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Is Lending Distance Really Changing? Distance Dynamics and Loan Composition in Small Business Lending*

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Abstract

Has information technology improved small businesses' credit access by hardening the information used in loan underwriting and reducing the importance of lender proximity? Previous research, pointing to increasing average lending distances, suggests that it has. Using over 20 years of Community Reinvestment Act data, we find that while average distances have increased substantially, distances at individual banks remain unchanged. Instead, average distance has increased because a small group of lenders specializing in high-volume, small-loan lending nationwide have increased their share of small business lending by 10 percentage points. Our findings imply that small businesses continue to depend on local banks. (JEL R21 G21 G38 L25)

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1 Introduction

Small businesses are more informationally opaque than other borrowers, so lenders have traditionally relied on soft information and relationship lending when assessing their creditworthiness. Because soft information is costlier to acquire at longer distances and harder to convey within large banking institutions, small businesses have predominantly relied on small, local lenders for credit.

Over the past 20 years, researchers have questioned whether distance continues to impede small-business lending. Improvements in information technology, such as small-business credit scoring, may have hardened information about small businesses and reduced the need for soft information. Such improvements could result in expanded (geographic) sizes in credit markets and in greater competition, thereby increasing financing options for small firms and reducing their cost of credit. Furthermore, these changes would increase new firm formation (and survival) and boost economic growth, particularly in rural markets where financing options may have been the most limited.

Despite their promise, we argue that these new technologies have not been as transformative or as broad-based as some have suggested. First, the new technologies may not be equally feasible options for all institutions. Implementing credit scoring systems, for example, can entail substantial fixed costs and require large amounts of historical data on loan performance to build and validate the models. Such a technology may only be feasible for large-volume lenders.

Second, distance can be a barrier to small business lending for reasons other than its effects on the costs of information acquisition. Lenders often require collateral, particularly on large loans, that can involve accounts receivable, inventories, or other assets that require on-site monitoring by the lender. Monitoring is more costly at longer distances. If these costs are prohibitively high, distance will continue as a barrier to lending, particularly for large loans, despite improvements in information technology.

Third, demand-side considerations may inhibit distant lending. In particular, small business owners may have a strong preference for local lenders, particularly if they use a bundle of banking services. For example, small businesses may prefer to use local banks for services such as cash management and may prefer to obtain credit from the same banks. Even if distant lenders are options, small businesses may thus prefer local relationships.

Many of the studies on the effects of technological change on small-business lending, discussed in the next section, explore whether lending distances are changing using a variety of empirical approaches and data sources, most of which are now over 10 years old. Often, these papers do not distinguish among loan or lender types. Instead, they generalize from one specific type of loan or institution to all small business lending and overlook the possibility of heterogeneous effects.

We expand on the existing literature by looking at changes in distance over a much longer time horizon and by investigating whether changes in average distances occurred uniformly across banks and loan types. Using over 20 years of data collected pursuant to the Community Reinvestment Act, we explore how average loan distances have changed for different loan origination amounts and for different types of lenders.

Our results confirm that average small-business-lending distances increased substantially (about 170%) between 1996 and 2017, with notable spikes preceding the two recessions that occurred during this period. However, we find no evidence that these increases resulted from lenders expanding the geographic areas over which they extend credit. In fact, *within-lender* changes in average distance have been minimal. The increase in average lending distance, and the spikes in average distance preceding both recessions, are the result of lenders who have always lent at longer distances accounting for a larger share of small business lending nationwide.

In particular, we find that most of the increase in lending distances can be attributed to 18 banks that specialize in originating a large volume of small, less than $100,000, loans ("small-loan lenders"). Their average lending distance in 1996 was over 1,200 miles, or 22-

times larger than that at other lenders, 54 miles. By the end of the sample period, the industry share of small-loan lenders increased from 3 to 13%. This increase accounts for almost all of the growth in average lending distances from 1996 to 2017 and for the spikes in average distance that occurred during this period.

These results offer a different interpretation of the changes that have occurred in small business lending. Rather than hardening information at the margin, technological change may have made evaluating hard information more efficient. This would boost the competitiveness of lenders who rely heavily on hard information, while conferring little benefit on lenders using soft information or on the small businesses for whom hard information is unavailable. The result would be an increased industry share for the lenders that are able to exploit the new technology, but little change in the behavior of other lenders. Moreover, for products where soft information plays a bigger role, such as larger loans, distance would remain a significant barrier to lending.

This interpretation has very different policy implications, particularly for antitrust and CRA enforcement. If lenders were expanding their geographic lending areas, more financing options would be available for small businesses and the geographic scope of competition would become less local. There might also be less need to ensure that local lenders were meeting the credit needs of their communities. Our results suggest that these policy conclusions are unsupported by the evidence and that local lenders remain important in small business lending.

The paper is organized as follows. We review the relevant research on small business lending and discuss the data used in the paper in the next two sections respectively. Section 4 documents the results of our analysis and Section 5 discusses robustness checks. Section 5 draws conclusions from these results and suggests additional areas for research.

2 Related Research

Evaluating the creditworthiness of small businesses can be challenging because they are more "informationally opaque" and harder to evaluate than larger firms (Petersen and Rajan, 1994; Berger and Udell, 1995). As a result, lenders have relied on the soft information acquired through relationship banking. Boot and Thakor (2000) define relationship banking as an activity that (1) involves investments by the financial institution in collecting proprietary information about the customer; and (2) entails multiple interactions to evaluate the profitability of these investments. They contrast this with transaction-oriented banking, which focuses on a single transaction with a borrower.

Because relationship banking requires multiple interactions, it is more suited to local relationships. As such, geographic proximity has been an important aspect of small business lending and most small business lending relationships involve local lenders (Kwast et al., 1997; Amel and Brevoort, 2005).

Relationship banking may also be more suitable for smaller lenders, such as community banks (Stein, 2002; Cole et al., 2004; Scott, 2004; Berger et al., 205; Berger and Black, 2011). Alessandrini et al. (2009) argue that, in addition to the physical distance between a bank and its borrowers (which they term "functional distance"), the distance between a bank's decision-making center and its retail bank branches also matters. The further this "operational distance," the harder it is for banks to convey any soft information acquired internally. This suggests that relationship banking is harder for large, geographically disperse organizations to engage in and is consistent with an extensive literature showing that smaller banking organizations do proportionately more small business lending than larger lenders (Berger et al., 1995; Peek and Rosengren, 1996; Berger et al., 2001; Avery and Samolyk, 2004; Levine et al., 2019).

While the importance of distance in small business lending has been well established,[1]

[1]The role of distance in small business lending extends beyond credit availability. Degryse and Ongena

several papers have hypothesized that technological improvements have reduced the importance of geographic proximity. The first to suggest this change was Petersen and Rajan (2002). They use data from two cross sectional surveys, the 1988 and 1993 Surveys of Small Business Finances (SSBFs), to construct a "synthetic panel" covering lending relationships established from 1973 through 1993. They find that small business lending distances are increasing and that small businesses are communicating with their lenders in more impersonal ways (i.e., less use of face-to-face interactions in branches). They attribute the increases to improved bank productivity and conjecture that the trend of increasing distances accelerated after 1993.

Other studies have used subsequent SSBF waves to explore changes in distances after 1993. Rather than using the synthetic panel approach of Petersen and Rajan (2002), which Brevoort et al. (2010) show suffers from significant survivorship biases that overstate distance changes, these studies compare distances across the cross sections provided by the SSBF. Brevoort and Wolken (2009) show that average lending distances grew more quickly between 1993 and 1998 than predicted by Petersen and Rajan (2002), but declined between 1998 and 2003. Moreover, Brevoort and Wolken (2009) find that median distances did not change appreciably over this period, which they interpret as evidence that distances are changing primarily in the upper tail of the distance distribution. Because the SSBF was terminated after 2003, it is not available for more recent years.

Two other sources of data have been used in the literature to explore the extent to which small business lending distances have increased. The first source of data come from the U.S. Small Business Administration's (SBA's) 7(a) Loan Program, which serves small businesses that are otherwise unable to obtain credit by providing credit guarantees of between 50 and 85% of balances. Unlike the SSBF, which was nationally representative, 7(a) loans account for a small portion of small business lending: 1.3% of loans and 4.1% of outstanding balances on small business loans under $1 million in 2005 according to United States Government

(2005) show that distance is related to loan pricing.

Accountability Office (2007).

A series of studies by DeYoung et al. (2008b), DeYoung et al. (2008a), and DeYoung et al. (2011) examine the SBA 7(a) data from 1984 to 2001 and find that average distances increased at steady rates prior to 1993 and thereafter accelerated. DeYoung et al. (2011) add information on credit scoring adoption by the largest banks from a 1998 Federal Reserve Bank of Atlanta survey and find a positive correlation between accelerating distances after 1993 and the adoption of credit scoring.

The second source of data comes from the Community Reinvestment Act (CRA). The CRA data record the number and dollar amount of small business loans originated by large commercial banks and thrifts in each county. Most studies that use these data focus on lending in local banking markets.[2] Hannan (2003), using data from from 1996-2001, and Anenberg et al. (2018), using data from 2000-2016, find that "out-of-market" lenders (that is, banks lending in markets where they have no local branches) account for an increasing share of small business loans. Brevoort and Hannan (2006) examine within-market lending by local banks from 1996-2004 and find that the importance of proximity has not diminished. One of the few studies that has examined average loan distances in the CRA data, by Granja et al. (2018), finds that average lending distances increased over this period and distances tend to be procyclical, increasing during economic expansions as banks take on more risk and decreasing during contractions as they become more risk averse.

The studies above present differing views on the dynamics of distance in small business lending. Many of these studies do not account for the heterogeneity in lenders and loan types, instead treating all small business loans and lenders as the same.

[2]These studies generally define local markets as metropolitan statistical areas (MSAs) or rural counties.

3 Data

3.1 CRA Data

We use data collected pursuant to the Community Reinvestment Act (CRA) on small business loan originations. Each year, banks report the number and total dollar volume of business loans originated for three loan-size categories: $100,000 or less, $100,001 to $250,000, and $250,001 to $1,000,000. Counts of the number of loans and aggregate loan amounts for each of the three loan-size categories are available for each bank or thrift at the county level.[3] To simplify our analysis, we consolidate the larger two loan-size categories into a single "large loan" category of loans for more than $100,000. We refer to loans for $100,000 or less as "small loans."

The CRA data have important limitations that are relevant to our study. Foremost among these is that the data are collected as aggregate totals and do not provide loan-level detail.[4] Thus, they cannot be used to examine how small business loans are priced or collateralized. They also do not distinguish between small business loans types, such as unsecured open-ended loans (e.g. credit cards) and closed-end collateralized loans (e.g. equipment loans or commercial mortgages). Underwriting across these loan types can vary substantially.

Another important limitation of the data is that smaller commercial banks and thrifts are exempt from the reporting requirements. Prior to 2005, independent institutions (those not part of a bank holding company (BHC)) with total assets of less than $250 million were exempt from reporting. Starting in 2005, independent institutions with less than $1 billion in assets (adjusted annually for inflation) became exempt. Institutions that are part of a

[3]CRA data are collected at the census-tract level, but only made publicly available at the county level. We use the public data in our analysis. Using the census-tract-level data does not qualitatively change our results.

[4]In some cases, loans can be aggregated by banks when reporting. For example, credit card loans extended to the employees of a single firm on the same date are treated as a single loan. Thus a bank extending 10 small-business credit cards, each with a $15,000 credit limit, would be reported a single loan for $150,000.

BHC with more than $1 billion in assets are required to report.

Finally, changes in reporting by large BHCs can result in significant changes in lending patterns by subsidiary banks.[5] For example, BHCs sometimes move a part of small business origination division from one subsidiary to another (usually specific types of loans such as credit cards are moved). Such changes can result in large jumps in originations and lending distance for subsidiaries from one year to the next.

3.2 Measuring Distance

We measure lending distances using data on bank branch locations from the annual Summary of Deposits (SOD) data collected by the Federal Deposit Insurance Corporation (FDIC). These data include the address and geographic coordinates for each branch of commercial banks and thrifts. Matching the CRA data to the SOD data can be problematic because the SOD and CRA data are reported at different times. SOD data reflect branch networks on June 30$^{\text{th}}$ of each year, while the CRA data for each year are collected on March 31$^{\text{st}}$ of the next year. Mergers, new bank formations, and bank closings can lead to unmatched CRA observations. In cases where the CRA data could not be matched to an SOD record, the CRA data were matched to SOD data from the subsequent year.[6] This additional step reduces the number of unmatched observations to only a handful.

We measure the distance between a bank and each county as the minimum, great-circle distance ("distance as the crow flies") between the geographic center of the county and the bank's closest branch.[7] While our analysis focuses primarily on individual banks and thrifts, many are part of larger BHCs. For these institutions, the distance to the nearest BHC branch may be more meaningful than the institution's own branches. Consequently, we calculate distance at both the bank and BHC levels, based on the "high holder" designated by

[5] Mergers can also result in large changes in originations.

[6] For example, when a bank that reported 2012 CRA data in March 2013 could not be matched to SOD data for that bank from June 2012, a match was attempted to the June 2013 SOD data.

[7] Like most other studies in this literature, we do not measure travel time or actual travel distances.

the National Information Center at the Federal Financial Institutions Examination Council (FFIEC). BHC-level analysis may be important because many large institutions concentrate loan holdings into specific subsidiaries. Using the high holder also mitigates the effects of reorganizations within a BHC, where banks merge or create new subsidiaries. While average distance is perforce shorter using BHCs, the basic distance dynamics do not appreciably change.

Besides BHC common ownership of banks, branches may not be the point of contact between a business and its lender. Some loans are originated in other business locations and may even be tied to purchase of specific items. For example, John Deere Financial is a lender in the CRA data that makes loans over large distances. Many of these loans are originated through John Deere dealerships and tied to the purchase or lease of John Deere equipment (e.g. tractors). Hence, our measures of distance may be inaccurate for such institutions. Such institutions are also difficult to detect in the data.

We limit our analysis to counties and branches in the contiguous United States and exclude lending in Alaska, Hawaii, and U.S. territories. We also exclude banks without branches in the contiguous U.S. We exclude these observations because of the discrete jump in distance that occurs because of the location of these areas. These exclusions are relatively few in number and volume.

3.3 Bank-Year and Bank-County-Year Data

Our main analysis uses a dataset in which each observation reflects the lending activity of a single bank in a single year ("bank-year" data). The measure of distance in this dataset is the dollar-weighted average distance of all small business loans made by the bank in that year. This dataset also includes bank characteristics, such as total assets and lending volume.

To make comparisons with earlier research, we also use a dataset where each observation provides a bank's lending activity in a county in a single year ("bank-county-year" data).

Table 1: Summary Statistics

	N	Mean	Median	Std.Dev.	Minimum	Maximum
Bank-Year						
Distance (Miles)	26,226	195.1	20.5	393.6	0.16	2,393
Assets ($Billions)	26,226	180.6	20.0	395.6	0.00	2,083
Bank-County-Year Data						
Distance (Miles)	1,819,008	195.1	5.6	488.4	0.00	2,772
Assets ($Billions)	1,819,026	180.6	20.0	395.4	0.00	2,083

Note: All values are weighted by loan volume.

This dataset includes all counties regardless of whether the bank made loans there. These zero-loan county observations are included to reduce sample selection bias that comes from only examining the counties to which loans are made. Since every bank could, hypothetically, lend to every county in the U.S., the fact that they do not lend in particular counties provides useful information about the importance of distance. Table 1 shows the summary statistics for these three datasets.

4 Changes in Small Business Lending over Time

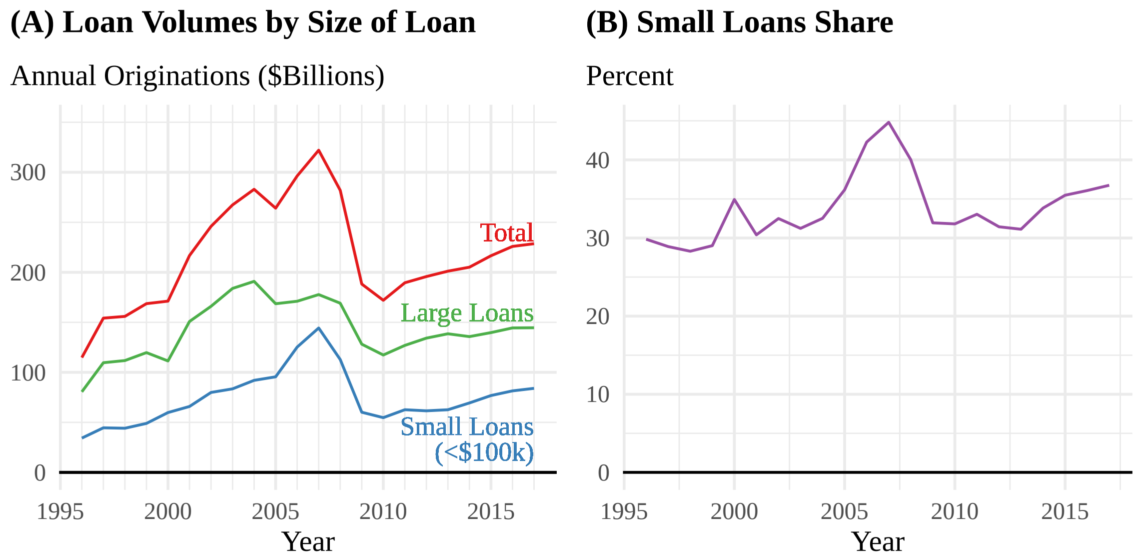
4.1 Overall Loan Volumes

Total small business lending, shown in Figure 1(A), increased substantially during the first half of our sample period, peaking at over $320 billion in 2007.[8] During the ensuing recession, lending fell sharply and, though steadily increasing since 2010, remains well below pre-recession levels.

Large and small loans both exhibit the same general pattern with two notable exceptions. The first is the effect of the 2005 changes in CRA reporting thresholds. While large-loan

[8] The increase considerably greater than the overall rise in prices of 56% indicated by the Consumer Price Index over this period.

Figure 1: CRA Loan Volume, Share, and Number

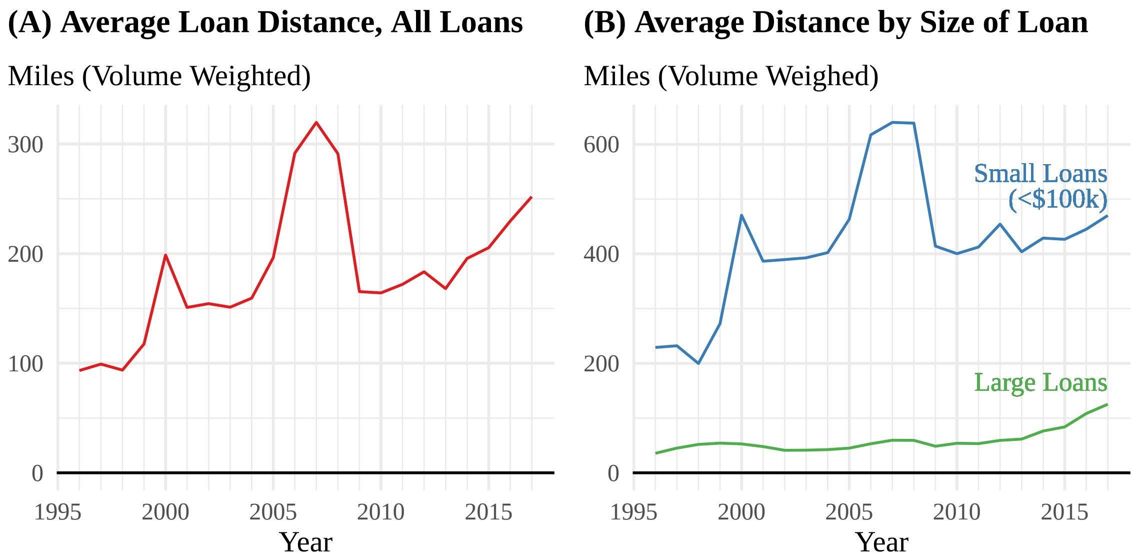


volumes dropped sharply in 2005, small-loan volumes continued to increase, suggesting that the small lenders exempted from CRA reporting were more heavily involved in large-loan lending.

The second notable difference is that small-loan volumes grew more rapidly than large loans over the entire sample, increasing small loans as a dollar-weighted share of lending. While the increase was not monotonic, small loans went from accounting for less than 30% of the dollar volume of loans in 1996-1999 (shown in Panel B of Figure 1) to almost 37% in 2017.[9] This growth is particularly remarkable given that the CRA's $100,000 threshold does not adjust for inflation. As discussed above, according to the Consumer Price Index, prices in 2017 were 56% higher than in 1996. This means that the equivalent of a $65,000 loan in 1996, which would then have been safely below the threshold, would not be considered a small loan in 2017.

[9]The growth in small loans is starker when not dollar weighted. Between 1996 and 2017, small-loan originations increased 224%, from 1.8 million to 5.8 million, compared to 63% for large loans.

Figure 2: Yearly Fixed Effects from Pooled and Within-Bank Estimations



4.2 Small Business Lending Distances

Against this backdrop of a rising small-loan share, average loan distances increased by 170% between 1996 and 2017 (Figure 2(A)). Figure 2(B) shows that the increases occurred for both small (<$100,000) and large loans, though growth in the former is considerably greater. As first noted by Granja et al. (2018), both recessions during this period, beginning in March 2001 and December 2007 respectively, were preceded by sharp increases in lending distance. Both coincided with spikes in the small-loan share. These temporary spikes aside, the long-term growth in average distances is consistent with an increasing willingness of lenders to lend over long distances.

However, a different story emerges when one looks at within-bank changes in lending distances. Using d_{it} to denote the average, volume-weighted lending distance of bank i in year t, we model average distances as

$$log(d_{it}) = \alpha_i + f(t) + \epsilon_{it} \tag{1}$$

where α_i is a bank-specific fixed effect and ϵ_{it} is an independent and identically distributed error term. The function $f(t)$ captures changes over time in average lending distances that we parameterize as

$$f(t) \equiv \sum_{(j=1997)}^{2017} I(t=j)\beta_j. \quad (2)$$

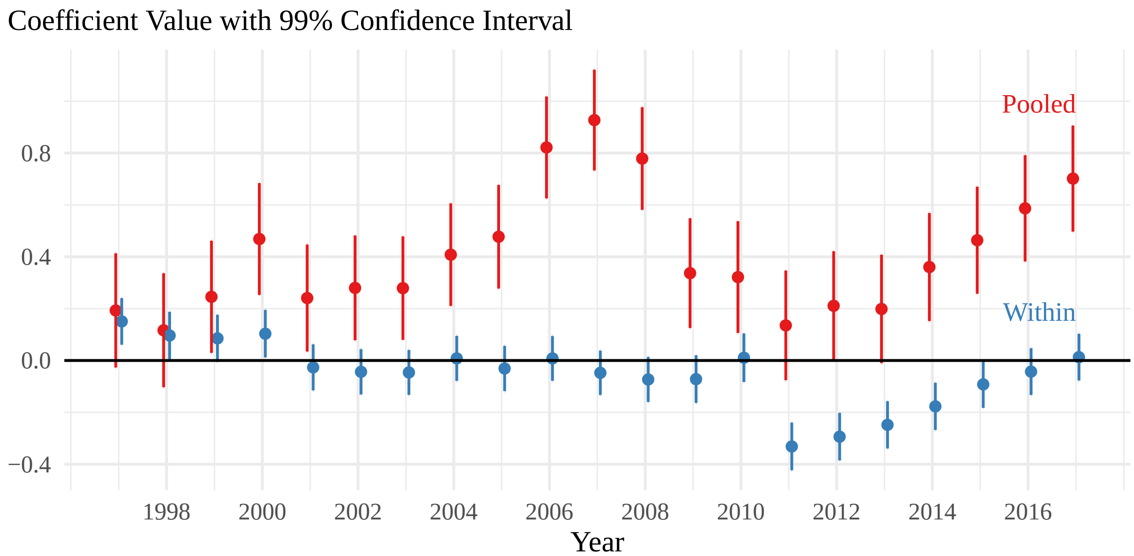
where β_j is a year-specific fixed effect. The equation is estimated using weighted least squares, where the weight for each observation is the dollar amount of loans made by bank i in year t.

Figure 3 shows the yearly fixed effects from the estimation of this model, along with the results from a pooled model without bank-specific fixed effects (i.e., $\alpha_i = \overline{\alpha}\ \forall i$). Coefficients from the pooled model closely mimic the average distances shown in Figure 2(A),[10] exhibiting the same overall increase over time and sharp spikes in average distances in 2000 and 2006-2008.

In contrast, the coefficients from our model with bank-specific fixed effects, the "within model," suggest that banks have not increased their lending distances. Between 1996 and 2010, within-bank distances were essentially flat. Distances declined sharply in 2011, possibly reflecting the significant regulatory changes that year, before gradually recovering. These results imply that the increase in distances observed in the pooled model, and shown in Figure 2(A), do not result from the bank-level changes that would be expected if technological change was increasing their willingness to lend at greater distances. Instead, those average distance changes reflect between-bank effects, with firms who persistently lend at longer distances accounting for a larger share of the lending.

[10]The patterns exhibited by the coefficients differ somewhat from the patterns exhibited in Figure 2 because the figure reports the log of the (dollar-weighted) average distance in each year and the coefficients reflect the dollar-weighted average of the log-distance for each bank.

Figure 3: Yearly Fixed Effects from Pooled and Within-Bank Estimations

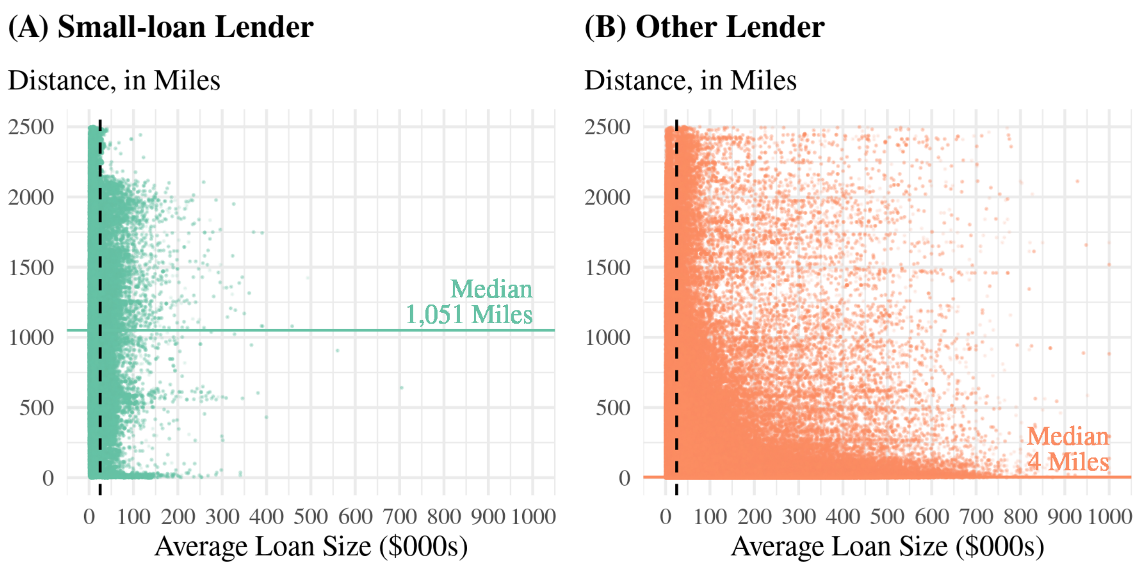


4.3 Lender Heterogeneity

As discussed in Section 2, the changes in lending technology that may be increasing loan distances may have been limited to uncollateralized small loans being made by lenders at scale. While the CRA data do not indicate which loans are collateralized, we can identify lenders that originate a high-volume of small loans. Specifically, we identify "small-loan" lenders that made at least \$1 billion in small loans in any year and whose dollar-weighted loan originations were at least 75% small loans. This designation is fixed over our sample so that a bank is either a small-loan lender or not ("other lender") in all years, regardless of their lending activity in any year.

Small-loan and other lenders differ substantially in their lending distances. Figure 4 shows the relationship between the average size of a loan made by a bank in a county and the distance between the county and that bank. Each dot shows an observation from our bank-county-year dataset, with observations for the 18 small-loan lenders in Panel (A) and other lenders in Panel (B).[11]

Figure 4: Average Distance by Average Loan Size



As shown in Figure 4, the vast majority of small loans made over 50 miles have average sizes well below $25,000. This pattern is observed for both bank types, but is much stronger for small-loan lenders. The median loan distance is about 1,000 miles for small-loan lenders and about 4 miles for other lenders. The vast majority of counties where a bank's average loan size exceeds $25,000 are considerably closer to the bank.[12]

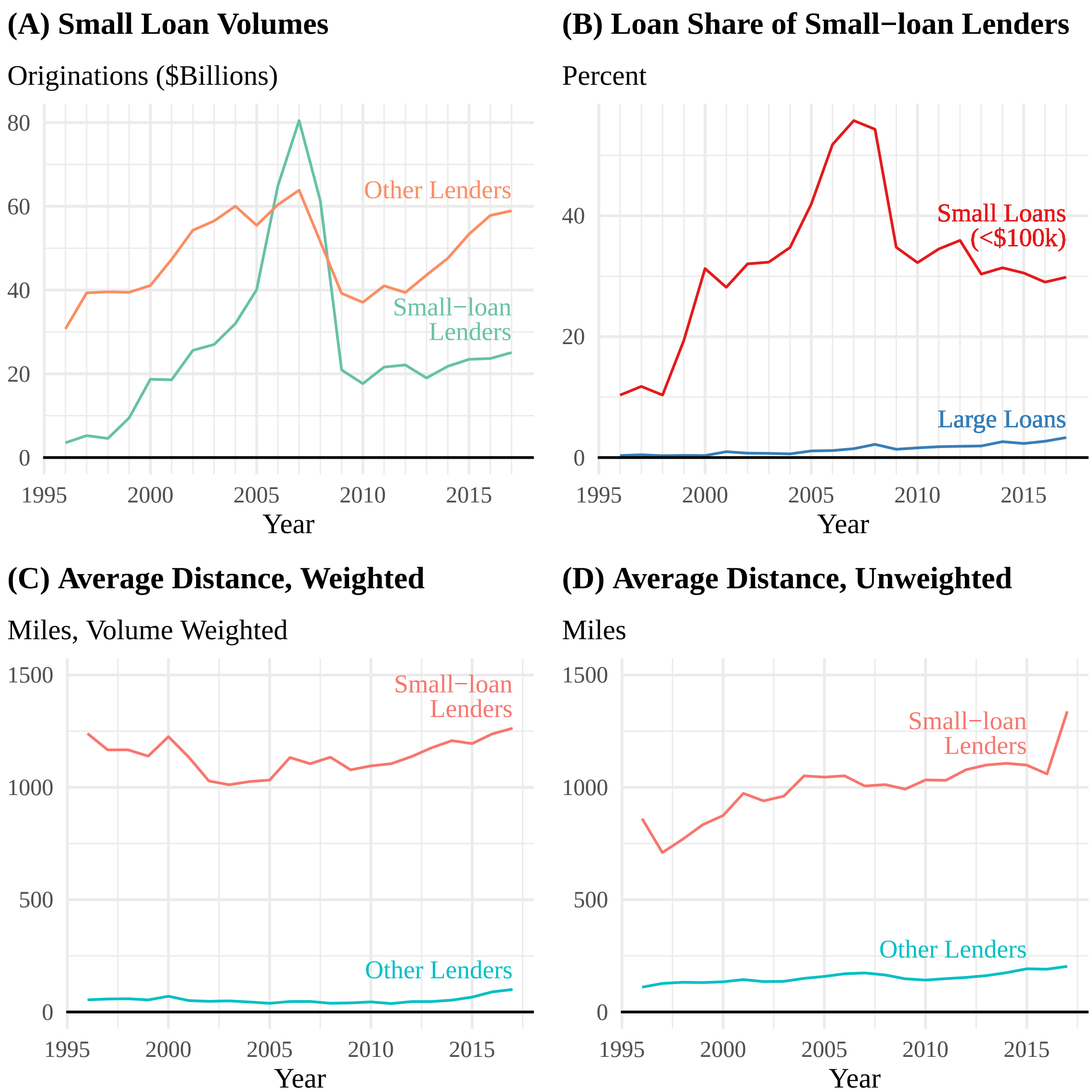
Their lending dynamics are also drastically different. At their peak, small-loan lenders accounted for almost 60% of small loans, up from about 10% in 1996 (Figure 5(B)). While their share declined after the Great Recession, they continue to account for about one-third of small loans. And though they account for a small share of large loans, small-loan lenders increased their industry share from 3 to 13% over our sample.

Panels (C) and (D) of Figure 5 show the weighted and unweighted average distances for

[11]We limit Figure 4 to observations with at least 5 loans. The scatterplot is qualitatively similar if all loans are used.

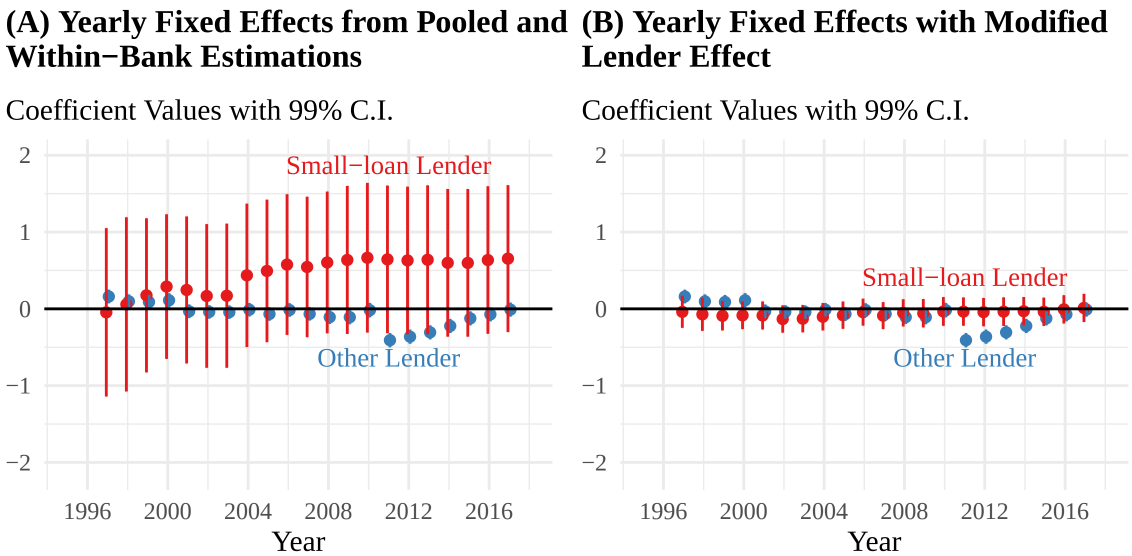
[12]As discussed in footnote 4, large loans reported in the CRA data can be aggregates of smaller loans. We suspect that many of the large loans reported by small-loan lenders are aggregated credit cards.

Figure 5: Small-Loan Lenders: Loan Totals and Average Distance



both lender types over time. Average distances at small-loan lenders hovered around 1,200 miles over the entire period. Distances at other lenders were similarly flat between 1996 and 2014, with modest increases in later years. To test whether average distances have been increasing within each of these lender group, we modify Equation 1 to include separate year-specific fixed effects for both small-loan and other lenders. Specifically, we reparameterize

Figure 6: Yearly Fixed Effects from Pooled and Within-Bank Estimations



$f(t)$ as

$$f'(t) \equiv \sum_{(j=1997)}^{2017} I(t=j)I(i \in S)\beta_j^s + I(i \in O)\beta_j^o \quad (3)$$

where S and O are the sets of small-loan and other lenders, respectively, and β_t^s and β_t^o are year-specific fixed effects for these two groups.

The estimation results for this new specification are shown in Figure 6(A). The estimated year-specific fixed effects for the other lenders mirror the estimates for the entire sample. Other than a sharp drop in lending distances in 2011, these lenders do not appear to have changed their lending distances since 1996.

Changes in with-bank lending distances at small-loan lenders are insignificant at the 5% level for all years.[13] This reflects, in part, large standard errors on the small-loan lender yearly fixed effects.

[13]While Figure 6 shows a 99% confidence interval, none of the yearly fixed effects for the small-loan lenders is statistically significant at the 5% level.

The size of the standard errors on the yearly fixed effects for the small-loan lenders can be attributed to a single bank. At the beginning of the sample period, this bank predominantly made large loans. In 2004, its lending activities were consolidated with those of another subsidiary of the same holding company, more than tripling its reported volume of small-loans. Average distances at this bank, which were below 30 miles from 1996-2003, increased to between 720 and 740 miles for the next 10 years until the bank ceased reporting.

If we modify our specification to allow for two different fixed effects for this one bank before and after the consolidation (covering 1996-2003 and 2004-2013, respectively), the resulting coefficient estimates on the yearly fixed effects are shown in Figure 6(B). This one change dramatically shrinks the standard errors on the yearly fixed effects for small-loan lenders. More importantly, it reveals that the apparent upward trend in within-small-loan-lender distances in Panel (A) was the result of this one reporting change.

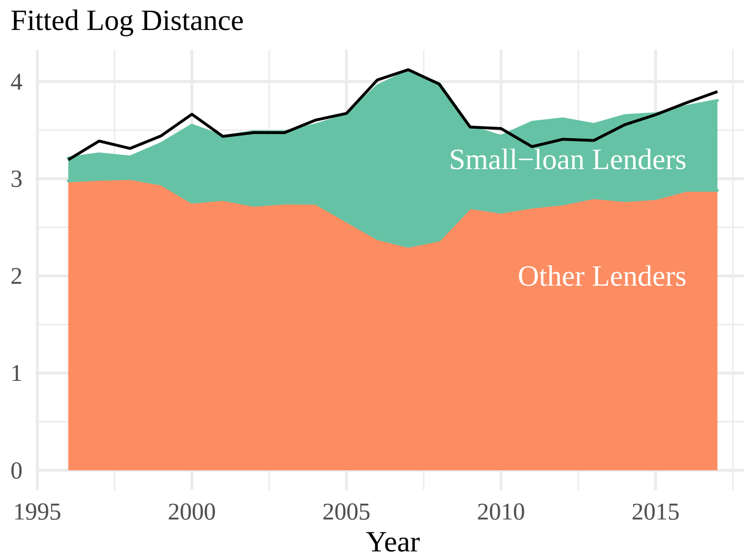
Neither small-loan nor other lenders exhibit the long-term increases in distance observed in the aggregate over time. Like the results from the earlier estimation, this implies that the changes in aggregate average distance reflect between-bank changes in industry shares; in particular, it implies that lenders who have always had higher average loan distances are increasing their industry share at the expense of banks that lend at shorter distances.

The effects of industry-share changes between the small-loan and other lenders can be demonstrated using the fixed-effect coefficient estimates shown in Figure 6(A). For any sample year t, the average log-distance can be written as

$$\overline{lnd_t} \equiv \sum_i log(d_{it}) * w_{it} = \sum_i (\widehat{\alpha}_i * w_{it}) + \hat{f}'(t) \tag{4}$$

where $\widehat{\alpha_i}$ and $\widehat{f'}(t)$ are the values of the bank- and year-specific fixed effects from the estimations in Figure 6 and w_{it} is the market-share of bank i in year t. The first of the terms on the right-hand-side of this equation reflects the contribution of changes in the market shares of lending institutions. We decompose this term into the portion attributable to small-loan

Figure 7: Between-Bank Effects for Small-Loan and Other Lenders



lenders, $\sum_{i \in S} \widehat{\alpha_i} * w_{it}$, and the portion attributable to other lenders $\sum_{i \in O} \widehat{\alpha_i} * w_{it}$.

Figure 7 shows this decomposition over time. The black line shows $\overline{lnd_t}$. Because $\overline{lnd_t}$ is a dollar-weighted average of logged bank-level distances (as opposed to the log of dollar-weighted average distances), it differs somewhat from the average distances shown earlier in Figure 2 though the trends are similar. The stacked areas show the between-effects for small-loan and other lenders. Differences between the height of the stacked areas and the black line reflects $\widehat{f'}(t)$, which can be positive or negative.

The height of the stacked areas confirm that the upwards trend in distances primarily reflects between-bank effects. The patterns for small-loan and other lenders, however, differ significantly. Small-loan lenders account for all of the long-term increase in distances, as well as for the spikes in average distances observed in 2000 and 2006-2008. In contrast, the contribution to the between-bank effects that other lenders make has largely been flat.

5 Robustness

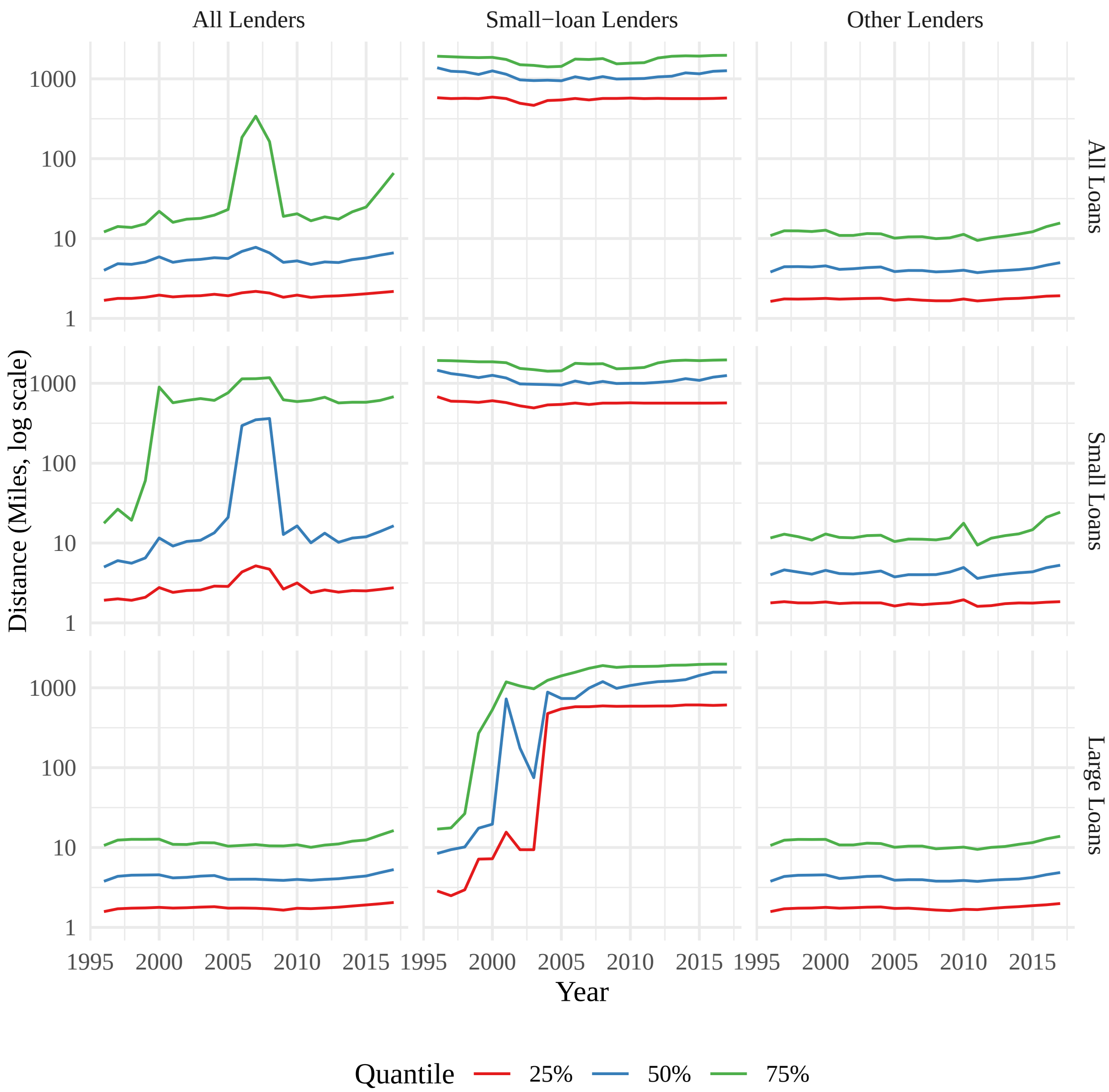
5.1 Distributional Effects

Like other papers in this literature, our analysis focuses on changes in average lending distances, which can conceal interesting dynamics in the distribution of distances. In this section, take a more complete look at how the distribution of loans distances is changing by focusing on the 25$^{\text{th}}$, 50$^{\text{th}}$, and 75$^{\text{th}}$ percentiles of the distribution of loan distances.

Figure 8 shows these percentiles of the distance distribution for our three loan types (shown in the three rows) and lender types (columns). The panels are presented using a base-10 log scale to accommodate the widely disparate lending distances. Across all loans and lenders (top-left panel), median distances remained short during our sample period, ranging from 4 miles in 1996 to 6.6 miles in 2017, with a peak of 7.8 miles in 2007. Movement was much more significant in the upper tail of the distribution, where the 75$^{\text{th}}$ percentile increased ten-fold from 6.6 to 66 miles from 1996 to 2017. Like the changes observed in average distances, much of this increase (as well as the sharp spike observed in 2006-2008) appears to reflect the increasing industry-share of small-loan lenders as the distributions for small-loan and other lenders did not show similarly sized increases (top-middle and top-right panels).

Distances increased for all three small-loan quantiles (middle-left panel), with notable spikes in 2006-2008. Like the results for all loans, the increases are substantially muted for the two lender groups, suggesting that most of the variation in the loan size distribution is the result of the increased market share of small-loan lenders. In particular, the large spike in median distance on small loans, from 21 miles in 2005 to 362 miles in 2007 and back to 13 miles in 2009, can be attributed to small-loan lenders accounting for over 50% of small loans during the spike (as shown earlier in Figure 5(B)). Increases in the median and 75$^{\text{th}}$ quantile of small-loan distances at other lenders are similar to those observed for average distances,

Figure 8: Distribution of Loan Distances by Loan Size and Lender Type



which reflected within-bank effects within this group of lenders.

Distances for large loans were predominantly local, with all three quantiles remaining flat at around 10 miles or less. There was a significant increase in large-loan distances at small-loan lenders during the first decade of our analysis, when all three quantiles increased to levels comparable to the distances at which these small-loan lenders extend small loans. However, small-loan lenders' industry share of large loans was sufficiently small (Figure 5(B)) that this change did not notably affect the industry distribution of large loans.

The patterns observed for these quantiles are consistent with the patterns observed for average distances. There have been significant increases in the distance distribution, though the within-lender-group differences have been much more stable. Notably, these graphs highlight the substantial heterogeneity in distance distributions between small-loan and other lenders overall and by loan type.

5.2 Adjusting for Maximum Distance

The range of distances over which a bank can lend will be limited by its location. Banks on either coast can lend at significantly longer distances than banks in the middle of the country. For example, the maximum lending distance for a bank in Wilmington, Delaware is about 2,500 miles, while the maximum for a Chicago bank 25% shorter. If both banks lend nationwide, average distances for the Wilmington bank will likely be larger because of its coastal location. This can create problems for our analysis. If banks that lend nationwide increase the geographic footprint of their branch networks, their average distance will decline even if their lending activity remained unchanged.

To adjust for the effects of branch networks, we calculate the largest distance between a bank's branch network and all of the counties in the contiguous U.S., which gives an upper bound on the bank's lending distance. We calculate each bank's lending distance as a percent of its maximum distance as a robustness check to our analysis.

Table 3: Volume Weighted Loan Distance

	All Banks		Small-loan Lenders		Other Lenders	
Year	Absolute (Miles)	Normalized (Percent)	Absolute (Miles)	Normalized (Percent)	Absolute (Miles)	Normalized (Percent)
1996	93	4.3	1,239	55.1	54	2.6
1997	99	4.7	1,167	51.5	58	2.8
1998	94	4.2	1,167	52.1	59	2.6
1999	118	6.0	1,139	51.3	54	3.2
2000	199	9.2	1,225	55.3	70	3.4
2001	151	7.2	1,135	50.5	51	2.8
2002	154	7.6	1,028	47.5	47	2.7
2003	151	7.5	1,012	46.9	49	2.8
2004	159	8.4	1,026	48.1	44	3.2
2005	196	9.7	1,032	47.0	39	2.6
2006	292	13.9	1,133	51.0	47	3.1
2007	320	15.0	1,105	49.3	47	3.1
2008	291	13.9	1,134	50.9	39	2.8
2009	165	8.4	1,078	49.4	40	2.8
2010	164	8.3	1,095	50.5	45	2.1
2011	172	8.5	1,105	50.3	37	2.4
2012	183	8.9	1,137	50.4	46	2.9
2013	168	8.2	1,176	50.3	46	3.1
2014	196	9.4	1,208	51.5	53	3.5
2015	205	10.0	1,195	51.4	66	4.1
2016	230	11.5	1,238	53.2	90	5.7
2017	252	12.5	1,263	54.3	100	6.2

Notes: Absolute distance measures the distance in miles from a county centroid where a loan is made to the nearest branch of the bank that made the loan. Normalized distance measure the absolute distance expressed as a percent of the maximum distance from any one of hte bank's branches to the furthest point in the continental United States.

Table 3 reports average lending distances in miles and as a percentage of maximum lending distance over time for all banks and for small-loan and other lenders respectively. Both distance measures exhibit similar time series patterns, suggesting that changes in bank branch networks are not driving our results.

5.3 Community Banks

Community banks have traditionally been an important source of small business credit and accounted for a disproportionate share of small business lending (Scott, 2004; Avery and Samolyk, 2004). However, community banks have declined both in number and as a share of bank industry assets in recent decades. If this decline has reduced their small-business-lending, then small businesses that otherwise would have obtained credit from community banks might have turned to small-loan lenders, particularly in rural or underserved markets where fewer local credit sources are available. The growth in industry share by small-loan lenders might have arisen because of the decline in community banks.

As discussed in Section 3, smaller institutions are exempt from the CRA's reporting requirements, so the CRA data do not capture lending by all community banks. Information about the lending activity of a broader spectrum of community banks' is provided by the Reports of Condition and Income ("Call Reports"). Each quarter, the Call Reports record the number and aggregate dollar amount of small business loans outstanding at commercial banks and thrifts. While not the same metric of small-business lending activity used by the CRA (which reports the number and dollar amount of loan originations), both data sources use the same loan-size-at-origination categories. As a result, the Call Reports can provide a more complete look at the industry share of community banks in small and large loans.

Table 4 shows measures of small-business lending activity of community banks derived from CRA and Call Report data.[14] The first three columns of the table report the community

[14]We define a "community bank" to be any bank, thrift, or bank holding company with less than $10 billion in assets. While this definition has been used by other studies and the Federal Reserve, it is more

banks' share of industry assets held by CRA-reporting institutions (derived from the Call Report data), of small-loan originations, and of large-loan originations respectively. The final three columns show the community-bank share of assets, small-loan balances, and large-loan balances based on the Call Report data for all reporting institutions.

As shown in the fourth column of Table 4, community banks' share of industry assets fell by more than half from 1996 to 2017. Among CRA-reporting institutions, the drop was even sharper (column 1), declining from 22 to 8% over the same period. The sharper decline for CRA reporters reflects, at least in part, the higher CRA-reporting threshold that took effect during the sample period, as shown by the particularly large decline in assets held by CRA reporters in 2005.

Consistent with the decline in assets, community banks' share of small-loan originations declined steadily over our sample period. In contrast, their share of large-loans has not declined notably. Between 1996 and 2004, community banks accounted for an increasing share of large loans reported in the CRA data (from 41 to 48%). When the CRA reporting thresholds changed in 2005, their share of large-loan originations fell immediately and has since held steady at around 37%, only a few percentage points lower than it was in 1996. The Call Report data, shown in Columns 4 to 6, show a consistent result. Community banks have declined as a share of small-loan balances, but not as a share of large loans. After growing slightly during the early part of the period, community banks' share of large-loan balances remained relatively stable at around 50%, which suggests that the decline in large-loan share for community banks in the CRA data primarily reflects the 2005 change in reporting requirements.

The stable industry share of community banks in large-loans to small businesses suggests that community banks remain an important source of small-business credit, despite their reduced numbers. However, community banks account for a notably small share of small

inclusive than the perhaps more widely used definition of less than $1 billion in assets. We use this broader definition because of the high reporting requirements for CRA data.

Table 4: Asset and Loan Share of Community Banks

	CRA Originations			Call Report Balances		
Year	Assets	Small Loans	Large Loans	Assets	Small Loans	Large Loans
1996	22	48	41	38	56	49
1997	23	39	40	37	56	48
1998	20	41	43	35	54	48
1999	19	39	45	34	52	49
2000	19	44	46	32	51	49
2001	18	40	45	30	49	50
2002	17	38	44	30	45	50
2003	17	31	45	28	44	51
2004	17	30	48	27	44	51
2005	12	22	37	26	42	51
2006	11	17	36	26	40	53
2007	10	17	36	25	36	51
2008	10	16	36	24	32	53
2009	10	18	35	23	29	52
2010	9	22	38	23	27	52
2011	8	15	36	22	29	52
2012	8	17	37	22	29	51
2013	8	15	37	21	27	50
2014	8	14	38	20	26	50
2015	8	14	38	20	25	48
2016	8	12	36	19	24	48
2017	8	15	37	18	21	46

Notes: All values are the shares of community banks in all banks. Community banks are those with $10 billion or less in assets.

loans, suggesting that at least some of the growth of the small-loan lenders may have come at the expense of community banks.

5.4 Different Definitions of Small-Loan Lenders

In this section, we explore the sensitivity of our results to the definition of a small-loan lender. Our definition has two parts. Lenders have to originate a large dollar volume of small loans and they have to specialize in that lending. While high-volume lending might be necessary to take advantage of new lending technologies, for the reasons discussed in Section 2, specialization is not as obviously necessary. In this section, we explore how our results are affected requiring specialization as part of our definition.

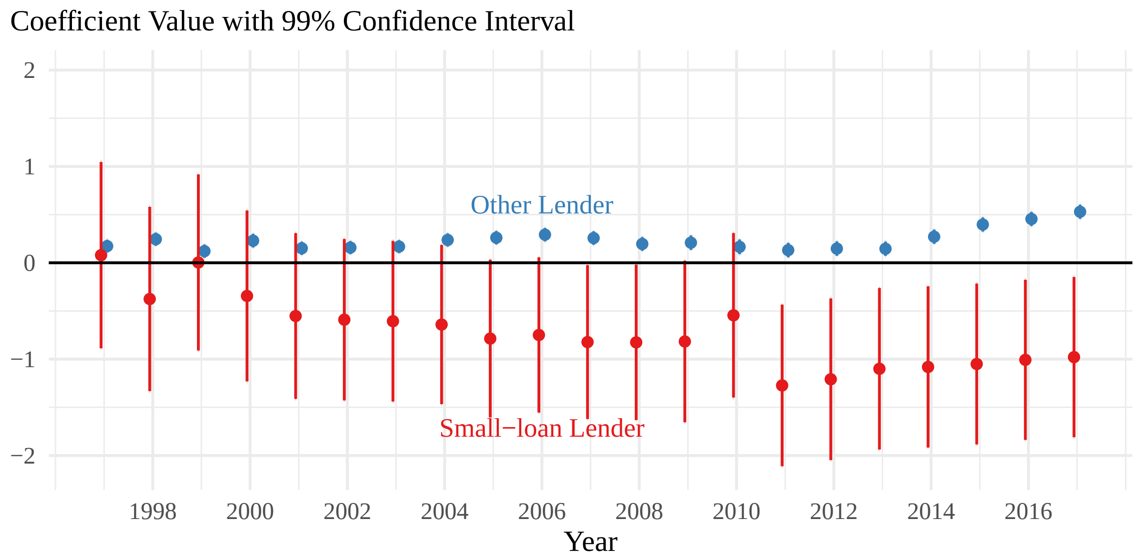
Removing the specialization requirement doubles the number of small-loan lenders from 18 to 36. The lending activity of these additional 18 banks ("alternative lenders") differs significantly from that of the small-loan lenders. Their share of small-loan volumes was roughly comparable to small-loan lenders (30.4% versus 35.7%), though the average size of the small loans they originated was 3-times larger ($22,000 versus $7,000). Their dollar-volume of large loans was almost 20-times that of small-dollar lenders and, as a result, their total loan volumes over the sample were twice as large as the small-loan lenders.

The distances over which these alternative lenders originated loans also differed substantially from the small-loan lenders. The average loan distance over the entire sample period for the alternative lenders was 47 miles, below that of the small-loan lenders (1,125 miles) and the other lenders (56 miles). This pattern in difference in distances also applied to small loans. The average distance for a small loan originated by these alternative lenders was 75 miles, below the average for small-loan lenders (1,125 miles) and other lenders (85 miles). This suggests that is a significant difference in business models between the small-loan and alternative lenders.

Nevertheless, expanding our definition of a small-loan lender to include these alternative lenders does not notably change our results. Figure 9 shows the coefficients from the within-bank estimations using the expanded definition.[15] Distances for both lender types

[15] We make the same adjustment made to the single small loan lender as in Figure 6(B).

Figure 9: Yearly Fixed Effects from Within-Bank Estimates by Type of Lender, using Expanded "Small-loan Lender" Definition



are essentially flat through 2012 and then diverge somewhat, with distances declining for the expanded small-loan lenders and increasing marginally for the narrower other lenders.[16] Despite this divergence, there is little evidence of a long-run increase in distances in small business lending.

5.5 County-Share Effects

Our analysis has followed much of the existing literature in focusing on changes in average lending distances. While averages would be expected to increase when the geographic scope of bank lending expands, other changes in the distribution of bank loans could obscure that outcome. For example, if the geographic distribution of small businesses became more urban, where distances would tend to be smaller, this could lower average lending distances even if lenders were willing to make loans at increasingly longer distances.

[16] This increase in lending is relative to the 1996 individual bank average, which is only a few miles in most cases.

In this section, we use an alternative approach to examine patterns in small business lending activity. Instead of focusing on average lending distances at banks, we look at county-level lending.

We begin by examining whether the relationship between a bank's market share in a given county and distance has systematically changed over time. This approach is similar to that of Hannan (2003), though our analysis focuses on counties instead of MSAs and uses measures of distance instead of a coarse distinction between local and non-local lenders.

We model a bank's share of lending in county, $CountyShare_{bct}$, as a function of the log-distance between its branch network and the county, time, and other factors. Specifically, we estimate:

$$CountyShare_{ict} = \alpha_i + \tau_{ct}^C + g(d_{ict}, t) + x_{it}\delta + \epsilon_{ict} \tag{5}$$

where α_i and τ_{ct}^C are bank and county-year-specific fixed effects, x_{it} is a vector of time-varying characteristics of bank i, and $g(d_{ict}, t)$ specifies the marginal effect of distance on county-market share and is defined as

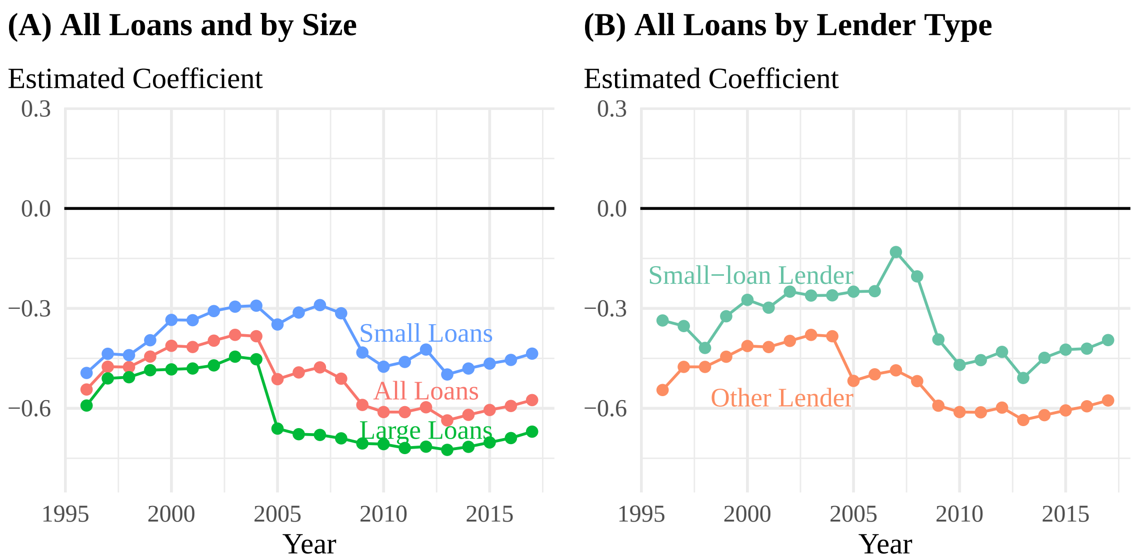
$$g(d_{ict}, t) \equiv \sum_{j=1996}^{2017} I(t = j) log(d_{ict}) \beta_j. \tag{6}$$

All else equal, if distance is becoming less of an impediment to lending, the market shares of more distant lenders should rise and β_t should increase (become less negative) with t.

We estimate four specifications of Equation 5. The first three are estimated using all loans, only small loans, and only large loans, respectively. Coefficients from these estimations are shown in Panel (A) of Figure 10. The final specification is estimated using all loans, but with separate time-distance effects for small-loan and other lenders as shown in Panel (B).

The results show no clear time-series trend in the estimated values of β_t, which change very little over the entire sample. While distance is less of an impediment to small-loan

Figure 10: Coefficient Estimates of County-level Market Shares

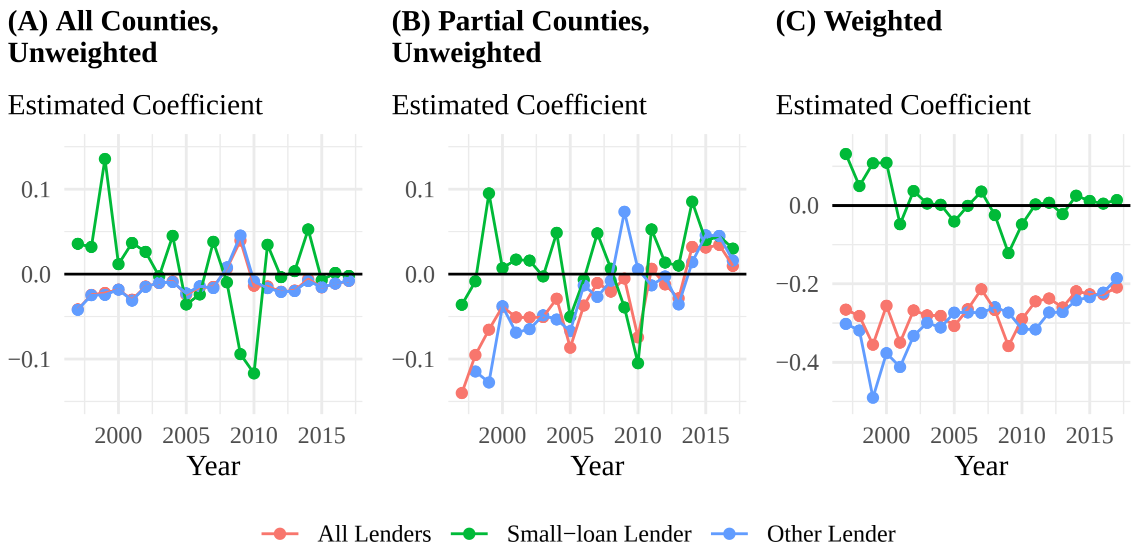


lending, patterns for both loan sizes largely mirror that for all loans. One notable difference is that the 2005 change in the CRA reporting threshold increased the relationship between distance and lending, particularly for large loans. Coefficient estimates for small-loan lenders, shown in panel (B), are less negative that for others, though neither exhibits a significant trend over the sample. These results are consistent with the idea that the role of distance on county-level market shares has not diminished appreciably over the sample.

We also estimate a version of Equation 5 using the percentage change in lending in each county by banks as the dependent variable. This is the same dependent variable used by Granja et al. (2018) and we follow their approach in defining the lending growth rate in a county as $ln(L_{ict}+1) - ln(L_{ic(t-1)}+1)$. However, our estimation differs from theirs in two primary ways. First, we do not include loan composition and macroeconomic condition variables as controls and we do not interact lnd with the macroeconomic conditions variable.[17] Second, we estimate our equation using all of the contiguous counties in the U.S. Granja

[17] Our specification is closest to the specification they used in Figure 7. We also use county-year and bank fixed effects as they do.

Figure 11: Estimates of County-level Loan Growth Rates



et al. (2018), in contrast, used only those counties where a bank had some lending in at least one year of the sample period (even if that bank did not have any lending in a particular year).

Again, we estimate the model using two specifications, one using common distance-time effects for all lenders and the other with different distance-time effects for small-loan and other lenders. The estimation results are shown in Panel (A) of Figure 11. The results suggest that distance is negatively associated with loan growth for all lenders and other lenders, though this relationship appears to have declined during the sample. In contrast, there is little consistent relationship between distance and loan growth at small-loan lenders, who lent nationwide all through our sample.

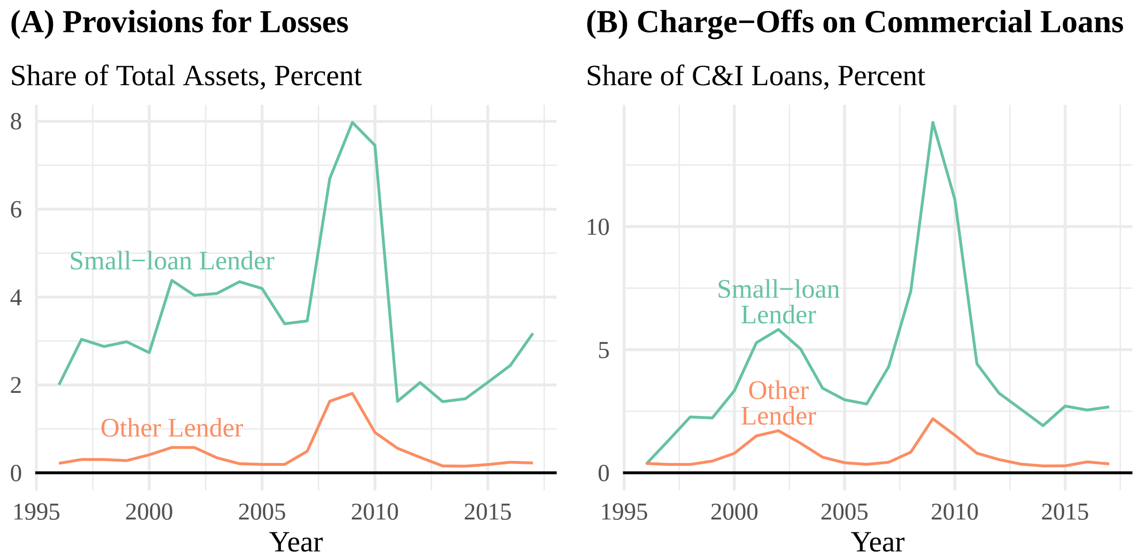
For comparison purposes with the results of Granja et al. (2018), Panel (B) of Figure 11 shows the coefficients for the same specifications that as in Panel (A), but that excludes county-bank pairs where the bank had no lending in any of the years in our sample. Estimation using the partial set of counties results in a steeper upward trend in the relationship between distance and loan growth to the extent that in later years loan growth is positively related to distance for all loans and both lender types. This suggests that our differences with the results of Granja et al. (2018) result from our using all of the counties in which banks could have lent.

Finally, using the change in $ln\left(L_{ict}+1\right)$ as a dependent variable can result in considerable heteroskedasticity. For example, a bank that originates a single \$1,000 loan in a county where it originated nothing the year before has a growth rate of almost 70% using this dependent variable. If the bank originates a single \$25,000 loan, the growth rate is 320%.[18] Such growth rates are difficult to match in counties where banks have more established lending programs. And since the counties where banks tend to do marginal amounts of lending tend to be on the periphery of their lending areas, this heteroskedasticity is related to the distances at which loans are originated.

To compensate, we estimate the same two specifications shown in Panels (A) and (B) but weight each observation by the dollar amount of originations in the previous year. Implicitly, this drops counties where a bank originated no loans in the previous year from the loan-growth calculation.[19] The coefficients from this estimation are shown in Panel (C). Broadly, the small loan lender results are similar to those in Panels (A) and (B), showing little relationship between loan growth and distance. However, the relationships between loan growth and distance for other lenders and all lenders are considerably more negative, though the strength of the relationship diminishes somewhat over time.

Taken together, the results of this section suggest that distance has not diminished notably in importance in small business lending over the sample. Small-business lending market shares of more distant lenders have not changed notably and loan growth rates have been slower in more distant counties.

Figure 12: Provisions for Losses and Charge-offs by Lender Type



5.6 Charge-offs and Loan Loss Provisions

The significant differences in lending distances between small-loan and other lenders suggest that they have different business models. The substitutability of the products being provided by these lender types is uncertain. Systematic differences in other characteristics between the loans originated by small-loan and other lenders could imply that these products are very different and, hence, less substitutable. Riskiness of their loan portfolios would be one such indication.

Differences in loan riskiness should manifest in expected losses on their loan portfolios. Figure 12 shows loan loss provisions as a share of total assets (Panel (A)) and charge-offs on commercial and industrial loans as a percentage of C&I assets (Panel (B)) for both loan types. In all years, both risk measures are significantly higher for small-loan lenders than they are for other lenders. This indicates that the loans from small-loan lenders are, on average, riskier. Because of the higher risk profiles, loans from small-loan lenders are likely

[18]Loan volumes are measured in thousands of dollars.

[19]Clearly, this sample is more restricted than the samples in Panels (A) and (B).

to have higher interest rates than loans from other lenders, suggesting that they may be imperfect substitutes.

6 Conclusion

Despite suggestions that technological change has revolutionized small business lending, our results indicate that commercial banks and thrifts have not notably expanded their geographic lending areas. While we confirm the results of earlier papers that average small-business lending distances have increased in the aggregate, we find that this change reflects between-bank effects and not the within-bank changes that would be consistent with banks lending at greater distances over time.

In particular, we find that almost all of the increase in average distances over our sample can be attributed to 18 lenders that specialize in high-volume, small-loan lending. The average lending distance at these small-loan lenders was over 1,200 miles in 1996, compared to about 50 miles for other lenders. While average lending distances among these small-loan lenders remained largely flat during our sample, their share of industry lending increased from 3 to 13%. This increase accounts for the vast majority of the increase in average distance and for the pre-recession spikes in distance observed during our sample.

The growing industry share of small-loan lenders is consistent with the technological improvements that occurred over this time, though it offers a different interpretation of how those changes have affected small business lending markets. If technological change were hardening information at the margin and allowing lenders to expand their geographic reach, as others have suggested, lending distances would have increased at the lender level. After more than 20 years, our results show no evidence of such a trend after 20 years.

Instead, the effects of technological change appear to have benefited the small number of lenders who were best positioned to exploit those new technologies. The industry share of these lenders, who specialize in originating a high-volume of small loans, increased significantly during our sample. Since they were already lending nationwide at the beginning of our sample, they were likely already relying almost entirely on hard information. This suggests that, instead of "hardening" previously soft information, these new technologies may simply have improved the efficiency of hard information processing, making lenders that rely on hard information more efficient while leaving lenders that rely on soft information dependent on relationship banking.

This alternative interpretation of how technological change has affected small business lending markets has important welfare implications. If, counterfactually, large and small loans were substitutable and lenders were increasingly able to use hard information to lend at greater distances, small business lending markets would become more nationally integrated. More financing options would be available for small businesses and, because of increased competition, credit would be offered on better terms. Bank lending would become more geographically diverse, so local economic shocks would be less likely to affect the credit available to local small businesses. In contrast, we find that small businesses continue to obtain large loans primarily from local banks, particularly community banks whose share of large bank loans has remained stable even as their number and share of banking industry assets has shrunk. This suggest that small businesses remain dependent on local lenders.

Our results also indicate that the composition of small business lending has been changing. Small-loan originations have grown more rapidly than large-loan originations, despite the fact that the threshold that defines these loan sizes does not adjust for inflation. There are several possible, non-mutually exclusive, explanations for this pattern.

First, borrowers may be substituting away from large loans towards small loans, possibly in response to expanded credit availability from small-loan lenders. While we believe the extent of such substitution is limited by the cost differences between large and small loans, particularly when the former are collateralized, there may be some substitution at the margin.

Second, the composition of small businesses may have changed so that the borrower pool includes a larger share of firms in industries that require fewer large loans. Third, small businesses may be substituting away from other forms of financing. For example, as small business credit cards have become more available, small businesses owners may be relying less on their personal credit cards to finance their business operations or on trade credit provided by their suppliers. Regardless of the contribution of each of these (or other) explanations, the rapid rise in small-loan lending suggests that the composition of small business financing may also have experienced a sizable shift.

Our analysis comes with caveats. Our definition of "small-loan lenders" is somewhat arbitrary and likely inexact. Any lender that originates a high volume of small loans could take advantage of these new technologies, even if they had other business lines involving large loans and relationship banking that prevented them from meeting our definition of a small-loan lender. Additional research that helps identify the product lines and lender types that have made the greatest use of the new technologies would be useful, particularly in analyzing the competitive effects of bank mergers on small business lending markets.

Additionally, our analysis is limited by the information available in the CRA data. Technological changes may have had heterogeneous effects on different loan types, such as collateralized loans. While this possibility is consistent with our results, the CRA data do not contain sufficient information to establish what loan types have been most affected. However, it is clear that future research on small business lending, particularly using the CRA data, should address the issue of heterogeneity in loans and lenders.

The CRA data also do not provide any information about the small-business borrowers that would allow us to separate demand and supply effects. We are therefore unable to ascertain why within-bank distances have not changed, particularly for lenders making small loans who were not already lending nationwide. This could be the result of demand-side factors. Small businesses could prefer to obtain credit from a local bank, perhaps preferring to bundle lending with other banking services, like cash management, at the same bank. Such bundling would be especially beneficial to small businesses with favorable soft information that would be revealed to the lender as the relationship is maintained. Demand-side considerations like this, could help explain why local lenders remain so important during this period of rapid technological change.

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