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On the Profitability and Cost of Relationship Lending

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On the Profitability and Cost of Relationship Lending[1]

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Abstract: We provide evidence on the costs and profitability of relationship lending by banks. We derive bank-specific measures of loan rate smoothing for small business borrowers in response to exogenous shocks to their credit risk and to interest rates, and then estimate cost and profit functions to examine how smoothing affects bank costs and profits.

Our results suggests that, in general, loan rate smoothing in response to a credit risk shock is not part of an optimal long-term contract between a bank and its borrower, while loan rate smoothing in response to an interest rate shock is.

JEL Classification Codes: G21, G30, L14

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ON THE PROFITABILITY AND COST OF RELATIONSHIP LENDING

1. Introduction

For some market participants, the financing of small businesses has become a type of Holy Grail in the fiercely competitive financial markets of the 1990s. In particular, many commercial banks—both large and small—have identified small business lending as a core business; this, at a time in which it has become increasingly difficult for all intermediaries to defend their traditional markets against increasing competition both from traditional and non-traditional competitors.

Different banks have offered different visions of the future direction of small business lending. In one view—espoused especially by larger banks—credit-scoring models and securitization remake the small business lending market in the image of the consumer loan market. We can refer to this type of lending as *transactional lending*. In another view, commercial banks—especially small banks—retain dominance in the small business loan market by exploiting a traditional strength: *relationship lending*, characterized by close monitoring, renegotiability, and implicit long-term contractual agreements. Needless to say, these two visions are not mutually exclusive; in the foreseeable future both types of lending will coexist and commercial banks will continue to retain a significant share of the small business loan market. However, the relative importance of transactional and relationship lending and the continuing dominance of commercial banks in the small business lending market as a whole are very much open questions.

In this paper we seek to provide some evidence on the costs and profitability of relationship lending by commercial banks, key elements in answering either question. We draw upon recent research that has given empirical support for loan rate smoothing as one of the distinctive features of relationship lending by banks.[1] Berger and Udell (1992) provide empirical evidence that banks smooth loan rates in response to interest rate shocks while Petersen and Rajan (1995) and Berlin and Mester (1997) provide evidence that banks smooth loan rates in response to changes in a firm's credit risk. All three papers support the idea that loan rate smoothing arises as part of optimal (perhaps implicit) contracts between borrowers and banks. Our own results and those of Petersen and Rajan also suggest that bank monopoly power may be a precondition for such contracts and that increasing competition may hinder relationship lending.

We take a two-step approach in this paper. In the first step, we generate measures of the *degree of smoothing* for each bank by estimating regression equations relating the markups on a bank's small business loans to changes in various measures of aggregate credit risk and interest rates, along the lines of Berger and Udell (1992) and Berlin and Mester (1997). In the second step, we estimate multiproduct cost and (alternative) profit functions for banks, including the bank-specific degree of smoothing.[2] We then investigate the effect on cost and profit of a higher degree of smoothing. We also examine whether the relationships between loan rate smoothing and bank costs or profits have changed over time and whether these relationships depend on bank size.

For the most part, our results offer little support for the interpretation that loan rate smoothing in response to *credit risk shocks* arises as part of an optimal contracting scheme. The predominant pattern in our results is that banks that offer smoother loan rates have lower costs and lower profits, a pattern that is difficult to reconcile with models of efficient multiperiod contracts. These results are more consistent with a view, common among practitioners, that bank loan-pricing practices have historically been inefficient, in particular, that loan rates have traditionally been too insensitive to credit risk.

In contrast, we find that— except for small banks—loan rate smoothing in response to *interest rate shocks* is associated with higher costs and higher profits, which is consistent with the hypothesis that smoothing is part of an optimal contracting scheme (as in Fried and Howitt, 1980).

The paper proceeds as follows. We present our hypotheses in more detail in the next section. In Section 3 we describe the data, and in Sections 4 and 5 we describe our empirical methodology. We present and interpret our empirical results in Sections 6 and 7, and conclude in the final section.

2. Hypotheses

For heuristic purposes it may be helpful to organize our thinking around two hypotheses about patterns of costs and profits. The *efficient contracting hypothesis* views loan rate smoothing as the outcome of an optimal contract between a borrower and its bank. Loan rate smoothing might be optimal for a number of reasons. Reduced liquidation costs (Berlin and Mester, 1997) or avoidance of credit rationing (Petersen and Rajan, 1995) are reasons that have been offered for loan rate smoothing in response to adverse credit risk shocks. Fried and Howitt (1980) provide a formal model that views loan rate smoothing as part of an optimal contract for risk-averse firms facing interest rate risk. Whatever motivation one stresses, if the loan rate smoothing aspect of relationship lending is valuable to the borrower, then it might be expected to generate profits for the bank, as long as loan markets are not perfectly competitive. Thus, we expect banks with a higher degree of smoothing would be more profitable.[3]

The prediction of efficient contracting for costs is not as straightforward. To the extent that a bank can offer smoother rates and remain profitable at the same time only by expending real resources, we might expect banks with a higher degree of smoothing to have higher costs. For example, making loans at concessionary rates in periods of high credit risk may require costly monitoring to identify those firms that will survive to pay compensatory rates in better times. And the provision of interest rate risk insurance will typically require some type of costly hedging activity by the bank. At the same time, it is not hard to envision scenarios in which loan rate smoothing reduces costs. For example, in a Stiglitz-Weiss type world, where high loan rates increase a firm's incentive to take inefficient risks, different banks might respond differently to high market interest rates. One bank might engage in costly monitoring to overcome information asymmetries while another might keep rates low to reduce the firm's incentives to take risks. The second type of bank would have smoother rates and lower costs than the first type of bank.

An alternative hypothesis has had more explicit support among practitioners and in the business press than in the academic literature. In this view, many bank lending practices—including the smoothing of loan rates—are inefficient.[4] In a typical statement from a former columnist at the *American Banker*, "In other words, banks are awakening to the fact that they have been overcharging and thus alienating those who provide the highest risk adjusted returns and undercharging those who produce returns below the hurdle rate. Otherwise put, at most banks, the better customers have been subsidizing the poorer ones." (Rose, 1990) This cross-subsidization is not part of an efficient intertemporal agreement, as in Petersen and Rajan (1995), but reflects incorrect pricing, just one of many obsolete banking practices that have flourished in protected and noncompetitive markets. We will call this view the *inefficient pricing hypothesis*.[5] An implication of this view is that the banker who gets his loan rates right (i.e., is not smoothing) should increase his profits. Thus, smoothing should be associated with lower profits.[6,7]

The implication of inefficient pricing for the relationship between smoothing and costs is also ambiguous. In one view, loan rates that imperfectly reflect default risk are merely one among a host of inefficiencies arising in protected markets, which would lead us to expect a positive relationship between smoothing and costs. Alternatively, the simple rules of thumb said to underlie inefficient bank loan pricing might be less costly than a more sensitive mechanism for assigning borrowers to appropriate risk classes. In this view, costs may be lower for banks that do more smoothing, at least in the short run.

Summarizing the preceding: According to the efficient contracting hypothesis, we expect loan rate smoothing to be *positively* related to profits, while according to the inefficient pricing hypothesis, we expect loan rate smoothing to be *negatively* related to profits. There are no definite predicted relationships between loan rate smoothing and costs. (Nonetheless, information about the empirical relationship between smoothing and costs should yield information about the source of the effect on profits, i.e., whether it is via revenues or cost.)

We consider explicitly the possibility that the relationship between smoothing and profitability or costs may have changed over time or that the relationship might differ for banks of different sizes. For example, greater liability-side competition (as in Berlin and Mester, 1997) or greater asset-side competition (as in Petersen and Rajan, 1995) will make relationship lending increasingly less feasible over time. Along with many other observers, we view the 1980s as a period of increasing competition. Findings consistent with the efficient contracting hypothesis earlier, but not later, in our sample period would be consistent with the view that greater competition tends to undermine relationship lending.

There are also a number of reasons to expect that smaller banks are more likely to engage profitably in lending relationships than larger banks, even holding constant average borrower size, the liability structure of the bank, and the bank's degree of monopoly power (all of which should independently affect the profitability of relationship lending). The enforceability of implicit contracts may be more difficult in large banking organizations, where more bureaucratic loan review structures may limit lender autonomy or where lenders' career paths undermine long-term personal relationships with borrowers.

But other reasons suggest that the profitability of loan rate smoothing may be *positively* related to bank size. First, larger banks have a greater capacity to hedge interest rate risk at low cost than do small banks. But even before the advent of credit risk derivatives, larger banks with diversified portfolios of firms might have had an advantage over smaller banks in providing insulation against aggregate credit shocks as well. This is especially true if the aggregate shocks have different regional or sectoral effects (and large banks diversify across regions and sectors).

3. Data

Our data cover the same panel of 126 banks investigated in Berlin and Mester (1997). These banks are those that reported in the Federal Reserve System's Quarterly Survey of the Terms of Bank Lending in each quarter from 1977Q1 through 1989Q4.[8] This survey collects information on the terms of each loan the bank made in a particular three- to five-day period near the beginning of the quarter. The entire sample of loans included over 600,000 loans that were priced above the prime rate.[9] We augmented these data with information on the banks' balance sheets and income statements, which we drew from the banks' quarterly Reports of Condition and Income (the Call Reports). The banks' average asset-size over our sample period ranged from $50 million to $137 billion (1982 dollars).

4. Estimating the Degree of Smoothing

The first step was to estimate a bank-specific measure of loan rate smoothing. Here, we estimated the following two regression:

$$MARKUP_{ijt} = a_{0j} + a_{1j}CREDIT\ RISK_{jt} + bX_{ijt}, \quad (1)$$

$$MARKUP_{ijt} = c_{0j} + c_{1j}MMR_{ijt} + dX_{ijt}, \quad (2)$$

where *i* refers to the loan, *j* refers to the bank, and *t* refers to the quarter. We estimated each regression using all of the banks' small business loans that were priced above the prime rate. For our purposes, a small business loan was one whose face value was less than $1 million and, if it was made under commitment or sold as a participation, the total commitment or total participation was also less than $1 million. There are over 480,000 such loans in our sample. MARKUP is the difference between the loan rate and the rate on a Treasury security that had the same duration as the loan.[10] To estimate (1) we used two alternative measures of credit risk: the quality spread (QUALSP) is the difference in rates between Moody's Aaa-rated bonds and Baa-rated bonds, and the state unemployment rate (UNEMPST) is the unemployment rate in the state where the bank was headquartered. QUALSP has the benefit of being a forward-looking measure of credit risk, but since it does not vary across banks, this measure does not incorporate much of the local variation in credit risk that is likely to be important to our small business borrowers. UNEMPST has the benefit of varying both across time and banks—thus capturing a lot of the cross-sectional information in our sample—but it can be a lagging indicator of credit risk.[11] The variable, MMR, used in regression (2) is the rate on a Treasury security with the same duration as the loan.

The vector X is a set of control variables that affect markups. It includes *borrower-specific* control variables: whether the loan was collateralized, whether it was made under commitment, the loan's face value, whether the loan was made at a fixed or floating rate, and the loan's duration. It also includes *bank-specific* control variables: the average asset size of the bank (in real terms) over the sample period, the bank's average loan-to-deposit ratio, its average equity-to-asset ratio, the level of loan charge-offs to total loans two and three years after the loan was made (as controls for credit standards), the bank's core deposits as a fraction of total deposits, and the Herfindahl index for the bank's deposit markets. MMR was included as a control variable in regression (1) and QUALSP was included as a control in regression (2). A time trend was also included in both regressions.

Note that in regressions (1) and (2), both the constant terms, a_{0j} and c_{0j}, and the coefficients on CREDIT RISK and MMR, a_{1j} and c_{1j}, respectively, were allowed to vary over banks. The estimates of this coefficient in regression (1) for each of our two alternative measures of credit risk, QUALSP and UNEMPST, provide two potential measures of loan rate smoothing in response to credit shocks, while the estimate of the coefficient on MMR in regression (2) provides a measure of loan rate smoothing in response to interest rate shocks. In each case, a smaller coefficient corresponds to more smoothing. So, we define two measures of the degree of credit-risk smoothing: SMOOTHQ_j is -1 times the estimated coefficient on QUALSP for bank *j* and SMOOTHU_j is -1 times the estimated coefficient on UNEMPST for bank *j*. Similarly, we define SMOOTHM_j as -1 times the estimated coefficient on MMR for bank *j*. Higher values for SMOOTHQ, SMOOTHU, and SMOOTHM indicate more smoothing.

5. Cost and Alternative Profit Function Specifications

To investigate the costs and profitability of loan rate smoothing, we estimate variable cost and profit functions that include our measure of smoothing in response to a credit shock and the associated credit risk measure, or our measure of smoothing in response to an interest rate shock and the one-year Treasury bill rate.[12] Instead of a standard profit function, which relates profit to input prices and output prices, we estimate the alternative profit function, which relates profit to input prices and output levels (and other control variables). This is because one of the avenues by which smoothing affects profits is via the price of loans; therefore, we do not want to hold output prices constant when evaluating the impact of smoothing on profits.

Since our sample includes only 126 banks, we needed a parsimonious specification of costs and profits and used a modified version of the Berger and Mester (1997) specification. Thus, we specified two outputs: y_1 = gross loans and leases and y_2 = all other assets less fixed assets. There are two variable inputs: purchased funds (i.e., large time deposits, foreign deposits, fed funds purchased, and all other liabilities except core deposits), whose price, w_1, is proxied by expenses for these funds divided by the volume of these funds; and labor, whose price, w_2, is proxied by salaries and benefits divided by number of employees. We include three fixed netputs (factors that have aspects of both inputs and outputs) in the cost and profit functions: core deposits, defined as domestic deposits minus large time deposits; fixed assets, which includes premises and other fixed assets; and financial capital.[13] We also include one environmental variable, the ratio of the bank's level of net chargeoffs of loans and leases to total gross loans and leases.[14] In addition, our specification includes the degree of loan rate smoothing, SMOOTHQ, SMOOTHU, or SMOOTHM along with the associated measure of credit risk (QUALSP or UNEMPST) or the one-year T-bill rate.[15] This procedure allows the degree of smoothing to affect cost and profits differently at different levels of credit risk or at different levels of interest rates.[16] Variable cost is measured as the sum of expenditures on the two variable inputs, i.e., expense of purchased funds, and expenditures on salaries and benefits. Variable profit is revenue from loans and assets other than fixed assets minus variable cost.[17] Finally, we also allow for a time trend and include a trend variable and its square. To conserve degrees of freedom, we did not interact these trend variables with any of the others.

We assumed the cost and profit functions were of the translog functional form, and we estimated the purchased funds (cost or profit) input share equation, along with the cost and profit function. (The input share equation corresponding to labor was dropped to avoid singularity, since the shares sum to one, but iterative SUR was used to obtain the estimates, so they are invariant to the share equation dropped.) Hence, the model estimated was as follows:

$$\begin{aligned} \ln V_t = {} & a_0 + \sum_{i=1}^{2} a_i \ln y_{it} + \sum_{j=1}^{2} b_j \ln w_{jt} + \frac{1}{2}\sum_{i=1}^{2}\sum_{j=1}^{2} s_{ij} \ln y_{it} \ln y_{jt} + \frac{1}{2}\sum_{i=1}^{2}\sum_{j=1}^{2} g_{ij} \ln w_{it} \ln w_{jt} \\ & + \sum_{i=1}^{2}\sum_{j=1}^{2} d_{ij} \ln y_{it} \ln w_{jt} + \sum_{k=1}^{6} f_k \ln z_{kt} + \frac{1}{2}\sum_{k=1}^{6}\sum_{j=1}^{6} r_{ij} \ln z_{kt} \ln z_{jt} \\ & + \sum_{k=1}^{6}\sum_{i=1}^{2} h_{ki} \ln z_{kt} \ln y_{it} + \sum_{k=1}^{6}\sum_{j=1}^{2} t_{kj} \ln z_{kt} \ln w_{jt} + \phi TR + \psi TR^2 + \epsilon_t \end{aligned} \tag{3}$$

$$S_{1t} = b_1 + \sum_{i=1}^{2} g_{i1} \ln w_{it} + \sum_{i=1}^{2} d_{i1} \ln y_{it} + \sum_{k=1}^{6} t_{k1} \ln z_{kt} + \xi_{1t}, \tag{4}$$

where $s_{ij} = s_{ji}$, $g_{ij} = g_{ji}$, and $r_{ij} = r_{ji}$ by symmetry, and

$$\sum_{j=1}^{2} b_j = 1, \quad \sum_{j=1}^{2} g_{ij} = 0, \; i=1,2,$$

$$\sum_{j=1}^{2} d_{ij} = 0, \; i=1,2, \quad \sum_{j=1}^{2} t_{kj} = 0, \; k=1,\ldots,6 \quad \text{by linear homogeneity.}$$

V = variable cost or variable profit

y_i = quantity of output i, i=1,2

w_j = price of variable input j, j=1,2

z_1 = degree of smoothing: SMOOTHQ, SMOOTHU, or SMOOTHM

z_2 = credit risk—QUALSP or UNEMPST, or one-year T-bill rate

z_3 = core deposits

z_4 = physical capital

z_5 = financial equity capital

z_6 = net chargeoffs of loans and leases/total gross loans and leases

TR = time trend

S_1 = purchased funds input share, i.e., expenditures on purchased funds divided by variable cost or profit

ϵ_t, ξ_{1t} are normally distributed error terms

and all variables (except the shares) are normalized by their means.

We estimated the cost and profit functions over our sample period from 1977Q1-89Q4. While the trend and trend-squared variables (and credit risk and market rate variables) allow for some movement of the cost and profit functions over time, we also divided our sample period and estimated separate functions over 1977Q1-82Q4 and 1983Q1-89Q4. This allows us to investigate whether the effect of smoothing on profits and cost has changed over time.[18] In addition, since there is a body of evidence that suggests that different sized banks may use different production technologies, we also estimated separate functions for banks in three different size categories based on the average real value (in 1982 dollars) of a bank's assets over 1977Q1-89Q4. The size categories were: assets less than $1 billion, assets between $1 billion and $10 billion, and assets over $10 billion. These three categories included 43, 67, and 16 banks, respectively.

6. Empirical Results

6.1 Credit-risk smoothing

6.1.1 Means and Medians by Smoothing Quartiles. Our two measures of smoothing are significantly positively correlated across banks, as expected, but their correlation is not so high that we'd want to proceed with a single measure: the Spearman rank correlation coefficient is 0.48. In other words, both measures are likely to provide some independent information. It is also interesting to note that the correlation between bank size and loan rate smoothing is not very strong: it is −0.47 for SMOOTHQ, −0.22 for SMOOTHU, and −0.55 for SMOOTHM.

Table 2 presents the means and medians of various characteristics of the banks in our sample across the quartiles defined by the smoothing variable SMOOTHQ. As can be seen, banks engaging in higher degrees of smoothing tend to be smaller in size and higher in capitalization. They are also more reliant on core deposits for funding, consistent with Berlin and Mester (1997), where we argue that market power over core depositors enables banks to offer borrowers loan rate smoothing in their loan contracts. There appears to be only a slight difference in loan performance for smoothers and nonsmoothers.

6.1.2 Profit and Cost Elasticities. Table 3 presents our results for the sample period as a whole and for both subperiods for the total sample of banks. The first point to note is that both measures of aggregate credit risk affect profits in the way one would expect, i.e., an increase in either QUALSP or UNEMPST has a significantly negative effect on profits. Thus, we can proceed with some confidence that our measures of credit risk are not unreasonable. For either measure of credit risk, the coefficient relating the degree of smoothing and profits is negative and significant, both for the entire sample period and for both subperiods. Thus, a bank with a smoother loan rate profile was less profitable throughout the sample period and in both subperiods. This does not support the efficient contracting hypothesis.

The effect of smoothing on cost is also consistently and significantly negative. From this, we can infer that the negative effect on profits is not the result of excessively high costs associated with loan rate smoothing, for example, high monitoring costs.

Table 4 presents results disaggregated by bank size. For either measure of credit risk, the coefficient relating risk to profitability has the correct (negative) sign every time it is statistically significant, both for the entire sample period and for the subperiods (Panels A, B, and C).[19]

Turning now to the relationship between the degree of smoothing and profitability, we focus on the small- and medium-size banks because the level of statistical significance for the largest banks is very low (and because the two credit risk measures yield conflicting results for the largest banks). For the smallest bank size class and for either measure of credit risk, we have a significantly *positive* relationship between profits and the degree of smoothing for the first subperiod and a significantly *negative* relationship for the second subperiod and for the sample period as a whole (Panel A). And for the medium-size banks we find a positive relationship for the second subperiod and for the sample period as a whole, significantly so, when credit risk is measured by the quality spread. This offers (partial) support for the efficient contracting hypothesis: that is, for small banks in the earlier part of our sample period and medium-size banks in the later part of our sample period we cannot reject the hypothesis that loan rate smoothing was part of an efficient contracting arrangement. The results for small banks are consistent with our prior that relationship lending is likely to be most important for smaller banks and that it is likely to be most feasible under less competitive conditions prevailing earlier in the sample period.[20]

The effect of the degree of smoothing on costs is significantly negative for both the small and medium-size class, for both the entire sample period and both subperiods.

6.2 Interest-rate smoothing

6.2.1 Means and Medians by Quartiles. Table 5 presents the means and medians of various characteristics of the banks in our sample across the quartiles defined by the smoothing variable SMOOTHM. The results are substantially similar to those for credit-risk smoothing, which is not surprising since the Spearman rank correlation between SMOOTHM and SMOOTHQ is 0.74. Banks engaging in higher degrees of smoothing tend to be smaller in size, higher in capitalization, and also more reliant on core deposits for funding. Further, there is only a slight difference in loan performance for smoothers and nonsmoothers.

6.2.2 Price and Cost Elasticities. The results for our sample of all banks are presented in the first column of Table 6. We expect bank profits to be negatively related to market interest rates, which holds both for the sample period as a whole and for both subperiods.[21] In the sample period and both subperiods, interest-rate smoothing raises both costs and profits. This evidence is consistent with the view that smoothing of loan rates in the face of interest rate shocks is part of an efficient contract and also that banks that smooth more undertake costly hedging activities.

Turning now to our results disaggregated by bank size (shown in panels A, B, and C of Table 6), the effect of higher market rates on bank profits is less consistent. For medium-size banks, higher market rates significantly decrease profits for the entire sample period and for both subperiods, as was true for the sample of all banks. However, for both small and large banks, higher market rates significantly *increase* profits for the sample period as a whole and for the second subperiod (contrary to our expectations). We have no ready explanation for the positive relationship, however, since the profit function includes the price of purchased funds and the level of core deposits as arguments, the positive relationship might indicate that at these banks loan rates increase more than the cost of core deposits in response to a general increase in market rates.

The effect of interest-rate smoothing on profits is always positive whenever it is significant for medium and large banks. The effect is negative (but insignificant) for medium-size banks in the first subperiod. The effect is quite different for small banks, where the relationship between smoothing and profits is either negative or insignificant. These results are broadly consistent with the joint hypothesis that interest-rate smoothing arises as part of an efficient contract and that only larger banks have a comparative advantage in providing customers with interest-rate risk insurance. With only one exception, the effect of smoothing on costs is also positive for medium-size and large banks (the exception is an insignificant negative sign for medium-size banks in the second subperiod). These results are broadly consistent with the view that banks that provide interest-rate smoothing for their customers then engage in costly hedging activities.

6.3 Further tests

Under the efficient contracting hypothesis, loan rate smoothing is part of a long-term relationship between a bank and its borrower. In any one period, a bank might earn negative profits under this strategy, but in the long run, the strategy should pay off if it is an equilibrium pricing strategy. Yet our profit model was estimated using quarterly data. While this should uncover the average relationship between smoothing and profits, we wanted to determine whether our results were robust to estimating the profit model using averaged data. Thus, we reran the regressions using averaged data for 1978-80, 1981-83, 1984-86, and 1987-89. For the full sample of banks and for the three size categories there is very little change in results: smoothing is associated with decreased profits.[22]

To provide further evidence regarding the relationship between smoothing and cost and profits, we derived bank-specific measures of cost and profit inefficiency and looked at the relationship between these measures and smoothing. To derive the bank-specific cost and profit inefficiency measures, we used the stochastic frontier approach (see Berger and Mester, 1997) and estimated equation (2) dropping the terms involving smoothing and including a composite error term, $v + u$, in place of ϵ. The composite error term consists of a two-sided normally distributed error, v, representing random error and a one-sided half normally distributed error term, u, representing inefficiency. Once the cost and profit frontiers were estimated, we used the expected value of u given $v+u$ and the mode of the conditional distribution of u given $v+u$ as two alternative measures of bank-specific inefficiency.[23] We then regressed these bank-specific inefficiency measures on a constant term and smoothing, again estimating for all banks over the full sample period and then separately for the two subperiods and for banks in the three size categories. We found that for all banks, both credit risk and interest rate risk smoothing were significantly associated with greater efficiency. Further, in those subperiods and size categories where we had found that credit-risk smoothing was unprofitable, smoothing was also significantly associated with greater efficiency. Thus, unprofitable credit-risk smoothing does not appear to be an indicator of generalized inefficiency at banks.[24]

6.4 Summary. We summarize our results as follows:

Our results generally do not support the view that loan rate smoothing as a type of insurance against credit-risk shocks is part of an efficient contract between banks and borrowers. For the full sample of banks over the full sample period and both subperiods, profits are significantly lower for those banks that offer smoother loan rate profiles in response to credit-risk shocks. We do find some support that smoothing could have been part of an efficient contract for smaller banks in the early subperiod (1977-82), as profitability was significantly positively related to smoothing in this case. This is consistent with the view that relationship lending is a small-bank phenomenon that has become less profitable in recent times as competition has increased.[25]

Our results are much more supportive of interest-rate risk smoothing being part of an efficient contract. Here we find a significantly positive relationship between profits and smoothing as insurance against interest-rate shocks for the full sample of banks over the entire sample period and the two subperiods. Our bank-size results indicate that it is the larger size banks that find interest-rate risk smoothing to be profitable (although it is also a costly activity, as smoothing and costs are positively related). These results might seem surprising to the extent that one views loan-rate smoothing as an aspect of relationship lending, which is the purview of smaller banks. However, larger banks are likely to be better able to hedge interest-rate risk than smaller banks, and this type of interest-rate risk insurance need not be confined to relationship loan contracts but might be an aspect of all bank lending.

In the cases where we found that smoothing was not associated with higher profits and, therefore, was not consistent with efficient contracting, we did not find that smoothing was associated with other inefficiencies on the part of the banks. Nor did we find that banks that ranked as being efficient used smoothing as part of an efficient contract any more so than less efficient banks did.

7. Some Alternative Explanations

Our heuristic hypotheses of efficient or inefficient pricing practices are clearly not the only possible explanations for loan-rate smoothing. And though there is no shortage of practitioners who subscribe to some version of the inefficient pricing story, this is a story without strong formal micro foundations. Since we did not find that credit-risk smoothing is part of efficient contracting on the part of the bank, it is natural to search for alternative explanations before placing too much weight on the idea that banks have systematically mispriced loans, undercharging high-risk borrowers and overcharging low-risk borrowers, especially since we do not find that credit-risk smoothing is related to general inefficiency on the part of our banks.

The most obvious alternative explanation of smoothing is that it is the result of monopoly power, that is, banks with smoother rates have more monopoly power in loan markets, everything else equal. The relationship between market power and price rigidity is one that has both theoretical and empirical foundations.[26] To some extent, the regressions used to develop the measures of smoothing take loan market power into account. In particular, we included loan size, bank size, and deposit market Herfindahl indices in our first stage pricing regressions from which we derived our smoothing measures. One might also argue for the inclusion of proxies for loan market power in the profit and cost equations. But this is unlikely to explain our results. If our measures of the degree of credit-risk smoothing are acting as proxies for monopoly power, then we would expect a positive relationship between these measures and profitability, contrary to the predominant pattern in our results. Alternatively, if monopoly rents were being dissipated in higher costs, as in some versions of the "quiet life" hypothesis, we would expect to see a systematic positive relationship between smoothing and costs, but we found a negative relationship between credit-risk smoothing and costs.

Another alternative interpretation of our smoothing variables is that they reflect bank-specific differences in credit policy or in the riskiness of the bank's population of borrowers. Again, our first stage regressions attempt to control for bank-specific credit policies by including future loan chargeoffs and attempt to control for differences in borrower risk characteristics by including contract terms that other studies have shown to be related to borrower risk, especially whether the loan is collateralized and whether it is granted under commitment.[27] Further, bank-specific differences in the relationship between changes in credit risk and portfolio risk should also be captured by the bank-specific constant term in our first stage regressions. Our second stage cost and profit regressions also control for the bank's portfolio risk by including the ratio of current net chargeoffs to loans and leases. Nonetheless, one might argue that these are imperfect controls for the riskiness of the bank's portfolio.

But the view that we have imperfectly controlled for bank portfolio risk—and that banks with a smoother loan rate profile are more diligent in increasing the stringency of their credit screens in response to adverse credit shocks—is also difficult to reconcile with our results. While stricter credit screens when aggregate risk increases might reduce monitoring costs—which would be consistent with the negative relationship between credit-risk smoothing and costs that is most prevalent in our results—it is harder to see why smoothing and profitability should be related negatively, according to this explanation. One possible explanation might be that more risk-averse bank owner/managers would use a more stringent credit policy, which would lower both expected returns and the riskiness of returns. But two things should be noted: first, in the cost and profit estimations, we do control for the bank's financial capital level and this should provide some control for risk preferences. Second, our sample of small banks is precisely that group for which the assumption of a risk-averse owner/manager is most convincing, yet these banks display a positive relationship between credit-risk smoothing and profitability (for the earlier part of our sample period). Having said this, the possibility that imperfect controls for portfolio risk are driving some of our results is a possibility worth exploring more carefully.[28]

8. Conclusion

In this paper, we conduct an empirical investigation of the hypothesis that loan rate smoothing in response to credit shocks and interest rate shocks is part of an efficient contracting scheme, as in Petersen and Rajan (1995) or Berlin and Mester (1997). In particular, we construct measures of the degree of smoothing in response to aggregate credit risk shocks and market interest rate shocks for a panel of banks during the 1977-89 time period. We then estimate (alternative) profit and cost functions to examine the relationship between smoothing and banks' profitability and costs. We estimate these profit and cost functions for the entire sample period and for two subperiods; for the entire sample of banks and also for the banks disaggregated by asset size.

According to the view that smoothing arises as part of a long-term efficient contract between a bank and its borrowers, we expect that profits will be greater for banks that engage in more smoothing. Regarding credit-risk smoothing, we find only limited evidence supporting the efficient contracting hypothesis, specifically, small banks in the first half of the sample period display a positive relationship between loan-rate smoothing in response to credit-risk shocks and profitability. However, the weight of the evidence is against the efficient contracting hypothesis. Our results regarding smoothing in response to shocks to market interest rates are more support of the efficient contracting hypothesis. Here we find that larger banks that offer this type of smoothing are more profitable, although it is costly to offer this insurance to borrowers (perhaps because the bank engages in costly hedging itself).

In the cases that did not support the efficient contracting hypothesis, an alternative explanation (consistent with the view of many practitioners) is that banks have historically engaged in inefficient pricing practices, charging excessively low risk premia to high-risk borrowers and excessively high risk premia to low-risk borrowers. However, if this were the case, one would expect to find smoothing positively correlated with other types of inefficiencies at banks, but our inefficiency results do not support this view. Thus, we feel our results are contrary to the simple inefficient pricing hypothesis as well. Given the tiny empirical literature exploring relationship lending, we view these results as a puzzle and challenge requiring further empirical testing.

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Table 1. Variable Definitions

markup (MARKUP)	loan rate minus rate on a Treasury security with the same duration as that of the loan, where duration is calculated as given below
quality spread (QUALSP)	yield on Baa-rated long-term bonds minus yield on Aaa-rated long-term bonds (Moody's ratings)
state unemployment (UNEMPST)	unemployment rate in the state in which the bank is headquartered
money market rate (MMR)	rate on a Treasury security with the same duration as that of the loan, where duration is calculated as given below
trend	linear time trend

Borrower-Specific Control Variables:

collateralized	= 1 if the loan was collateralized and 0 otherwise
commitment	= 1 if the loan was made under a preexisting commitment and 0 otherwise
face value	face value of the loan in millions of 1982 dollars
fixed base rate	= 1 if loan has a fixed base rate and 0 otherwise
duration	duration of the loan in years. Before 1982, the frequency of interest compounding was not included in the STBL data set, so for these loans, duration = maturity (if a maturity date was stated for the loan) and duration = 1/365 (if no maturity date was stated for the loan). (We also reran regressions calculating duration assuming frequency of interest compounding was monthly, using the maturity indicated if a maturity date was stated for the loan or maturity = 1/12 if no maturity date was stated for the loan. This alternative yielded similar results.)

Bank-Specific Control Variables:

total assets	bank's total assets in millions of 1982 dollars, averaged over the sample period 1977Q1-1989Q4
loans/deposits	bank's total loans / total deposits, averaged over the sample period 1977Q1-1989Q4
equity/assets	bank's total equity capital / total assets, averaged over the sample period 1977Q1-1989Q4
chargeoffs-2	bank's net chargeoffs / total loans in the second year after loan is granted
chargeoffs-3	bank's net chargeoffs / total loans in the third year after loan is granted
core deposits	bank's deposits with denominations less than $100,000 as a fraction of total liabilities, averaged over the sample period 1977Q1-1989Q4.
Herfindahl	weighted-average of Herfindahl indexes in all deposit markets in which bank gets deposits, where weights are the fraction of deposits bank gets from the market
bank dummy variables	dummy variable for each bank

Table 2. Means and Medians Across Smoothing Quartiles†

		Q1 Less Smoothing	Q2	Q3	Q4 More Smoothing
		SMOOTHQ < −2.35	−2.35 SMOOTHQ< −2.02	−2.02 SMOOTHQ< −1.81	−1.81 SMOOTHQ
Total Assets‡	**mean**	$22.6 billion[2,3,4]	$5.4 billion[1,3,4]	$2.7 billion[1,2,4]	$1.7 billion[1,2,3]
	median	$4.4 billion[2,3,4]	$3.0 billion[1,3,4]	$1.1 billion[1,2,4]	$0.6 billion[1,2,3]
Equity/Assets	**mean**	5.64%[2,3,4]	5.96%[1,3,4]	6.96%[1,2]	7.01%[1,2]
	median	5.58%[2,3,4]	5.81%[1,3,4]	6.40%[1,2,3]	6.78%[1,2,3]
Core Deposits/Assets	**mean**	48.4%[2,3,4]	56.1%[1,3,4]	65.2%[1,2,3]	68.1%[1,2,3]
	median	49.4%[2,3,4]	57.8%[1,3,4]	68.8%[1,2]	67.4%[1,2]
Net Charge Offs/Assets	**mean**	0.087%[3]	0.084%	0.077%[1]	0.083%
	median	0.052%[3,4]	0.055%[3,4]	0.042%[1,2]	0.041%[1,2]
Nonperforming Loans & Leases/Assets	**mean**	1.86%[2,3,4]	1.46%[1]	1.43%[1]	1.50%[1]
	median	1.54%[2,3,4]	1.24%[1,3,4]	0.92%[1,2]	0.98%[1,3]

† Smoothing quartiles are defined by SMOOTHQ. The means and medians for all variables are computed for banks over 1977Q1-89Q4 except for nonperforming loans & leases/assets, which is computed over 1982Q4-89Q4.
‡ In 1982 dollars.

[1]Significantly different from Q1 at the 10% or better level.
[2]Significantly different from Q2 at the 10% or better level.
[3]Significantly different from Q3 at the 10% or better level.
[4]Significantly different from Q4 at the 10% or better level.

Table 3. Relationship Between Credit-Risk Smoothing, Profits, and Costs for the Entire Bank Sample†

	Credit Risk Measure	
	SMOOTHQ	**SMOOTHU**
1977-89		
Elasticity of Profit with respect to Credit Risk	−6.38* (−2.60)	−0.0246* (−5.67)
Elasticity of Profit with respect to Credit-Risk Smoothing	−0.1398* (−4.91)	−40.19* (−6.11)
Elasticity of Cost with respect to Credit-Risk Smoothing	−0.0629* (−6.30)	−12.56* (−5.74)
1977-82		
Elasticity of Profit with respect to Credit Risk	−11.45* (−4.01)	−0.63* (−6.85)
Elasticity of Profit with respect to Credit-Risk Smoothing	−0.043 (−0.964)	−24.77* (−1.91)
Elasticity of Cost with respect to Credit-Risk Smoothing	−0.069* (−4.05)	−26.14* (−6.18)
1983-89		
Elasticity of Profit with respect to Credit Risk	−17.56* (−2.68)	−0.043 (−7.88)
Elasticity of Profit with respect to Credit-Risk Smoothing	−0.12* (−3.24)	−24.4* (−3.23)
Elasticity of Cost with respect to Credit-Risk Smoothing	−0.036* (−3.18)	−11.44* (−4.76)

† t-statistics in parentheses.
* Statistically significant at the 5% level. **Statistically significant at the 10% level.

Table 4. Relationship Between Credit-Risk Smoothing, Profits, and Costs for Banks by Size†

	A. Banks with Assets Less Than $1 Billion (43 banks)‡		B. Banks with Assets Between $1 Billion and $10 Billion (67 banks)‡		C. Banks with Assets Greater Than $10 Billion (16 banks)‡	
	Credit Risk Measure		Credit Risk Measure		Credit Risk Measure	
	SMOOTHQ	**SMOOTHU**	**SMOOTHQ**	**SMOOTHU**	**SMOOTHQ**	**SMOOTHU**
1977-89						
Elasticity of Profit with respect to Credit Risk	0.619 (0.209)	−0.0096* (−2.05)	−2.40 (−0.755)	0.0015 (0.354)	−8.26 (−1.31)	0.0006 (0.036)
Elasticity of Profit with respect to Credit-Risk Smoothing	−0.059* (−2.66)	−17.01* (−2.53)	0.044* (2.05)	1.24 (0.192)	−0.088 (−0.564)	20.36 (0.29)
Elasticity of Cost with respect to Credit-Risk Smoothing	−0.097* (−8.80)	−14.71* (−4.72)	−0.026* (−4.50)	−23.64* (−16.68)	0.1125* (8.16)	−28.97* (−5.13)
1977-82						
Elasticity of Profit with respect to Credit Risk	−4.199 (−1.22)	−0.0017 (−0.199)	−2.47 (−0.799)	0.0016 (0.23)	−7.85* (−1.81)	−0.0745* (−3.07)
Elasticity of Profit with respect to Credit-Risk Smoothing	0.072* (1.99)	2.70 (0.25)	−0.081* (−2.91)	−1.42 (−0.14)	−0.082 (−0.428)	−61.56 (−0.52)
Elasticity of Cost with respect to Credit-Risk Smoothing	−0.131* (−7.35)	−13.54* (−2.92)	−0.017* (−2.06)	−17.32* (−8.72)	0.038* (2.50)	−42.76* (−7.57)
1983-89						
Elasticity of Profit with respect to Credit Risk	−16.937* (−2.07)	−0.009** (−1.46)	1.262 (0.158)	−0.018* (−3.35)	−36.74* (−2.17)	−0.084* (−2.32)
Elasticity of Profit with respect to Credit-Risk Smoothing	−0.176* (−5.37)	−32.90* (−3.66)	0.1002* (3.38)	9.143 (1.12)	−0.317 (−0.837)	49.74 (0.389)
Elasticity of Cost with respect to Credit-Risk Smoothing	−0.12* (−8.94)	−20.10* (−5.62)	−0.021* (−2.84)	−26.99* (−13.92)	0.147* (5.77)	−27.61* (−3.19)

† t-statistics in parentheses.
‡Assets are real assets averaged over 1977Q1-89Q4 in 1982 dollars.
* Statistically significant at the 5% level. **Statistically significant at the 10% level.

Table 5. Means and Medians Across Interest-Rate Smoothing Quartiles†

		Q1 Less Smoothing	Q2	Q3	Q4 More Smoothing
		SMOOTHM <0.018	**0.018 SMOOTHM< 0.062**	**0.062 SMOOTHM< 0.106**	**0.106 SMOOTHM**
Total Assets‡	**mean**	$19.1 billion[2,3,4]	$5.4 billion[1,3,4]	$6.6 billion[1,2,4]	$1.2 billion[1,2,3]
	median	$4.7 billion[2,3,4]	$2.3 billion[1,3,4]	$1.6 billion[1,2,4]	$0.45billion[1,2,3]
Equity/Assets	**mean**	5.80%[2,3,4]	6.03%[1,3,4]	6.44%[1,2,4]	7.29%[1,2,3]
	median	5.66%[2,3,4]	5.90%[1,3,4]	6.11%[1,2,4]	6.99%[1,2,3]
Core Deposits/Assets	**mean**	47.7%[2,3,4]	57.6%[1,3,4]	60.3%[1,2,4]	72.0%[1,2,3]
	median	49.8%[2,3,4]	57.1%[1,3,4]	60.2%[1,2,4]	73.2%[1,2,3]
Net Charge Offs/Assets	**mean**	0.081%	0.082%	0.081%	0.087%
	median	0.053%[2,3,4]	0.050%[1,3,4]	0.044%[1,2]	0.043%[1,2]
Nonperforming Loans &	**mean**	1.66%[2]	1.40%[1,3,4]	1.60%[2]	1.58%[2]
Leases/Assets	**median**	1.32%[2,3,4]	1.12%[1]	1.14%[1]	1.11%[1]

† Smoothing quartiles are defined by SMOOTHM. The means and medians for all variables are computed for banks over 1977Q1-89Q4 except for nonperforming loans & leases/assets, which is computed over 1982Q4-89Q4.
‡ In 1982 dollars.

[1]Significantly different from Q1 at the 10% or better level.
[2]Significantly different from Q2 at the 10% or better level.
[3]Significantly different from Q3 at the 10% or better level.
[4]Significantly different from Q4 at the 10% or better level.

Table 6. Relationship Between Interest-Rate Smoothing, Profits, and Costs for All Banks and for Banks by Size†

	All Banks	A. Banks with Assets Less Than $1 Billion (43 banks)‡	B. Banks with Assets Between $1 Billion and $10 Billion (67 banks)‡	C. Banks with Assets Greater Than $10 Billion (16 banks)‡
1977-89				
Elasticity of Profit with respect to Interest Rate Shock	−0.0175* (−3.02)	0.032* (6.4)	-0.01** (-1.83)	0.02** (1.89)
Elasticity of Profit with respect to Interest-Rate Smoothing	1.12* (5.2)	−0.065 (−0.49)	0.80* (4.75)	1.72* (2.05)
Elasticity of Cost with respect to Interest-Rate Smoothing	0.749* (10.64)	−0.288* (−4.62)	0.03 (0.64)	0.499* (6.2)
1977-82				
Elasticity of Profit with respect to Interest Rate Shock	−0.55* (−6.64)	-0.004 (-0.62)	-0.023* (-3.57)	-0.02** (-1.74)
Elasticity of Profit with respect to Interest-Rate Smoothing	2.066* (5.19)	0.12 (0.51)	−0.064 (−0.254)	8.86* (6.53)
Elasticity of Cost with respect to Interest-Rate Smoothing	1.43* (10.62)	−0.56* (−5.91)	0.202* (3.65)	0.07 (0.85)
1983-89				
Elasticity of Profit with respect to Interest Rate Shock	−0.015** (−1.53)	0.033* (3.47)	-0.02* (-2.57)	0.042* (2.08)
Elasticity of Profit with respect to Interest-Rate Smoothing	0.982* (3.77)	−0.358* (−1.97)	1.15* (5.69)	0.87 (0.53)
Elasticity of Cost with respect to Interest-Rate Smoothing	0.479* (6.09)	−0.397* (−5.17)	−0.018 (−0.35)	0.559* (4.24)

† t-statistics in parentheses.
‡Assets are real assets averaged over 1977Q1-89Q4 in 1982 dollars.
* Statistically significant at the 5% level. **Statistically significant at the 10% level.

Notes

1. We recognize that there are other aspects of relationship lending, e.g., protection against credit rationing.

2. The alternative profit function relates profit to input prices and output levels (as opposed to input prices and output prices). See below and Berger and Mester (forthcoming) for further discussion.

3. There is ample empirical evidence that loan markets are not perfectly competitive for small business loans, for example, Hannan (1991). See Berlin and Mester (1997) for a model in which loan rate smoothing is positively related to bank profits.

4. We reiterate that we state this hypothesis primarily for heuristic purposes and recognize its weak micro foundations, especially the lack of a satisfying rationale for *systematic* pricing mistakes. Nonetheless, empirical findings of large deviations from efficiency (e.g., average cost inefficiency of 20-25 percent) have been routinely documented in the literature. For a summary of some of these findings see Berger and Mester (1997).

5. Broadly consistent with the views of those who propound this view, we use the term *inefficient* pricing. However, there is nothing inherently inefficient about a pricing policy that places a weight on non-pecuniary considerations. For example, a pricing policy that takes into account the value of the personal relationship between the banker and his customer, or for that matter, other business dealings between the banker and his customer, may maximize joint utility without maximizing profits. We might just as well have called this hypothesis, the *It's a Wonderful Life hypothesis*.

6. We are being loose here. To make this claim about profitability, we must assume that essentially all banks engage in loan rate smoothing and that there are few banks that engage in an opposite type of inefficient pricing, increasing firms' loan rates disproportionately when credit risk increases and lowering firms' loan rates disproportionately when credit risk decreases.

7. In the "Wonderful Life" interpretation, we would expect more smoothing and lower profits for those banks and customers who place more value on non-pecuniary factors.

8. We end our sampling period in 1989 to maintain a consistent panel without losing too many banks to mergers and failures.

9. We restrict attention to above-prime loans because we expect the relationship aspects of lending to be more important for above-prime borrowers. See Berlin and Mester (1997) for a more complete discussion and analysis of the differences between above- and below-prime borrowers.

10. See Table 1 for a full listing and description of all variables.

11. Average borrower size is also larger for larger banks, so local market conditions are likely to be more important to borrowers of smaller banks. Accordingly, we tend to weight results using UNEMPST relatively more heavily, the smaller the bank. Of course, our sample selection techniques censor most truly large borrowers, who borrow from multiple banks or have access to money markets and who produce for national markets. For such borrowers, a lending bank's local market conditions are not likely to be a good measure of credit risk.

12. We use the one-year Treasury bill rate rather than MMR, since MMR is a *loan-specific* variable and not a bank-specific variable.

13. Hughes, et al. (1996), among others, argue for the inclusion of financial capital in profit and cost studies.

14. An alternative would have been the ratio of nonperforming loans and leases to total gross loans and leases, but nonperforming loans and leases were not available on the Call Reports until 1982Q4.

15. In section 6.3 we discuss the results of a model that allows for X-inefficiency on the part of banks, omits smoothing as a variable in the model, and drops the share equations to allow for allocative inefficiencies.

16. Because the number of loans used in obtaining estimates of SMOOTHQ, SMOOTHU, and SMOOTHM is so large (over 480,000 observations), the standard errors of these estimates are very small, i.e., the estimates are very precise. Hence, we can essentially ignore the fact that these terms are estimated when we enter them into the cost and profit functions.

17. Because so very few observations involved negative variable profits, we dropped these observations and used a log-profit specification.

18. Note that over our full sample period, the average ROA and ROE in the commercial banking industry was 0.84 percent and 14.0 percent, respectively. Profitability was higher in the earlier subperiod than in the latter subperiod, with ROA and ROE equal to 0.98 percent and 16.7 percent, respectively, over 1977-82, and equal to 0.72 percent and 11.7 percent, respectively, over 1983-89.

19. But it should be noted that the statistical relationship between the risk measures and profitability is typically weak for all but the largest banks. This is particularly true for the earlier half of our sample period.

20. The results for medium-size banks are difficult to reconcile with the view that relationship lending is facilitated by less competitive banking markets. But we have some doubts about the proper interpretation of the positive effect of smoothing on profits for medium-size banks, which is significant only when credit risk is measured by QUALSP and only in the second subperiod. In this subperiod, QUALSP has a positive (although insignificant) effect on profits.

21. The negative relationship between profits and market interest rates should hold for two reasons: (i) Banks' liabilities are typically of shorter duration than their assets, and (ii) Given the short duration of most bank loans, the one-year Treasury bill rate is highly correlated with other short-term rates and may serve as an indicator of the stance of monetary policy. To the extent that short-term rates are predictors of GDP growth, as shown in work by Bernanke and Blinder (1992), the distinction between loan rate smoothing in response to credit-risk shocks and loan rate smoothing in response to interest-rate shocks is somewhat blurry.

22. The only change in results is that two of the elasticities of profits with respect to smoothing become insignificant because of decreased degrees of freedom. Note that because of too few degrees of freedom, we could not estimate the model over the subperiods with the averaged data.

23. In a few cases the frontier could not be estimated, since the residuals were not skewed in the direction

predicted by the stochastic frontier approach.

24. To examine this issue further, we identified the more efficient half of our sample (using the distribution-free approach that gives each bank's average level of efficiency over the sample period), and reestimated the profit and cost functions that included smoothing and credit risk or interest rate. For this subgroup of more efficient banks, we did not find that the largely negative relationship between credit-risk smoothing and profitability was reversed.

25. While we also find a significantly positive relationship between smoothing and profits for medium-size banks in the later subperiod (1983-89) when credit risk is measured by the quality spread, we are wary of concluding that this is evidence of efficient contracting, because in this case profits are positively related to credit risk (which seems quite unlikely).

26. See Carlton (1986) for empirical evidence and Rotemberg and Saloner (1987) for a theoretical model.

27. Berger and Udell (1990) provide evidence that collateralized loans are granted to riskier borrowers and Avery and Berger (1991) provide evidence that loans made under commitment are granted to less risky borrowers.

28. In our earlier paper we found no compelling evidence that loan rate smoothing was being driven by changes in credit screens.