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WORKING PAPER NO. 97-3/R

ON THE PROFITABILITY AND COST OF RELATIONSHIP LENDING

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and
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ON THE PROFITABILITY AND COST OF RELATIONSHIP LENDING

Abstract

We provide some preliminary evidence on the costs and profitability of relationship lending by commercial banks. Drawing upon recent research that has identified loan rate smoothing as a significant element in lending relationships between banks and firms, we carry out a two-stage procedure. In the first stage, we derive bank-specific measures of the extent to which the banks in our sample engage in loan rate smoothing for small business borrowers in response to exogenous shocks to their credit risk. In the second stage, we estimate cost and (alternative) profit functions to examine how loan rate smoothing affects a bank's costs and profits. On the whole our evidence says that loan rate smoothing is associated with *lower* costs and *lower* profits. These results do not support the hypothesis that loan rate smoothing arises as part of an optimal long-term contract between a bank and its borrower. However, we do find some limited support for smoothing as part of an optimal contract for small banks early in our sample period.

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. 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, along the lines of 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 and a measure of credit risk.[1] 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 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. Our 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 risk.

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.

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[1]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.

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. To the extent that a bank can offer smoother rates and remain profitable at the same time only by expending real resources, we expect banks with a higher degree of smoothing to have higher costs, all else equal. 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. But 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 completely competitive. In this case, banks with a higher degree of smoothing would be more profitable.[2] Thus, higher costs and higher profits would be the pattern most consistent with the efficient contracting hypothesis.

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.[3] 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.

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[2] See Berlin and Mester (1997) for a model in which loan rate smoothing is positively related to bank profits.

[3] 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 (forthcoming).

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*.[4] 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.[5,6]

The implications of inefficient pricing for the relationship between smoothing and costs are not so clear. 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 both to profits and costs. According to the inefficient pricing hypothesis,

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[4] 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*.

[5] 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.

[6]In the "Wonderful Life" interpretation, we would expect more smoothing and lower profits for those banks and customers who place more value on nonpecuniary factors.

we expect loan rate smoothing to be *negatively* related to profits, while there are no definite predicted relationships between loan rate smoothing and costs.

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. Thus, we expect to find the strongest evidence for efficient contracting among smaller banks.

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.[7] This survey collects information on the terms of each loan the

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

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.[8] 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 (measured in 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 regression:

$$\text{MARKUP}_{ijt} = a_{0j} + a_{1j}\text{CREDIT RISK}_{jt} + bX_{ijt}, \tag{1}$$

where *i* refers to the loan, *j* refers to the bank, and *t* refers to the quarter. We estimated the 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.[9] MARKUP is the difference between the loan rate and the rate on a Treasury security that had the same duration as the loan. 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

[8] 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.

[9] There are over 600,000 small business loans in our sample.

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.[10]

The vector X is a set of control variables that affect markups.[11] 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.[12] The market interest rate on the duration-matched Treasury security, and a time trend were also included.

Note that both the constant term, a_{0j}, and a_{1j}, the coefficient on CREDIT RISK, were allowed to vary over banks. The estimates of this coefficient for each of our two measures of credit risk, QUALSP and UNEMPST, provide two potential measures of loan rate smoothing in response to credit shocks. Note that in each case, an adverse credit-risk shock implies an increase in QUALSP or UNEMPST, so that loan

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[10]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.

[11] See Berlin and Mester (1997) for a more extensive discussion of the control variables.

[12]This Herfindahl index is the weighted-average of the Herfindahl indexes in all deposit markets in which the bank gets deposits, where the weight is the fraction of its deposits the bank gets from the market.

markups would rise, but the markup would rise less at a bank that was engaging in more smoothing than another bank. In other words, a smaller coefficient on the credit risk variable corresponds to more smoothing. So, we define two measures of the degree of 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*. Higher values for SMOOTHQ and SMOOTHU indicate more smoothing.

5. Cost and Alternative Profit Function Specifications

To investigate the costs and profitability of loan rate smoothing, we include our smoothing measures, along with our measure of credit risk, in variable cost and alternative variable profit function estimations. Note that we estimate the alternative profit function, which relates profit to input prices and output levels (and other control variables) rather than a standard profit function, which relates profit to input prices and output prices. 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 (forthcoming) 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 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 or SMOOTHU, and the associated measure of credit risk, QUALSP or UNEMPST. Including a measure of credit risk allows the effect of smoothing on cost and profits to vary with the severity of credit risk. 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.[15] 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:

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

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

$$
S_{1t} = b_1 + \sum_{i=1}^{2} g_{i1} \ln w_{it} + \sum_{i=1}^{2} d_{i1} \ln y_{it} + \sum_{k=1}^{6} t_{k1} \ln z_{kt} + \xi_{1t}, \tag{3}
$$

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 or SMOOTHU

z_2 = credit risk, QUALSP or UNEMPST

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.[16] 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 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 0.67. 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 weak at best. For example, the correlation between

[16]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.

average bank asset size and SMOOTHQ is only −0.26 and the correlation between bank size and SMOOTHU is an insignificant 0.13.

Table 1 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.

6.2 Profit and Cost Elasticities. Table 2 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, that is, 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 supports the inefficient pricing hypothesis but not the efficient contracting hypothesis.

The effect of the degree of smoothing on costs is less consistent. The signs of the coefficients on SMOOTHQ and SMOOTHU are negative for the sample period as a whole, although the effect is insignificant at conventional levels for SMOOTHQ. This coefficient is negative and significant for both measures of credit risk for the 1977-82 subperiod. The 1983-89 subperiod gives conflicting results for the two measures of credit risk. The coefficient is again negative and significant for SMOOTHU, but it is positive—although insignificant—for SMOOTHQ. Taken together, the results for all banks suggest that loan rate smoothing is associated with lower costs, when there is an association at all. Once again, there is little support for the efficient contracting hypothesis.

Table 3 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 that it is statistically significant, both for the entire sample period and for the subperiods (Panels A, B, and C). However, the statistical relationship between our 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.

Turning now to the relationship between the degree of smoothing and profitability, we find that for the two larger size classes of banks, the coefficient is always negative, significantly so in all but one case (Panels B and C). This supports the inefficient pricing hypothesis for these larger banks. For the smallest bank size class and for either measure of credit risk, however, 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). This is the one result that offers (partial) support for the efficient contracting hypothesis: that is, for small banks in the earlier part of our sample period, we cannot reject the hypothesis that loan rate smoothing was part of an efficient contracting arrangement.

The relationship between the degree of smoothing and costs is more erratic when banks are disaggregated by size. In particular, the coefficient on SMOOTHU is always significantly negative for the largest banks, both for the subperiods and for the entire sample period (Panel C). On the other hand, the coefficient on SMOOTHQ is significantly positive for these same banks for the later part of the sample period and for the sample period taken as a whole (the coefficient is insignificant for the earlier half of the sample period). Recall that we believe our credit risk measure, SMOOTHQ, is a better proxy for credit risk for larger banks than is SMOOTHU, since these larger banks are less likely to operate in localized markets. Thus, we feel that the results for SMOOTHQ are perhaps a better indicator of the relationship between cost and smoothing for the larger size category.

For the two smaller size classes and for either measure of credit risk, the coefficient on the degree of smoothing is negative whenever it is significant (Panels A and B). Note, however, the sign of the coefficient on SMOOTHU is highly insignificant for the smallest size class in the earlier subperiod (Panel A). And recall that credit risk is likely to be better measured by SMOOTHU than by SMOOTHQ for the smaller banks in our sample. This result provides further weak support for the efficient contracting hypothesis for the smallest banks in the sample in the earlier subperiod.

6.3 Robustness. 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.[17]

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

[17]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.

measures and smoothing. To derive the bank-specific cost and profit inefficiency measures, we used the stochastic frontier approach 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. 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. In almost all cases, the results showed that banks engaged in a higher degree of smoothing were less efficient.[18] An exception was the smallest banks in the earliest subperiod—in this case there is no statistically significant relationship between smoothing and profit efficiency or cost efficiency. These results support those discussed above.

6.4 Summary. We summarize our results as follows:

For the second half of our sample period (1983-89) the efficient contracting hypothesis is rejected for all sizes of banks. Profits are typically significantly lower for those banks that offer smoother loan rate profiles. Further, costs are lower in all but one instance (large banks with aggregate credit risk as measured by the quality spread). For the earlier part of the sample period (1977-82), the story is essentially the same for larger banks—those in the two larger size classes. There is always a negative association between profitability and loan rate smoothing for these banks. The relationship between smoothing and costs is erratic and sensitive to the measure of risk in the earlier part of the sample period.

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[18]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.

The efficient contracting hypothesis, which predicts higher profits and costs for banks that smooth, is never supported completely. However, in the earlier part of the sample period, we do find a positive relationship between loan rate smoothing and profits among the smallest group of banks in our sample. During this period, we find no evidence of a positive relationship between costs and loan rate smoothing, but when credit risk is measured by UNEMPST, the negative relationship is very weak.[19] Thus, one could argue that the small banks found that loan rate smoothing was part of an optimal contracting strategy in the late 1970s and early 1980s, but that in more recent times, the value of this type of contract has diminished. The fact that it is the smallest banks that found smoothing to be profitable and that it was in the earlier part of the sample period is consistent with anecdotal evidence that relationship lending is a small-bank phenomenon that has become less profitable in recent times.

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. It is natural to search for alternative explanations for our results before placing too much weight on the idea that banks have systematically mispriced loans, undercharging high-risk borrowers and overcharging low-risk borrowers.

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

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[19]While we can make a credible argument that for the smaller banks, which operate largely in local loan markets, UNEMPST is the measure of credit risk that best captures the information in our sample, we cannot ignore the significantly negative relationship between smoothing and costs when QUALSP is the measure of credit risk.

relationship between market power and price rigidity is one that has both theoretical and empirical foundations.[20] 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 smoothing are acting as proxies for monopoly power, then we would expect a positive relationship between smoothing 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. Although our regressions contain some instances of a positive relationship between loan rate smoothing and costs, the opposite relationship is more common.

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.[21] 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

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

[21] 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.

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 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 this is the one group of banks displaying a positive relationship between loan rate 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.[22]

8. Conclusion

In this paper, we conduct an empirical investigation of the hypothesis that loan rate smoothing in response to credit shocks is part of an efficient contracting scheme, as in Petersen and Rajan (1995) or Berlin

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

and Mester (1997). In particular, we construct measures of the degree of smoothing for a panel of banks during the 1977-89 time period. We then estimate cost and (alternative) profit functions to examine the relationship between smoothing and banks' costs and profitability. We estimate these cost and profit 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 costs will be higher and profits greater for banks that engage in more 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 and profitability. However, the weight of the evidence is against the efficient contracting hypothesis. For medium and large banks in the first half of the sample period, and for all banks in the second half of the sample period, smoothing and profitability are negatively related. Although the relationship between smoothing and costs is more erratic, a significantly negative relationship is the more common finding.

We consider various alternative explanations of our results. The results appear to be most consistent with a view common among practitioners 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. Practitioners who are proponents of this view have typically argued that competition from banks, nonbank intermediaries, and capital markets has increasingly forced banks to charge loan rates more in line with true credit risk. However, given the weak formal micro foundations of this inefficient pricing view, we are wary of drawing any conclusions on the basis of these results about the future role of banks in the small business lending markets. And 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. Means and Medians Across Smoothing Quartiles†

		Q1 Less Smoothing	Q2	Q3	Q4 More Smoothing
		SMOOTHQ < −2.14	−2.14 ≤ SMOOTHQ < −1.84	−1.84 ≤ SMOOTHQ < −1.65	−1.65 ≤ SMOOTHQ
Total Assets‡	**mean**	$18.3 billion[2,3,4]	$8.8 billion[1,3,4]	$2.5 billion[1,2]	$2.4 billion[1,2]
	median	$3.8 billion[2,3,4]	$2.2 billion[1,3,4]	$1.6 billion[1,2,4]	$0.93billion[1,2,3]
Equity/Assets	**mean**	5.91%[2,3,4]	6.07%[1,3,4]	6.77%[1,2]	6.82%[1,2]
	median	5.67%[2,3,4]	5.92%[1,3,4]	6.42%[1,2]	6.56%[1,2]
Core Deposits/Assets	**mean**	53.3%[2,3,4]	56.4%[1,3,4]	61.4%[1,2]	66.7%[1,2,3]
	median	54.2%[2,3,4]	60.7%[1,3,4]	61.6%[1,2,4]	65.8%[1,2,3]
Net Charge Offs/Assets	**mean**	0.090%[2]	0.078%[1]	0.080%	0.084%
	median	0.054%[3,4]	0.050%[3,4]	0.044%[1,2]	0.043%[1,2]
Nonperforming Loans & Leases/Assets	**mean**	1.84%[2,3,4]	1.45%[1]	1.47%[1]	1.48%[1]
	median	1.54%[2,3,4]	1.09%[1]	1.14%[1,4]	0.99%[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 1% or better level.

[2.] Significantly different from Q2 at the 1% or better level.

[3.] Significantly different from Q3 at the 1% or better level.

[4.] Significantly different from Q4 at the 1% or better level.

Table 2. Relationship Between Smoothing, Costs, and Profits for the Entire Bank Sample†

	Credit Risk Measure	
	SMOOTHQ	**SMOOTHU**
1977-89		
Elasticity of Profit with respect to Credit Risk	−6.60*	−0.0196*
	(−2.78)	(−4.51)
Elasticity of Cost with respect to Smoothing	−0.00112	−17.6*
	(−0.115)	(−6.16)
Elasticity of Profit with respect to Smoothing	−0.227*	−91.9*
	(−8.45)	(−10.6)
1977-82		
Elasticity of Profit with respect to Credit Risk	−11.1*	−0.0598*
	(−4.02)	(−6.67)
Elasticity of Cost with respect to Smoothing	−0.0361*	−53.3*
	(−2.18)	(−9.36)
Elasticity of Profit with respect to Smoothing	−0.170*	−121.0*
	(−3.96)	(−6.89)
1983-89		
Elasticity of Profit with respect to Credit Risk	−16.3*	−0.0370*
	(−2.53)	(−6.69)
Elasticity of Cost with respect to Smoothing	0.0162	−11.70*
	(1.47)	(−3.78)
Elasticity of Profit with respect to Smoothing	−0.192*	−50.4*
	(−5.49)	(−5.10)

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

Table 3. Relationship Between Smoothing, Costs, and Profits 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	0.0989 (0.0333)	−0.00799** (−1.758)	−2.56 (−0.802)	0.00175 (0.398)	−6.32 (−1.08)	0.0141 (0.839)
Elasticity of Cost with respect to Smoothing	−0.0502* (−4.61)	−12.8* (−3.56)	−0.0266* (−4.14)	−23.1* (−15.2)	0.0632* (4.46)	−43.4* (−8.10)
Elasticity of Profit with respect to Smoothing	−0.0730* (−3.38)	−29.8* (−3.80)	−0.0904* (−3.73)	−27.7* (−3.81)	−1.12* (−7.73)	−392.0* (−6.35)
1977-82						
Elasticity of Profit with respect to Credit Risk	−4.20 (−1.23)	0.00787 (0.995)	−2.13 (−0.692)	0.00436 (0.617)	−9.56* (−2.52)	−0.0628* (−2.74)
Elasticity of Cost with respect to Smoothing	−0.0838* (−5.21)	−1.72 (−0.329)	0.00428 (0.507)	−18.5* (−8.43)	−0.00483 (−0.349)	−28.6* (−7.21)
Elasticity of Profit with respect to Smoothing	0.172* (5.17)	25.77* (2.16)	−0.156* (−5.26)	−7.01 (−0.590)	−1.11* (−6.61)	−357.0* (−4.29)
1983-89						
Elasticity of Profit with respect to Credit Risk	−18.0* (−2.20)	−0.00469 (−0.755)	0.803 (0.0998)	−0.0178* (−3.24)	−35.3* (−2.14)	−0.0820* (−2.51)
Elasticity of Cost with respect to Smoothing	−0.0744* (−5.43)	−10.9* (−2.42)	−0.0228* (−2.78)	−22.7* (−11.3)	0.118* (4.21)	−66.7* (−8.80)
Elasticity of Profit with respect to Smoothing	−0.128* (−3.98)	−31.5* (−2.86)	−0.0908* (−2.62)	−33.5* (−3.83)	−1.38* (−3.70)	−365.0* (−3.52)

† 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.