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Deregulation, technological change, and the business-lending performance of large and small banks

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Abstract

According to DeYoung et al. [Journal of Financial Services Research, 2004] deregulation and technological change has divided the US banking industry into two primary size-based groups: very large banks, specializing in the use of "hard" information to make standardized loans and smaller banks, specializing in the use of "soft" information and relationship development to make non-standardized loans. We evaluate business-lending performance for small and large banks over the 1993–2001 period. Small business lending by small banks is characterized by relationship development and non-standardized loans. Consistent with DeYoung et al.'s model, we find that, after controlling for market concentration, cost of funds, and a variety of other factors that might influence yields, smaller banks perform better than larger banks in the small business lending market. However, larger banks appear to have the advantage in credit card lending, a market characterized by impersonal relationships and standardized loans. Interestingly, we find evidence that larger banks have been making inroads in the market for the smallest business loans, a result consistent with the use of credit scoring by large banks to make very small business loans [Berger et al., Journal of Money, Credit, and Banking, 2004].

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1. Introduction

Recent changes in regulation and the widespread adoption of new banking technologies have had a profound impact on the business of banking. These changes have important implications for the competitive structure of the banking industry. Similarly, consolidation has sparked concern about the future of small banks. Small banks are a primary source of financing for small business firms, which are an important engine of economic growth.

A substantial literature suggests that relationship development and the reduction of asymmetric information is at the heart of the financial intermediation process (e.g., Diamond, 1984; Boot, 2000). DeYoung et al. (2004) argue that deregulation and technological change have transformed the banking industry into two primary size-based groups. The first group is comprised of very large banking institutions, characterized by the use of "hard" information, impersonal relationships, low unit costs, and standardized loans. The second group is made up of small banks, characterized by the use of "soft" information, relationship development, higher unit costs, and non-standardized loans. Berger et al. (2002) suggest that because of different sets of incentives within the organizational structures of small and large banks, small banks have a comparative advantage (relative to large banks) in making loans based on "soft" information. They define soft information as information that "cannot be credibly communicated from one agent to another" (p. 3). Soft information may be important in the lending process when firms are in existence for a short period of time and/or firms that lack a long history of verifiable financial information (see also Stein, 2002). Many of these firms are likely to be small.

Prior research by Carter et al. (2004) finds evidence consistent with the notion that small banks have better small business-lending performance than large banks. We extend their research by examining how lending performance at small and large banks has changed over the period of 1993–2001, a time period characterized by important regulatory and technological changes. Our measure of lending performance is the net return on loans, defined as interest revenue, less net charge-offs and allocated expenses. This differs from the measure used by Carter et al. who do not include expenses as part of their performance measure. If small business lending is more expensive, the benefits of earning higher yields are reduced and in some cases may be eliminated.

We find an inverse relationship between bank size and the net return on small business lending, suggesting that smaller banks are better at making these types of loans. Interestingly, the advantage in this market, held by small banks, appears to have declined for the smallest loans (e.g., <$100,000). This result is consistent with Berger et al.'s (2004) findings that credit scoring has allowed larger banks to make inroads in the market for very small business loans. We also find evidence that larger banks perform better with respect to credit card lending. These results are consistent with the implications of DeYoung et al.'s (2004) model of deregulation and technological change.

The paper proceeds as follows: Section 2 provides a review of the relevant literature; Section 3 discusses methodology and data; Section 4 presents our results while Section 5 concludes.

2. Literature review: Business lending at large and small banks

2.1. Do small banks have an advantage in lending?

A number of studies have addressed the issue of lending performance by large and small banks. There are a number of possible sources of a small bank advantage in certain lending markets. First, small banks may have access to information not available to large banks. Nakamura (1993a,b, 1994); Peterson and Rajan (1994), and Mester et al. (2003) suggest that small banks have access to better credit information than large banks through the firm's deposit accounts. For example, a bank loan officer monitoring a business deposit account can observe adverse (or favorable) trends in inflows and outflows of funds (i.e. sales and expenses). Importantly, this information would only be useful for making credit decisions if the firm has one deposit relationship. Small firms dealing with small banks fit this profile. In contrast, a large bank dealing with a large firm having multiple divisions and multiple banking relationships would not be able to effectively monitor business deposit accounts.

A second reason small banks might have an advantage is that they develop lending relationships to reduce asymmetric information problems. In contrast, the typical career path of a loan officer at a large bank frequently involves changes in location and responsibility, making long-term relationships more difficult to develop and maintain. Diamond (1984), Boot (2000), and many others suggest that these activities are a source of economic value for financial institutions. Peterson and Rajan (1994) document the value of lending relationships. Further, Peterson and Rajan (1995) suggest that small banks in less competitive markets have a greater incentive to invest in loan relationships because there is less chance that the borrower will switch to a competing lender. Akhigbe and McNulty (2003) report that 57% of small US banks are in non-metropolitan areas, so the typical small bank should have greater investment in small-firm relationships, which could give them an advantage in their lending activities.

A third reason small banks may have an advantage in some lending markets is their organizational structure. Udell (1989) argues that there is an agency problem between a bank and its loan officers because a loan officer may use his position for personal gain to the detriment of the bank. Nakamura (1993b) suggests that this agency problem is less severe at small banks because senior management is closer to both the loan officer and the commercial loan customer, thus monitoring costs are lower.

Finally, the type of information used in the evaluation of a loan may differ depending on the size of the bank. For instance, Cole et al. (2004) find that small banks tend to use more subjective measures (i.e., "soft" information) to analyze business loans, while large banks use quantitative financial data (i.e., "hard" information). Further, Berger et al. (2002) find that firms doing business with large banks typically interact in more impersonal ways, with shorter, less exclusive banking relationships than firms dealing with small banks. Berger and Udell (2002) argue that small, closely held organizational structures, with few managerial levels are best at resolving agency problems and managing the soft information about clients acquired

by loan officers. Recent evidence suggests that community-banking institutions have a niche in generating soft information that is rated highly by small firms (Scott, 2004). Further, the results of Scott's study suggest an inverse relationship between loan officer turnover and soft information acquisition. DeYoung et al. (2004) argue that smaller banks can effectively use soft information to evaluate non-standard loans (e.g., small business loans), while large banks can use hard information to analyze more standardized loans (e.g., credit card loans).

Taken together, prior research suggests that the combination of access to deposit accounts, relationship development, organizational structure, and the generation and use of soft information may give small banks an advantage in some markets. However, large banks also have advantages that help them dominate certain lending markets, such as the ability to readily adopt new technology and take advantage of scale economies to offer standardized services at low unit costs.

2.2. Changes in regulation and technology

Two important recent regulatory changes came in the form of the 1994 Riegle–Neal Interstate Banking and Branching Efficiency Act and the 1999 Graham–Leach–Bliley Act. Riegle–Neal effectively ended the hodgepodge of state-by-state reciprocal compacts and geographic restrictions on branching while Graham–Leach–Bliley repealed the Glass–Steagall Act of 1933 by allowing commercial banks to become more heavily involved in other activities, such as investment banking. The result of these regulatory changes, particularly Riegle–Neal, was a flood of bank mergers that, according to Berger et al. (2003), was the highest in terms of number and value of banks acquired over any five-year period. An important consequence of deregulation and technological change has been increased competition in the banking industry.

DeYoung and Hunter (2003) and DeYoung et al. (2004) present a framework for analyzing the effects of deregulation and technological change. They argue that prior to deregulation, most banks tended to be small, less efficient, and have high unit costs. However, in the post deregulation environment, some banks became very large, developed economies of scale, and had low unit costs. [1] As such, these banks should enjoy advantages in the production of more standardized products and services, such as credit card loans and standardized mortgage loans. However, some banks stayed relatively small, did not reap the benefits of scale economies, and had higher unit costs. They predict that these banks should enjoy advantages in non-standardized products and services, such as small business loans and personalized private banking. Thus, banks that are small are expected to make use of soft information to specialize in products and services that are more personalized, while

[1] While we do not directly address the issue of economies of scale in this paper, a substantial literature finds scale effects in the banking industry. DeYoung et al. (2004) provide a brief review of several studies that investigate the existence of some degree of economies of scale in banking.

large banks should make use of hard information to specialize in standardized products and services.

In addition to deregulation, the adoption of new technology, such as electronic payment systems, ATM networks, and Internet banking, has also produced dramatic changes in the financial services industry. DeYoung et al. (2004) argue that these technologies allow banks to further reduce unit costs, particularly large banks that are better able to afford new technology. As a result, they suggest that some segments of retail banking (e.g., home mortgages, credit card loans, and online brokerage) have evolved into a high volume, low cost business, dominated by large financial institutions. Nevertheless, it is not clear that the market for non-standardized products has been affected in the same way by technological change.

Particularly relevant to this study is the adoption of credit scoring to evaluate very small business loans. Credit scoring makes use of the credit history of the entrepreneur in the evaluation of a small business loan. Berger et al. (2004) find evidence that the use of credit scoring is associated with an increase in lending. An important research question, which we address, is whether the use of credit scoring by large banks allows them to successfully compete against smaller community banks in making small business loans.

Changes in technology and regulation have dramatically changed the market for financial services. These changes have allowed large banks to grow larger, take advantage of economies of scale, and use hard information to dominate the market for standardized financial services products. The primary empirical question this research addresses is whether the above mentioned advantages of small banks allow them to successfully carve out a market niche in which they use soft information and relationships to more profitably provide non-standardized financial services. In the following section, we discuss our hypotheses and data sources used in this investigation.

3. Data and methodology

3.1. Model development and hypotheses

Given the prior discussion, business loan yields can be greater at small banks because of the hypothesized advantages discussed above. However, small business loans tend to have higher gross yields than loans to larger businesses, regardless of whether the loan is made by a large or small bank. Because small banks tend to have a greater percentage of small business loans in their portfolios, they also tend to have higher gross yields. Thus, in addition to enjoying the hypothesized small bank advantages discussed in the prior section, a small bank may earn higher yields on business lending because they have a greater proportion of higher yielding small business loans in their loan portfolios. To address this issue, we propose a model that clearly separates the size-of-bank from the size-of-loan effects. Following Carter et al. (2004), we posit that interest revenue on business loans depends on the dollar amount of small business loans outstanding at that bank (SMBUS), the dollar

amount of all other business loans outstanding at that bank (BLOAN − SMBUS), and bank size. Finally, we include a term to capture interaction between bank size and the dollar amount of outstanding small business loans (SMBUS×TASSET). The hypothesized relationship is shown in Eq. (1):

$$I_{it} = \beta_1 \mathrm{SMBUS}_{it} + \beta_2(\mathrm{BLOAN}_{it} - \mathrm{SMBUS}_{it}) + \beta_3(\mathrm{SMBUS}_{it} \times \mathrm{TASSET}_{it}) + \beta_4 \ln(\mathrm{TASSET}_{it}) + \varepsilon_{it}, \tag{1}$$

where I_{it} = interest revenue on business loans for bank i at time t, less allocated expenses and net charge-offs (i.e., charge-offs less recoveries) on business loans; SMBUS_{it} = amount of small business loans for bank i at time t; BLOAN_{it} = total amount of business loans for bank i at time t; TASSET_{it} = total assets for bank i at time t, and ε_{it} = standard error term.

We scale both sides of Eq. (1) by total business loans (BLOAN) so that the dependent variable is expressed as a percentage, allowing us to compare net returns for banks of different sizes. The effect of scaling both sides of the model is shown below in Eq. (2):

$$\frac{I_{it}}{\mathrm{BLOAN}_{it}} = \beta_1 \frac{\mathrm{SMBUS}_{it}}{\mathrm{BLOAN}_{it}} + \beta_2 \frac{(\mathrm{BLOAN}_{it} - \mathrm{SMBUS}_{it})}{\mathrm{BLOAN}_{it}} + \beta_3 \frac{(\mathrm{SMBUS}_{it} \times \mathrm{TASSET}_{it})}{\mathrm{BLOAN}_{it}} + \beta_4 \frac{\ln(\mathrm{TASSET}_{it})}{\mathrm{BLOAN}_{it}} + \frac{\varepsilon_{it}}{\mathrm{BLOAN}_{it}}. \tag{2}$$

Rearranging Eq. (2) results in

$$\frac{I_{it}}{\mathrm{BLOAN}_{it}} = (\beta_1 - \beta_2) \frac{\mathrm{SMBUS}_{it}}{\mathrm{BLOAN}_{it}} + \beta_2 + \beta_3 \frac{(\mathrm{SMBUS}_{it} \times \mathit{TASSET}_{it})}{\mathrm{BLOAN}_{it}} + \beta_4 \frac{\ln(\mathrm{TASSET}_{it})}{\mathrm{BLOAN}_{it}} + \frac{\varepsilon_{it}}{\mathrm{BLOAN}_{it}}. \tag{3}$$

Our measure of lending performance is $I_{it}/\mathrm{BLOAN}_{it}$ which we term "Net Return" (NETRET). Specifically, NETRET is defined as interest income from business lending, less total expenses, allocated based upon the ratio of interest income on business loans to total income, and net charge-offs, scaled by the total amount of outstanding business loans. Substituting NETRET_{it} for $I_{it}/\mathrm{BLOAN}_{it}$ results in

$$\mathrm{NETRET}_{it} = (\beta_1 - \beta_2) \frac{\mathrm{SMBUS}_{it}}{\mathrm{BLOAN}_{it}} + \beta_2 + \beta_3 \frac{(\mathrm{SMBUS}_{it} \times \mathrm{TASSET}_{it})}{\mathrm{BLOAN}_{it}} + \beta_4 \frac{\ln(\mathrm{TASSET}_{it})}{\mathrm{BLOAN}_{it}} + \frac{\varepsilon_{it}}{\mathrm{BLOAN}_{it}}. \tag{4}$$

To explore how the relationships among the net return, size, and the amount of business lending have changed over the sample period, we incorporate a time term, similar to that used by Hunter and Timme (1986, 1991). As such, $T = 0, 1, 2, \ldots, 8$ for years 1993–2001. We then modify Eq. (4) by adding interaction terms between T and each of the terms in Eq. (4). The resulting model is shown in Eq. (5) below:

$$\begin{aligned}\mathrm{NETRET}_{it} = {} & (\beta_1 - \beta_2)\frac{\mathrm{SMBUS}_{it}}{\mathrm{BLOAN}_{it}} + \beta_2 + \beta_3\frac{(\mathrm{SMBUS}_{it} \times \mathrm{TASSET}_{it})}{\mathrm{BLOAN}_{it}} \\ & + \beta_4\frac{\ln(\mathrm{TASSET}_{it})}{\mathrm{BLOAN}_{it}} + (\theta_1 - \theta_2)T\frac{\mathrm{SMBUS}_{it}}{\mathrm{BLOAN}_{it}} + \theta_2 T \\ & + \theta_3 T\frac{(\mathrm{SMBUS}_{it} \times \mathrm{TASSET}_{it})}{\mathrm{BLOAN}_{it}} + \theta_4 T\frac{\ln(\mathrm{TASSET}_{it})}{\mathrm{BLOAN}_{it}} + \frac{\varepsilon_{it}}{\mathrm{BLOAN}_{it}}. \end{aligned} \tag{5}$$

We use thetas (θ) rather than betas (β) to distinguish the coefficients on the terms incorporating the time variable. The economic interpretation of the theta coefficients is essentially the same as the betas with the exception that they account for the effect of time on the parameters of the model.

We also include several control variables in our estimation of Eq. (5). Because returns on small business loans may vary due to changes in interest rates, we include the mean of the annualized monthly yields on 90-day, constant maturity US Treasury Bills. The size of loan may also affect the yield. One reason for this is that the relative cost of making larger loans is less. In addition, competitive pressures tend to reduce yields, especially on larger loans. Thus, the average size of a bank's business loans should help explain the net yield. The data necessary to calculate the average size of a bank's *total* business loans are not available from the Call Reports, so we use the average size of a bank's *small* business loans (AVG_SIZE_SMBUS) as a proxy. AVG_SIZE_SMBUS is calculated using data from the June Call Reports and is equal to the total amount of a bank's small business loans (<$1 million) divided by the number of small business loans.

Another factor that might influence loan yield is the level of competition in the market. Berger et al. (2001) find that small business loan rates depend more on the structure of the market than on the size of the bank making the loan. The effect of differences in market competition is measured by including the logarithm of the Herfindahl–Hirschman Index (LNHERF). We calculate the Herfindahl–Hirschman Index by county, using the FDIC's branch office survey.

Keeton (1995) argues that small banks affiliated with bank holding companies may act more like large banks. To control for this possibility, we include a dummy variable (BHCDUM) that is equal to one if the bank is a member of a bank holding company, and zero otherwise.

Finally, we include two measures of bank risk that might affect managerial incentives in making and pricing loans. These measures are: (1) GAP/TASSET, the absolute value of the 12-month maturity mismatch; i.e., the gap between a bank's variable rate assets and its variable rate liabilities, scaled by total assets and (2) LIQUIDITY/TASSET, total liquid assets divided by total assets.

The estimation of Eq. (5) allows us to test four important hypotheses:

- *Hypothesis 1 [H1]: Returns on business loans have remained constant over time.* We investigate this hypothesis by evaluating the partial derivative of net return, with respect to the time variable (i.e., $\partial\mathrm{NETRET}/\partial T$), using the estimated parameters of the model. The analytic form of this derivative is

$$\frac{\partial \text{NETRET}}{\partial T} = (\theta_1 - \theta_2)\frac{\text{SMBUS}}{\text{BLOAN}} + \theta_2 + \theta_3\frac{(\text{SMBUS} \times \text{TASSET})}{\text{BLOAN}} + \theta_4\frac{\ln(\text{TASSET})}{\text{BLOAN}}. \quad (6)$$

We then test whether the value of the partial derivative is equal to zero. A finding that $\partial \text{NETRET}/\partial T$ is less than zero is consistent with the notion that yields on business loans have declined due to increased competition.

- *Hypothesis 2 [H2]: Yields for business loans are the same for small banks as for large banks.* We investigate this hypothesis by evaluating $\partial \text{NETRET}/\partial \text{TASSET}$ and testing whether it is equal to zero. This partial derivative takes on the following form:

$$\frac{\partial \text{NETRET}}{\partial \text{TASSET}} = \beta_3\frac{\text{SMBUS}}{\text{BLOAN}} + \beta_4\frac{1}{\text{BLOAN} \times \text{TASSET}} + \theta_3 T\frac{\text{SMBUS}}{\text{BLOAN}} + \theta_4 T\frac{1}{\text{BLOAN} \times \text{TASSET}}. \quad (7)$$

This hypothesis is an important test of whether small banks have an advantage in business lending. Failure to reject this hypothesis implies that the rate of return on business loans is the same for small banks as for large banks, suggesting that small banks are no more effective making business loans than large banks. Alternatively, rejection of Hypothesis 2 suggests that returns on business lending are related to bank size. A finding that $\partial \text{NETRET}/\partial \text{TASSET} < 0$ would be consistent with small banks having an advantage in the market for certain types of business lending (e.g., those made to their traditional customer group, small business). It is important to note that the evaluation of $\partial \text{NETRET}/\partial \text{TASSET}$ is accomplished holding all other variables constant. A finding that $\partial \text{NETRET}/\partial \text{TASSET} \neq 0$ is not attributable to differences in the ratio of small business loans (which may have different yields compared to larger business loans) to total business loans or to market concentration.

- *Hypothesis 3 [H3]: The relationship between the return to small business loans and bank size has remained constant over time.* We test this hypothesis by evaluating $\partial^2 \text{NETRET}/\partial T \partial \text{TASSET}$ and testing whether it is equal to zero. This is an important test of the effect of changes in regulation and technology on banks' business-lending performance. Eq. (8) provides the form of this partial derivative:

$$\frac{\partial^2 \text{NETRET}}{\partial T\, \partial \text{TASSET}} = \theta_3\frac{\text{SMBUS}}{\text{BLOAN}} + \theta_4\frac{1}{\text{BLOAN} \times \text{TASSET}}. \quad (8)$$

Changes in regulation or technology might alter the relationship between net return and bank size. A rejection of the null hypothesis suggests that the relationship between net return and size varies over time.

- *Hypothesis 4 [H4]*: *The relationship between the net return on business loans and bank size is constant with respect to size (i.e., the relationship between net return and size is linear).* We investigate this hypothesis by testing whether the second

partial derivative of net return, with respect to bank size (∂^2NETRET/∂TASSET^2) is equal to zero. This partial derivative can be expressed as

$$\frac{\partial^2 \text{NETRET}}{\partial \text{TASSET}^2} = -\beta_4 \frac{1}{\text{BLOAN} \times \text{TASSET}^2} - \theta_4 T \frac{1}{\text{BLOAN} \times \text{TASSET}^2}. \quad (9)$$

Failure to reject this hypothesis is consistent with the existence of a linear relationship between size and lending performance. Rejection of the null hypothesis, in this case, suggests a non-linear relationship between business-lending performance and bank size.

3.2. Data sources

In this study, we use data from the FDIC's *Report of Condition and Income* (Call Report) over the 1993–2001 period. These data are available on the Federal Reserve Bank of Chicago's website (http://www.chicagofed.org/economic_research_and_data/commercial_bank_data.cfm). We obtain data on loans to small businesses from the June call reports. We use the mean of the annualized monthly yields on 90-day, constant maturity US Treasury Bills to measure the level of interest rates. These data are obtained from the Federal Reserve Bank of St. Louis website (http://www.stls.frb.org/fred/). We do not include banks having total assets less than $300 million in our sample because of differences in the way interest income is reported for banks under and over $300 million in total assets. [2] We also eliminate those banks with missing or unusable data. The resulting sample consists of 8330 observations for the nine-year period. In Table 1, we report the mean, standard deviation, and median for several variables for our sample banks. The average size of a sample bank is $4.5 billion with a median size of $727 million. Almost 85% are located in a MSA and 83% are affiliated with a bank holding company. On average, business loans (C&I) make up almost 13% of total assets with small business loans (<$1 million) accounting for about 57% of total business loans.

We break out our sample into small and large banks for a rough comparison of several variables. Following Nakamura (1994) we categorize banks with total assets greater than $1 billion as large banks; we consider those with total assets between $300 million and $1 billion to be small banks. [3] Table 2 reports means and *t*-tests for comparisons of large and small banks. Relative to small banks, large banks

[2] As discussed in Carter et al. (2004, footnote 8) prior to 2001, interest income from all other loans was included with interest income from commercial loans for banks with total assets less than $300 million in the Call Reports. While we are concerned about the loss of so many small banks, there is no way to accurately compute the net return on *business* loan for these banks. Beginning in 2001, the reporting of interest income for banks with less than $300 million in total assets was consistent with those banks having greater than $300 million in total assets. As a robustness check, we perform our analysis separately on the 2001 data. While not reported in this paper, the results for 2001 are consistent with those reported in this paper, suggesting that the exclusion of banks with total assets less than $300 million does not alter the primary findings of this paper.

[3] DeYoung et al. (2004) create several categories of banks but use $1 billion at the cut off between large community banks and mid-sized banks (large banks begin at $10 billion).

Table 1
Descriptive statistics for sample banks (1993–2001)

Variable	Mean	Standard deviation	Median
Total assets	$\$4.51\times10^9$	$\$2.22\times10^{10}$	$\$7.27\times10^8$
Herfindahl–Hirschman Index	0.2405	0.1232	0.2176
MSA location dummy	0.8462	0.3608	1.0000
BHC member dummy	0.9310	0.2535	1.0000
C&I loans as a percentage of total assets	0.1274	0.0872	0.1080
Small business loans as a percentage of total assets	0.0642	0.0473	0.0565
Small business loans as a percentage of all C&I loans	0.5724	0.2932	0.6048
Credit card loans as a percentage of total assets	0.0178	0.0595	0.0048
Net yield on C&I loans	0.0200	0.0233	0.0192
Net yield on credit card loans	0.0092	0.0578	0.0105

This table reports means, standard deviations, and medians for several variables for sample banks over the period of 1993 through 2001. The data and are taken from the FDIC's *Report of Condition and Income* (Call Reports), made available on the Federal Reserve Bank of Chicago's website (http://www.chicagofed.org/economic_research_and_data/commercial_bank_data.cfm). The number of observations is 8330.

are more likely to operate in more competitive metropolitan markets, are more likely to be affiliated with a bank holding company, make relatively fewer small business loans but more credit card loans.

4. Empirical results

We present results of the estimation of Eq. (5) and tests of our hypotheses in Tables 3 and 4. The dependent variable in each of the models shown in both tables is the net return on business lending (NETRET). In Table 3, our measure of small business lending includes all business loans with original amounts less than $1 million, while in Table 4; we restrict small business loans to those business loans with original amounts less than $100,000. In each table we provide two sets of estimates: pooled OLS and random effects. The incorporation of the time term in our model allows us to test how lending performance has changed with respect to time. Further, we can test whether the relationship between bank size and lending performance was constant over the time period. For brevity, we do not report the results for some of the control variables (e.g., BHC dummy, 12-month maturity gap, liquid assets, etc.).

Before addressing tests of our four hypotheses, we make note of the results for some of the other variables. As expected, the level of interest rates, as measured by the 30-day US Treasury-Bill rate is positive and significant for all models, suggesting the relationship between market interest rates and our measure of lending performance (NETRET) is positive. Additionally, the estimates for the logarithm of the Herfindahl–Hirschman Index are positive and statistically significant. This result is consistent with the proposition that interest rates on loans are higher in more con-

Table 2
Comparisons of large and small banks (1993–2001)

Variable	1993–1995 only ($n = 1107$)	1996–1998 only ($n = 1055$)	1999–2001 only ($n = 1102$)	Complete sample 1993–2001 ($n = 3264$)
Panel A: Large banks				
Total assets	$\$7.83\times10^9$	$\$1.09\times10^{10}$	$\$1.34\times10^{10}$	$\$1.07\times10^{10}$
	(1.83×10^{10})	(3.15×10^{10})	(4.72×10^{10})	(3.45×10^{10})
Herfindahl–Hirschman Index	0.227	0.221	0.223	0.224
	(0.096)	(0.089)	(0.099)	(0.095)
MSA location dummy	0.973	0.955	0.936	0.955
	(0.162)	(0.206)	(0.246)	(0.208)
BHC member dummy	0.978	0.965	0.964	0.969
	(0.146)	(0.184)	(0.187)	(0.173)
C&I loans as a percentage of total assets	0.146	0.149	0.145	0.146
	(0.092)	(0.099)	(0.104)	(0.098)
Small business loans as a percentage of total assets	0.048	0.052	0.053	0.051
	(0.034)	(0.035)	(0.040)	(0.037)
Small business loans as a percentage of all C&I loans	0.392	0.437	0.454	0.427
	(0.257)	(0.268)	(0.263)	(0.264)
Credit card loans as a percentage of total assets	0.029	0.025	0.019	0.024
	(0.063)	(0.076)	(0.084)	(0.075)

Variable	1993–1995 only ($n = 1643$)	1996–1998 only ($n = 1621$)	1999–2001 only ($n = 1802$)	Complete sample 1993–2001 ($n = 5066$)
Panel B: Small banks				
Total assets	$\$5.32\times10^{8***}$	$\$5.44\times10^{8***}$	$\$5.43\times10^{8***}$	$\$5.40\times10^{8***}$
	(1.84×10^{8})	(1.78×10^{8})	(1.73×10^{8})	(1.78×10^{8})
Herfindahl–Hirschman Index	0.240***	0.249***	0.263***	0.251***
	(0.118)	(0.135)	(0.154)	(0.137)
MSA location dummy	0.837***	0.776***	0.721***	0.776***
	(0.370)	(0.417)	(0.448)	(0.417)
BHC member dummy	0.902***	0.909***	0.908***	0.906***
	(0.297)	(0.288)	(0.288)	(0.291)
C&I loans as a percentage of total assets	0.111***	0.114***	0.120***	0.115***
	(0.073)	(0.075)	(0.081)	(0.077)
Small business loans as a percentage of total assets	0.066***	0.073***	0.079***	0.073***
	(0.049)	(0.050)	(0.053)	(0.051)
Small business loans as a percentage of all C&I loans	0.620***	0.679***	0.697***	0.666***
	(0.302)	(0.260)	(0.247)	(0.272)
Credit card loans as a percentage of total assets	0.015***	0.012***	0.011***	0.013***
	(0.043)	(0.044)	(0.049)	(0.046)

This table reports means and standard deviations for several variables for sample banks over the period of 1993 through 2001. The data and are taken from the FDIC's *Report of Condition and Income* (Call Reports), made available on the Federal Reserve Bank of Chicago's website (http://www.chicagofed.org/economic_research_and_data/commercial_bank_data.cfm). Statistical significance for tests of differences in means at the 10%, 5%, or 1% level are indicated by *, **, ***, respectively.

centrated, less competitive markets. While not reported in Table 3, the average size of a small business loan is negative and significant in both of the models. The ratio of

Table 3
Estimates of the relationship between NETRET for business loans, small business lending activity, bank size, and time, where small business loans are those business loans with original amounts less than $1 million

	Model 1 pooled OLS ($n = 7924$)	Model 2 random effects ($n = 7924$)
Constant	-0.0183^{***}	-0.0115^{*}
	(0.0049)	(0.0070)
Amount of small business loans	0.0082^{***}	0.0059^{***}
	(0.0021)	(0.0017)
Interaction between the amount of small business loans and size (total assets)	$-5.47\times10^{-10***}$	-4.42×10^{-10}
	(2.13e−10)	(3.85e−10)
Size (natural logarithm of total assets)	0.1075	0.0830^{***}
	(0.0973)	(0.0028)
Time dummy	-0.0006^{**}	-0.0007^{***}
	(0.0003)	(0.0002)
Time dummy * amount of small business loans	0.0004	0.0002
	(0.0004)	(0.0003)
Time dummy * interaction between the amount of small business loans and size (natural logarithm of total assets)	3.89×10^{-11}	2.08×10^{-11}
	(3.38×10^{-11})	(5.15×10^{-11})
Time dummy * size (natural logarithm of total assets)	−0.0222	-0.0167^{***}
	(0.0194)	(0.0055)
US T-Bill rate	0.4165^{***}	0.3970^{***}
	(0.0282)	(0.0219)
Natural logarithm of the Herfindahl-Hirschmann Index	0.0022^{***}	0.0020^{**}
	(0.0005)	(0.0009)
R^2	0.060	0.058
F statistic	39.12^{***}	
Wald χ^2		478.54^{***}
H1: $\frac{\partial \text{NETRET}}{\partial T}$	$-3.78\times10^{-4***}$	$-5.69\times10^{-4***}$
	(3.59×10^{-5})	(2.70×10^{-5})
H2: $\frac{\partial \text{NETRET}}{\partial \text{TASSET}}$	$-2.18\times10^{-10***}$	$-2.01\times10^{-10***}$
	(3.39×10^{-12})	(2.63×10^{-12})
H3: $\frac{\partial^2 \text{NETRET}}{\partial \text{TASSET}\,\partial T}$	1.01×10^{-11}	2.73×10^{-12}
	(7.41×10^{-12})	(5.57×10^{-12})
H4: $\frac{\partial^2 \text{NETRET}}{\partial \text{TASSET}^2}$	$-1.28\times10^{-16*}$	$-9.93\times10^{-17*}$
	(7.69×10^{-17})	(5.98×10^{-17})

This table presents pooled OLS and random effects estimates of the relationship between NETRET for business loans, small business lending activity, bank size, and time. The dependent variable in all regressions is NETRET, which is the yield for business loans, less pro-rated expenses and net loan charge-offs scaled by total business loans. The data are for the period of 1993–2001 and are taken from the FDIC's *Report of Condition and Income* (Call Reports), made available on the Federal Reserve Bank of Chicago's website (http://www.chicagofed.org/economic_research_and_data/commercial_bank_data.cfm). Pooled OLS is used to estimate model 1, while a random effects model is used to estimate model 2. For brevity, we do not report coefficient estimates for several of the control variables (e.g., BHC dummy, 12-month maturity gap, liquid assets, etc.). Statistical significance at the 10%, 5%, or 1% level is indicated by *, **, ***, respectively. The standard errors are reported in parentheses beneath the parameter estimates (robust standard errors are reported for the OLS models (see White, 1980)).

Table 4
Estimates of the relationship between NETRET for business loans, small business lending activity, bank size, and time, where small business loans are those business loans with original amounts less than $100,000

	Model 1 pooled OLS ($n = 7891$)	Model 2 random effects ($n = 7891$)
Constant	-0.0191^{***}	-0.0152^{**}
	(0.0048)	(0.0070)
Amount of small business loans	0.0246^{***}	0.0184^{***}
	(0.0042)	(0.0031)
Interaction between the amount of small business loans and size (total assets)	$-1.64\times10^{-9***}$	-1.39×10^{-9}
	(5.47e−10)	(9.50e−10)
Size (natural logarithm of total assets)	0.0996	0.0750^{***}
	(0.0944)	(0.0280)
Time dummy	-6.86×10^{-5}	-0.0004^{**}
	(1.97×10^{-4})	(0.0002)
Time dummy * amount of small business loans	-0.0013^{*}	-0.0009^{*}
	(0.0008)	(0.0006)
Time dummy * interaction between the amount of small business loans and size (natural logarithm of total assets)	9.76×10^{-11}	8.54×10^{-11}
	(8.86×10^{-11})	(1.23×10^{-10})
Time dummy * size (natural logarithm of total assets)	−0.0208	-0.0152^{***}
	(0.0188)	(0.0055)
US T-Bill rate	0.4054^{***}	0.3938^{***}
	(0.0282)	(0.0219)
Natural logarithm of the Herfindahl–Hirschmann Index	0.0023^{***}	0.0023^{***}
	(0.0005)	(0.0009)
R^2	0.055	0.053
F statistic	35.39^{***}	
Wald χ^2		446.96^{***}
H1: $\frac{\partial \text{NETRET}}{\partial T}$	$-3.78\times10^{-4***}$	$-5.79\times10^{-4***}$
	(3.35×10^{-5})	(2.48×10^{-5})
H2: $\frac{\partial \text{NETRET}}{\partial \text{TASSET}}$	$-2.54\times10^{-10***}$	$-2.13\times10^{-10***}$
	(3.76×10^{-12})	(2.83×10^{-12})
H3: $\frac{\partial^2 \text{NETRET}}{\partial \text{TASSET}\partial T}$	8.89×10^{-12}	$9.42\times10^{-12*}$
	(6.93×10^{-12})	(5.07×10^{-12})
H4: $\frac{\partial^2 \text{NETRET}}{\partial \text{TASSET}^2}$	$-1.18\times10^{-16*}$	$-8.96\times10^{-17*}$
	(7.10×10^{-17})	(5.39×10^{-17})

This table presents pooled OLS and random effects estimates of the relationship between NETRET for business loans, small business lending activity, bank size, and time. The dependent variable in all regressions is NETRET, which is the yield for business loans, less pro-rated expenses and net loan charge-offs scaled by total business loans. The data are for the period of 1993–2001 and are taken from the FDIC's *Report of Condition and Income* (Call Reports), made available on the Federal Reserve Bank of Chicago's website (http://www.chicagofed.org/economic_research_and_data/commercial_bank_data.cfm). Pooled OLS is used to estimate model 1, while a random effects model is used to estimate model 2. For brevity, we do not report coefficient estimates for several of the control variables (e.g., BHC dummy, 12-month maturity gap, liquid assets, etc.). Statistical significance at the 10%, 5%, or 1% level is indicated by *, **, ***, respectively. The standard errors are reported in parentheses beneath the parameter estimates (robust standard errors are reported for the OLS models (see White, 1980)).

liquid assets to total assets is negative and significant in the random effects model; however, neither the BHC dummy variable nor the 12-month maturity gap is significant in any of the models.

Using the estimation results, we evaluate the partial derivatives associated with our four null hypotheses. Tests of the hypotheses are reported beneath the parameter estimates. To recapitulate our hypotheses: we evaluate four partial derivatives using the estimation results for Eq. (5). The hypotheses and derivatives are $\partial\text{NETRET}/\partial T$ [H1], $\partial\text{NETRET}/\partial\text{TASSET}$ [H2], $\partial^2\text{NETRET}/\partial\text{TASSET}\partial T$ [H3], and $\partial^2\text{NETRET}/\partial\text{TASSET}^2$ [H4]. Hypothesis 1 [H1] tests whether net returns on business lending have been constant over time. Rejection of H1 suggests that returns have not been constant. Further, a significant, negative result for $\partial\text{NETRET}/\partial T$ is consistent with declining yields due to increased competition. We examine the issue of yields on business lending at large and small banks by testing Hypothesis 2 [H2]. A finding that $\partial\text{NETRET}/\partial\text{TASSET}$ is negative suggests that the net return on business lending decreases as bank size increases (i.e., small bank advantage). Our third hypothesis [H3] investigates whether the relationship between size and net returns on business lending have remained constant over time. A positive result for $\partial^2\text{NETRET}/\partial\text{TASSET}\partial T$ is consistent with larger banks making use of technological innovation to improve performance on business lending. Finally, Hypothesis 4 [H4] examines whether the relationship between net return on business loans and bank size is constant with respect to size.

As shown in Table 3, we find statistically significant, negative results for tests of Hypothesis 1 ($\partial\text{NETRET}/\partial T$) in both models. These results suggest that returns to business lending have declined over the sample period and is consistent with the hypothesis that there has been downward pressure on rates due to increased competition in the business lending market. In our test of Hypothesis 2, we find a significant inverse relationship between size and net returns to business lending ($\partial\text{NETRET}/\partial\text{TASSET}$), suggesting that the net return on business lending declines as bank size increases. We interpret this result as evidence that small banks have an advantage in the market for small business loans, their traditional type of business loan. This result is consistent with earlier work by Carter et al. (2004). [4] To investigate whether larger banks have improved their net returns on business lending relative to small banks, we test Hypothesis 3 ($\partial^2\text{NETRET}/\partial\text{TASSET}\partial T$). While $\partial^2\text{NETRET}/\partial\text{TASSET}\partial T$ is positive for both models, it is not statistically significant in either case. Therefore, we cannot reject the null hypothesis that the returns to business lending and bank size have remained constant over time. Finally, we test H4 and find significant, negative estimates for $\partial^2\text{NETRET}/\partial\text{TASSET}^2$, suggesting that the relationship between bank size and net returns is not constant. Further, this result suggests that business-lending performance becomes even worse for large

[4] As a robustness check, we use 2001 data in which banks with total assets between \$25 million and \$300 million are included in the sample. In this year, the Call Report forms were changed so that these smaller banks report interest income in a manner consistent with larger banks (see Footnote 2). The estimated value of $\partial\text{NETRET}/\partial\text{TASSET}$ (Hypothesis 2) is -2.46×10^{-10} (standard error $=4.44\times10^{-11}$). This estimate is significant at the 1% level and is consistent with the results reported in Table 3.

banks as bank size increases. This result differs from that of Carter et al. who find that as bank size increases, the relationship between lending performance and bank size becomes less negative. A possible reason for the difference is that they do not include expenses in their measure of lending performance.

In Table 4, we report the results for the estimation of Eq. (5) in which we include only the smallest group of business loans (e.g., original amounts less than $100,000). We consider this group of loans to explore the implications of Berger et al.'s (2004) research on the effect of credit scoring by estimating our model for different definitions of a small business loan. Berger et al. find evidence that the use of small business credit scoring is particularly useful in evaluating business loans of under $100,000. If larger banks were using credit scoring effectively, we might expect to see some change in lending performance for large banks when the under $100,000 definition is used to define small business loans. The results for tests of Hypotheses 1, 2, and 4 are consistent with those reported in Table 3. However, we want to focus our attention on Hypothesis 3 and test whether $\partial^2 \mathrm{NETRET}/\partial \mathrm{TASSET}\,\partial T$ is equal to zero.

For both models, the second cross-partial derivative of the net return, with respect to both size and time ($\partial^2 \mathrm{NETRET}/\partial \mathrm{TASSET}\,\partial T$) is positive. While the result is not statistically significant in Model 1, it is significant in Model 2 ($p = 0.06$, two-tailed test). What is particularly intriguing about this result is that it provides evidence that over the 1993–2001 time period, larger banks have been improving their lending performance for the smallest set of small business loans. This finding is consistent with Berger et al.'s (2004) result suggesting that credit scoring is associated with higher average prices and expanded quantities of credit for small business loans under $100,000.

We present results for the relationship between credit card lending performance, credit card lending activity, and bank size in Table 5. We include these results because these types of loans tend to be more standardized, involve less soft and more hard information, and do not require relationship development. According to the theory discussed earlier, we expect larger banks to have an advantage in this lending market.

The results presented in Table 5 are for the estimation of Eq. (5) using random effects. The results for OLS are almost identical and are not presented. A couple of interesting points related to the control variables are worth mentioning. First, the estimated coefficient for the T-Bill rate is negative and significant at the 10% level. The inverse relationship between the coefficient estimate and the net return on credit card loans is no doubt due to the "stickiness" of interest rates on these types of loans. This is in contrast to the results for business loans, which exhibit highly significant positive relationships between net return and the T-Bill rate. A second point is the lack of a significant relationship between the net return and the Herfindahl–Hirschmann Index. This result is consistent with credit card loans being made at a distance and not being affected by local market conditions.

Of particular interest is the result for the test of Hypothesis 2 ($\partial \mathrm{NETRET}/\partial \mathrm{TASSET}$). We find a significant, positive estimate for $\partial \mathrm{NETRET}/\partial \mathrm{TASSET}$,

Table 5
Estimates of the relationship between NETRET for credit card loans, credit card lending activity, bank size, and time

	Model 1 random effects ($n = 11{,}370$)
Constant	-30.1718^{***}
	(7.6322)
Amount of credit card loans	0.1524
	(0.1605)
Interaction between the amount of credit card loans and size (total assets)	-3.21×10^{-10}
	(1.56×10^{-9})
Size (natural logarithm of total assets)	2.1527^{***}
	(0.5532)
Time dummy	4.1863^{**}
	(0.9775)
Time dummy * amount of credit card loans	−0.0023
	(0.0039)
Time dummy * interaction between the amount of credit card loans and size (total assets)	4.37×10^{-11}
	(2.51×10^{-10})
Time dummy * size (natural logarithm of total assets)	-0.3101^{***}
	(0.0716)
US T-Bill rate	-1.8450^{*}
	(1.0916)
Natural logarithm of the Herfindahl–Hirschman Index	−0.0077
	(0.0185)
R^2	0.004
Wald χ^2	48.73^{***}
H1: $\frac{\partial \text{NETRET}}{\partial T}$	0.0173^{***}
	(0.0005)
H2: $\frac{\partial \text{NETRET}}{\partial \text{TASSET}}$	$4.27\times10^{-7***}$
	(1.55×10^{-8})
H3: $\frac{\partial^2 \text{NETRET}}{\partial \text{TASSET}\partial T}$	$-1.53\times10^{-7***}$
	(4.12×10^{-9})
H4: $\frac{\partial^2 NETYLD}{\partial \text{TASSET}^2}$	$-1.07\times10^{-11***}$
	(4.81×10^{-13})

This table presents random effects estimates of the relationship between NETRET for credit card loans, credit card lending activity, bank size, and time. The dependent variable in all regressions is NETRET, which is the yield for credit card loans, less pro-rated expenses and net loan charge-offs scaled by total credit card loans. The data are for the period of 1993–2001 and are taken from the FDIC's *Report of Condition and Income* (Call Reports), made available on the Federal Reserve Bank of Chicago's website (http://www.chicagofed.org/economic_research_and_data/commercial_bank_data.cfm). For brevity, we do not report coefficient estimates for several of the control variables (e.g., BHC dummy, 12-month maturity gap, liquid assets, etc.). Statistical significance at the 10%, 5%, or 1% level is indicated by *, **, ***, respectively. The standard errors are reported in parentheses beneath the parameter estimates.

suggesting that larger banks perform better with respect to credit card lending. This result is as predicted by DeYoung et al.'s (2004) theory that larger banks should be more successful in markets characterized by less personalized service, lower unit costs, and standardized products.

5. Conclusions

This paper adds to a growing body of research into differences in lending performance at small and large banks, and the reasons for these differences. Consolidation in the banking industry has sparked concern about the survival of small banks, and the availability of credit to small businesses. However, if small banks have an advantage in processing credit information, compared to large banks, they should continue to survive. We evaluate business-lending performance for small and large banks over the 1993–2001 period. This market is characterized by the use of "soft" information, relationship development, high unit costs, and non-standardized loans. Consistent with the model proposed by DeYoung et al. (2004), we find that, after controlling for market concentration, cost of funds, and a variety of other factors that might influence yields, smaller banks perform better than larger banks in the business lending market. This result is not due to differences in the composition of business loan portfolios at small and large banks or market concentration since the ratio of small business loans to total business loans and market concentration are held constant throughout our analysis.

Interestingly, the relationship between bank size and credit card lending performance is quite different. Larger banks appear to have the advantage in credit card lending; a market characterized by the use of "hard" information, impersonal relationships, low unit costs, and standardized loans. In addition, we find evidence that larger banks have been making inroads in the market for the smallest business loans, a result consistent with the use of credit scoring by large banks to make very small business loans (Berger et al., 2004).

These results are important because they point to the likelihood that small banks will survive in the future despite that fact that the banking market is increasingly dominated by large banks. The viability of small banks should ease concerns about the availability of credit to small businesses. Additionally, this research is informative concerning the role of small banks in the financial intermediation process.

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