and economic environments and find that most banks continue to be sensitive to credit, interest-rate, and term-structure shocks. However, the sensitivity to term-structure shocks seems to have lessened over time for certain groups of banks, although the results are not universal. In addition, our results show that banks in general are not able to hedge fully against interest-rate volatility. The sensitivity of net interest margins to interest-rate volatility for different groups of banks varies across subsample periods; this varying sensitivity could reflect interest-rate regime shifts as well as the degree of hedging activities and market competition. Finally, by investigating the sensitivity of ROA to interest-rate and credit shocks, we have some evidence that banks of different specializations were able to price actual

and expected changes in credit risk more efficiently in the recent period than in previous periods. These results also demonstrate that banks of all specializations try to offset adverse changes in net interest margins so as to mute their effect on reported after-tax earnings.

1. Introduction

The banking industry has undergone considerable structural change since the early 1980s as the legislative and regulatory landscape governing the industry has evolved. The structural changes, in turn, have had significant effects on the degree of market competition and the scope of products and services provided by banks as well as significant effects on the sources of bank earnings. Despite these developments, credit and interest-rate risks still largely account for the fundamental risks to bank earnings and equity valuation as well as to the contingent liability borne by the FDIC insurance funds. The relative importance of credit and interest-rate risks for bank earnings and the FDIC's contingent liability has varied over time in response to changes in the macroeconomic, regulatory, and competitive environments.[1]

Despite the rising importance of fee-based income as a proportion of total income for many banks, net interest margins (NIM) remain one of the principal elements of bank net cash flows and after-tax earnings.[2] As shown in figure 1, except for very large institutions and credit card specialists, noninterest income still remains a relatively small and usually more stable component of bank earnings. As a result, despite earnings diversification, variations in net interest income remain a key determinant of changes in profitability for a majority of banks. However, research in the area of bank interest-rate risk and the behavior of NIM has been largely limited since the late 1980s, when the savings and loan crisis brought the issue of interest-rate risk to the fore. Understanding the systematic effects of changes in interest-rate and credit risks on bank NIM will likely help the FDIC better prepare for variations in its contingent liability associated with adverse developments in the macroeconomic and financial market environment.

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[1] For example, Duan et al. (1995) posit that interest-rate risk dominated the volatility of the FDIC's contingent liabilities in the early 1980s—the time of high interest-rate volatility—whereas credit risk became the leading factor in the late 1980s and early 1990s, as interest-rate volatility subsided.

[2] Throughout this paper, net interest margins are defined as annualized quarterly net interest income (interest income less interest expense) as a ratio of average earning assets.

The objective of this paper is twofold. First, this paper develops a new dynamic model of bank NIM that reflects the managerial decision process in response to credit, interest, and term-structure shocks. We focus our analysis primarily on variations in net interest margins, although bank managers adjust their portfolios in order to manage reported after-tax profit rather than net interest margins. However, given that the variation in net interest income is the key determinant of earnings volatility for many banks, understanding the degree to which these shocks affect the bank's net interest income would help us identify the channels through which they could affect overall bank profitability and the responses bankers make to manage reported profitability. The degree to which the bank can change the portfolio mix and/or hedge in the short term would determine the magnitude of the effect of interest-rate changes and other shocks on bank profitability.

Our second objective is to use a large set of data, consisting of quarterly bank and financial market data from first quarter 1986 to second quarter 2003, to evaluate the model. In addition, we investigate whether the sensitivity to shocks varies across diverse bank groups on the basis of their product-line specializations as well as different regulatory regimes. We focus on the effects of three key legislative changes on bank NIM during the sample period: the Depository Institutions Deregulation and Monetary Control Act (DIDMCA) of 1980, which set in motion the phasing out of the Regulation Q ceilings on deposits; the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991; and the Riegle-Neal Interstate Banking and Branching Efficiency Act (Riegle-Neal) of 1994, which became effective in July 1997.[3] These pieces of legislation have likely changed the sensitivity of bank NIM to credit, interest-rate, and term-structure shocks, for they spurred price competition for deposits that

[3] See FDIC (1997) for a detailed discussion of the legislative and regulatory history of the banking crisis of the 1980s and early 1990s.

reduced volatility in bank lending, improved the capital positions of banks, allowed geographic and earnings diversification, and changed the general competitive landscape. No empirical study to date has investigated the effects of these legislative changes on the behavior of bank NIM.

Empirical evidence and casual observation reinforce the view that banks with different product-line specializations tend to have distinctive business models and corresponding risk-management practices and characteristics. In addition, banks with different product-line specializations also face different competitive landscapes, with some bank groups experiencing progressively more intense competition than others. To maximize profitability and enhance bank value, bankers attempt to choose a product mix that best fits their perceived markets and managerial expertise, thus gaining a competitive advantage for lending, investing, and raising funds through deposits. For most banks, the choice of market means some degree of specialization in particular product lines and geographic locations. The bank portfolios associated with these various product lines are likely to exhibit different degrees of sensitivity to interest-rate and credit-risk changes. The extent to which bankers can offset adverse interest-rate changes and hedge adverse credit-risk changes will depend on the principal product line of the bank, the flexibility of the portfolio in responding to change, and the cost and availability of hedges for a particular portfolio.

Our empirical results show that net interest margins associated with some bank portfolios derived from specializing in certain product lines are considerably more sensitive to interest-rate changes than others. The magnitude of these effects depends on the repricing composition of existing assets and liabilities: banks that have a higher proportion of net short-term assets in their portfolio experience a greater boost in their NIM as interest rates rise. We find that changes in bank net interest margins are typically negatively related to interest-rate volatility but positively related to increases in the slope of the yield curve. Changes in the yield spread have significant and lingering effects on NIM for many bank groups, but the effects are particularly notable for mortgage specialists and small community banks. We find that, for most bank groups, after-tax earnings are less sensitive to interest-rate changes than NIM are, but the degree of sensitivity differs among banks with different product-line specialties.

We find that bank NIM are negatively related to an increase in realized and expected credit losses, particularly among banks specializing in commercial-type loans (i.e., commercial and industrial loans and commercial real estate loans). We posit that this inverse relationship between realized credit risk, as indicated by an increase in nonperforming loans, and net interest margins exists because, in the short run, risk-averse bank managers reallocate their funds to less default-risky, lower-yielding assets in response to an increase in the credit risk of their portfolios. This response is reinforced by bank examiners, who encourage banks to reduce their exposure to risky credits when loan quality is observed to be deteriorating. Banks' net interest margins are positively related to a size-preserving increase in high-yielding, and presumably higher-risk, loans. We generally find that the estimated parameters of the models differ by subperiod for banks with different product-line specialties in ways that are statistically and economically meaningful.

This paper extends the existing literature on NIM in three important respects. First, we develop a dynamic behavioral model of variations in NIM in response to market shocks that more closely resembles the actual decision-making process of bank managers than existing models. Second, by treating the banking industry as inherently heterogeneous (which we do by dividing banks into groups based on their product-line specializations), we are able to proxy broad differences in business models and managerial practices within the banking industry, and identify groups of banks that are most sensitive to credit, interest-rate, and/or term-structure shocks. Finally, we are able to test the importance of shifts in regulatory regime in behavioral differences across subperiods for the same group of banks.

The rest of the paper is organized as follows: section 2 reviews the literature relating to interest effects on bank net interest margins; section 3 presents a theoretical model of bank behavior in response to interest-rate shocks; section 4 discusses the data, the empirical variables, and the empirical specifications for the model; section 5 presents the results of both the full sample period and the subsample periods; and section 6 concludes the paper.

2. Literature Review

Despite significant regulatory concern paid to the interest-rate risk that banks face (OCC [2004]; Basel Committee on Banking Supervision [2004]), research on a key component of earnings that may be most sensitive to interest shocks—namely, bank net interest margins—has been limited thus far, particularly for U.S. banks. With a few exceptions discussed in this section, there has been little published research on the effects of interest-rate risk on bank performance since the late 1980s. Theoretical models of net interest margins have typically derived an optimal margin for a bank, given the uncertainty, the competitive structure of the market in which it operates, and the degree of its management's risk aversion. The fundamental assumption of bank behavior in these models is that the net interest margin is an objective to be maximized. In the dealer model developed by Ho and Saunders (1981), bank uncertainty results from an asynchronous and random arrival of loans and deposits. A banking firm that maximizes the utility of shareholder wealth selects an optimal markup (markdown) for loans (deposits) that minimizes the risks of surplus in the demand for deposits or in the supply of loans. Ho and

Saunders control for idiosyncratic factors that influence the net interest margins of an individual bank, and derive a "pure interest margin," which is assumed to be universal across banks. They find that this "pure interest margin" depends on the degree of management risk aversion, the size of bank transactions, the banking market structure, and interest-rate volatility, with the rate volatility dominating the change in the pure interest margin over time.

Allen (1988) extends the single-product model of Ho and Saunders to include heterogeneous loans and deposits, and posits that pure interest spreads may be reduced as a result of product diversification. Saunders and Schumacher (2000) apply the dealer model to six European countries and the United States, using data for 614 banks for the period from 1988 to 1995, and find that regulatory requirements and interest-rate volatility have significant effects on bank interest-rate margins across these countries.

Angbazo (1997) develops an empirical model, using Call Report data for different size classes of banks for the period between 1989 and 1993, incorporating credit risk into the basic NIM model, and finds that the net interest margins of commercial banks reflect both default and interest-rate risk premia and that banks of different sizes are sensitive to different types of risk. Angbazo finds that among commercial banks with assets greater than $1 billion, net interest margins of money-center banks are sensitive to credit risk but not to interest-rate risk, whereas the NIM of regional banks are sensitive to interest-rate risk but not to credit risk. In addition, Angbazo finds that off-balance-sheet items do affect net interest margins for all bank types except regional banks. Individual off-balance-sheet items such as loan commitments, letters of credit, net securities lent, net acceptances acquired, swaps, and options have varying degrees of statistical significance across bank types.

Zarruk (1989) presents an alternative theoretical model of net interest margins for a banking firm that maximizes an expected utility of profits that relies on the "cost of goods sold" approach. Uncertainty is introduced to the model through the deposit supply function that contains a random element.[4] Zarruk posits that under a reasonable assumption of decreasing absolute risk aversion, the bank's spread increases with the amount of equity capital and decreases with deposit variability. Risk-averse firms lower the risk of profit variability by increasing the deposit rate. Zarruk and Madura (1992) show that when uncertainty arises from loan losses, deposit insurance, and capital regulations, a higher uncertainty of loan losses will have a negative effect on net interest margins. Madura and Zarruk (1995) find that bank interest-rate risk varies among countries, a finding that supports the need to capture interest-rate risk differentials in the risk-based capital requirements. However, Wong (1997) introduces multiple sources of uncertainty to the model and finds that size-preserving increases in the bank's market power, an increase in the marginal administrative cost of loans, and mean-preserving increases in credit risk and interest-rate risk have positive effects on the bank spread.

Both the dealer and cost-of-goods models of net interest margins have two important limitations. First, these models are single-horizon, static models in which homogenous assets and liabilities are priced at prevailing loan and deposit rates on the basis of the same reference rate. In reality, bank portfolios are characterized by heterogeneous assets and liabilities that have different security, maturity, and repricing structures that often extend far beyond a single horizon. As a result, assuming that bankers do not have perfect foresight, decisions regarding loans and deposits made in one period affect net interest margins in subsequent periods as banks face changes in interest-rate volatility, the yield curve, and credit risk. Banks' ability to respond

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[4] Uncertainty in the bank's deposit supply function is modeled as $D^* = D(R_D) + \mu$ where R_D is the interest rate on deposits and μ is a random term with a known probability density function.

to these shocks in the period *t* is constrained by the ex ante composition of their assets and liabilities and their capacity to price changes in risks effectively. In addition, the credit cycle and the strength of new loan demand determine the magnitude of the effect of interest-rate shocks on banks' earnings. In this regard, Hasan and Sarkar (2002) show that banks with a larger lending slack, or a greater amount of "loans-in-process," are less vulnerable to interest-rate risk than banks with a smaller amount of loans in process. Empirical evidence, using aggregate bank loan and time deposit (CD) data from 1985 to 1996, indicates that low-slack banks indeed have significantly more interest-rate risk than high-slack banks. The model also makes predictions regarding the effect of deposit and lending rate parameters on bank credit availability that were not empirically tested with aggregate data.

The second important limitation of both the dealer and cost-of-goods models of net interest margins is that they treat the banking industry either as being homogenous or as having limited heterogeneous traits based only on their asset size. However, banks with distinct production-line specializations usually differ in terms of their business models, pricing power, and funding structure, all of which likely affect net interest margin sensitivity to interest-rate and other shocks. For instance, in the 1980s and early 1990s, credit card interest rates were typically viewed as "sticky" or insensitive to market rates, a view suggesting imperfect market competition (Ausubel [1991]; Calem and Mester [1995]). This view would imply that net interest margins of credit card banks, as a group, would be significantly less sensitive to interest-rate shocks than other banks. Furletti (2003) documents notable changes in credit card pricing due to intense competition over the past decade; however, it is not clear how these changes have affected credit card specialists' sensitivity to interest-rate and other shocks. In comparison, mortgage lenders, as a group, have a balance sheet with a significant mismatch in the maturity of their assets and liabilities, and they are therefore more likely to be sensitive to changes in the yield curve.

3. A Model of Bank Behavior

Discussed in this section is a model of the effects of interest-rate and credit risk changes using the mismatching of asset and liability repricing frequencies. The model is a standard approach to evaluating changes in NIM due to changes in interest rates and credit quality as loans that are passed-due or charged off are essentially repriced in the current period.

3.1 Interest-Rate Changes

The model of bank behavior relating to net interest margins used in this paper assumes that at each period a bank can significantly but not completely choose the amount of its investment in assets and liabilities of different repricing frequencies, given past choices that are immutable. Admittedly, this is a fuzzy statement as to the choices available to a bank, but banks have a moderate degree of control over their asset mix in the short run (from quarter to quarter) by purchasing or selling assets of different repricing frequencies. As suggested above, banks' choices of principal product-line specializations will determine the market conditions they face that may limit their ability to make rapid asset portfolio adjustments. The same is true for bank liabilities. Bankers can pay them early, deposits can be received and withdrawn at random, and some of them, like federal funds and repurchase agreements, are under the control of the bank and can be changed overnight.

In contrast to banks' ability to make portfolio adjustments, banks have little control over market interest-rate changes and interest-rate volatility. When contracts on assets or liabilities are negotiated, banks may, through market power, be able to set levels or markups (markdowns) over index rates such as LIBOR, but are unable to control index rate changes. In addition, we assume that markups are contractually fixed in the short run. Furthermore, banks are unable to change their chosen product-line specializations in the short run, so such changes are strategic options only.

In our modeling of bank responses to credit and interest-rate risks, we assume that banks are most interested in achieving the best after-tax profit performance they can in order to provide shareholders with maximum value. Maximizing shareholder value in a dynamic context, however, is a daunting problem and requires considerable judgment. Not only do bank managers have to choose the optimal financial service product mix (product-line specialization, in this study) and geographic diversification, but they also need to set the lending rate and fees, hedge credit quality and volatility changes, manage their liability structure, and gauge the moods of the equity and debt markets to favorable or unfavorable news so as to increase or protect shareholder value. Given these underlying conditions regarding banks' motivations and their ability to change their portfolios and their positions as interest-rate takers, we assume that banks operate such that they will change their portfolio mix only to increase profits and maximize shareholder value over a 12-month horizon. As discussed above, the net interest margin is the major source of net income for most banks, and therefore a strategy of maximizing its value in the short run may be a reasonable proximate goal for achieving maximum bank profits in the short run. If risk-neutral pricing were prevalent in financial markets, banks would all price loans in a similar way, and short-run maximization of the expected value of net interest margins would be a proper bank objective.[5] However, banks can do better. They can make decisions as to the timing of

[5] As pointed out in the introduction, banks in general have been increasing fee income as a way to achieve greater long-run profitability. Fee income is difficult to adjust in the short run in response to interest-rate changes because

credit charge-offs, changing portfolios for credit risk purposes, and changing asset structure by buying or selling liquid assets (U.S. government and agency debt).

To best consider the interest-rate sensitivity of net interest margin, we consider the net interest margin as a function of interest rates on assets and liabilities and the shares of each as a ratio to earning assets at each repricing frequency. Throughout the development of the model, we are assuming that the bank has chosen its product-line specialization and that the assets and liabilities reflect this choice for each bank. This relationship can be formally stated as

$$NIM_{pt} = NII_{pt} / EA_{pt} = \left(\sum_{k=1}^{m} y_{kt} EA_{kt} - r_{kt} L_{kt} \right) p \Big/ EA_{pt} \qquad (1)$$

where p refers to product line p, NIM_{pt} is net interest margin in t, NII_t is net interest income (interest income less interest expense) in t, EA_{pt} is the amount of interest-earning assets in the portfolio in t, y_k is the interest rate on assets of repricing frequency k, EA_k is the amount of earning assets in repricing frequency k, r_k is the interest rate on liabilities for repricing frequency k, and L_k is the amount of liabilities for repricing frequency k. Operationally, the first repricing frequency, for example, would be overnight.

Since *NIM* will be subject to changes in interest rates on earning assets and interest-bearing liabilities, changes in individual investments in earning assets, funding from interest-bearing liabilities and changes in the overall investment in earning assets, the continuous change in *NIM*, *dNIM*, is a function of these bank management portfolio decisions and of time. In general, this can be expressed more formally, assuming continuous time and using (1) for any product line, as follows:

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of its longer-term contractual basis. One exception is for credit card banks, where fees can be modified at the will of the lender, as can interest rates on outstanding balances of accumulated interest and original principal.

$$dNIM_t = \frac{\partial NIM_t}{\partial NII_t} dNII_t + \frac{\partial NIM_t}{\partial EA_t} dEA_t = \frac{dNII_t}{EA_t} - \frac{NII_t}{EA_t^2} dEA_t \quad (2)$$

where the changes in *NII* and *EA*, *dNII* and *dEA*, are the result of changes in the interest rates, dy_k and dr_k and bank management decisions on investments in *EA*. The product-line index is dropped to simplify the notation.

Noting that the total derivative of *NII* can be expanded in terms of interest-rate, earning asset, and liability changes:

$$dNII_t = \sum_{k=1}^{m} \frac{\partial NII_t}{\partial y_k} dy_k - \frac{\partial NII_t}{\partial r_k} dr_k = \sum_{k=1}^{m} EA_k dy_k + y_k dEA_k - L_k dr_k - r_k dL_k \quad (3)$$

In this formulation, we assume that interest-rate changes are independent of each other, which is not usually the case. We can change this assumption by substituting a term-structure and credit-risk spread factor model for each interest-rate change. For the *NIM* modeling, we will use a more simplified approach that can accommodate the term-structure and credit-risk spread effects on *NIM*.

Expressing the interest change effects on *NIM*, we substitute (3) into (2) for *dNII* resulting in

$$dNIM_t = \frac{\left(\sum_{k=1}^{m} EA_k dy_k + y_k dEA_k - L_k dr_k - r_k dL_k \right)}{EA_t} - NIM_t \frac{dEA_t}{EA_t} \quad (4)$$

Note that the final term in (4) is the proportional change in *EA* over the preceding period times the current period *NIM*. This term is negatively related to the change in *NIM*, implying that if all other factors are held constant, increases in earning assets will tend to decrease the net interest margin. With respect to the first term in (4), constant interest rates mean that all dy_k and dr_k are zero such that the proportion of each asset and liability component relative to EA_t would have no effect on the change in *NIM*. Under these ceteris paribus conditions, this term is the ratio of the change in *NII* resulting from a change in each asset and liability component, with each component's proportion to *EA* held constant. If dEA_t is positive and each dEA_k and dL_k grows at the same positive rate as earning assets, the effect would be to increase *NII* such that *dNII* was positive as long as NIM_t was positive. The net effect on *NIM* under these conditions is zero.

The implication of this result is important for interpreting the effect of the growth in earning assets on banks' net interest margins. Without advantageous changes in interest rates or changes in the composition of assets and liabilities relative to earning assets, a growth in earning assets will have little effect on *NIM*. Banks should experience an increase in *NII* by practically the same proportion as *EA*. Therefore, management cannot rely solely on growth to increase *NIM* or profitability but must manage the composition of assets and liabilities to achieve greater *NIM* and ROA, given management's expectation of changes in interest rates and term structure.

To complete the model for estimation, changes in interest rates are assumed to be outside the control of management and each is subject to a continuous time, stochastic diffusion process as follows:

$$dy_k = f(y_k, t)dt + \sigma_{y_k} dz_k \qquad (5)$$

where σ_{yk} is the standard deviation of changes in y_k, $f(y_k,t)$ is a drift term or mean for dy_k, and dz_k is a Weiner process of interest-rate changes with repricing frequency k. We assume, for simplicity, that each y_k and r_k follows the same stochastic processes so that dz depends only on the repricing frequency, k. Furthermore, the drift term requires a hypothesis for its value. If it is hypothesized that there is a tendency of regression toward a mean (e.g., Vasicek and Heath-Jarrow-Morton models), the sign of the term will depend on whether interest rates are above or below the mean. Another hypothesis is that the drift term is zero because interest rates follow a random walk once regime shifts are complete (see Ingersoll [1987], 403).[6] Since we do not wish to impose an interest-rate adjustment hypothesis or a term-structure hypothesis on bankers' adjustment to interest-rate changes, we will allow the data to provide estimates of the effect of interest-rate and term-structure changes.[7] These interest-rate diffusion processes can be substituted into (4) for the final model:

$$dNIM_t = \frac{\left(\sum_{k=1}^{m} EA_k f\left(y_k, t\right) + EA_k \sigma_{y_k} dz_k + y_k dEA_k - L_k f\left(r_k, t\right) - L_k \sigma_{r_k} dz_k - r_k dL_k \right)}{EA_t} - NIM_t \frac{dEA_t}{EA_t}$$

(6)

The drift terms, $f(y_k,t)$ and $f(r_k,t)$, pose an interesting way of viewing the sign of any estimation of the coefficient on EA_k or L_k. If these terms are zero and $E(dz_k)$ is zero, the effect of changes in earning assets is strictly conditioned by interest rate changes.

If interest rates increase for assets and liabilities with repricing frequencies of less than one year, the change in *NIM*, all other factors held constant, depends on the relative shares of earning assets and liabilities repricing within one year. If short-term liabilities have a greater proportion of EA_t than assets, *dNIM* will be negative and *NIM* will fall in the next period. Note also that the effect of interest-rate volatility on NIM, σ_{yk} and σ_{rk}, will be in the same direction as respective interest-rate changes, meaning that higher interest volatility has the same relationship as an increase in interest rates depending on the sign of the repricing gap, the difference between assets and liabilities in the same repricing frequency, or cumulative repricing frequencies.

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[6] The hypothesis of a random walk is perhaps most appropriate for the period under analysis. From 1984 to the present, there have been several regime shifts in interest-rate levels due to the substantial and sustained decline of inflation and shifts in monetary policy. The purpose of our study is not to explain these shifts but to allow the data to provide parameter estimates of bankers' responses to interest-rate changes.

[7] In dealing with data on a quarterly frequency, we considered the imposition of the unbiased expectations hypothesis on interest-rate changes and the conjoint assumption of risk-neutral pricing to be a second-order constraint for the purposes of this study. The focus of this study is to estimate bankers' reactions to prior interest-rate, term-structure, and volatility changes and not to impose a particular model. The unbiased expectations hypothesis will be used to help interpret the estimated coefficients, since the pricing that results is risk neutral.

Furthermore, the change in *NIM* is inversely related to the level of prior-period *NIM* and, since NIM_t is always positive, to the rate of change in *EA*, ceteris paribus. Since the rate of change in *EA* can be positive or negative, its sign must be accounted for in estimations.

By way of comparison, another approach to modeling changes in *NIM* is to use Ito's lemma by assuming that the change in *NIM* follows a diffusion process as below:

$$dNIM_t = \left(\sum_{k=1}^{m} \frac{\partial NIM_t}{\partial NII_t} \frac{\partial NII_t}{\partial y_k} dy_k - \sum_{k=1}^{m} \frac{\partial NIM_t}{\partial NII_t} \frac{\partial NII_t}{\partial r_k} dr_k \right) + \frac{\partial NIM_t}{\partial t} dt + \frac{1}{2} \sum_{i=1}^{m} \sum_{j=1}^{m} \sigma_{ij} \frac{\partial^2 NIM_t}{\partial x_i \partial x_j} \quad (7)$$

where all variables are as described above, x_i and x_j are interest rates composed of *y* and *r* and stated this way in (7) for simplicity, and σ_{ij} is the covariance among all interest-rate changes of assets, *dy*, and liabilities, *dr*. To expand (7), note that the terms in parentheses are equivalent to equation (4), where earning assets are allowed to change. The middle term in (7) is the drift of *NIM* over time and can be thought of as a trend in *NIM*. When the diffusion process for interest rates is substituted from (5) into (7), the term in parentheses is equivalent to (6). This approach adds the drift and the second-order stochastic term within the double sum in (7). This final term can be interpreted as the portfolio effect on $dNIM_t$ due to interest-rate volatility and correlation—a portfolio risk effect. If interest rates are positively correlated within most interest-rate regimes (see Hanweck and Hanweck [1995]; Hanweck and Shull [1996]), the σ_{ij} are positive and the sign of the double-sum term will depend on the sign of the second derivative of *NIM* with respect to interest rates. This term could be positive or negative depending on whether the interest rates are only for assets or only for liabilities. For asset terms the sign is negative; for asset and liability terms the sign depends on the weight of assets and liabilities at each repricing period and is likely to be negative for one-year repricing items; and for all liabilities the sign is likely to be positive. With positive correlations of interest-rate changes, we expect the weight of the terms to be such that changes in volatility will be negatively related to the change in *NIM* for most banks regardless of product-line specialization. This result is consistent with the hypothesis expressed in equation (6), but with the correlations of interest-rate changes added. Thus, this approach reinforces the role of interest volatility for changes in *NIM*.

This form of a model of *NIM* change is much less theoretically appealing because it assumes that earning assets and liabilities are almost exclusively stochastic, similar to the assumption of Ho and Saunders (1981), when it is well known that banks can and do change the distribution of assets and liabilities among their repricing buckets substantially from quarter to quarter for strategic purposes, presumably to take advantage of expected future interest-rate changes (see Saunders and Cornett [2003], chap. 9, for this evidence). Thus, we focus our empirical work using the model represented by (6) while taking advantage of the insights of the second model regarding interest-rate volatility and correlation by maturity and risk class.

3.2 Credit Risk

Some important factors influencing changes in *NIM* have been left out of the models above in order to achieve simplicity in focusing on interest-rate change effects on *NIM*. One important factor, as pointed out by Zarruk and Madura (1992), Angbazo (1997), and Wong (1997), is the effect of credit risk or risk of loan losses on *NIM*. Angbazo and Wong hypothesized that *NIM* should be positively related to loan losses, arguing that greater credit risk would mean that banks would charge higher premiums. An implication of this hypothesis is that expected increases in credit risk would prompt banks to raise interest-rate markups on the basis of these perceived future loan losses. Although it may be the case in the long run that greater credit risk will lead to higher *NIM* through the pricing of risk, quarterly or short-run changes in the *NIM* are more likely to respond inversely to increases in credit risk. Like Zarruk and Madura, we argue that when faced with higher uncertainty of loan losses—that is, an increase in credit risk of their portfolios—risk-averse bank managers will shift funds to less default-risky, lower-yielding assets over the short-term horizon. In addition, bank examiners will put pressure on banks to reduce their exposure to risky credits when loan quality starts to deteriorate. These supervisory actions imply that a deterioration in loan quality, indicated by rising loan losses or nonperforming loans relative to earning assets, causes banks to lose interest income from these loans and move funds to less default-risky, lower-yielding assets. Both effects tend to decrease *NIM* in the short run, so that decreases in credit quality tend to decrease *NIM*.

We can integrate these concepts directly into the above model by using equation (6). The total change in NIM, $dNIM_t$, now becomes a function of interest-rate changes and credit-quality changes. We can incorporate credit quality by defining the value of an earning asset as composed of two components: the promised value, less the value of an option held by the bank (the lender) to take over the assets of the borrower if the loan is not paid off on time and in full.[8] An increase in the value of this option means that the credit quality of the borrower has decreased and the bank's credit risk has increased. This relationship is shown more formally as

$$EA_k = BEA_k - P_t(A_b, BEA_k, T, Rf_k) \qquad (8)$$

where EA_k is the market value of the earning asset of repricing frequency k, BEA_k is the promised value of the debt, $P_t()$ is the put option on the assets of the firm, A_b, T is the time to repricing, and Rf_k is the value of the default risk-free rate for repricing frequency k. Since the

[8] See Black and Cox (1976); Merton (1974); and Cox and Rubenstein (1985), 378–80 for the structural models for debt valuation. Conceptually, the value of the shareholders' interest can be thought of as a call option on the assets of the firm, with the ability to put the assets to the debt holders if the value of the assets is less than the promised value of the debt. Thus debt holders, lenders such as banks, have a short put option on the firm's assets with a strike price of the promised value of the debt.

book value of interest-earning assets is approximately equal to the promised value, we can substitute EA_k in equation (6) with equation (8) to arrive at the following relationship:

$$dNIM_t = \frac{\left(\sum_{k=1}^{m}(BEA_k - P_t())f(y_k,t) + (BEA_k - P_t())\sigma_{y_k} dz_k + y_k d(BEA_k - p()) - L_k f(r_k,t) - L_k \sigma_{r_k} dz_k - r_k dL_k\right)}{(BEA_k - P_t())}$$

$$- NIM_t \frac{d(BEA_t - P_t())}{(BEA_t - P_t())}$$

(9)

Since the promised value of the debt is fixed, the value of the put option directly reflects changes in credit risk. An increase in the value of the put option means that the put is closer to being in the money and default is more likely. By considering these factors, we see that the change in NIM is inversely related to increases in credit risk.

We can evaluate the effect of interest-rate changes on default-risky debt by using equation (8). An increase in the base interest-rate index will reduce the promised value, BEA_k, by increasing the discount factor. However, a rise in interest rates will also reduce the value of the put option because the present value of the strike price (the promised value) is reduced. The reduction implies that default-risky debt is less sensitive to a given change in the interest-rate index than default-free debt. If default risk is independent of interest-rate changes, bank specializing in higher credit-risk lending should be less interest sensitive than banks with concentrations in default-risky debt.

4. Data and the Empirical Model

In this section we describe the data, the empirical variables (for interest-rate shock, for term-structure shock, for credit shock, other institutional variables, and for seasonality), and our empirical specifications.

4.1 Data

We obtained individual bank data for the estimation of these models from the Reports of Condition and Income (Call Reports) collected on a quarterly basis by the FDIC from the first quarter of 1986 to the second quarter of 2003. Data for financial market variables are from Haver Analytics and the Federal Reserve Board of Governors. Because of issues related to data consistency and availability, BIF-insured thrifts and Thrift Financial Report filers are excluded from the sample. Although available, bank data before the first quarter of 1986 were excluded from the sample because of the existence of Regulation Q, which constrained banks' ability to adjust interest rates on deposits in response to changes in market interest rates.[9] To exclude spurious financial ratios, we restricted the sample to commercial banks with earning assets of $1 million or more and a ratio of earning assets to total assets exceeding 30 percent. This left 22,077 commercial bank observations in the sample of banks that were in existence for one or more quarters over the sample period. We also excluded any observation with missing data points, reducing the sample to 17,789 commercial banks.

We then divided the sample into 12 different bank groups based on the specialization and asset size of the bank at the end of each quarter. These bank groups practically correspond to the classification method used by the FDIC to identify a specialty peer group of insured institutions except that we make three main alterations to the FDIC peer grouping to better reflect differences in the institutions' risk characteristics. First, we break down "commercial lenders" more finely to better reflect differences in risk characteristics between commercial and industrial (C&I) loan and commercial real estate (CRE) loan portfolios. Second, we separate consider noninternational banks with assets over $10 billion to account for potentially greater reliance on hedging activities that may offset the adverse effects of interest-rate shocks. Finally, to be able

[9] The final phasing out of Regulation Q occurred in the second quarter of 1986.

to compare asset size over time, we use real assets rather than nominal assets to classify bank size groups.[10] This classification method helps stratify commercial banks on the basis of their business models, portfolio compositions, and risk characteristics. Given dissimilarities in their risk characteristics, we expect banks in these different groups to exhibit varying degrees of sensitivity to credit, interest-rate, and term-structure shocks. We also considered a classification method based on derivative activities; however, data on derivatives are severely limited, particularly for the full sample period, so it would be difficult to assess the extent to which commercial banks use derivatives for hedging purposes. We use asset size as a proxy to identify groups of banks most likely to use derivatives to hedge their interest-rate risk.

The 12 bank groups are

- International banks
- Large noninternational banks with real assets over $10 billion
- Agricultural banks
- Credit card banks
- Commercial and industrial (C&I) loan specialists
- Commercial real estate (CRE) specialists
- Commercial loan specialists
- Mortgage specialists
- Consumer loan specialists
- Other small specialists with real assets of $1 billion or less
- Nonspecialist banks with real assets of $1 billion or less
- Nonspecialist banks with real assets between $1 billion and $10 billion.

[10] To compute real assets, we divided nominal assets by the CPI-U price-level index for the quarter.

Because of the size and diversity of the group of commercial loan specialists and the grouop of small nonspecialists, each is further broken down into three groups on the basis of the size of their real assets. Appendix 1 describes the criteria for each of these bank groups. Each bank is classified in 1 of the 12 groups in a given quarter, but it may belong to 2 or more bank groups throughout the sample period as the bank changes its asset composition or its business model or both. For each bank group, we eliminated any bank that did not belong to the group for at least four quarters, thus making the final sample 16,522 commercial banks.

The Call Reports require banks to report cumulative year-to-date income and expenses on a quarterly basis. Reflecting this reporting standard, most studies and quarterly reports by the FDIC and Federal Reserve of bank performance report NIM as an annualized, cumulative value (see the FDIC release of the Quarterly Bank Performance Report at www.FDIC.gov). The use of quarterly cumulative reports tends to smooth changes in NIM, reducing actual quarterly variations. To overcome this problem, we focus on quarterly changes in the net interest margin. For the second quarter through the fourth quarter of each year, we estimate actual income and expenses for the quarter by subtracting the previous quarter's cumulative reported values from the current cumulative reported values. For the first quarter, we use reported income and expenses for the quarter. We then annualize these values by multiplying each by four. We compared the resulting series with the cumulative series in model estimation and found that the resulting series' performance was much more consistent with the hypothesized behavior. Therefore, all income and expense derived data are based on adjusted series. The reported earning assets—the denominator of computed ratios—are the average of ending values for the quarter and the previous quarter.

Nine panels in figure 1 show trends in net interest margins and noninterest income for each of our 12 bank groups. These panels show a long-term trend of a decline in net interest margins for most bank types, beginning around the 1992–1993 period. In particular, international banks have experienced a significant compression in their net interest margins since the early 1990s, with the median net interest margin for the group falling by more than 175 basis points. It is not clear how much of this long-term decline can be attributed to the low interest-rate environment, greater competitive pressure, or regulatory changes that made securitization and other off-balance-sheet activities more attractive. However, it is interesting to note that the peak year in net interest margins roughly corresponds to the implementation of capital regulation rules and prompt corrective action as specified in FDICIA.

Aggregate industry statistics show a growing importance of noninterest income as a source of bank earnings. The FDIC Quarterly Banking Profile shows that noninterest income rose from 31 percent of quarterly net operating revenue in first quarter 1995 to 41 percent in second quarter 2003. However, most bank groups did not experience a notable increase in noninterest income as a percentage of average earning assets over most of the sample period. In fact, the median quarterly noninterest income as a percentage of average earning assets remained mostly stable for most bank groups throughout the 1990s. DeYoung and Rice (2004) suggest that the long-term increase in noninterest income may have already peaked as the risk-return trade-off reached a plateau.

International banks, large banks with real assets exceeding $10 billion, and credit card specialists did experience a sharp increase in noninterest income over the sample period. The median ratio of noninterest income to average earning assets for the international bank group rose sharply after 1997, overtaking net interest margins as the primary source of this grooup's earnings. This trend likely reflects earnings and product diversification and a greater reliance on off-balance-sheet instruments by these banks in response to deregulation, capital regulation, and financial market developments.[11] Rogers and Sinkey (1999) found that banks that are larger and have smaller net interest margins and fewer core deposits, as is the case of international banks, tend to engage more heavily in nontraditional activities.

As figure 1 shows, large banks with real assets greater than $10 billion saw their noninterest income rise steadily, although net interest income still represents their primary source of earnings. The net interest margin fluctuated between 3.5 percent and 4.5 percent of average earning assets for this group of banks. Unlike for other bank groups, for credit card specialists the median net interest margins did not exhibit a discernible downward trend in the 1990s. The median net interest margin for credit card banks increased sharply in the 2001–2003 period despite a steady decline in short-term interest rates. At the same time, the median noninterest income for the group has risen sharply since 1997. This trend likely reflects a widespread use of risk-based pricing and risk-related fees in response to heightened rate competition and greater availability of credit card loans to higher-risk and higher-revenue-generating borrowers than previously.[12]

Figure 2 presents the median quarterly return on average earning assets (ROA) for selected groups of banks. The median ROA for large and midtier banks has improved significantly since the implementation of FDICIA, and it has remained more stable since then compared with prior periods. Between 2002 and 2003, however, large banks with real assets greater than $10 billion saw their ROA rising sharply, whereas international and midtier

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[11] See Angbazo (1997) for the effects of off-balance-sheet instruments on net interest margins. Angbazo found a negative relationship between letters of credit, net securities lent, and net acceptances acquired and net interest margins, but a positive relationship between net loans originated/sold and net interest margins.

[12] See Furletti (2003) for discussions of recent developments in credit card pricing and fee income.

nonspecialists reported weaker earnings. These differing trends suggest diversity across these three largest asset size groups in their business models in terms of asset composition, correlation among earning components, and earnings management. The earnings volatility of international banks suggests that they are vulnerable to market factors other than those included in our model; however, discussion on the effect of these factors on bank earnings is outside the scope of this paper. As for large banks, the median ROA for small nonspecialist banks made discrete improvements in 1992. The ROA of these banks, particularly the smallest asset size group, has exhibited a high degree of seasonality over time.

4.2 Empirical Variables

Appendix 2 lists the explanatory variables included in our empirical model and their expected signs. All variables representing financial ratios or interest rates are expressed in annualized percentage terms. Bank-specific variables and financial market variables included in the empirical model are derived from the theoretical model of bank behavior presented in section 3 of this paper. Table 1 presents descriptive statistics for bank-specific variables for each bank group. To preserve earnings data for an individual institution at a given time, we did not adjust the bank data for mergers and acquisitions that occurred over the sample period. Instead, we screened the sample for any aberrant data on an individual-bank basis. As discussed below, there exist significant variations in the value of each of these bank-specific variables across bank groups as well as within the given bank group.

4.2.1 Interest-Rate-Shock Variables

VOL_1Y represents short-term interest-rate volatility and is measured by the standard deviation of a weekly series of one-year Treasury yields for the quarter. ST_DUMMY is a dummy variable that takes a value of one if the one-year Treasury yield rose during the quarter, and zero if the yield fell. Figure 4 illustrates a mostly positive but imperfect correlation between the quarterly short-term interest-rate volatility and the level of short-term interest rates. Equation (7) posits that the coefficients for both VOL_1Y and ST_DUMMY would have a negative sign for most banks.

The duration gap between assets and liabilities measures respective changes in assets and liabilities due to an interest-rate shock and is a key determinant of bank net interest margins (Mays [1999]). The duration gap reflects the repricing frequency of assets and liabilities as well as the value of embedded call options. Data necessary to calculate the duration gap are not collected in the Call Report for commercial banks, so we are prevented from using a reported duration gap in our empirical model. As a proxy for the interest-rate sensitivity of bank portfolios, we use net short-term assets—the difference between short-term assets and short-term liabilities. We define a repricing frequency less than one year as “short term.” STGAP_RAT is net short-term assets as a percentage of earning assets. Although there have been changes in Call Report data items and their definitions over time, we believe that STGAP_RAT is generally comparable over time because many of these changes affected both assets and liabilities. Our definition of STGAP_RAT includes nonmaturing liabilities that are discussed more fully below. Table 1 shows that, whereas international banks and credit card specialists tend to have better matched assets and liabilities than other bank groups, consumer loan specialists, mortgage specialists, other small specialists, and small nonspecialist banks tend to have the most unmatched balance sheets. Holding everything else constant, we expect the coefficient for

STGAP_RAT to have a negative sign since longer-term assets have higher yields than shorter-term assets with the same risk characteristics. In addition, we expect the size of STGAP_RAT to have a positive effect on NIM when short-term interest rates rise.

Flannery and James (1984) show that deposits with uncertain maturity, such as demand deposits, regular savings accounts, and small time deposits, have an effective maturity longer than one year. This finding suggests that the “effective” cost of these liabilities is relatively insensitive to changes in market interest rates. Indeed, Mays (1999) found that thrifts with a high percentage of nonmaturing deposits, defined as the sum of demand deposits and regular savings, experienced a positive increase in net interest margins in response to a positive interest-rate shock. Although these relationships may have changed in recent years as short-term interest rates have reached 1.0 percent and less, we can test for any changes in this structure with models estimated for different periods. We include NM_RAT, nonmaturing deposits as a percentage of earning assets, in the model to proxy for the degree of interest-rate sensitivity of the bank’s funding from nonmaturing deposits. As shown in table 1, commercial loan specialists and small nonspecialist banks seem to rely most heavily on nonmaturing deposits to fund their lending, whereas international and credit card banks fund their lending activities with more interest-rate-sensitive liabilities. On the basis of previous studies, we expect the coefficient for NM_RAT to have a positive sign. In addition, we expect the size of NM_RAT to have a marginal and positive effect on NIM as interest rates rise, given the documented insensitivity of nonmaturing liabilities to interest rate changes (Mays [1999]).

4.2.2 Term-Structure-Shock Variables

Figures 3 through 5 present historical trends in the financial market variables included in our empirical model. DS5Y_1Y is the change in the spread between five-year and one-year Treasury yields (yield spread). Given that maturities of bank assets are generally longer than those of bank liabilities, we expect DS5Y_1Y to be positively related to DNIM_RAT. Figure 3 shows that the average DNIM_RAT for mortgage lenders has roughly tracked DS5Y_1Y over time, although it seems to respond to the changing shape of the yield curve with one- or two-quarter lags. A similar correlation exists between DNIM_RAT and DSY_1Y for other groups of lenders, although visually the relationship is not as strong.

4.2.3 Credit-Shock Variables

DLN_AST and DCI_RAT are changes in, respectively, the ratio of loans to earning assets and the ratio of C&I loans to earning assets from the prior quarter. Both variables proxy a size-preserving increase in higher-yielding assets and are expected to be positively related to DNIM_RAT. Table 1 shows that C&I specialists, CRE specialists, and credit card specialists experienced the largest increases in median loan-to-asset ratios during the sample period, whereas international banks, small other-specialty banks, and midtier nonspecialists reported the largest declines. All bank subgroups other than C&I specialists experienced, on average, a decline in C&I loan-to-asset ratios over the sample period.

We use the spread between the Baa corporate bond and the Aaa corporate bond yields (CSPRD) to proxy for shocks in the credit market due to deterioration in credit quality or to other credit market disturbances or to both, which may result in reduced liquidity in the market as well as credit rationing. Among previous episodes of these credit events are the Mexican peso crisis in 1995 and the Russian devaluation and default in August 1998 (the latter preceded the near collapse of Long-Term Capital Management in the fall of 1998). In addition, as shown in figure 5, CSPRD is also closely related to the credit-risk premium measured by the spread between the C&I loan rate and the intended federal funds rate. The relationship appears to have tightened in the 1990s for C&I loans of all sizes, thus indicating that banks, both small and large, are better able to price expected changes in credit risk. The coefficient for CSPRD is expected to have a negative sign if banks are unable to increase loan rates but ration the supply of credit.

DNPERF_RAT is a change in the ratio of nonperforming assets to earning assets (NPERF_RAT). This variable represents a change in realized credit losses, and is used as a proxy for a "credit shock." International banks, credit card specialists, and C&I specialists have the highest median NPERF_RAT. The median value of DNPERF_RAT is close to zero; however, there are some institutions within each group with large positive or negative values. As discussed in section 3, the coefficient for DPERF_RAT is expected to have a negative sign if banks are unable to price credit risk effectively in the short term, as bank managers shift funds to lower-yielding assets.

4.2.4 Other Institutional Variables

Net interest margin (NIM_RAT) is annualized net interest income for the quarter divided by average earnings assets. Table 1 shows that the median NIM_RAT varies significantly across bank groups, with international banks having the lowest NIM_RAT on average (2.7 percent), whereas while credit card specialists have the highest average NIM (9.3 percent). The median DNIM_RAT, the change in NIM_RAT between *t-1* and *t*, is close to zero for most bank groups, although there are institutions experiencing a large change in net interest margins on a quarter-to-quarter basis. The derivation of the change in NIM presented in equation (6) of section 3.1

shows

that

$$dNIM_t = \frac{\left(\sum_{k=1}^{m} EA_k f(y_k, t) + EA_k \sigma_{y_k} dz_k + y_k dEA_k - L_k f(r_k, t) - L_k \sigma_{r_k} dz_k - r_k dL_k \right)}{EA_t} - NIM_t \frac{dEA_t}{EA_t}$$

This suggests that if the rate of change in EA is held constant, the change in NIM should be inversely related to the level of prior-period NIM. The coefficient for the lagged value of NIM_RAT is therefore expected to have a negative sign.

ROA is annualized after-tax net income for the quarter divided by average earning assets, and DROA is the change in ROA from the previous quarter. Median ROA varies from 0.95 for mortgage and consumer credit specialists to 2.33 for credit card specialists. Like DNIM_RAT, the median DROA is close to zero; however, some large positive or negative numbers are observed in the sample. DNONII_RAT is an annualized noninterest income for the quarter divided by average earning assets, while DSECGL_RAT is annualized security gains and losses for the quarter divided by average assets. Both variables proxy the effects of bank earnings diversification on net interest margins. Signs of these variables could be positive or negative, depending on whether these earnings are substituted for or complementary to NIM.

Finally, LOGAST is the log of total real assets derived as nominal assets deflated by the urban consumer price index (CPI-U). Table 1 shows that there is a negative cross-section relationship between the asset size of the bank within the group and the median NIM_RAT. This relationship implies that, ceteris paribus, the asset size would be also negatively correlated to DNIM_RAT, and therefore we expect the coefficient for LOGAST to have a negative sign. However, as shown from the model development in section 3, a simple change in the scale of operations for an individual bank should have no effect on changes in net interest margin.

4.2.5 Seasonality

As discussed in section 4.1, reported earnings of small banks tend to exhibit significant seasonality. Reported ROA for these banks is consistently and significantly lower in the fourth quarter of the year than in any other quarter. This pattern raises some questions about the reliability of reported earnings for earlier quarters of the year. To control for these seasonal patterns in reported earnings, we include three quarterly dummy variables. QTR2 takes a value of one if the reported period is the second quarter, QTR3 if it is the third quarter, and QTR4 if it is the fourth quarter.

4.3 Empirical specifications

Our empirical model of net interest margins is a one-way random-effects model and is specified as follows:

$$y_{i,t} = \gamma_1 y_{i,t-1} + \beta' x_{i,t-2} + \varphi' z_{t-1} + \tau d_{quarter} + v_{it}$$

(8)

where $i = 1, \ldots, N$, $t = 1,\ldots,T$, $v_{it} = \alpha_i + u_{it}$. α_i, is a random-disturbance term unique for the ith observation, and both α_i and u_{it} are assumed to be normally distributed. $y_{i,t}$ is the dependent variable, the change in NIM, $x_{i,t-2}$ is a vector of bank-specific explanatory variables, $z_{i,t-1}$ is a vector of financial market explanatory variables and $d_{quarter}$ are quarterly dummies. Finally, γ, β, ϕ, and δ are a vector of coefficients. Section 4.2 has just discussed the expected signs of each of these coefficients.

Following Brock and Franken (2002), bank-specific variables enter the model with two-quarter lags; thus we avoid the potential endogeneity problems that may exist for these variables. We estimate the model using the generalized-least-squares (GLS) technique, based on the estimated disturbance variances. For dynamic random-effect models, the GLS estimator is equivalent to the maximum likelihood estimator. The GLS estimator is consistent and asymptotically normally distributed as the number of cross-sectional observations, N, approaches infinity (Hsiao [2003]). N is very large for all the bank groups in our sample except international banks, large noninternational banks, and credit card specialists. We address potential heterogeneity and serial correlation problems in model specifications by controlling for the size of the institution, applying cross-sectional random effects, and adding a lagged value of the dependent variable. As an alternative to GLS estimation, we also tested the mixed-model specification, which allows us to explicitly control for heteroscedasticity and serial correlation problems in the unbalanced panel (Littell et al. [1996]). Within the mixed-model framework, we tested for a potential bias arising from a number of institutions appearing only for a limited number of quarters, a bias that was not controlled in the GLS specification, and we found the effect to be insignificant. The results of the mixed-model specification were more or less similar to those of the GLS estimation and are therefore not reported in this paper.

For each bank group, the empirical model for changes in net interest margins (DNIM_RAT) to be tested is as follows:

$$
\begin{aligned}
DNIM\_RAT_{it} = {} & c + \beta_1 * VOL\_1Y_{it-1} + \beta_2 * ST\_Dummy_{it-1} + \beta_3 * STGAP\_RAT_{it-2} + \beta_4 * NM\_RAT_{it-2} \\
& + \beta_5 * STGAP\_SD_{it-1} + \beta_6 * NM\_SD_{t-1} \quad \text{Interest Rate Risk} \\
& + \beta_7 * DS5Y\_1Y_{t-1} + \beta_8 * DS5Y\_1Y_{t-2} + \beta_9 * DS5Y\_1Y_{t-3} + \beta_{10} * DS5Y\_1Y_{t-4} \quad \text{Term Structure Risk} \\
& + \beta_{11} * DLN\_AST_{t-2} + \beta_{12} * DCI\_RAT_{it-2} + \beta_{13} * DCSPRD_{t-1} + \beta_{14} * DNPERF\_RAT_{it-2} \quad \text{Credit Risk} \\
& + \beta_{15} * LOGAST_{it-1} + \beta_{16} * NIM\_RAT_{it-2} + \beta_{17} * DNIM\_RAT_{it-1} + \beta_{18} * DNONII\_RAT_{it-2} \\
& + \beta_{19} * DESCGL\_RAT_{t-2} + \beta_{20} * QTR2 + \beta_{21} * QTR3 + \beta_{22} * QTR4
\end{aligned}
\qquad (9)
$$

The second empirical model we test measures the effect of interest-rate, term-structure, and credit-risk shocks on overall profitability of the bank and has the same empirical specification as the net interest margin model. We expect the ROA of banks with well-diversified earning sources to be less sensitive to interest-rate and other shocks than net interest margins. In other words, the better diversified a bank's earnings are, the less significant are the coefficients for most dependent variables; in other words again, bank earnings are expected to be less sensitive to these shocks. The empirical model for changes in ROA (DROA) for each bank group is specified as

$$\left.\begin{aligned} DROA_{it} = c + \beta_1 * VOL\_1Y_{it-1} + \beta_2 * ST\_Dummy_{it-1} + \beta_3 * STGAP\_RAT_{it-2} + \beta_4 * NM\_RAT_{it-2} \\ + \beta_5 * STGAP\_SD_{it-1} + \beta_6 * NM\_SD_{t-1} \end{aligned}\right\} \text{Interest Rate Risk}$$

$$\left. + \beta_7 * DS5Y\_1Y_{t-1} + \beta_8 * DS5Y\_1Y_{t-2} + \beta_9 * DS5Y\_1Y_{t-3} + \beta_{10} * DS5Y\_1Y_{t-4} \right\} \text{Term Structure Risk}$$

$$\left. + \beta_{11} * DLN\_AST_{t-2} + \beta_{12} * DCI\_RAT_{it-2} + \beta_{13} * DCSPRD_{t-1} + \beta_{14} * DNPERF\_RAT_{it-2} \right\} \text{Credit Risk}$$

$$\begin{aligned} &+ \beta_{15} * LOGAST_{it-1} + \beta_{16} * NIM\_RAT_{it-2} + \beta_{17} * DNIM\_RAT_{it-1} + \beta_{18} * QTR2 \\ &+ \beta_{19} * QTR3 + \beta_{20} * QTR4 \end{aligned} \qquad (10)$$

We also test these models for stability over four separate subsample periods representing changes in legislation that had effects on competition in the banking industry. These periods, discussed more fully in the next section, are 1986–1988, 1989–1991, 1992 to the second quarter of 1997, and the third quarter of 1997 to the second quarter of 2003.

5. The Results

Here we discuss the results first for the full sample period and then for the subsample periods.

5.1 Full Sample Period results

Tables 2A and 2B summarize the results of cross-sectional time series regressions on DNIM_RAT and DROA for each of the 12 bank groups. We applied the Hausman test for the presence of one-way random effects for all bank groups. Except for international banks, we cannot reject the presence of random effects for these groups of banks. The F-test shows that one-way fixed effects exist for international banks. On the basis of these test results, we applied one-way random-effects estimation to all bank groups other than international banks and applied one-way fixed-effects estimation to international banks.

The statistical significance of explanatory variables and the size of coefficients for these variables vary considerably across bank groups. The goodness of the fit for the DNIM_RAT model measured by the modified R-square varies from 0.10 for consumer loan specialists to 0.37 for international banks, credit card specialists, and midtier nonspecialist banks. The goodness of the fit for the DROA model varies from 0.32 for consumer loan specialists to 0.54 for small nonspecialists with real assets greater than $300 million.

In general, the regression results presented in tables 2A and 2B imply that different types of banks are sensitive to different types of shocks. Larger and more diversified institutions and credit card specialists appear to be less vulnerable to interest-rate and term-structure shocks, but still sensitive to credit shocks. Both of these relationships may reflect the greater use of off-balance-sheet instruments that help these institutions hedge their interest-rate risk. In comparison, agricultural banks, mortgage specialists, commercial loan specialists with real assets less than $300 million, and small nonspecializing banks with real assets less than $300 million are sensitive to all three types of shocks examined in this paper—credit, interest-rate, and term-structure shocks.

5.1.1 Sensitivity to Interest-Rate Shocks

The lagged ratio of net short-term assets (STGAP_RAT2) generally has a small negative coefficient, when significant. The finding implies that, ceteris paribus, banks with longer-term net assets experience greater variations in net interest margins. As found by Mays (1999), the lagged ratio of nonmaturing deposits to earning assets (NM_RAT2) has a small positive coefficient, when significant. These results suggest, as hypothesized, that the interest-rate sensitivity associated with a bank's funding has a significant, positive effect on the bank's net interest margins, regardless of the interest-rate environment. Two interaction terms included in the model—STGAP_SD1 and NM_SD1—are designed to capture the marginal effect of an increase in net short-term assets (STGAP_RAT2) and nonmaturing deposits (NM_RAT2) when short-term interest rates rise (ST_DUMMY1 = 1). A negative coefficient for the short-term interest-rate dummy variable (ST_DUMMY1), when considered together with interaction terms, can be interpreted as showing that when short-term interest rates increase, there is an adverse effect on the change in net interest margins for banks with no net short-term assets or nonmaturing deposits. The two interaction terms, STGAP_SD1 and NM_SD1, have positive signs for almost all bank groups and, when statistically significant, suggest that an increase in short-term interest rates has an increasingly positive effect on the change in net interest margins as the proportion of net short-term assets or nonmaturing deposits increases.

The economic significance of these coefficients also varies across the 12 bank groups. For instance, in the case of C&I specialists, holding everything else constant, net interest margins would be 6 basis points lower in the quarter following an increase in the interest rate. A 10 percent increase in STGAP_RAT2 or NM_RAT2 would offset that decline by 4 basis points. For mortgage specialists, an increase in the short-term interest rate is followed by a 12-basis-point decline in NIM, with a 10 percent increase in STGAP_RAT2 or NM_RAT2 offsetting this decline by less than 1 basis point and 3 basis points, respectively. Dissimilarities between C&I specialists and mortgage specialists in the sensitivity of NIM to an increase in interest rates likely reflect inherent differences in the maturity and interest-rate terms of the two groups' loan portfolios.

With a few exceptions, our two measures of interest-rate shocks—interest-rate volatility (VOL_1Y1) and a short-term interest-rate dummy variable (ST_DUMMY)—have negative coefficients, when significant. These results seem to contradict the findings of previous research on determinants of net interest margins, which showed that interest-rate volatility positively affects the *level* of net interest margins. However, the results are in line with our model that tests for the effect of interest-rate volatility on the quarterly *change* in net interest margins. We find that as we hypothesized in the equation (7), given the balance-sheet composition of banks in our sample, higher interest-rate volatility lowers the change in net interest margins. The coefficients are economically significant and vary widely across bank groups. A 1-percentage-point increase in interest-rate volatility, measured by the standard deviation of one-year Treasury yields within the quarter, is followed by about a 4- to 6-basis-point decline in NIM for most bank groups. The coefficients are significantly larger for C&I specialists and credit card specialists, which tend to have shorter-term and more default-risky assets. A 1-percentage-point increase in interest-rate volatility leads to a 23-basis-point decline in NIM for C&I specialists and a 137-basis-point decline in NIM for credit card specialists. These results also suggest that most banks are unable to hedge against interest-rate risk effectively, at least in the short term. In comparison, mortgage lenders that typically have assets with longer maturities appear to benefit from higher interest-rate volatility. A 1 percent increase in interest-rate volatility leads to a 6-basis-point increase in

NIM for mortgage specialists. In the next section, we show significant within-group variations in banks' sensitivity to interest-rate volatility across different regulatory and economic regimes.

5.1.2 Term-Structure-Shock Variables

Lagged changes in the Treasury yield spread (DS5Y_1Y1, DS5Y_1Y2, DS5Y_1Y3, and DS5Y_1Y4) have positive and lingering effects on the change in net interest margins for mortgage specialists and small nonspecialist banks with real assets greater than $50 million, up to four quarters following the initial shock. On the other hand, none of the coefficients for the four lagged values of the change in the Treasury yield spread is significant for credit card specialists and midtier nonspecialist banks. For the remaining bank groups, the change in the Treasury yield spread affects the variation in net interest margins only with a noticeable lag, and one-quarter lagged change in the Treasury yield spread (DS5Y_1Y1) has a significantly negative coefficient for some bank groups. For many bank groups, coefficients for two-quarter and three-quarter lagged change in the Treasury yield spread (DS5Y_1Y2 and DS5Y_1Y3) are significantly positive. For instance, ceteris paribus, a 100-basis-point increase in the yield spread boosts NIM for mortgage specialists by 11 basis points two quarters after the initial shock, and 9 basis points three quarter after. In the case of small nonspecialists, the effects are similar but less economically significant. A 100-basis-point increase in the yield spread leads to about a 6-basis-point increase two quarters following the initial shock. These results suggest that banks that have a large percentage of long-term fixed-rate assets, such as mortgages, are more vulnerable to a flattening of the yield curve than other types of banks. These results also support our hypothesis that portfolio composition, asset concentration, and business models, separately represented by bank groupings, are critical to an understanding of the effects of a term-structure shock on bank net interest margins over time.

5.1.3 Credit-Shock Variables

The coefficient for the lagged value of the change in the ratio of loans to earning assets (DLN_AST2) is positive and significant for most banks groups, as hypothesized. However, the coefficient is significant but negative for agricultural banks, C&I specialists, commercial loan specialists with real assets less than $50 million, and consumer loan specialists. On the basis of the interpretation of this variable as a proxy for a size-preserving increase to higher earning assets, a negative sign may imply either that these banks attract new loans by offering lower rates or that they do not price the credit risk of new loans correctly or both. The results show that a 10-percentage-point increase in the loan-to-asset ratio typically accounts for a 2- to 4-basis-point increase in NIM, although large noninternational banks benefit significantly more (8 basis points) from the same increase.

The lagged value of the change in the C&I loan ratio (DCI_RAT2) has significantly negative coefficients for commercial loan specialists with real assets over $300 million, other small specialists, and small nonspecialist banks with real assets over $300 million. The negative coefficient is contrary to prior expectations. It may reflect exogenous variables not specified in the model, such as the competitive market landscape affecting loan pricing. Alternatively, for this group of banks, a trade-off and diversification benefit may exist between an expansion to higher-yielding assets and higher risk. Agricultural banks and mortgage specialists, however, seem to benefit from expanding their C&I loan portfolios—a diversification effect for these banks.

The lagged value of a change in the credit spread (DCSPRD1) has a negative and significant coefficient for most bank groups, a result suggesting that banks tighten underwriting standards following credit market disturbances. In addition, despite the fact that banks do charge a higher risk premium in response to higher credit risk, as shown in figure 5, banks are typically unable to fully price credit risk and may instead rely on credit rationing. The effect of changes in the credit spread appears to be economically significant for many bank groups, although there are significant variations across groups. For instance, it is estimated that a 100-basis-point increase in the credit spread subsequently reduces NIM by 5 basis points for CRE specialists, 16 basis points for C&I specialists, and 20 basis points for consumer specialists. As in the case of interest-rate volatility, within-group results for the change in the credit spread vary significantly across regulatory and economic regimes. These results are discussed in the next section.

With the exception of agricultural banks, the coefficient for the lagged value of the change in the nonperforming asset ratio (DNPERF_RAT2) is negative, when significant. In most cases, credit-quality deterioration, measured by DNPERF_RAT2, has considerably weaker economic significance than the forward-looking loan-quality variable (DCSPRD1). However, credit shocks appear to have particularly significant effects on credit card lenders, with a 1-percentage-point increase in the nonperforming asset ratio leading to a 53-basis-point reduction in NIM. This result may be primarily driven by subprime lenders that tend to be very credit sensitive. Although several proxy measures for subprime lenders—such as a dummy variable to indicate the top 5 percentile in terms of the loan yield—were considered, these variables were ultimately dropped from the model because of data limitations. The results of credit-shock variables suggest that, as we hypothesized in section 3, banks are unable to effectively price an *unexpected* increase in credit losses, and managers respond to this increase in the short term by shifting funds to less default-risky and lower-yielding assets.

5.1.4 Other Institutional Variables

Other institutional variables have generally similar effects on the change in net interest margins (DNIM_RAT) across bank groups, with some notable exceptions. The coefficient for the lagged value of net interest margins (NIM_RAT2) is negative and significant at the 1 percent level for all bank groups. This is in line with the expectation, as presented in equation (6), that posits a negative correlation between the lagged *level* of net interest margins and the *change* in net interest margins. The lagged change in net interest margins (DNIM_RAT1) has a significant negative coefficient, implying error correction over time. Coefficients for DNIM_RAT1 and NIM_RAT2 have the largest coefficients among all explanatory variables. Estimates show that on average, a 100-basis-point increase in the lagged change in NIM leads to a 55-basis-point increase in NIM in the subsequent quarter. On average, the 100-basis-point difference in two-quarter lagged NIM translates to the 31-basis-point difference in the change in NIM on average.

The lagged value of the change in the noninterest income ratio (DNONII_RAT2) is significant and positive for some groups, including large noninternational banks, agricultural banks, CRE specialists, and commercial loan specialists with real assets less than $50 million; however, it is significantly negative for the others, such as commercial loan specialists with real assets over $300 million, other small specialists, small nonspecialist banks, and midtier nonspecialist banks. This result shows that not all banks have reaped diversification benefits from noninterest income.

The coefficient for the lagged value of the change in security gains and losses (DSECGL_RAT2) has a negative sign, where significant, except for mortgage specialists. This implies that, except for mortgage specialists, security gains and losses are typically a complementary source of earnings. However, for mortgage specialists, net interest margins and security gains and losses seem to move together, perhaps because of a common response to changes in short-term interest rates.

Finally, with the exception of midtier nonspecialist banks, the coefficient for the log of total assets (LOGAST2) shows that the change in net interest margins is inversely related to asset size, when significant. In other words, holding all else constant, the larger the bank in terms of assets, the less sensitive the net interest margins will be with respect to a proportional change in the asset size of the bank.

5.1.4 Comparison with the ROA Model

The results of the ROA model are mostly similar to those of the net interest margin models, with a few exceptions. Changes in the ratio of loans to earning assets (DLN_AST2) as well as the C&I loan ratio (DCI_RAT2) have positive effects on the change in net interest margins, where significant. This result suggests that holding all else constant, the average bank earns higher profits by shifting to higher-risk, and presumably, higher yielding, assetsthat may not always be reflected in higher net interest margins. As in the case of the net interest margin model, the coefficient for the change in nonperforming assets (DNPERF_RAT2) is negative for all bank groups, where significant. Coefficients for net short-term assets (ST_GAP2) and nonmaturing deposits (NM_RAT2) are negative and positive, respectively, as expected. Estimates in the ROA model show that as with the NIM model, an increase in short-term interest rates has a positive effect on the change in net interest margins as the proportion of net short-term assets or nonmaturing deposits increases for all banks except credit card specialists, where the sign is negative and significant.

Overall profitability of the bank appears to be significantly less sensitive to the term-structure shock than net interest margins. The widening of the Treasury yield spread negatively affects the change in ROA for the majority of banks, with one-, three-, and four-quarter lags. For a majority of bank groups, the one-quarter lagged change in the Treasury yield spread has a negative and significant coefficient. This may reflect the fact that the Treasury yield spread is a leading indicator of the business cycle. The Treasury yield spread tends to become narrower several quarters before the beginning of a recession and then subsequently widens as the Federal Reserve lowers short-term interest rates to stimulate the economy. As the recession goes on, loan quality diminishes, and banks react by increasing provisions for loan losses, a highly cyclical component of bank earnings. This reaction would tend to compress bank earnings when the Treasury yield spread widened rapidly.

In comparison, the ROA is more sensitive to interest-rate volatility than net interest margins for most bank groups. These results suggest that, despite their diversification, banks are unable to hedge effectively against interest-rate volatility. In terms of credit shocks, the coefficient for the lagged value of the change in the credit spread (DCSPRD1) tends to be positive, although not always statistically significant, for banks with a greater focus on commercial lending. These results suggest that while banks tighten their lending standards when the credit spread widens, reducing their loan volume, they also tend to rely on higher fees to compensate for higher credit risk.

5.1.5 Seasonality

As is evidenced from the quarterly time series charts, net interest margins and ROA show seasonality in the reported data. To account for this, we used quarterly dummy variables in the regression models. Coefficients for the three quarterly dummy variables—QTR2, QTR3, and QTR4—indicate significant seasonality in reported net interest margins and ROA. The change in the net interest margins is significantly higher in the later quarters of the year than in the first quarter, with the third quarter showing the greatest difference from the first quarter. In comparison, for most bank groups other than large and midtier banks, the reported change in the ROA is significantly lower in the fourth quarter of the year than in the first quarter. This difference is economically significant. On average, the change in NIM was 12 basis points higher in the third quarter than in the first quarter, while the reported change in ROA was 39 basis points lower in the fourth quarter than in the first quarter. These results are consistent with banks' conducting earnings management via the net interest margin in the later quarters and with banks' penchant for deferring loan losses and other charges until the year-end quarter.

5.2 Subsample Period Results

Over our sample period, the banking industry underwent a series of major legislative and regulatory changes, severe thrift and banking crises, and an unprecedented consolidation movement. Presumably these changes have had numerous effects on the way banks operate. It is therefore reasonable to assume that earnings sensitivity to interest-rate and other shocks would vary across different regulatory and economic regimes. As we discussed in section 1, we focus primarily on the effects of three key legislative changes during this period: DIDMCA, FDICIA, and Riegle-Neal. These pieces of legislation are important to the banking industry because they spurred a price competition for deposits that led to less volatility in bank lending, improved the capital positions of banks, allowed geographic and earnings diversification, and changed the general competitive landscape.

To test the effects of these changes on the sensitivity of bank earnings, we test our model in four different subsample periods: 1986–1988, 1989–1991, 1992 to the second quarter of 1997, and the third quarter of 1997 to the second quarter of 2003. We separate the first two periods from each other in order to separate the post–Regulation Q period (1986–1988) from the exogenous effect of a banking crisis, recession, and credit crunch (1989–1991)—an effect that would have distorted the sensitivity of bank earnings to interest-rate and other shocks. The Riegle-Neal provision that allows bank mergers across state lines became effective on June 1, 1997. As a result, we would expect some notable differences between the last subsample period and previous periods in earnings sensitivity to interest-rate and other shocks. We present the estimation results of the models for the subsample periods for net interest margin for selected bank groups in tables 3A through 3C.[13] In this section, we discuss within-group variations across subsample periods, focusing primarily on variables that exhibit the greatest variations.

We expect that the progressive movement to greater competition in banking may have increased the ability of banks to adjust loan and deposit rates more readily as the economic environment changed. Accordingly, this increased ability may have smoothed changes in net interest margin and reduced the effect of interest-rate changes on net interest margins. In contrast, banks may have chosen to specialize more in the face of greater competition, taking advantage of clientele more suitable to the bank and avoiding competition with larger banking

[13] International and credit card banks do not have enough observations for subperiod variations to be analyzed; as a result, we left them out of this section. In the case of other groups, such as C&I lenders, patterns of their within-group variation are similar to the patterns of other groups presented in the paper, so to avoid duplication we do not report the results.

companies. This increase in specialization may have resulted in portfolio structures that are less flexible.

5.2.1 Interest-Rate Shocks

As with the full sample, lagged values of net short-term assets (STGAP_RAT2) have generally negative coefficients, when significant, while lagged values of nonmaturing deposits (NM_RAT2) have significantly positive coefficients, when significant. The coefficient for interest-rate volatility shifts from being positive in the 1992–1997:Q2 period to negative in the 1997:Q3–2003:Q2 period. Two factors potentially explain these results. One is differences in the market interest-rate environment between the two periods, if interest-rate volatility actually captures the movement in the short-term interest rate. However, our model includes a dummy variable for the change in short-term interest rates (ST_DUMMY1) that controls for the change in the interest-rate environment. Coefficients for interest-rate volatility and the short-term interest-rate dummy variables are often both statistically significant, although they generally have opposite signs. The second possible explanation is that an increase in market competition in the later period may have constrained the banks' ability to factor interest-rate volatility into their pricing decisions. These empirical findings indicate that, despite diversification, most banks are still unable to hedge interest-rate risk effectively by using off-balance-sheet instruments.[14]

5.2.2 Term-Structure Shocks

[14] Our results show that large banks are better able to hedge interest-rate volatility. The coefficient for interest-rate volatility is positive for large noninternational banks in the most recent period. We did not present subsample results for large noninternational banks because of the small size of N in earlier periods.

Our results show that earnings sensitivity to term-structure shocks has changed over time for most banks. Most banks appear to remain vulnerable to term-structure shocks in the post–Riegle-Neal era. Interestingly, in many cases, changes in the yield spread had weaker explanatory power in earlier periods than in the more recent period. This may reflect the fact that many banks faced significant financial difficulties in earlier periods, and therefore their earnings performance was primarily determined by bank-specific factors rather than market factors. As a result, a more useful comparison may be that of coefficients between the 1992–1997:Q2 period and the 1997:Q3–2003:Q2 period. The coefficient for the one-quarter lagged yield spread (DS5Y_1Y1) changed sign from positive in the 1992–1997:Q2 period to negative in the more recent period, while net interest margins are consistently and positively related to two-quarter and three-quarter lagged yield spreads (DS5Y_1Y2 and DS5Y_1Y3), when significant. These results suggest that changes in the narrowing of the Treasury yield spread still have lingering and positive effects on net interest margins, but with a greater lag than previously. Although some lenders, such as mortgage specialists and small nonspecialist banks, appear to be somewhat less sensitive to term-structure shocks in the more recent period than previously, others, including commercial lenders, seem to be more sensitive to term-structure shocks. These results may reflect changes in mortgage specialists and smaller banks' balance-sheet and earnings composition as well as the use of greater off-balance-sheet funding vehicles, such as securitization, which are not captured in our model.

5.2.3 Credit Shocks

Many banks appear to be better able to price expected changes in credit risk in the more recent period than previously. The coefficient for the change in the credit spread (DCSPRD1) was generally negative in the 1992–1997:Q2 period but was positive in the most recent period. This result is similar to what we found for the change in the nonperforming asset ratio. The main difference between these two explanatory variables is that the credit spread tends to be a forward-looking indicator, whereas the nonperforming asset ratio is backward looking. More to the point, we can view the lagged change in the credit spread as the anticipated change in credit risk, and the lagged change in the nonperforming asset ratio as the actual change in credit risk. Together, these results suggest that banks may have become more efficient in pricing credit risk in the more recent period, as market competition increased while regulatory restrictions relating to loan rates eased. For agricultural banks, mortgage loan specialists, C&I specialists, and other nonspecialist banks with real assets less than $50 million, coefficients for lagged values of nonperforming assets in the net interest margin model shifted from being negative in earlier subsample periods to being significantly positive in the last subperiod. These results may also suggest that in the more recent period, banks are relying more on pricing than on quantity control in response to heightened credit risk. If an increase in credit risk primarily results in tighter underwriting standards or the curtailment of loan supply, as was the case during the credit crunch in the 1980s and 1990s, greater credit spreads would depress earnings. The change in credit spread in the most recent period leads to improvement in NIM and implies that banks respond to higher credit risk more by charging higher rates through risk-based pricing and other tools than by reducing loan supply.

6. Conclusion

This paper presents a dynamic model of bank behavior that captures net interest margin dynamics as banks face *unanticipated* credit, interest-rate, and term-structure shocks. We show that net interest margins for commercial banks in different bank groups, defined in terms of the product-line specialization and asset size of each bank at the end of each quarter, usually respond in a predictable yet dissimilar way to unanticipated shocks. These differences likely reflect a significant variation in asset composition (in terms of repricing frequencies and credit risks) and business model across these groups. We present the results of cross-section time series random-effects regression estimation that show that quarterly changes in net interest are sensitive to credit, interest-rate, and term-structure shocks for most bank groups, but with varying degrees. The size of the coefficient for variables that proxy these shocks, as well as the speed of changes in net interest margins in response to term-structure shocks, vary widely across these groups. In general, large and more diversified banks seem to be vulnerable to credit shocks but less sensitive to interest-rate or term-structure shocks. In comparison, credit card specialists are not sensitive to increased short-term interest-rate volatility or a change in the shape of the yield curve. As hypothesized, we show that the greater the proportion of net short-term assets and nonmaturing deposits a bank holds, the more positive the effect of an increase in short-term interest rates on net interest margins. Finally, we present evidence that banks continue to be sensitive to credit, interest-rate, and term-structure shocks even after they are allowed to operate across state lines. However, for some bank groups the sensitivity to term-structure shocks seems to have lessened somewhat, although the results are not universal. On the other hand, banks seem to be more constrained than previously in their ability to factor in interest-rate volatility, possibly because of increased competition in the general lending arena. Finally, our results suggest that many banks appear to be able to price actual and expected credit risk more efficiently than in earlier periods.

The models estimated and the results reported in this study are a comprehensive contribution to an understanding of the systematic effects of changes in interest-rate and credit risks on bank NIM, one of the principal elements of bank cash flows, and after-tax earnings. Since a fundamental risk to the earnings and equity valuation of a majority of FDIC-insured institutions largely arises from credit and interest-rate risks, these bank risks remain the key elements underlying the contingent liability borne by the FDIC insurance funds. Modeling the magnitude and significance of these effects is an important contribution to the FDIC for its risk-management purposes. These models allow the FDIC to pose scenarios, such as an unanticipated increase in interest rates, and trace the effects on the rapidity with which bank profitability might weaken and the degree to which banks could become exposed to the adverse effects of credit risks. Further analysis can contribute to estimating the increase in the chance of bank default and failure and the increase in the FDIC's chances of loss.

Future research may expand these models to other earnings components, such as noninterest income and security gains and losses so as to more consistently model interest-rate risk as it independently affects each component of bank earnings. With new banking activities such as securitization that allow banks to move certain assets off the balance sheet, certain components of noninterest income have likely become more sensitive to interest-rate shocks. If various earning components for certain bank groups respond similarly to unanticipated shocks over time, the benefits these banks derive from earnings diversification would be more limited than otherwise. Future studies may also want to model explicitly the competitive market structure in which the bank operates and the effect of that structure on banks' abilities to respond to unanticipated shocks. The local competitive landscape may have a particularly significant effect on small, locally based banks. However, lack of data on bank loan concentrations in local areas continues to challenge researchers in this endeavor. Finally, developing a new and more refined methodology to classify the banking industry into unique product-line specializations would enhance our understanding of various business models.

APPENDIX 1: Descriptions of Bank Groupings

Bank Grouping	Description
International banks	Banks with real assets over $10 billion and foreign assets over 25 percent of total assets.
Large noninternational banks	Noninternational banks with real assets over $10 billion.
Agricultural banks	Banks with the sum of agricultural and farmland-secured loans in excess of 25 percent of total assets.
Credit card specialists	Banks with the sum of credit card loans, credit card-related asset backed securities, and credit card loans sold and securitized with recourse in excess of 50 percent of total assets.
Commercial and industrial (C&I) loan specialists	Banks with C&I loans in excess of 25 percent of total assets.
Commercial real estate (CRE) loan specialists	Banks with CRE loans in excess of 25 percent of total assets.
Commercial loan specialists	Banks that are not classified as C&I or CRE specialists and the sum of whose C&I and CRE loans is in excess of 25 percent of total assets. The group is further broken down into three subgroups by real asset size: less than $50 million, between $50 million and $300 million, and greater than $300 million in real assets.
Mortgage loan specialists	Banks with the sum of mortgage loans and mortgage-backed securities in excess of 50 percent of total assets.
Consumer loan specialists	Banks that are not classified as credit card specialists or mortgage specialists and the sum of whose consumer loans and residential real estate loans is in excess of 50 percent of total assets.
Other small specialists	Banks with a loan-to-asset ratio less than 40 percent and real assets less than $1 billion.
Small nonspecialist banks	Banks not in other groups and with real assets less than $1 billion. The group is further broken down into three subgroups by real asset size: less than $50 million, between $50 million and $300 million, and greater than $300 million in real assets.
Midtier nonspecialist banks	Banks not in other groups and with real assets between $1 billion and $10 billion.

APPENDIX 2: Description of Explanatory Variables

Variable Name	Description	Expected Sign
<u>Interest-Rate Risk</u>		
vol_1y1	Standard deviation of one-year Treasury yields (weekly series) in *t-1*.	–
st_dummy1	1 if the one-year Treasury yield increased between *t* and *t-1*; 0 if the one-year Treasury yield decreased between *t* and *t-1*.	–
stgap_rat2	The ratio of assets with remaining maturity less than one year *less* liabilities with remaining maturity less one year (net short-term assets) to earning assets in *t-2*.	–
nm_rat2	The ratio of nonmaturing deposits (transactional deposits, money market, and regular savings) to earning assets in *t-2*.	+
stgap_sd1	Interaction term between stgap_rat2 and st_dummy1.	+
nm_sd1	Interaction term between nm_rat2 and st_dummy1.	+
<u>Term-Structure Risk</u>		
ds5y_1y1	Difference in 5-year and 1-year Treasury yield spreads between *t-2* and *t-1*.	+
ds5y_1y2	Difference in 5-year and 1-year Treasury yield spreads between *t-3* and *t-2*.	+
ds5y_1y3	Difference in 5-year and 1-year Treasury yield spreads between *t-4* and *t-3*.	+/–
ds5y_1y4	Difference in 5-year and 1-year Treasury yield spreads between *t-5* and *t-4*.	+/–
<u>Credit Risk</u>		
dln_ast2	Difference in the loan-to-earning assets ratio between *t-3* and *t-2*.	+
dci_rat2	Difference in the commercial and industrial (C&I) loans to earning assets ratio between *t-3* and *t-2*.	+

Dcsprd1	Difference in Baa-rated and Aaa-rated corporate bond yield spreads between *t-2* and *t-1*.	–
Variable Name	**Description**	**Expected Sign**
dnperf_rat2	Difference in the nonperforming assets to earning assets ratio between *t-3* and *t-2*.	–
<u>Other Institutional Variables</u>		
Logast2	Log of total assets in *t-2*.	–
nim_rat2	Annualized quarterly net interest income divided by average earning assets (net interest margin)—*two-quarter lag (t-2).*	–
Roa2	Annualized quarterly net income divided by average earning assets (return on average earning assets)—*two- quarter lag (t-2).*	–
dnim_rat1	Difference in net interest margins between *t-2* and *t-1*.	–
droa1	Difference in the return on average earning assets between *t-2* and *t-1*.	–
Dnonii_rat2	Difference in the noninterest income to average earning assets ratio between *t-3* and *t-2*.	+/–
Dsecgl_rat2	Difference in the security gains/losses to average earning assets ratio between *t-3* and *t-2*.	+/–
<u>Seasonal Dummy</u>		
qtr2	1 if the reporting period is the second quarter of the year, 0 otherwise.	+/–
qtr3	1 if the reporting period is the third quarter of the year, 0 otherwise.	+/–
qtr4	1 if the reporting period is the fourth quarter of the year, 0 otherwise.	+

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Table 1: Descriptive Statistics by Bank Grouping

Variables included in this table are net interest income to average earning assets (NIM_RAT), return on average assets (ROA), noninterest income to average earning assets (NONII_RAT), security gains/losses to average earning assets (SECGL_RAT), loans to earning assets ratio (LN_AST), C&I loans to earning assets ratio (CI_RAT), nonperforming assets to earning assets ratio (NPERF_RAT), net short-term assets to earning assets ratio (STGAP_RAT), and log of total assets (LOGAST). All variables beginning with "d"—for example, DNIM_RAT—represent quarterly changes. See appendix 2 for further details on variables.

	International Banks					Large Non-Internatinoal Banks				
Variables	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	2.84	2.72	1.06	0.07	10.06	4.08	4.01	1.29	-0.02	17.60
dnim_rat	-0.01	-0.02	0.55	-7.36	8.27	-0.01	-0.02	0.58	-7.20	10.47
roa	0.71	1.01	1.60	-12.98	6.25	1.33	1.40	1.49	-26.70	12.82
droa	-0.01	0.00	2.15	-14.54	13.85	-0.01	0.00	1.48	-22.79	14.95
nonii_rat	2.89	2.59	1.35	-0.87	11.90	2.86	2.00	3.25	-4.35	28.33
dnonii_rat	0.02	0.02	1.06	-7.70	11.44	0.01	0.01	1.39	-16.04	18.52
secgl_rat	0.07	0.04	0.16	-1.71	1.06	0.05	0.01	0.27	-4.80	2.98
dsecgl_rat	0.00	0.00	0.19	-1.79	1.94	0.00	0.00	0.35	-4.77	4.80
ln_ast	59.05	68.83	22.64	7.05	89.39	75.16	76.01	13.61	7.67	105.17
dln_ast	-0.26	-0.22	3.18	-21.83	15.36	0.08	0.08	4.26	-39.71	49.88
ci_rat	25.07	25.60	12.50	0.29	55.37	22.33	21.48	11.79	0.00	69.96
dci_rat	-0.20	-0.15	1.58	-7.48	6.27	-0.11	-0.03	2.08	-17.42	22.52
nperf_rat	2.38	1.83	2.12	0.00	9.08	1.50	0.91	1.77	0.05	24.62
dnperf_rat	-0.01	-0.02	0.44	-1.98	2.89	0.02	-0.01	0.44	-2.08	7.11
stgap_rat	-1.89	-4.86	17.77	-53.25	47.47	-31.86	-33.59	16.72	-76.31	59.16
nm_rat	26.74	27.16	13.82	1.39	63.67	45.14	44.66	16.32	0.02	100.37
logast	17.68	17.60	0.76	16.21	19.70	16.77	16.62	0.61	16.12	19.70

	Agricultural Banks					Credit Card Specialists				
Variables	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	4.32	4.27	0.86	-12.56	27.89	10.65	9.34	8.03	-67.66	163.72
dnim_rat	0.00	0.00	0.63	-23.34	27.13	0.09	0.04	5.95	-106.72	104.23
roa	1.06	1.23	1.59	-111.46	48.21	3.31	2.33	7.55	-137.90	113.01
droa	0.02	0.01	2.04	-96.26	63.77	0.18	0.04	7.03	-126.57	93.44
nonii_rat	0.63	0.52	0.64	-37.37	45.64	17.33	5.39	40.13	-52.44	823.58
dnonii_rat	0.00	0.00	0.59	-37.75	41.26	0.59	0.01	17.40	-189.27	384.50
secgl_rat	0.03	0.00	0.40	-29.19	69.51	0.00	0.00	0.29	-14.22	2.56
dsecgl_rat	0.00	0.00	0.54	-69.57	69.51	0.00	0.00	0.38	-13.92	14.22
ln_ast	55.55	56.39	16.68	0.21	115.60	93.45	100.63	15.35	0.00	179.67
dln_ast	0.22	0.37	4.05	-59.58	57.54	0.42	0.05	7.84	-82.41	86.27
ci_rat	7.80	6.86	4.95	0.00	55.14	1.99	0.00	4.63	0.00	44.61
dci_rat	-0.01	-0.01	1.33	-39.28	29.58	-0.07	0.00	2.33	-90.32	22.54
nperf_rat	1.48	0.80	2.18	-0.81	46.29	1.94	1.42	2.22	0.00	39.83
dnperf_rat	-0.03	-0.01	0.84	-22.08	26.18	0.03	0.01	1.04	-21.76	30.68
stgap_rat	-31.07	-32.79	17.81	-144.94	98.72	-6.72	-5.22	49.61	-163.96	117.49
nm_rat	43.33	42.43	10.33	0.00	215.64	14.06	2.42	20.53	0.00	100.40
logast	9.95	9.94	0.77	6.51	13.78	12.74	12.62	1.81	7.21	16.11

	C&I Specialists					CRE Specialists				
Variables	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	5.04	4.89	1.55	-19.85	35.60	4.97	4.88	1.22	-13.11	34.10
dnim_rat	-0.01	0.00	0.85	-40.66	29.07	-0.02	-0.01	0.66	-25.93	29.51
roa	0.23	0.99	4.21	-199.12	39.53	0.90	1.18	2.39	-122.89	44.62
droa	-0.08	0.01	4.60	-195.20	206.50	-0.02	0.02	2.46	-116.79	88.58
nonii_rat	1.45	0.96	6.15	-14.87	512.58	1.11	0.85	1.33	-21.40	55.17
dnonii_rat	0.02	0.01	1.57	-57.08	87.11	0.00	0.00	0.86	-46.51	50.92
secgl_rat	0.04	0.00	0.31	-11.60	9.08	0.02	0.00	0.25	-23.50	9.15
dsecgl_rat	0.00	0.00	0.42	-11.79	17.61	0.00	0.00	0.32	-23.50	17.78
ln_ast	76.02	76.64	10.82	28.62	123.13	76.30	76.85	10.43	31.71	123.23
dln_ast	0.56	0.49	5.14	-56.57	88.09	0.36	0.39	4.30	-37.04	71.45
ci_rat	37.27	34.62	9.19	25.32	101.48	12.34	11.88	6.68	0.00	37.87
dci_rat	0.46	0.33	4.34	-52.81	88.67	-0.22	-0.05	2.41	-68.60	23.69
nperf_rat	2.69	1.40	3.85	-1.83	58.87	1.94	0.82	3.54	-11.85	63.62
dnperf_rat	0.15	0.00	1.40	-24.26	46.22	0.07	0.00	1.08	-45.86	47.35
stgap_rat	-25.24	-26.27	18.38	-109.26	101.81	-32.03	-32.99	18.44	-166.68	91.77
nm_rat	53.04	53.09	17.65	0.00	125.87	51.25	50.69	17.09	0.00	203.15
logast	11.17	10.90	1.41	7.21	16.12	11.32	11.22	1.05	7.08	16.07

Table 1: Descriptive Statistics by Bank Groupings

Variables included in this table are net interest income to average earning assets (NIM_RAT), return on average assets (ROA), non-interest income to average earning assets (NONII_RAT), security gains/losses to average earning assets (SECGL_RAT), loan-to-earning asset ratio (LN_AST), C&I loans to earning asset ratio (CI_RAT), non-performing asset to earning asset ratio (NPERF_RAT), net short-term assets to earning asset ratio (STGAP_RAT) and log of total assets (LOGAST). All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. See Appendix 2 for further details on variables.

	Commerical Loan Specialists -- Real Assets <=$50 Mil.					Commerical Loan Specialists -- Real Assets $50 - 300 Mil.				
Variables	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	5.00	4.91	1.06	-17.18	32.64	4.66	4.60	0.87	-11.87	21.74
dnim_rat	0.00	0.00	0.64	-23.28	23.05	-0.01	0.00	0.47	-17.81	15.64
roa	0.60	1.05	2.79	-153.73	41.66	1.04	1.22	1.60	-66.22	45.12
droa	0.01	0.03	3.19	-147.59	137.16	0.00	0.01	1.83	-63.16	63.17
nonii_rat	1.18	0.95	1.19	-18.38	58.04	1.08	0.89	1.32	-17.46	67.89
dnonii_rat	0.00	0.00	1.00	-122.81	27.21	0.01	0.00	0.79	-52.60	61.78
secgl_rat	0.03	0.00	0.30	-15.89	16.65	0.04	0.00	0.27	-14.72	9.34
dsecgl_rat	0.00	0.00	0.41	-16.47	16.58	0.00	0.00	0.36	-15.62	14.72
ln_ast	69.41	69.90	10.72	24.46	111.15	69.07	69.66	10.71	26.97	103.53
dln_ast	0.17	0.27	4.51	-42.58	40.99	0.08	0.24	3.44	-47.88	50.05
ci_rat	17.01	16.96	6.04	0.24	42.77	15.59	15.19	5.88	0.23	35.04
dci_rat	-0.08	0.00	2.75	-58.08	29.11	-0.09	-0.02	2.07	-43.16	22.67
nperf_rat	2.27	1.15	3.72	-1.63	204.54	1.64	0.89	2.43	-0.97	65.80
dnperf_rat	0.03	0.00	1.14	-22.46	34.97	0.02	-0.01	0.73	-27.23	31.41
stgap_rat	-33.44	-34.63	17.95	-136.06	54.67	-36.91	-37.88	16.30	-163.32	56.15
nm_rat	53.14	51.92	15.26	0.00	157.84	52.67	51.40	13.23	0.01	141.77
logast	10.16	10.24	0.48	7.30	10.82	11.56	11.49	0.48	10.82	12.61

	Commerical Loan Specialists -- Real Assets >$ 300 Mil.					Mortgage Specialists				
Variables	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	4.41	4.40	0.82	-1.10	18.81	3.95	3.84	1.13	-15.25	25.16
dnim_rat	-0.01	0.00	0.43	-15.36	14.53	0.00	0.00	0.54	-20.38	14.28
roa	1.05	1.25	1.47	-42.41	22.03	0.91	0.95	1.33	-42.71	46.79
droa	-0.01	0.01	1.53	-40.09	42.06	0.01	0.00	1.45	-54.88	45.71
nonii_rat	1.54	1.28	1.71	-3.94	37.38	0.79	0.44	2.01	-32.05	85.93
dnonii_rat	0.01	0.01	0.68	-17.59	20.29	0.00	0.00	1.09	-84.57	50.77
secgl_rat	0.04	0.00	0.28	-5.92	7.42	0.05	0.00	0.37	-14.32	13.82
dsecgl_rat	0.00	0.00	0.35	-8.36	6.80	0.00	0.00	0.49	-16.31	14.53
ln_ast	71.78	72.69	10.92	28.39	102.15	66.52	70.41	19.31	0.00	122.72
dln_ast	0.05	0.22	3.34	-37.12	47.62	0.09	0.08	3.55	-84.83	58.48
ci_rat	17.30	17.32	5.95	1.47	56.99	2.87	1.68	3.45	0.00	26.36
dci_rat	-0.09	-0.01	1.81	-24.69	18.78	-0.01	0.00	1.08	-78.14	21.70
nperf_rat	1.64	0.95	2.12	-2.23	40.25	1.22	0.60	1.99	-4.75	78.77
dnperf_rat	0.02	-0.01	0.67	-22.83	20.87	-0.01	-0.01	0.74	-31.82	67.99
stgap_rat	-38.44	-39.19	15.08	-135.34	44.88	-41.49	-43.37	21.82	-166.53	106.00
nm_rat	52.35	51.74	12.97	0.00	176.65	41.79	41.50	16.41	0.00	109.45
logast	13.79	13.52	0.95	12.61	16.12	11.33	11.21	1.33	6.66	16.10

	Consumer Loan Specialists					Other Small Specialists				
Variables	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	3.70	3.63	1.00	-7.62	25.16	3.99	3.96	1.02	-8.21	36.17
dnim_rat	-0.01	-0.02	0.42	-19.60	13.51	-0.03	-0.02	0.72	-52.21	28.15
roa	0.98	0.95	1.24	-42.71	46.79	1.26	1.18	3.77	-60.51	439.70
droa	-0.01	0.00	1.36	-54.88	45.71	0.03	0.00	4.18	-437.39	434.83
nonii_rat	1.10	0.71	5.27	-5.19	321.09	1.79	0.64	11.18	-18.75	737.07
dnonii_rat	0.01	0.00	1.34	-84.57	50.77	0.01	0.00	6.68	-733.19	721.77
secgl_rat	0.02	0.00	0.25	-9.27	8.69	0.06	0.00	0.90	-22.92	102.57
dsecgl_rat	0.00	0.00	0.41	-14.77	13.85	0.00	0.00	1.22	-98.10	102.34
ln_ast	77.41	77.13	8.76	45.84	115.57	29.73	31.82	8.40	-1.12	40.00
dln_ast	-0.02	0.04	3.35	-84.83	47.77	-0.48	-0.17	3.83	-100.62	36.09
ci_rat	5.75	5.12	4.21	0.00	27.29	5.26	4.46	4.07	-3.58	36.87
dci_rat	0.02	0.00	0.82	-25.95	11.45	-0.14	-0.03	1.58	-60.66	21.24
nperf_rat	1.34	0.78	1.86	0.00	33.47	0.89	0.43	2.45	-1.36	196.05
dnperf_rat	-0.01	0.00	0.42	-21.33	14.90	-0.05	-0.01	1.29	-101.04	160.83
stgap_rat	-49.59	-51.14	18.28	-102.75	106.00	-40.42	-44.09	24.60	-156.93	101.12
nm_rat	39.79	39.34	16.19	0.00	109.45	51.46	49.83	17.55	0.00	225.05
logast	11.46	11.34	1.33	6.76	16.10	10.55	10.53	1.03	6.87	13.81

Table 1: Descriptive Statistics by Bank Groupings

Variables included in this table are net interest income to average earning assets (NIM_RAT), return on average assets (ROA), non-interest income to average earning assets (NONII_RAT), security gains/losses to average earning assets (SECGL_RAT), loan-to-earning asset ratio (LN_AST), C&I loans to earning asset ratio (CI_RAT), non-performing asset to earning asset ratio (NPERF_RAT), net short-term assets to earning asset ratio (STGAP_RAT) and log of total assets (LOGAST). All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. See Appendix 2 for further details on variables.

	Small Non-Specialists w/ Real Assets <=$50 Mil.					Small Non-Specialists w/ Real Assets $50 - $300 Mil.				
Variables	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	4.65	4.58	0.93	-22.62	39.40	4.35	4.32	0.82	-21.93	50.32
dnim_rat	-0.01	0.00	0.65	-85.52	23.96	-0.01	0.00	0.48	-41.64	27.12
roa	0.95	1.15	1.82	-125.17	67.43	1.20	1.27	1.12	-38.73	98.62
droa	0.01	0.01	2.18	-123.13	124.24	0.01	0.01	1.28	-98.39	86.06
nonii_rat	0.96	0.75	1.65	-10.77	134.68	0.95	0.70	2.76	-66.10	162.65
dnonii_rat	0.00	0.00	0.87	-59.41	87.25	0.00	0.00	0.94	-66.98	57.92
secgl_rat	0.04	0.00	0.37	-44.60	24.68	0.03	0.00	0.29	-15.06	11.72
dsecgl_rat	0.00	0.00	0.49	-45.62	44.71	0.00	0.00	0.40	-15.30	16.34
ln_ast	58.91	58.61	10.46	40.00	104.56	59.62	59.58	10.49	40.00	106.95
dln_ast	0.01	0.13	3.71	-54.56	89.10	0.01	0.13	3.24	-59.72	99.98
ci_rat	8.69	7.96	5.09	0.00	37.67	8.73	8.03	4.83	0.00	63.20
dci_rat	-0.09	-0.03	1.80	-65.01	22.00	-0.09	-0.03	1.46	-37.48	33.48
nperf_rat	1.58	0.90	2.45	-0.84	135.12	1.13	0.71	1.44	-0.44	30.50
dnperf_rat	-0.03	-0.01	0.86	-50.65	71.97	-0.03	-0.02	0.47	-16.26	13.08
stgap_rat	-37.79	-39.44	19.04	-202.53	107.11	-39.38	-41.01	17.92	-224.11	100.00
nm_rat	49.66	48.09	13.62	0.00	184.46	49.39	48.08	12.68	0.00	204.15
logast	10.01	10.12	0.57	7.11	10.82	11.44	11.34	0.46	10.82	12.61

	Small Non-Specialists w/ Real Assets >$300 Mil.					Mid-Tier Non-Specialists				
Variables	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	4.29	4.27	0.82	-1.36	20.74	3.97	4.13	1.17	-4.11	20.83
dnim_rat	0.00	0.00	0.47	-16.24	15.63	-0.04	-0.01	0.70	-15.89	15.25
roa	1.17	1.26	1.16	-52.36	20.47	1.24	1.21	1.44	-9.44	51.95
droa	-0.02	0.01	1.50	-81.17	18.94	-0.01	0.00	1.49	-48.04	53.71
nonii_rat	1.37	1.09	1.36	-4.80	30.95	2.16	1.49	3.23	-1.09	78.11
dnonii_rat	-0.01	0.01	1.69	-128.33	18.41	-0.01	0.01	1.89	-74.68	72.99
secgl_rat	0.04	0.00	0.30	-5.47	8.07	0.05	0.00	0.35	-7.34	4.74
dsecgl_rat	0.00	0.00	0.39	-7.63	7.36	0.00	0.00	0.43	-7.34	7.37
ln_ast	62.58	62.93	10.70	40.01	98.31	58.04	60.86	16.95	0.01	100.00
dln_ast	-0.09	0.05	3.82	-33.60	49.69	-0.38	-0.02	5.88	-94.02	99.99
ci_rat	10.10	9.62	4.89	0.00	26.73	11.30	11.42	5.82	0.00	33.12
dci_rat	-0.15	-0.04	1.52	-21.99	16.84	-0.17	-0.02	1.87	-41.79	19.56
nperf_rat	1.03	0.64	1.47	-0.89	33.85	1.08	0.72	1.28	-0.98	13.75
dnperf_rat	-0.03	-0.02	0.38	-4.67	11.24	-0.05	-0.02	0.33	-4.63	3.95
stgap_rat	-44.26	-45.92	16.46	-181.19	59.97	-41.02	-44.11	21.78	-144.21	99.96
nm_rat	53.41	53.34	13.22	0.64	224.55	51.85	51.54	18.60	0.02	183.29
logast	13.08	13.01	0.33	12.61	13.81	14.63	14.55	0.60	13.82	16.12

Table 2A: Cross-sectional Time Series Regression with Random Effects (NIM) 1986:Q1–2003:Q2

Independent variables are presented by types of risk they represent— interest-rate risk, term-structure risk, and credit risk; also presented are institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional-specific variables other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d"—for example, DNIM_RAT—represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two-quarter (t-2) lags, respectively. The Hausman test rejected random effects for "international" institutions; therefore, results for international banks represent an estimate using cross-sectional time series regression with fixed effects.

	International Banks*	**Large Non-International Banks**	**Agricultural Banks**	**Credit Card Specialists**	**C&I Specialists**	**CRE Specialists**
Intercept	3.3067 ***	1.2475 ***	1.8520 ***	5.3794 ***	2.2551 ***	2.0949 ***
	(1.0724)	(0.3965)	(0.043)	(1.0838)	(0.0919)	(0.0551)
Interest Rate Risk						
vol_1y1	-0.0714	0.1489	-0.0412 ***	-1.3689 *	-0.2287 ***	-0.0515 **
	(0.1651)	(0.1164)	(0.011)	(0.7649)	(0.0357)	(0.0225)
st_dummy1	-0.1092	-0.3171 ***	-0.0560 ***	-0.0435	-0.0616 **	-0.0741 ***
	(0.0794)	(0.0743)	(0.0107)	(0.1857)	(0.0251)	(0.0148)
stgap_rat2	-0.0035 *	-0.0023	-0.0012 ***	-0.0044	0.0017 ***	-0.0001
	(0.0021)	(0.0015)	(0.0001)	(0.0027)	(0.0004)	(0.0002)
nm_rat2	0.0034	0.0009	0.0074 ***	0.0041	0.0102 ***	0.0070 ***
	(0.0033)	(0.0017)	(0.0002)	(0.0028)	(0.0005)	(0.0003)
stgap_sd1	0.0031	0.0028 **	0.0032 ***	0.0081 **	0.0040 ***	0.0037 ***
	(0.002)	(0.0015)	(0.0001)	(0.0033)	(0.0005)	(0.0003)
nm_sd1	0.0031	0.0074 ***	0.0034 ***	-0.0022	0.0037 ***	0.0043 ***
	(0.0026)	(0.0015)	(0.0002)	(0.0034)	(0.0005)	(0.0003)
Term Structure Risk						
ds5y_1y1	-0.1232	0.0395	-0.0228 ***	-0.0506	-0.0791 ***	-0.0019
	(0.0809)	(0.0531)	(0.0054)	(0.3879)	(0.0167)	(0.0101)
ds5y_1y2	0.0252	0.0764	0.0842 ***	0.3319	0.0007	0.0155
	(0.0849)	(0.0541)	(0.0057)	(0.3959)	(0.0182)	(0.0102)
ds5y_1y3	-0.0493	0.1390 ***	0.0979 ***	0.3410	0.0670 ***	0.0666 ***
	(0.0842)	(0.0534)	(0.0057)	(0.3985)	(0.0183)	(0.0102)
ds5y_1y4	0.1583 **	-0.0296	0.0159 ***	-0.5244	0.0173	0.0270 ***
	(0.0764)	(0.0519)	(0.0051)	(0.3636)	(0.0162)	(0.0098)
Credit Risk						
dln_ast2	0.0103	0.0085 ***	-0.0008 **	0.0076	-0.0030 ***	-0.0006
	(0.0067)	(0.0028)	(0.0003)	(0.0089)	(0.0009)	(0.0005)
dci_rat2	-0.0082	-0.0003	0.0065 ***	-0.0139	0.0011	-0.0006
	(0.0139)	(0.0062)	(0.0009)	(0.0294)	(0.0011)	(0.0009)
dcsprd1	0.0836	0.0739	-0.1264 ***	-0.6030	-0.1627 ***	-0.0472 **
	(0.1934)	(0.1174)	(0.0128)	(0.8826)	(0.0423)	(0.0224)
dnperf_rat2	-0.0166	-0.0427 **	0.0081 ***	-0.5330 ***	-0.0134 ***	-0.0147 ***
	(0.0416)	(0.0166)	(0.0014)	(0.0938)	(0.0032)	(0.0022)
Other Institutional Variables						
logast1	-0.1466 **	-0.0085	-0.0643 ***	-0.1205	-0.0880 ***	-0.1048 ***
	(0.0616)	(0.0225)	(0.0039)	(0.0812)	(0.0073)	(0.0043)
nim_rat2	-0.4520 ***	-0.3146 ***	-0.3834 ***	-0.3226 ***	-0.3759 ***	-0.2917 ***
	(0.0423)	(0.0189)	(0.0022)	(0.016)	(0.0048)	(0.0032)
dnim_rat1	-0.6740 ***	-0.5301 ***	-0.6605 ***	-0.5873 ***	-0.5755 ***	-0.5378 ***
	(0.0378)	(0.0223)	(0.0021)	(0.0164)	(0.0051)	(0.0038)
dnonii_rat2	-0.0211	0.0233 ***	0.0036 *	-0.0017	0.0003	0.0055 **
	(0.0165)	(0.008)	(0.002)	(0.005)	(0.0022)	(0.0023)
dsecgl_rat2	-0.0056	0.0089	-0.0067 ***	-1.0742 ***	-0.0153 *	-0.0124 *
	(0.087)	(0.0318)	(0.0023)	(0.2034)	(0.0086)	(0.007)
Seasonal Dummy						
qtr2	-0.0273	0.0840 **	0.0951 ***	-0.1682	0.1325 ***	0.1615 ***
	(0.0539)	(0.0368)	(0.0038)	(0.2545)	(0.0116)	(0.0071)
qtr3	0.0704	0.0942 **	0.1736 ***	0.0256	0.1568 ***	0.1835 ***
	(0.0563)	(0.039)	(0.0039)	(0.2674)	(0.0128)	(0.0075)
qtr4	0.2361 ***	0.0842 **	0.0794 ***	-0.3015	0.1177 ***	0.1049 ***
	(0.054)	(0.0377)	(0.0037)	(0.2509)	(0.0121)	(0.0073)
# of Cross Sections	15	89	4308	145	2378	3564
Time Series Length	70	70	70	70	70	70
R-Square	0.37	0.25	0.36	0.37	0.28	0.26

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 2A: Cross-sectional Time Series Regression with Random Effects (NIM) 1986:Q1–2003:Q2

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively. Hausman test rejected random effects for "international" institutions; therefore, results for international banks represent an estimate using cross-sectional time series regression with fixed effects.

	Commerical Loan Specialists <=$50 mil.	**Commerical Loan Specialists $50 - $300 mil.**	**Commerical Loan Specialists >$300 mil.**	**Mortgage Specialists**	**Consumer Specialists**	**Other Small Specialists**
Intercept	1.2048 ***	1.5601 ***	0.9470 ***	1.5647 ***	0.3317 ***	1.9708 ***
	(0.0902)	(0.0778)	(0.087)	(0.0704)	(0.0948)	(0.0751)
Interest Rate Risk						
vol_1y1	-0.0864 ***	-0.0597 ***	-0.0165	0.0626 **	-0.0161	0.0464 *
	(0.0239)	(0.0164)	(0.0272)	(0.0263)	(0.0452)	(0.0263)
st_dummy1	-0.0971 ***	-0.0764 ***	-0.0937 ***	-0.1204 ***	-0.1388 ***	-0.1251 ***
	(0.0192)	(0.0151)	(0.0257)	(0.0158)	(0.0317)	(0.0172)
stgap_rat2	-0.0002	-0.0001	-0.0005	0.0008 ***	0.0003	-0.0004 ***
	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0004)	(0.0002)
nm_rat2	0.0072 ***	0.0063 ***	0.0046 ***	0.0046 ***	-0.0003	-0.0004
	(0.0003)	(0.0003)	(0.0005)	(0.0004)	(0.0006)	(0.0003)
stgap_sd1	0.0031 ***	0.0028 ***	0.0024 ***	0.0006 **	0.0019 ***	0.0030 ***
	(0.0003)	(0.0002)	(0.0004)	(0.0003)	(0.0005)	(0.0002)
nm_sd1	0.0040 ***	0.0035 ***	0.0030 ***	0.0025 ***	0.0028 ***	0.0048 ***
	(0.0004)	(0.0003)	(0.0005)	(0.0003)	(0.0007)	(0.0003)
Term Structure Risk						
ds5y_1y1	-0.0276 **	0.0092	0.0065	0.0418 ***	0.0683 ***	-0.0166
	(0.0117)	(0.0079)	(0.0132)	(0.0132)	(0.023)	(0.013)
ds5y_1y2	0.0341 ***	0.0464 ***	0.0424 ***	0.1090 ***	0.0301	0.0652 ***
	(0.0123)	(0.0084)	(0.0139)	(0.0132)	(0.0239)	(0.0138)
ds5y_1y3	0.0727 ***	0.0823 ***	0.0571 ***	0.0893 ***	0.1093 ***	0.0359 ***
	(0.0124)	(0.0084)	(0.0139)	(0.0133)	(0.0241)	(0.0136)
ds5y_1y4	0.0272 **	0.0297 ***	0.0519 ***	0.0565 ***	0.0106	0.0454 ***
	(0.0111)	(0.0076)	(0.0126)	(0.0124)	(0.0218)	(0.0121)
Credit Risk						
dln_ast2	-0.0013 **	0.0009 *	0.0033 ***	0.0023 ***	-0.0034 ***	0.0022 ***
	(0.0006)	(0.0006)	(0.001)	(0.0007)	(0.0012)	(0.0008)
dci_rat2	0.0012	0.0008	-0.0058 ***	0.0045 *	-0.0010	-0.0097 ***
	(0.0009)	(0.0009)	(0.0018)	(0.0025)	(0.0027)	(0.0019)
dcsprd1	-0.0836 ***	-0.0665 ***	-0.0426	-0.1168 ***	-0.2021 ***	-0.1876 ***
	(0.028)	(0.0187)	(0.031)	(0.0282)	(0.0525)	(0.0316)
dnperf_rat2	-0.0049 **	-0.0118 ***	-0.0211 ***	0.0041	0.0034	-0.0055 **
	(0.0023)	(0.0025)	(0.0047)	(0.0041)	(0.0062)	(0.0022)
Other Institutional Variables						
logast1	-0.0312 ***	-0.0625 ***	-0.0155 ***	-0.0629 ***	-0.0099	-0.0630 ***
	(0.0085)	(0.0064)	(0.0057)	(0.0056)	(0.0079)	(0.0065)
nim_rat2	-0.2807 ***	-0.2771 ***	-0.2461 ***	-0.2577 ***	-0.0508 ***	-0.3557 ***
	(0.0039)	(0.0035)	(0.0059)	(0.0046)	(0.0037)	(0.0041)
dnim_rat1	-0.5222 ***	-0.5173 ***	-0.4909 ***	-0.4978 ***	-0.2841 ***	-0.5931 ***
	(0.0044)	(0.004)	(0.0072)	(0.0054)	(0.007)	(0.0041)
dnonii_rat2	0.0043 **	-0.0008	-0.0106 ***	0.0011	-0.0013	-0.0013 ***
	(0.002)	(0.0023)	(0.0041)	(0.0022)	(0.0022)	(0.0002)
dsecgl_rat2	0.0092	0.0014	-0.0004	0.0181 ***	-0.0192	0.0022
	(0.0058)	(0.0045)	(0.0078)	(0.0052)	(0.0153)	(0.0024)
Seasonal Dummy						
qtr2	0.1638 ***	0.1393 ***	0.0863 ***	0.0377 ***	0.1449 ***	0.0544 ***
	(0.0078)	(0.0053)	(0.0089)	(0.0084)	(0.0149)	(0.0087)
qtr3	0.1903 ***	0.1592 ***	0.1302 ***	0.0324 ***	0.1699 ***	0.0773 ***
	(0.0083)	(0.0056)	(0.0094)	(0.0088)	(0.0157)	(0.0093)
qtr4	0.1011 ***	0.0942 ***	0.0877 ***	0.0275 ***	0.1399 ***	0.0562 ***
	(0.0079)	(0.0054)	(0.0089)	(0.0084)	(0.0148)	(0.0085)
# of Cross Sections	3220	3300	917	1659	1220	2146
Time Series Length	70	70	70	70	70	70
R-Square	0.25	0.26	0.23	0.21	0.10	0.34

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 2A: Cross-sectional Time Series Regression with Random Effects (NIM) 1986:Q1 – 2003:Q2

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively. Hausman test rejected random effects for "international" institutions; therefore, results for international banks represent an estimate using cross-sectional time series regression with fixed effects.

	Small Non-Specialists <=$50 mil		**Small Non-Specialists $50 - $300 mil.**		**Small Non-Specialists > $300 mil**		**Mid-Tier Non-Specialists**	
Intercept	2.2397	***	1.2624	***	0.4606	*	0.5442	
	(0.0643)		(0.0689)		(0.2379)		(0.3499)	
Interest Rate Risk								
vol_1y1	-0.0176		-0.0125		0.0515		-0.0322	
	(0.0143)		(0.014)		(0.0467)		(0.0851)	
st_dummy1	-0.1279	***	0.0350	***	0.0464		0.0349	
	(0.012)		(0.0112)		(0.0427)		(0.0536)	
stgap_rat2	0.0001		-0.0008	***	-0.0004		0.0000	
	(0.0000)		(0.0002)		(0.0005)		(0.0000)	
nm_rat2	0.0075	***	0.0035	***	0.0058	***	0.0014	
	(0.0002)		(0.0002)		(0.0008)		(0.001)	
stgap_sd1	0.0017	***	0.0036	***	0.0027	***	0.0025	***
	(0.0001)		(0.0002)		(0.0006)		(0.0008)	
nm_sd1	0.0034	***	0.0019	***	0.0008		0.0003	
	(0.0002)		(0.0002)		(0.0008)		(0.001)	
Term Structure Risk								
ds5y_1y1	-0.0345	***	0.0178	***	0.0370	*	-0.0014	
	(0.007)		(0.0068)		(0.0222)		(0.0405)	
ds5y_1y2	0.0587	***	0.0635	***	0.0601	**	-0.0409	
	(0.0075)		(0.0073)		(0.0234)		(0.042)	
ds5y_1y3	0.0901	***	0.0966	***	0.0500	**	0.0039	
	(0.0075)		(0.0073)		(0.0234)		(0.0421)	
ds5y_1y4	0.0420	***	0.0340	***	0.0406	*	0.0532	
	(0.0067)		(0.0065)		(0.0213)		(0.0385)	
Credit Risk								
dln_ast2	0.0036	***	0.0010	*	0.0047	***	0.0001	
	(0.0005)		(0.0005)		(0.0013)		(0.0017)	
dci_rat2	0.0008		0.0012		-0.0060	*	0.0019	
	(0.0009)		(0.0011)		(0.0031)		(0.0047)	
dcsprd1	-0.1501	***	-0.0875	***	-0.0626		0.0064	
	(0.017)		(0.0164)		(0.0535)		(0.0976)	
dnperf_rat2	-0.0063	***	-0.0030		-0.0504	***	-0.0022	
	(0.0019)		(0.0031)		(0.0135)		(0.0251)	
Other Institutional Variables								
logast1	-0.0898	***	-0.0366	***	0.0317	*	0.0605	***
	(0.006)		(0.0058)		(0.0177)		(0.0231)	
nim_rat2	-0.3909	***	-0.2614	***	-0.2970	***	-0.3948	***
	(0.0027)		(0.0027)		(0.0099)		(0.0139)	
dnim_rat1	-0.6812	***	-0.5238	***	-0.5236	***	-0.6348	***
	(0.0028)		(0.0033)		(0.0114)		(0.0136)	
dnonii_rat2	-0.0089	***	-0.0050	***	-0.0068	***	-0.0099	**
	(0.0018)		(0.0014)		(0.0021)		(0.0047)	
dsecgl_rat2	-0.0053	**	-0.0009		0.0161		0.0141	
	(0.0026)		(0.0035)		(0.0125)		(0.0223)	
Seasonal Dummy								
qtr2	0.1062	***	0.1142	***	0.0860	***	0.0508	*
	(0.0047)		(0.0046)		(0.0148)		(0.027)	
qtr3	0.1607	***	0.1307	***	0.0937	***	0.1025	***
	(0.005)		(0.0049)		(0.0157)		(0.028)	
qtr4	0.0884	***	0.0873	***	0.0760	***	0.1085	***
	(0.0047)		(0.0046)		(0.0147)		(0.0267)	
# of Cross Sections	4869		3406		432		221	
Time Series Length	70		70		70		70	
R-Square	0.35		0.27		0.25		0.37	

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 2B: Cross-sectional Time Series Regression with Random Effects (ROA) 1986:Q1 – 2003:Q2

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DROA – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively. Hausman test rejected random effects for "international" institutions; therefore, results for international banks represent an estimate using cross-sectional time series regression with fixed effects.

	International Banks*	**Large Non-International Banks**	**Agricultural Banks**	**Credit Card Specialists**	**C&I Specialists**	**CRE Specialists**
Intercept	-3.4242	0.0943	-0.1312	4.2925 ***	-2.9175 ***	-0.0689
	(3.6403)	(0.8674)	(0.1129)	(1.1928)	(0.3308)	(0.1592)
Interest Rate Risk						
vol_1y1	-1.2934 **	-0.2030	-0.4314 ***	-2.4592 ***	-0.9534 ***	-0.2697
	(0.5662)	(0.2771)	(0.0318)	(0.9106)	(0.18)	(0.0784)
st_dummy1	-0.0188	-0.2201	0.1942 ***	0.0665	-0.2919 **	-0.0430
	(0.2702)	(0.176)	(0.0308)	(0.2215)	(0.1271)	(0.0517)
stgap_rat2	0.0087	-0.0021	-0.0058 ***	0.0015	-0.0009	-0.0029
	(0.0072)	(0.0032)	(0.0003)	(0.0032)	(0.0019)	(0.0008)
nm_rat2	0.0166	0.0031	0.0066 ***	0.0108 ***	0.0103 ***	0.0050
	(0.011)	(0.0035)	(0.0007)	(0.0032)	(0.0022)	(0.0009)
stgap_sd1	0.0079	0.0025	0.0059 ***	-0.0008	0.0037	0.0014
	(0.0069)	(0.0036)	(0.0004)	(0.0039)	(0.0023)	(0.0009)
nm_sd1	0.0154 *	0.0076 **	0.0012 *	-0.0108 ***	0.0073 ***	0.0031
	(0.0088)	(0.0036)	(0.0007)	(0.004)	(0.0024)	(0.001)
Term Structure Risk						
ds5y_1y1	0.7192 ***	0.1137	-0.0361 **	-0.6660	-0.3855 ***	-0.1273
	(0.2779)	(0.126)	(0.0155)	(0.4632)	(0.0844)	(0.035)
ds5y_1y2	-0.6067 **	-0.2226 *	-0.0272 *	0.1554	-0.1463	0.0498
	(0.2948)	(0.129)	(0.0165)	(0.4728)	(0.0925)	(0.0355)
ds5y_1y3	0.0866	-0.0747	0.2882 ***	0.7509	0.2678 ***	0.0248
	(0.2912)	(0.1273)	(0.0165)	(0.4752)	(0.0929)	(0.0355)
ds5y_1y4	0.4549 *	0.2445 **	0.0024	0.3258	-0.2823 ***	-0.0812
	(0.2617)	(0.1235)	(0.0148)	(0.4337)	(0.082)	(0.0341)
Credit Risk						
dln_ast2	-0.0135	0.0083	0.0021 **	0.0162	0.0137 ***	0.0098
	(0.023)	(0.0066)	(0.0009)	(0.0107)	(0.0045)	(0.0018)
dci_rat2	-0.0101	-0.0218	0.0171 ***	0.0269	0.0051	0.0042
	(0.0469)	(0.0146)	(0.0026)	(0.035)	(0.0054)	(0.0031)
dcsprd1	1.7532 ***	0.4188	0.0495	1.3212	0.0036	0.2474
	(0.6588)	(0.2797)	(0.0371)	(1.0534)	(0.2145)	(0.0782)
dnperf_rat2	0.0032	-0.0788 **	-0.0903 ***	0.0536	-0.3096 ***	-0.1859
	(0.1526)	(0.0368)	(0.004)	(0.1122)	(0.0162)	(0.0077)
Other Institutional Variables						
logast1	0.2804	0.0266	0.0646 ***	-0.1741 *	0.2604 ***	0.0258
	(0.2122)	(0.0508)	(0.0106)	(0.0905)	(0.027)	(0.0133)
roa2	-0.9266 ***	-0.5438 ***	-0.8367 ***	-0.5037 ***	-0.6476 ***	-0.5224
	(0.0583)	(0.0288)	(0.0032)	(0.0175)	(0.0084)	(0.0053)
droa1	-0.9803 ***	-0.7057 ***	-0.9323 ***	-0.6227 ***	-0.8560 ***	-0.7892
	(0.0425)	(0.0222)	(0.0023)	(0.0173)	(0.0061)	(0.0042)
Seasonal Dummy						
qtr2	-0.5645 ***	-0.0891	0.0260 **	-0.2963	-0.2525 ***	-0.0393
	(0.1803)	(0.0878)	(0.0111)	(0.3043)	(0.0595)	(0.0249)
qtr3	-0.4450 **	0.1407	0.0150	0.0116	-0.3114 ***	-0.1301
	(0.1919)	(0.0928)	(0.0115)	(0.3192)	(0.0651)	(0.0263)
qtr4	-0.0195	-0.1157	-0.5448 ***	-0.5725 *	-1.0279 ***	-0.5085
	(0.1838)	(0.0902)	(0.0108)	(0.2996)	(0.0617)	(0.0256)
# of Cross Sections	15	89	4308	145	2378	3564
Time Series Length	70	70	70	70	70	70
R-Square	0.52	0.35	0.48	0.35	0.36	0.35

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 2B: Cross-sectional Time Series Regression with Random Effects (ROA) 1986:Q1 – 2003:Q2

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DROA – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively. Hausman test rejected random effects for "international" institutions; therefore, results for international banks represent an estimate using cross-sectional time series regression with fixed effects.

	Commerical Loan Specialists <=$50 mil.	**Commerical Loan Specialists $50 - $300 mil.**	**Commerical Loan Specialists >$300 mil.**	**Mortgage Specialists**	**Consumer Specialists**	**Other Small Specialists**
Intercept	-4.4615 ***	0.9300 ***	0.4310	-0.2145 *	-0.1781	-0.6373 *
	(0.3991)	(0.2404)	(0.2695)	(0.128)	(0.2485)	(0.3818)
Interest Rate Risk						
vol_1y1	-0.5512 ***	-0.3628 ***	-0.1674 *	-0.0803	-0.3274 **	-0.2528 *
	(0.1058)	(0.0557)	(0.0885)	(0.0619)	(0.131)	(0.1483)
st_dummy1	-0.1910 **	-0.0255	0.0895	0.0453	-0.2696 ***	0.0504
	(0.0851)	(0.0512)	(0.0836)	(0.037)	(0.092)	(0.0968)
stgap_rat2	-0.0056 ***	-0.0045 ***	-0.0048 ***	-0.0023 ***	-0.0001	0.0008
	(0.0011)	(0.0007)	(0.0011)	(0.0005)	(0.0012)	(0.0009)
nm_rat2	0.0081 ***	0.0055 ***	0.0058 ***	0.0084 ***	0.0035 *	-0.0013
	(0.0015)	(0.0009)	(0.0014)	(0.0008)	(0.0018)	(0.0017)
stgap_sd1	0.0048 ***	0.0022 ***	0.0032 **	0.0008	0.0002	0.0032 **
	(0.0013)	(0.0008)	(0.0013)	(0.0006)	(0.0014)	(0.0013)
nm_sd1	0.0061 ***	0.0016 *	0.0009	-0.0010	0.0038 **	0.0002
	(0.0016)	(0.0009)	(0.0015)	(0.0008)	(0.0019)	(0.0019)
Term Structure Risk						
ds5y_1y1	-0.3077 ***	-0.1314 ***	-0.0695	-0.1599 ***	-0.2526 ***	-0.1478 **
	(0.0515)	(0.0269)	(0.0428)	(0.031)	(0.0668)	(0.0729)
ds5y_1y2	-0.0113	-0.0722 **	-0.0263	0.0678 **	0.0583	-0.0955
	(0.0543)	(0.0283)	(0.0451)	(0.0312)	(0.0695)	(0.0779)
ds5y_1y3	0.3432 ***	0.1622 ***	-0.0170	0.0560 *	0.1630 **	0.0742
	(0.0547)	(0.0284)	(0.0453)	(0.0314)	(0.07)	(0.0767)
ds5y_1y4	-0.1289 ***	-0.0544 **	-0.0173	0.0033	-0.0109	0.0145
	(0.0491)	(0.0256)	(0.041)	(0.0291)	(0.0633)	(0.068)
Credit Risk						
dln_ast2	0.0136 ***	0.0054 ***	0.0082 ***	-0.0036 **	0.0030	-0.0160 ***
	(0.0027)	(0.0019)	(0.0031)	(0.0017)	(0.0035)	(0.0047)
dci_rat2	0.0013	0.0078 ***	0.0032	0.0139 **	0.0077	0.0278 **
	(0.0041)	(0.003)	(0.0057)	(0.006)	(0.0078)	(0.0109)
dcsprd1	-0.0156	0.1284 **	0.0193	-0.0501	-0.1393	-0.0848
	(0.1237)	(0.0635)	(0.1007)	(0.0662)	(0.1523)	(0.178)
dnperf_rat2	-0.1687 ***	-0.1966 ***	-0.1371 ***	-0.1203 ***	-0.0860 ***	-0.0243 **
	(0.0101)	(0.0084)	(0.0155)	(0.0096)	(0.0181)	(0.0121)
Other Institutional Variables						
logast1	0.4411 ***	-0.0502 **	-0.0135	0.0472 ***	0.0758 ***	0.1832 ***
	(0.0385)	(0.0204)	(0.0184)	(0.0108)	(0.0215)	(0.0352)
roa2	-0.7317 ***	-0.6963 ***	-0.6360 ***	-0.7080 ***	-0.6276 ***	-0.8231 ***
	(0.0063)	(0.0054)	(0.0095)	(0.0072)	(0.0118)	(0.0057)
droa1	-0.8707 ***	-0.8765 ***	-0.8041 ***	-0.8241 ***	-0.8198 ***	-0.8517 ***
	(0.0047)	(0.0042)	(0.0078)	(0.0056)	(0.0088)	(0.0052)
Seasonal Dummy						
qtr2	-0.0591 *	0.0066	-0.0937 ***	-0.0149	0.0509	-0.1753 ***
	(0.0347)	(0.0181)	(0.0288)	(0.0198)	(0.0436)	(0.049)
qtr3	-0.1058 ***	0.0254	-0.0715 **	-0.0804 ***	-0.0276	-0.1533 ***
	(0.0366)	(0.0191)	(0.0306)	(0.0206)	(0.0457)	(0.0522)
qtr4	-0.6353 ***	-0.3350 ***	-0.2860 ***	-0.2630 ***	-0.4498 ***	-0.4807 ***
	(0.0348)	(0.0182)	(0.0288)	(0.0198)	(0.043)	(0.0482)
# of Cross Sections	3220	3300	917	1659	1220	2146
Time Series Length	70	70	70	70	70	70
R-Square	0.42	0.44	0.38	0.40	0.32	0.39

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 2B: Cross-sectional Time Series Regression with Random Effects (ROA) 1986:Q1 – 2003:Q2

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DROA – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively. Hausman test rejected random effects for "international" institutions; therefore, results for international banks represent an estimate using cross-sectional time series regression with fixed effects.

	Small Non-Specialists <=$50 mil	**Small Non-Specialists $50 - $300 mil.**	**Small Non-Specialists > $300 mil**	**Mid-Tier Non-Specialists**
Intercept	-1.8796 ***	1.1603 ***	1.4211 **	0.7014
	(0.1771)	(0.1648)	(0.5771)	(0.625)
Interest Rate Risk				
vol_1y1	-0.3427 ***	-0.2525 ***	-0.3757 ***	-0.1157
	(0.0441)	(0.0331)	(0.116)	(0.1735)
st_dummy1	-0.0357	0.1698 ***	0.2319 **	0.3914 ***
	(0.037)	(0.0264)	(0.1061)	(0.1082)
stgap_rat2	-0.0003 **	-0.0029 ***	-0.0023 *	0.0000 ***
	(0.0001)	(0.0004)	(0.0013)	(0)
nm_rat2	0.0052 ***	0.0023 ***	-0.0026	0.0031 *
	(0.0007)	(0.0006)	(0.0019)	(0.0018)
stgap_sd1	0.0007	0.0040 ***	0.0035 **	0.0081 ***
	(0.0004)	(0.0004)	(0.0015)	(0.0015)
nm_sd1	0.0008	-0.0002	-0.0018	0.0000
	(0.0007)	(0.0006)	(0.002)	(0.0021)
Term Structure Risk				
ds5y_1y1	-0.1385 ***	-0.0840 ***	-0.1036 *	-0.0529
	(0.0214)	(0.0161)	(0.0551)	(0.0827)
ds5y_1y2	-0.0355	-0.0118	0.0130	-0.0752
	(0.0229)	(0.0172)	(0.0581)	(0.0861)
ds5y_1y3	0.2090 ***	0.1213 ***	0.0535	-0.0387
	(0.0229)	(0.0171)	(0.0583)	(0.0863)
ds5y_1y4	0.0047	0.0049	-0.0592	0.0149
	(0.0204)	(0.0153)	(0.0529)	(0.0789)
Credit Risk				
dln_ast2	0.0142 ***	0.0065 ***	0.0113 ***	0.0074 **
	(0.0014)	(0.0012)	(0.0032)	(0.0034)
dci_rat2	0.0080 ***	0.0108 ***	-0.0004	-0.0030
	(0.0027)	(0.0025)	(0.0078)	(0.0096)
dcsprd1	-0.0471	0.0294	0.2667 **	0.7010 ***
	(0.0524)	(0.0389)	(0.1328)	(0.1997)
dnperf_rat2	-0.0977 ***	-0.0396 ***	-0.2562 ***	-0.1627 ***
	(0.0058)	(0.0073)	(0.0336)	(0.0511)
Other Institutional Variables				
logast1	0.2419 ***	-0.0373 ***	-0.0337	-0.0084
	(0.017)	(0.0142)	(0.0436)	(0.0423)
roa2	-0.7488 ***	-0.7377 ***	-0.7847 ***	-0.6256 ***
	(0.0038)	(0.0043)	(0.0129)	(0.0195)
droa1	-0.8794 ***	-0.8347 ***	-0.8781 ***	-0.8360 ***
	(0.0028)	(0.0035)	(0.0096)	(0.0153)
Seasonal Dummy				
qtr2	-0.0092	-0.0161	0.0191	-0.0190
	(0.0146)	(0.0109)	(0.0367)	(0.0552)
qtr3	-0.0230	-0.0212 *	-0.0305	0.1212 *
	(0.0155)	(0.0115)	(0.0389)	(0.0575)
qtr4	-0.5424 ***	-0.2612 ***	-0.1007 ***	-0.0318
	(0.0145)	(0.0108)	(0.0366)	(0.0547)
# of Cross Sections	4869	3406	432	221
Time Series Length	70	70	70	70
R-Square	0.46	0.43	0.54	0.43

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level
*** Significant at the 1% Level)

Table 3A: Cross-sectional Time Series Regression with Random Effects
Subsample Periods—Agricultural Banks and Mortgage Loan Specialists

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively.

	Agricultrual Banks				**Mortgage Loan Specialists**			
	1986 - 1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2	1986 - 1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2
Intercept	5.6046 ***	3.3325 ***	1.6648 ***	1.6408 ***	4.2783 ***	4.1440 ***	1.6248 ***	2.0441 ***
	(0.1722)	(0.1279)	(0.074)	(0.0744)	(1.0755)	(0.3375)	(0.1104)	(0.1323)
Interest Rate Risk								
vol_1y1	0.3796 ***	0.0025	0.2210 ***	-0.2920 ***	1.5830 *	-0.4766 **	0.1585 ***	0.0169
	(0.0923)	(0.0586)	(0.0162)	(0.0247)	(0.9202)	(0.2203)	(0.0372)	(0.0459)
st_dummy1	-0.0176	-0.2054 ***	-0.0299 **	0.0001	0.0327	-0.5403 ***	-0.1097 ***	-0.0990 ***
	(0.035)	(0.0284)	(0.0152)	(0.0162)	(0.1885)	(0.0852)	(0.0231)	(0.0218)
stgap_rat2	-0.0022 ***	-0.0003	-0.0007 ***	-0.0003	0.0009	0.0023 **	0.0008 **	0.0001
	(0.0005)	(0.0003)	(0.0002)	(0.0002)	(0.0035)	(0.0011)	(0.0004)	(0.0004)
nm_rat2	0.0168 ***	0.0114 ***	0.0077 ***	0.0048 ***	0.0069	0.0048 **	0.0040 ***	0.0041 ***
	(0.0009)	(0.0007)	(0.0004)	(0.0004)	(0.0055)	(0.0021)	(0.0006)	(0.0007)
stgap_sd1	0.0026 ***	0.0040 ***	0.0027 ***	0.0040 ***	-0.0024	0.0019 **	0.0007 *	0.0001
	(0.0005)	(0.0003)	(0.0002)	(0.0002)	(0.0032)	(0.001)	(0.0004)	(0.0004)
nm_sd1	0.0003	0.0070 ***	0.0021 ***	0.0052 ***	-0.0023	0.0080 ***	0.0025 ***	0.0022 ***
	(0.0007)	(0.0005)	(0.0003)	(0.0003)	(0.0042)	(0.0014)	(0.0005)	(0.0004)
Term Structure Risk								
ds5y_1y1	-0.5360 ***	0.1371 ***	0.0303 ***	-0.0679 ***	-2.0785 **	0.1285	0.2002 ***	-0.0083
	(0.0862)	(0.0319)	(0.0111)	(0.0082)	(0.9687)	(0.1185)	(0.0256)	(0.0149)
ds5y_1y2	0.5067 ***	0.0083	0.1338 ***	0.1520 ***	2.0824	-0.6062 **	0.1196 ***	0.0866 ***
	(0.1346)	(0.0832)	(0.0112)	(0.0096)	(1.3437)	(0.2995)	(0.0256)	(0.0177)
ds5y_1y3	-0.3716 ***	0.0304	0.0456 ***	0.0902 ***	-1.7131	0.6785 ***	0.1087 ***	0.1144 ***
	(0.1055)	(0.0532)	(0.0088)	(0.009)	(1.0637)	(0.1969)	(0.0201)	(0.0164)
ds5y_1y4	0.0349	0.0669 ***	0.0278 ***	-0.0657 ***	-0.8511 *	0.0260	0.0558 ***	0.0090
	(0.0393)	(0.022)	(0.0079)	(0.0098)	(0.4464)	(0.092)	(0.0182)	(0.0186)
Credit Risk								
dln_ast2	0.0036 ***	0.0004	-0.0028 ***	-0.0019 ***	-0.0044	0.0073 ***	-0.0006	0.0017 *
	(0.0009)	(0.0006)	(0.0005)	(0.0005)	(0.0074)	(0.0025)	(0.001)	(0.001)
dci_rat2	0.0072 ***	0.0042 **	0.0059 ***	0.0046 ***	-0.0089	-0.0066	0.0055	0.0151 ***
	(0.0023)	(0.0018)	(0.0014)	(0.0014)	(0.0186)	(0.0073)	(0.0041)	(0.004)
dcsprd1	-0.4000 ***	-0.2984 ***	-0.0538	0.0054	-2.2226	0.2572 **	-0.4492 ***	-0.0004
	(0.148)	(0.0353)	(0.0419)	(0.0182)	(1.5587)	(0.1265)	(0.0971)	(0.034)
dnperf_rat2	-0.0124 ***	0.0090 ***	0.0162 ***	0.0089 ***	-0.0244	0.0050	0.0016	0.0303 ***
	(0.0028)	(0.003)	(0.0025)	(0.0026)	(0.0308)	(0.0077)	(0.0068)	(0.0087)
Other Institutional Variables								
logast1	-0.2963 ***	-0.1134 ***	-0.0345 ***	-0.0330 ***	-0.2474 ***	-0.1828 ***	-0.0416 ***	-0.0607 ***
	(0.0159)	(0.0116)	(0.0067)	(0.0067)	(0.0905)	(0.027)	(0.0087)	(0.0107)
nim_rat2	-0.8457 ***	-0.6475 ***	-0.4074 ***	-0.3687 ***	-0.4934 ***	-0.5642 ***	-0.3175 ***	-0.4074 ***
	(0.0064)	(0.0064)	(0.004)	(0.0046)	(0.0453)	(0.018)	(0.0077)	(0.0083)
dnim_rat1	-0.9446 ***	-0.8166 ***	-0.6084 ***	-0.5827 ***	-0.5177 ***	-0.7081 ***	-0.5596 ***	-0.5076 ***
	(0.0047)	(0.0051)	(0.0039)	(0.0043)	(0.0401)	(0.0154)	(0.0085)	(0.0089)
dnonii_rat2	0.0035	0.0063 *	0.0037	-0.0019	0.0200	0.0330 **	0.0001	0.0062 **
	(0.0041)	(0.0038)	(0.0035)	(0.0037)	(0.0383)	(0.0145)	(0.0032)	(0.0027)
dsecgl_rat2	-0.0080 **	0.0055	-0.0119 ***	0.0058	-0.0019	0.0276 *	0.0073	0.0326 ***
	(0.0041)	(0.0061)	(0.0034)	(0.009)	(0.0498)	(0.0166)	(0.0067)	(0.0077)
Seasonal Dummy								
qtr2	-0.1173 ***	0.0043	0.1150 ***	0.1225 ***	0.1411	0.0155	-0.0075	0.0527 ***
	(0.0128)	(0.012)	(0.006)	(0.0065)	(0.1686)	(0.0466)	(0.013)	(0.0116)
qtr3	0.2656 ***	0.1146 ***	0.1980 ***	0.0961 ***	0.9627 *	0.4006 ***	0.0221 *	0.0408 ***
	(0.0488)	(0.0306)	(0.0054)	(0.0077)	(0.5071)	(0.1102)	(0.0118)	(0.0143)
qtr4	-0.2299 ***	0.1055 ***	0.1146 ***	-0.0182 **	-0.9948	0.1519 ***	0.0372 ***	0.0059
	(0.0711)	(0.0086)	(0.0052)	(0.0076)	(0.725)	(0.0364)	(0.0115)	(0.014)
# of Cross Sections	3629	3274	3221	2447	83	482	1105	856
Time Series Length	12	12	22	24	12	12	22	24
R-Square	0.51	0.43	0.33	0.31	0.26	0.35	0.25	0.25

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 3B: Cross-sectional Time Series Regression with Random Effects
Sub-sample Periods – Commercial Loan Specialists

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively.

	Commercial Loan Specialists w/ Real Assets <$50 million				**Commercial Loan Specialists w/ Real Assets >=$300 million**			
	1986 - 1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2	1986 - 1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2
Intercept	2.5168 ***	2.4953 ***	1.6914 ***	1.7292 ***	0.9702 ***	0.6949 ***	2.0593 ***	1.8136 ***
	(0.3113)	(0.2849)	(0.1928)	(0.2492)	(0.2507)	(0.2211)	(0.215)	(0.2036)
Interest Rate Risk								
vol_1y1	0.2044	-0.3966 ***	0.3127 ***	-0.4435 ***	-0.1775	-0.5719 ***	0.0785	-0.2818 ***
	(0.1542)	(0.1246)	(0.0396)	(0.0754)	(0.1394)	(0.1092)	(0.0573)	(0.071)
st_dummy1	-0.1881 ***	-0.1645 ***	-0.0309	0.0028	-0.0539	-0.3083 ***	-0.0059	0.0529
	(0.0531)	(0.0563)	(0.0315)	(0.043)	(0.0535)	(0.0551)	(0.056)	(0.05)
stgap_rat2	-0.0005	-0.0016 **	-0.0008 *	-0.0028 ***	0.0020 **	-0.0029 ***	-0.0023 **	-0.0036 ***
	(0.0008)	(0.0007)	(0.0005)	(0.0007)	(0.001)	(0.0008)	(0.0009)	(0.0008)
nm_rat2	0.0120 ***	0.0087 ***	0.0073 ***	0.0056 ***	0.0061 ***	0.0009	0.0076 ***	0.0029 ***
	(0.001)	(0.001)	(0.0006)	(0.0009)	(0.0013)	(0.0012)	(0.0011)	(0.0011)
stgap_sd1	0.0034 ***	0.0060 ***	0.0032 ***	0.0044 ***	0.0016	0.0044 ***	0.0031 ***	0.0053 ***
	(0.0009)	(0.0007)	(0.0005)	(0.0007)	(0.0011)	(0.0008)	(0.001)	(0.0007)
nm_sd1	0.0032 ***	0.0087 ***	0.0030 ***	0.0054 ***	0.0006	0.0064 ***	0.0021 **	0.0049 ***
	(0.0009)	(0.0008)	(0.0006)	(0.0007)	(0.001)	(0.0009)	(0.001)	(0.0008)
Term Structure Risk								
ds5y_1y1	-0.4897 ***	-0.1557 **	0.0428	-0.0828 ***	0.0655	-0.1123 *	0.0544	-0.0127
	(0.1545)	(0.0673)	(0.0267)	(0.0243)	(0.1396)	(0.06)	(0.039)	(0.0229)
ds5y_1y2	0.6729 ***	0.1873	0.1462 ***	0.1456 ***	-0.0404	-0.5589 ***	0.0370	0.1264 ***
	(0.229)	(0.1803)	(0.0267)	(0.0287)	(0.2086)	(0.154)	(0.0388)	(0.027)
ds5y_1y3	-0.2639	0.1309	-0.0032	0.0807 ***	0.2582	0.5416 ***	0.0382	0.0510 **
	(0.1761)	(0.1158)	(0.0211)	(0.0268)	(0.1605)	(0.1004)	(0.0308)	(0.0252)
ds5y_1y4	0.0036	-0.2109 ***	0.0340 *	-0.1298 ***	0.1011	0.0248	0.0716 ***	-0.1773 ***
	(0.0698)	(0.0483)	(0.019)	(0.0312)	(0.063)	(0.0429)	(0.0277)	(0.0296)
Credit Risk								
dln_ast2	0.0004	0.0001	0.0001	-0.0016	-0.0003	0.0027 *	0.0109 ***	-0.0027
	(0.0014)	(0.0013)	(0.001)	(0.0014)	(0.0017)	(0.0016)	(0.002)	(0.0018)
dci_rat2	0.0000	-0.0005	-0.0022	0.0061 **	-0.0083 ***	-0.0035	-0.0085 **	-0.0021
	(0.0019)	(0.0018)	(0.0017)	(0.0025)	(0.0031)	(0.0027)	(0.0041)	(0.0038)
dcsprd1	-0.3179	-0.2093 ***	0.2640 ***	0.1263 **	0.3038	0.1655 **	-0.2002	0.2220 ***
	(0.2538)	(0.0782)	(0.1008)	(0.0551)	(0.2311)	(0.0703)	(0.147)	(0.052)
dnperf_rat2	-0.0091 **	-0.0028	0.0054	-0.0020	-0.0109	-0.0148 **	0.0008	-0.0361
	(0.0043)	(0.0041)	(0.0047)	(0.0085)	(0.0078)	(0.0075)	(0.0126)	(0.0223)
Other Institutional Variables								
logast1	-0.0827 ***	-0.0812 ***	-0.0471 ***	-0.0579 **	0.0051	0.0239 *	-0.0399 ***	-0.0372 ***
	(0.0289)	(0.0265)	(0.018)	(0.0239)	(0.0161)	(0.0144)	(0.0141)	(0.0134)
nim_rat2	-0.5094 ***	-0.4534 ***	-0.3517 ***	-0.3290 ***	-0.3222 ***	-0.2477 ***	-0.4476 ***	-0.3947 ***
	(0.0117)	(0.0111)	(0.0076)	(0.0091)	(0.0156)	(0.015)	(0.0141)	(0.0123)
dnim_rat1	-0.7058 ***	-0.6822 ***	-0.5351 ***	-0.5084 ***	-0.4742 ***	-0.4814 ***	-0.6647 ***	-0.5258 ***
	(0.01)	(0.0103)	(0.0084)	(0.0096)	(0.0188)	(0.0169)	(0.0136)	(0.0119)
dnonii_rat2	0.0089 ***	-0.0011	-0.0105 **	-0.0085	0.0115 *	0.0132 *	-0.0351 ***	-0.0209 **
	(0.003)	(0.0047)	(0.0044)	(0.0076)	(0.0063)	(0.007)	(0.0102)	(0.0089)
dsecgl_rat2	0.0138	-0.0063	-0.0008	-0.0098	0.0153	-0.0126	-0.0041	-0.0223
	(0.0096)	(0.0154)	(0.009)	(0.0246)	(0.0144)	(0.0181)	(0.0137)	(0.0169)
Seasonal Dummy								
qtr2	0.0753 ***	0.1736 ***	0.2012 ***	0.1598 ***	0.1399 ***	0.0311	0.0692 ***	0.0933 ***
	(0.023)	(0.0262)	(0.0139)	(0.0188)	(0.0202)	(0.0235)	(0.0206)	(0.0177)
qtr3	0.4786 ***	0.1194 *	0.1958 ***	0.0759 ***	0.2216 ***	0.2836 ***	0.1246 ***	0.0429 *
	(0.0863)	(0.0666)	(0.0124)	(0.0233)	(0.0777)	(0.0579)	(0.0182)	(0.0221)
qtr4	-0.0611	0.0768 ***	0.1592 ***	-0.0441 *	0.2836 ***	0.0521 ***	0.0843 ***	0.0133
	(0.1176)	(0.0189)	(0.0122)	(0.023)	(0.1073)	(0.0169)	(0.0178)	(0.0218)
# of Cross Sections	1212	1045	1280	1055	351	388	406	358
Time Series Length	12	12	22	24	12	12	22	24
R-Square	0.36	0.37	0.27	0.22	0.26	0.22	0.34	0.35

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 3C: Cross-sectional Time Series Regression with Random Effects
Sub-sample Periods – Other Non-Specialist Banks

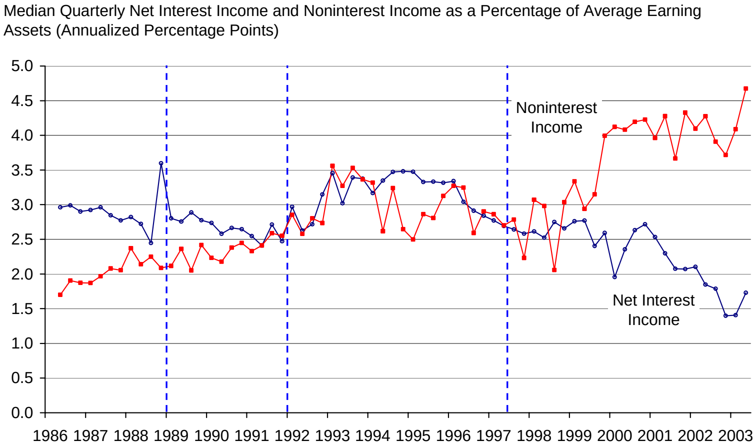
Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively.

	Other Non-Specialist Banks w/ Real Assets <$50 million				**Other Non-Specialist Banks w/ Real Assets >= $300 million**			
	1986 - 1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2	1986 - 1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2
Intercept	4.3752 ***	3.0332 ***	4.3591 ***	1.3266 ***	1.7709 *	0.2221	0.7483	1.4564 ***
	(0.1958)	(0.1612)	(0.171)	(0.1386)	(1.0168)	(0.7037)	(0.5234)	(0.3799)
Interest Rate Risk								
vol_1y1	0.4619 ***	-0.0902	0.2157 ***	-0.3670 ***	-0.3606	0.0364	0.2429 **	0.0013
	(0.089)	(0.0658)	(0.0245)	(0.045)	(0.2583)	(0.2082)	(0.1041)	(0.0819)
st_dummy1	-0.1028 ***	-0.0572 *	-0.1100 ***	0.0673 **	0.0221	-0.1016	0.1294	-0.0044
	(0.0294)	(0.0295)	(0.021)	(0.0277)	(0.1126)	(0.1144)	(0.0887)	(0.0521)
stgap_rat2	-0.0030 ***	-0.0014 ***	-0.0025 ***	0.0001	-0.0053 ***	-0.0019	0.0000	-0.0014 **
	(0.0004)	(0.0004)	(0.0003)	(0.0000)	(0.0017)	(0.0016)	(0.0015)	(0.0007)
nm_rat2	0.0085 ***	0.0088 ***	0.0102 ***	0.0042 ***	0.0082 ***	0.0001	0.0101 ***	-0.0012
	(0.0007)	(0.0006)	(0.0005)	(0.0006)	(0.0031)	(0.0024)	(0.0017)	(0.0012)
stgap_sd1	0.0051 ***	0.0035 ***	0.0022 ***	0.0033 ***	0.0068 ***	0.0044 ***	0.0024	0.0031 ***
	(0.0005)	(0.0004)	(0.0003)	(0.0004)	(0.0017)	(0.0015)	(0.0017)	(0.0007)
nm_sd1	0.0032 ***	0.0048 ***	0.0033 ***	0.0039 ***	0.0042 **	0.0049 **	-0.0010	0.0028 ***
	(0.0006)	(0.0005)	(0.0004)	(0.0005)	(0.002)	(0.0019)	(0.0016)	(0.001)
Term Structure Risk								
ds5y_1y1	-0.6135 ***	-0.0331	0.0253	-0.0356 **	0.0376	-0.0219	-0.0143	0.0366
	(0.0861)	(0.0368)	(0.0166)	(0.0149)	(0.2447)	(0.1126)	(0.0674)	(0.0272)
ds5y_1y2	0.7619 ***	0.2410 ***	0.1610 ***	0.1426 ***	-0.3118	0.1276	0.1965 ***	0.0471
	(0.1317)	(0.0922)	(0.0168)	(0.0178)	(0.3845)	(0.2882)	(0.0683)	(0.032)
ds5y_1y3	-0.4234 ***	-0.0182	0.1045 ***	0.0786 ***	0.4646	0.1810	-0.0896 *	0.1126 ***
	(0.1028)	(0.0593)	(0.0131)	(0.0168)	(0.3049)	(0.1861)	(0.0537)	(0.0301)
ds5y_1y4	-0.0797 **	-0.0575 **	0.0657 ***	-0.0336 *	-0.0027	-0.1303	0.1405 ***	-0.0413
	(0.0387)	(0.0255)	(0.0118)	(0.0186)	(0.1098)	(0.0809)	(0.0482)	(0.0344)
Credit Risk								
dln_ast2	0.0023 **	0.0024 ***	0.0051 ***	0.0011	-0.0045	0.0024	-0.0006	0.0001
	(0.001)	(0.0009)	(0.0008)	(0.001)	(0.0033)	(0.0026)	(0.0027)	(0.0018)
dci_rat2	0.0010	-0.0001	0.0029 *	0.0000	-0.0060	0.0000	-0.0021	0.0032
	(0.0016)	(0.0014)	(0.0017)	(0.0026)	(0.0057)	(0.0059)	(0.0078)	(0.005)
dcsprd1	-0.5320 ***	-0.3024 ***	-0.0373	0.1169 ***	0.1100	-0.0700	0.3555	-0.0051
	(0.1449)	(0.0408)	(0.0623)	(0.0337)	(0.4191)	(0.1253)	(0.2564)	(0.0606)
dnperf_rat2	-0.0117 ***	0.0023	0.0024	0.0231 ***	-0.0498 **	-0.0430 **	-0.0433	-0.0636 **
	(0.0033)	(0.0033)	(0.0037)	(0.0058)	(0.022)	(0.0205)	(0.0323)	(0.032)
Other Institutional Variables								
logast1	-0.2094 ***	-0.1247 ***	-0.1702 ***	-0.0334 ***	0.0399	0.0986 *	0.0267	-0.0600 **
	(0.0182)	(0.0149)	(0.016)	(0.0128)	(0.0761)	(0.0516)	(0.0386)	(0.029)
nim_rat2	-0.6498 ***	-0.5128 ***	-0.7056 ***	-0.2801 ***	-0.7166 ***	-0.3845 ***	-0.3860 ***	-0.1911 ***
	(0.007)	(0.0073)	(0.0052)	(0.0065)	(0.0246)	(0.0305)	(0.0242)	(0.0138)
dnim_rat1	-0.8194 ***	-0.7070 ***	-0.8953 ***	-0.5716 ***	-0.8460 ***	-0.5474 ***	-0.5428 ***	-0.3022 ***
	(0.0055)	(0.0063)	(0.0048)	(0.0081)	(0.0174)	(0.0307)	(0.0264)	(0.0217)
dnonii_rat2	0.0011	0.0179 ***	-0.0377 ***	-0.0155 ***	-0.0491 **	-0.0057	-0.0959 ***	-0.0039 ***
	(0.0031)	(0.0041)	(0.0034)	(0.0054)	(0.0198)	(0.016)	(0.025)	(0.0015)
dsecgl_rat2	-0.0082 *	-0.0028	-0.0063	0.0140	0.0258	-0.0354 *	0.0168	0.0271
	(0.0045)	(0.0035)	(0.0056)	(0.0144)	(0.0164)	(0.0208)	(0.0336)	(0.0231)
Seasonal Dummy								
qtr2	0.0098	0.1242 ***	0.1111 ***	0.1004 ***	0.0795 **	0.0425	0.1065 ***	0.1043 ***
	(0.0119)	(0.0139)	(0.0087)	(0.0115)	(0.034)	(0.0433)	(0.0358)	(0.0201)
qtr3	0.4492 ***	0.0866 **	0.1544 ***	0.0739 ***	0.1176	0.0201	0.0962 ***	0.0772 ***
	(0.0482)	(0.0342)	(0.0079)	(0.0141)	(0.1365)	(0.106)	(0.0319)	(0.0247)
qtr4	-0.2230 ***	0.1050 ***	0.1081 ***	-0.0132	0.4171 **	-0.0070	0.0974 ***	0.0783 ***
	(0.0688)	(0.01)	(0.0077)	(0.0139)	(0.2046)	(0.032)	(0.0314)	(0.0245)
# of Cross Sections	2883	2596	2518	1623	136	131	211	149
Time Series Length	12	12	22	24	12	12	22	24
R-Square	0.45	0.36	0.56	0.21	0.35	0.32	0.29	0.39

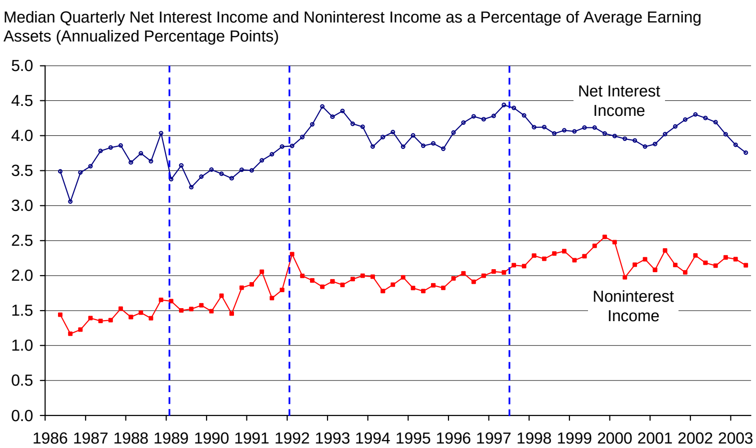
Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Figure 1: Median Quarterly Net Interest Income and Noninterest Income as a Percentage of Average Earning Assets (Annualized Percentage Points)

Panel 1: International Banks



Panel 2: Large Non-International Banks



Panel 3: Agricultural Banks

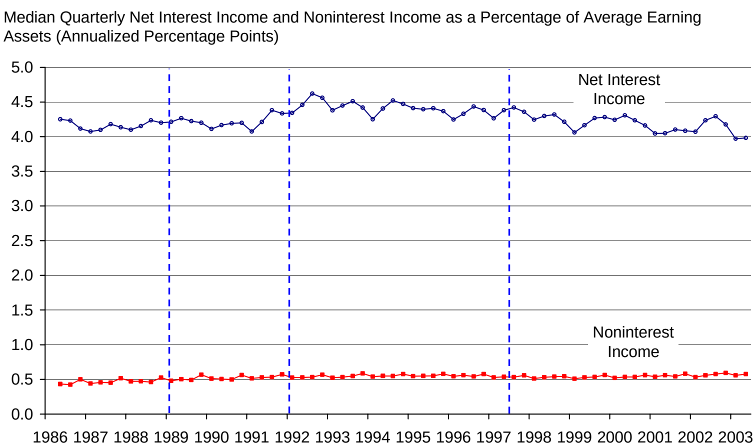
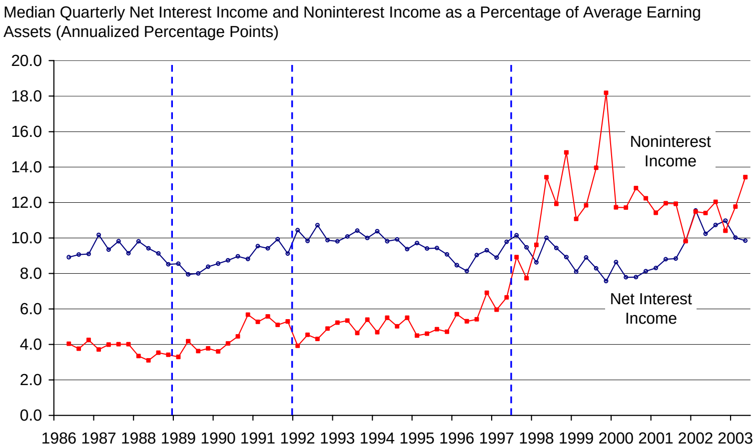
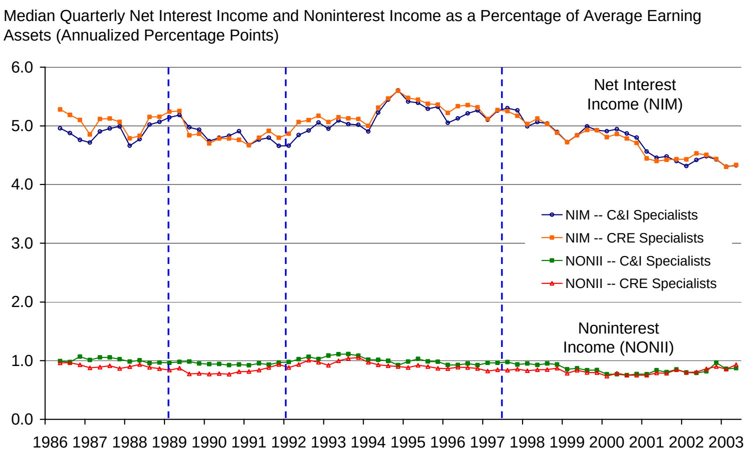


Chart 1: Median Quarterly Net Interest Income and Non-interest Income as a Percentage of Average Earning Assets (Annualized Percentage Points)

Panel 4: Credit Card Specialists



Panel 5: C&I and CRE Specialists



Panel 6: Commercial Loan Specialists

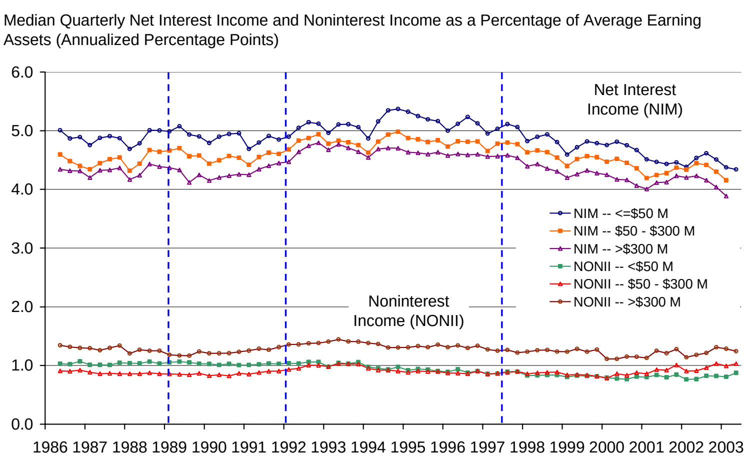
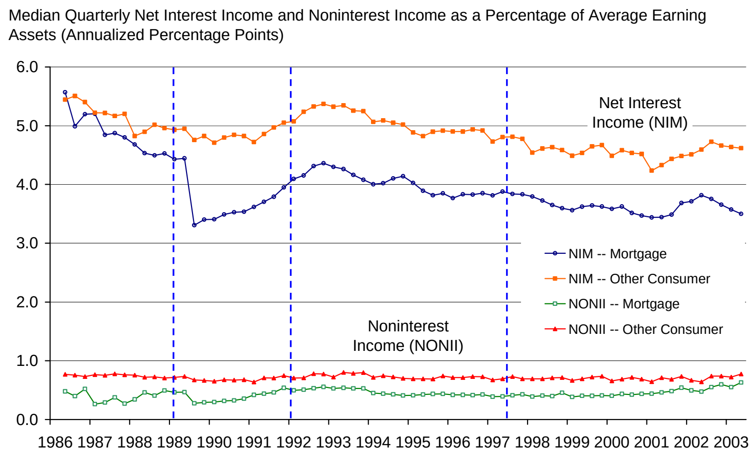
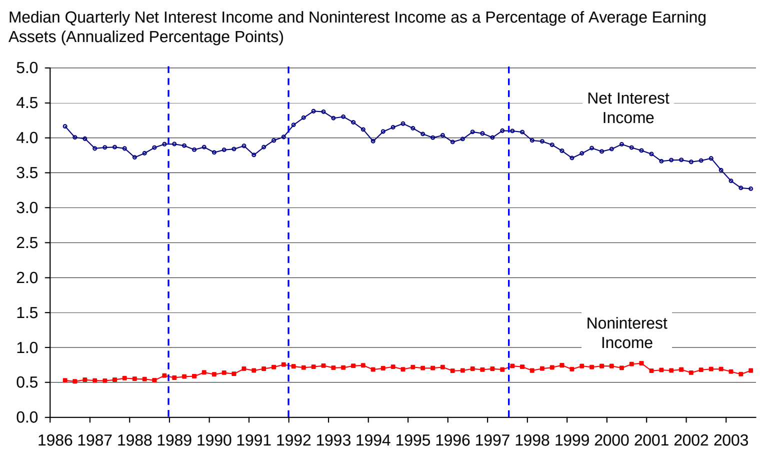


Chart 1: Median Quarterly Net Interest Income and Non-interest Income as a Percentage of Average Earning Assets (Annualized Percentage Points)

Panel 7: Mortgage and Other Consumer Loan Specialists



Panel 8: Other Small Specialists



Panel 9: Small and Mid-Tier Non-Specialist Banks

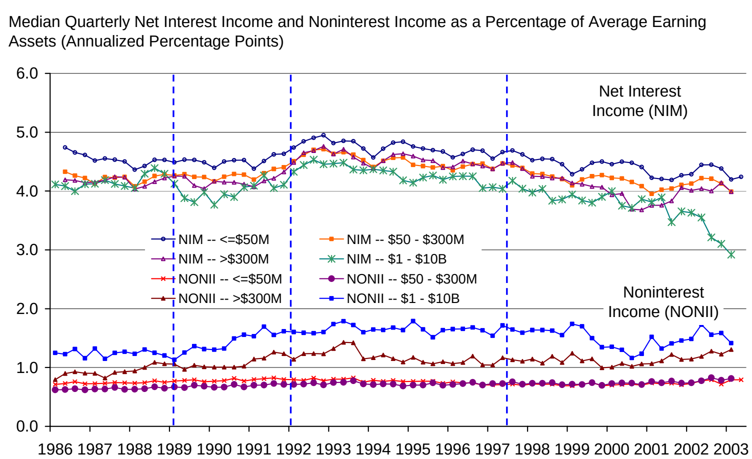
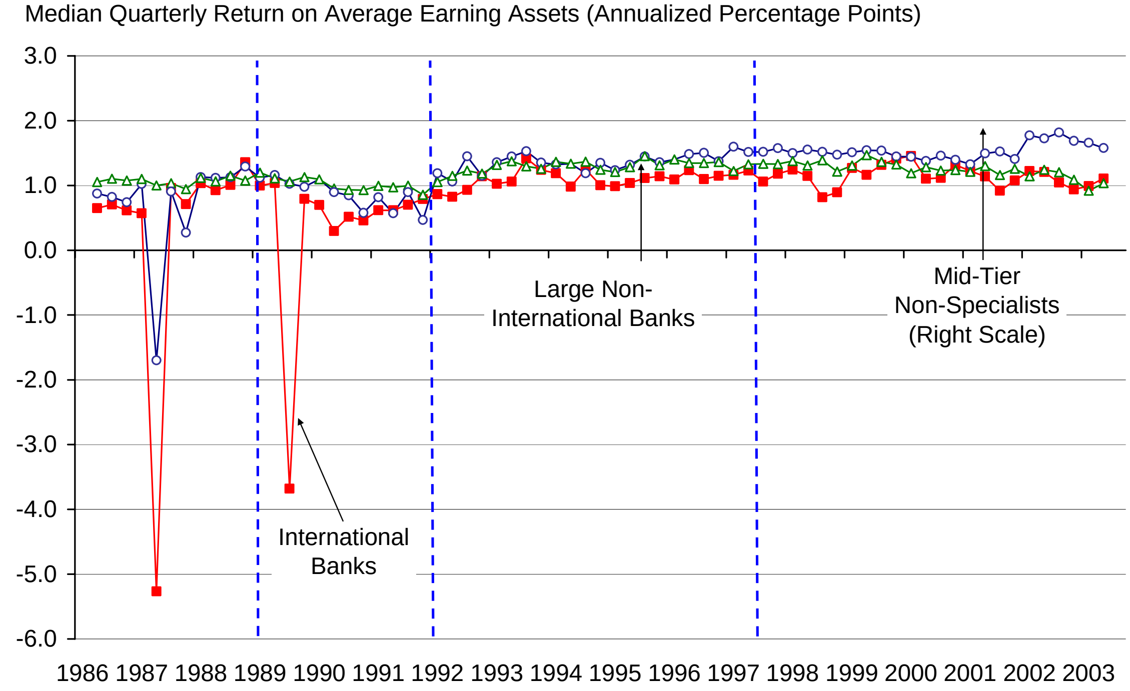


Figure 2: Selected Median Quarterly Return on Average Earning Assets
(Annualized Percentage Points)

Large Banks



Small Non-Specialist Banks

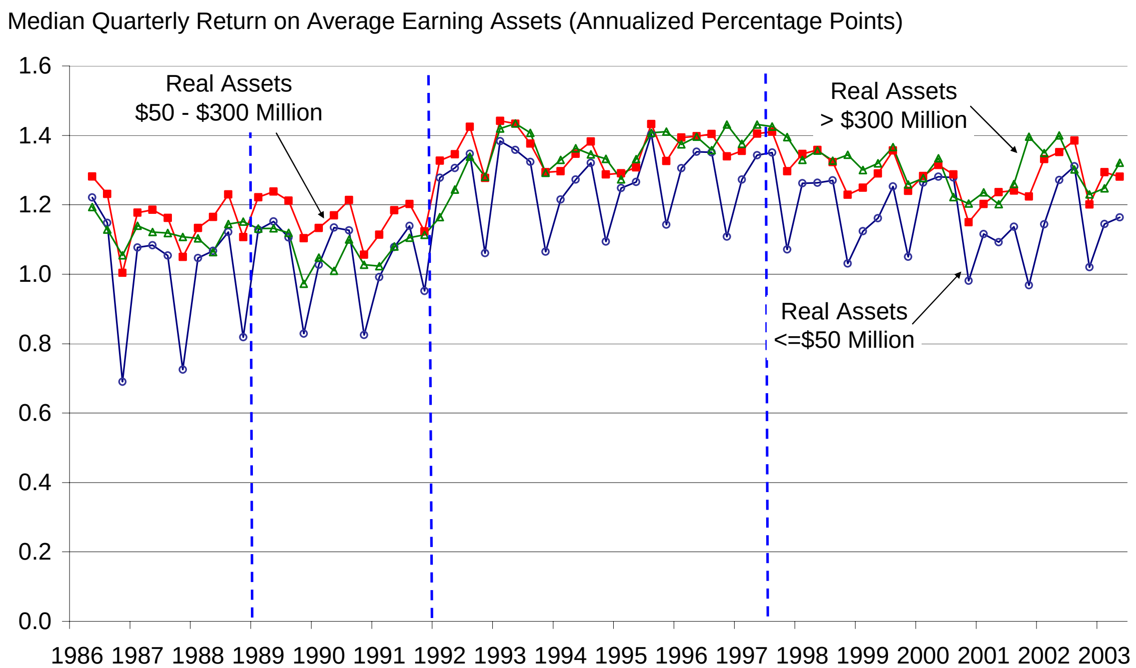


Figure 3: Trend in Changes in Net Interest Margins and Yield Spreads (1986:Q2–2003:Q2)

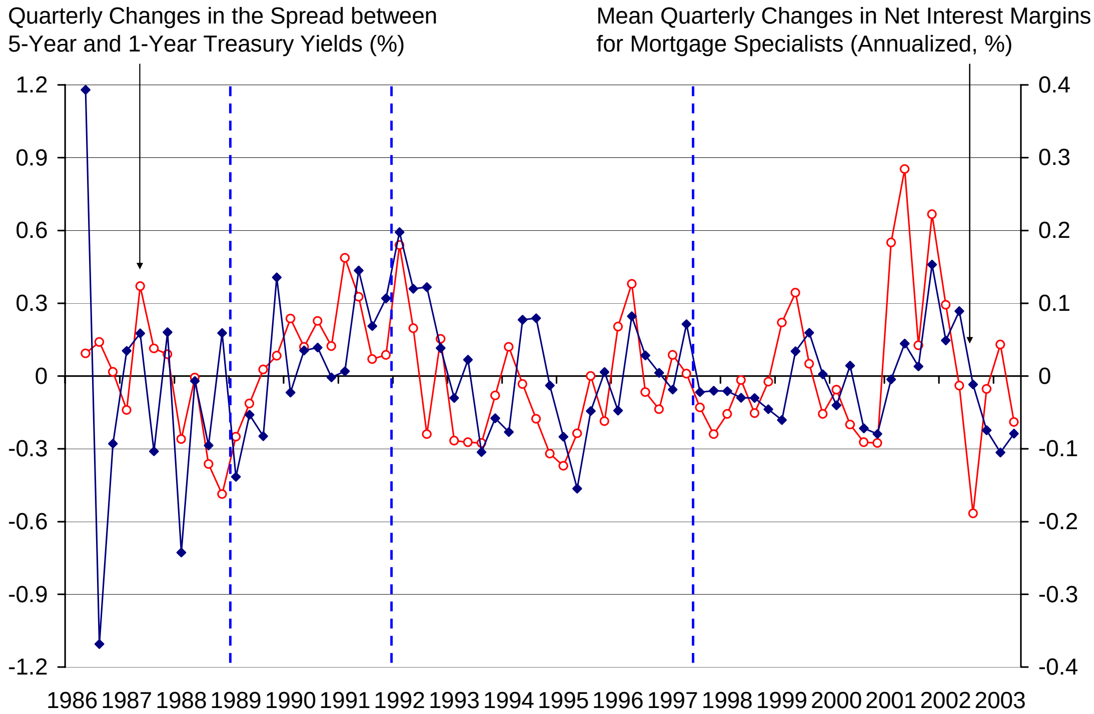
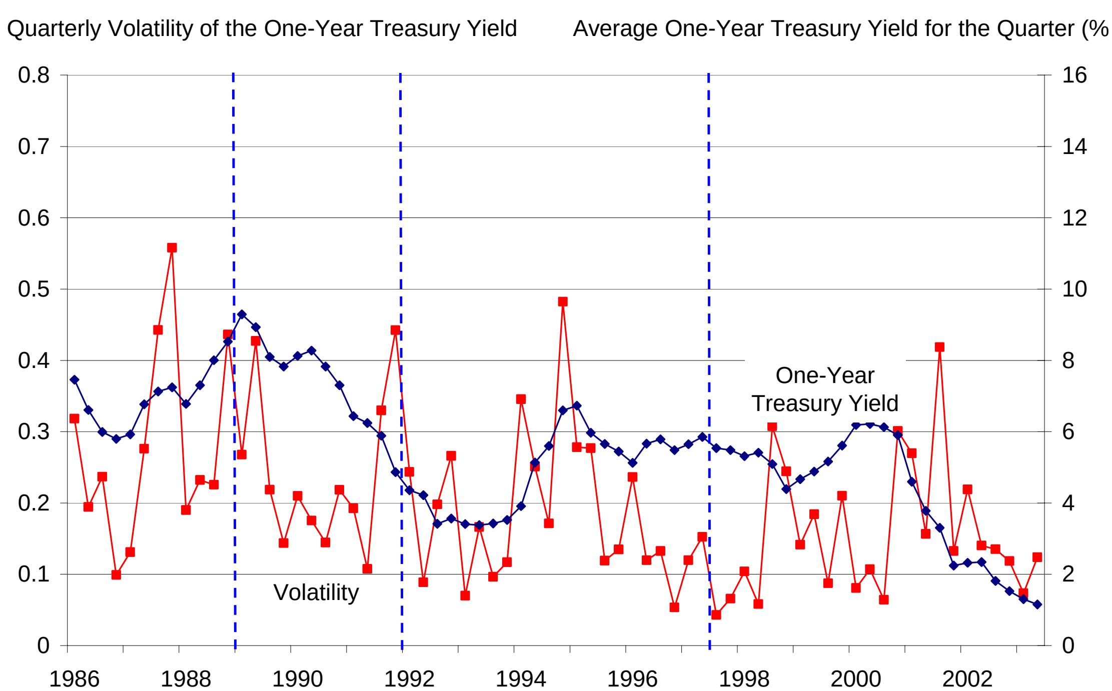


Figure 4: Trends in the One-Year Treasury Yield and Its Volatility (1986:Q2–2003:Q2)

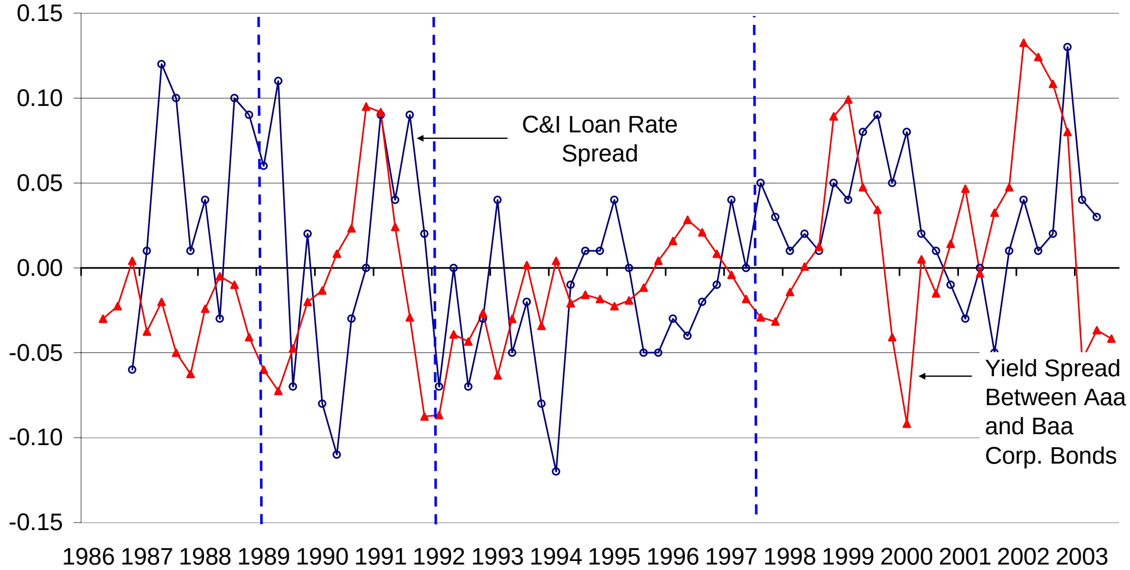


Source: Haver Analytics and the Federal Reserve Board

Figure 5: Trend in Credit Spreads: 1986:Q2–2003:Q2

5A: Loans Over $1 Million

Quarterly Changes in Yield Spreads Between Aaa and Baa Corporate Bonds and C&I Loan Rate Spread Over Intended Fed Funds Rate (4-Quarter Moving Average -- Percentage Points)



5B: Loans Less Than $1 Million

Quarterly Changes in Yield Spreads Between Aaa and Baa Corporate Bonds and C&I Loan Rate Spread Over Intended Fed Funds Rate (4-Quarter Moving Average -- Percentage Points)