



Urbanization, agglomeration economies, and access to mortgage credit[☆]

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ABSTRACT

We examine the effect of urban agglomeration on access to mortgage credit using HMDA data from 1994 to 2008. Previous studies suggest that agglomeration should increase access to specialized workers and information, both of which should enhance liquidity in mortgage lending. Findings indicate that agglomeration economies increase mortgage origination rates and loan amounts in the 1990s, and especially so in higher risk locations. However, agglomeration effects dissipated over the study period. While we do not identify the microfoundations of these patterns, the decline in the influence of agglomeration coincides with the dramatic expansion of secondary mortgage markets and development of information technology, both of which should have reduced regional disparities in access to credit.

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1. Introduction

This paper is based on two ideas that have not been brought together in previous work. The first is that agglomeration of economic activity and urbanization improves access to specialist workers and information, enhancing efficiency. The second is that mortgage lending relies heavily on information flows among specialized and often-times nearby workers. Together, these ideas would seem to suggest that urbanization and the related agglomeration of economic activity may enhance access to credit. Nevertheless, despite large literatures on both the productivity effects of agglomeration and the geography of mortgage lending, we know little about how urbanization affects access to credit. This paper seeks to fill that gap.

Consider first the mortgage application process. Before a typical mortgage application is originated, a variety of individuals with specialized skills assess the merits of the borrower and the loan. They include real estate agents, appraisers, loan brokers, accountants and credit underwriters, as well as secondary market and other lender personnel. Information flows among these specialized actors ultimately determine whether a loan application is accepted or denied. At the same time, borrowers incur pecuniary and non-pecuniary costs when submitting an application and have incentives to avoid submitting loan applications that have little chance of being originated. Nevertheless, as shown in

Panel A of [Table 1](#), summary measures based on HMDA data indicate that in most years from 1994 to 2008, only 75 to 80% of conforming size conventional home purchase loan applications were originated (details on the HMDA data will be provided later).¹ The implied 20 to 25% denial rate suggests that improved access to information remains relevant to the mortgage market. This suggests a possible role for agglomeration as a determinant of loan application outcomes.

In the last few decades, a large and growing literature has provided compelling evidence that urbanization enhances productivity for a wide range of industries (see, for example, [Rosenthal and Strange, 2001, 2004](#); [Duranton and Puga, 2004](#); [Glaeser and Gottlieb, 2009](#)). Related spillover effects arise at the city level (e.g. [Glaeser et al., 1992](#); [Henderson et al., 1995](#); [Combes et al., 2012](#)) and also with spatial concentration within a given industry ([Martin et al., 2011](#); [Rosenthal and Strange, 2004, 2005, 2008](#); [Henderson and Arzaghi \(2008\)](#)). A triumvirate of mechanisms is often considered as drivers of such productivity effects, including improved access to intermediate inputs, specialized labor, and information ([Holmes, 1999](#); [Rosenthal and Strange, 2001](#); [Costa and Kahn, 2000](#); [Ellison et al., 2010](#); [Bleakley and Lin, 2011](#); [Jofre-Monseny et al., 2011](#); [di Addario, 2011](#)). Nevertheless, although there exist many studies of the impact of agglomeration on manufacturing ([Moomaw, 1981](#); [Nakamura, 1985](#); [Henderson, 1986](#); [Ciccone and Hall, 1996](#); [Rosenthal and Strange, 2003](#); [Drucker and Feser, 2012](#)), some on the service sector (e.g. [Henderson and Arzaghi \(2008\)](#)), and a few on retail activity (e.g. [Rosenthal and Ross, 2010](#)), assessment of agglomeration effects on access to mortgage credit has been largely absent.

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¹ HMDA refers to the Home Mortgage Disclosure Act.

Table 1
Origination rates and 2nd secondary market activity for conventional, home purchase loans—all census tracts.

Year	Originations per tract	Denials per tract	Originations/ (orig + denials)	Secondary market purchases per tract	Purchases/ originations
<i>Panel A: Conforming size loans</i>					
1994	38.95	7.12	0.82	23.68	0.58
1996	43.21	13.44	0.77	30.49	0.68
1998	53.44	18.68	0.74	46.19	0.84
2000	56.36	18.68	0.74	47.92	0.81
2001	60.10	14.04	0.78	53.55	0.86
2002	64.83	11.86	0.81	61.22	0.91
2003	74.51	13.81	0.81	72.21	0.94
2004	88.66	18.70	0.80	90.09	0.99
2005	105.63	25.29	0.79	109.41	0.99
2006	99.80	27.12	0.77	110.89	1.07
2007	65.72	17.89	0.76	73.84	1.06
2008	33.55	8.40	0.78	35.46	1.01
<i>Panel B: Non-conforming size loans</i>					
1994	8.41	1.06	0.91	4.31	0.47
1996	8.43	1.36	0.89	4.95	0.54
1998	10.88	1.30	0.90	9.12	0.74
2000	12.80	1.88	0.87	8.32	0.61
2001	10.69	1.52	0.88	7.86	0.65
2002	12.92	1.62	0.89	9.88	0.71
2003	16.33	2.48	0.87	13.01	0.76
2004	20.47	3.92	0.86	17.21	0.72
2005	23.10	5.47	0.84	21.99	0.80
2006	15.38	5.20	0.80	14.70	0.82
2007	11.12	4.65	0.76	8.13	0.68
2008	6.13	2.13	0.81	2.99	0.43

While the idea that agglomeration may enhance access to credit is seemingly intuitive, at least two factors may mitigate such effects. The first is the well-known expansion of the secondary mortgage market. As also shown in Table 1, the share of originated loans that were sold to the secondary market increased dramatically post-1994 (see the last column of each panel in Table 1). That expansion of secondary market activity is widely thought to have ameliorated regional disparities in the supply and demand for mortgage credit. If less-developed areas had formerly suffered from excess demand for credit, then the association between agglomeration and access to credit should have weakened as the secondary market expanded. Reinforcing that possibility is the equally dramatic explosion in information technology that has occurred since the early 1990s. The internet and related technologies have greatly improved access to information and reduced the cost of doing business from afar.² That too may have weakened any relationship between agglomeration and access to credit. On balance, therefore, whether agglomeration of economic activity and urbanization enhances access to credit remains uncertain and may have evolved over time.

Our empirical analysis is based on a panel of census tract level data using loan records from Home Mortgage Disclosure Act (HMDA) files for the years 1994–2008. We use two measures to proxy for credit access: the census tract share of loan applications that are originated in a given year (the extensive margin), and the tract-level median size of loans requested (the intensive margin). Later in the paper we argue that if a credit rationing equilibrium prevails such that loan rates do not clear the market, then urbanization economies likely would increase the share of loan applications that are originated.³ In addition, to the extent

that agglomeration economies reduce the loan rate offered to a given applicant, urbanization is also expected to increase the median size of loans requested. To measure agglomeration we use the log of the number of census tracts in the county where the loan is originated. County-level geography is used here because the influence of local agglomerations of mortgage brokers, lawyers, real estate agents, and other credit market participants likely extends beyond the immediate census tract in which a borrower is situated.

In most of the analysis to follow we focus on conventional loans that are at or below the funding size limits that define the GSE-conforming loan market. Over most of the study period, such loans account for roughly 80% of mortgage originations. They are also subject to relatively well-defined underwriting guidelines and are eligible for purchase by Fannie Mae and Freddie Mac (the government sponsored agencies, or GSEs). As such, in comparison to non-conforming loans, conforming size loans tend to be relatively similar in size and are subject to relatively uniform underwriting standards. This facilitates risk assessment, pooling, and secondary market securitization of conforming size loans. Consistent with that view, one would expect secondary markets to play a more prominent role in the financing of conforming size versus non-conforming loans. This is confirmed in Table 1. Notice that in every year since 1994 the conforming size sector of the market (Panel A) has been notably more reliant on secondary market financing than the non-conforming sector (Panel B). This is evident from the ratio of secondary market loan purchases to originations shown in the last column of the two panels. Moreover, reliance on secondary markets has become essentially complete for the conforming size sector. For that market segment, purchase/origination ratios increased from 58% in 1994 to levels at or above 1 since 2004 (the ratio can exceed 1 because some loans are sold more than once in a given year).

Two additional points are worth emphasizing based on summary measures in Table 1. First, as is well known, loan originations rose sharply from the mid-1990s to a peak in 2005 and then fell back sharply with the onset of the housing and financial crisis. Second, secondary market purchases also shot up from the mid-1990s to a peak in 2005 and then declined. These patterns suggest the importance of both cyclical fluctuation and ongoing structural change (e.g., expansion of secondary markets and information technology) to mortgage market outcomes since the early 1990s.

Bearing the above in mind, we begin by pooling data across survey years over the 1994–2008 period. MSA fixed effects are included in the models and control for time invariant MSA attributes. Identification is based on within-MSA variation across census tracts and over time, bearing in mind that our key measure of agglomeration – the number of census tracts in a county – is time-invariant. Although results provide a useful jumping off point, this model specification does not control for tract-level time-varying factors that could be correlated with the local scale of development and related agglomeration economies.⁴ It also does not do justice to the marked expansion of both secondary markets and information technology described above. For these reasons, we follow the pooled 1994–2008 models with a series of year-by-year models that both control for MSA fixed effects and also allow for changes in market conditions over the sample horizon.

As a final feature of our empirical design, we consider the degree to which urbanization disproportionately improves access to credit for high risk populations that are most likely to have their loan applications turned down. To do this, we stratify census tracts across the country into low- and high-risk populations using two different stratification schemes. In some models we separate tracts with historically high versus low rates of unemployment. In other models we separate

² Petersen and Rajan (2002), for example, argue that information technology has allowed the geographic distance between small businesses and their lenders to increase, suggesting that the importance of proximity to lenders may have diminished in recent years.

³ As will become apparent, we build off of a model of equilibrium credit rationing from Stiglitz and Weiss (1981). For related discussion, in part based on concerns about discrimination in mortgage markets, see also Canner and Gabriel (1992), Duca and Rosenthal (1993), Munnell et al. (1996), Berkovec et al. (1998), and Deng and Gabriel (2006), among others.

⁴ For example, rising local property values could prompt loan applicants to request larger loans but would not necessarily encourage lenders to issue larger loans, in which case origination rates could fall. If over our sample horizon (1994–2008) property values rise more in heavily developed locations within a given MSA, then unobserved changes in local property values could obscure evidence of agglomeration effects.

tracts into those that have been classified by the department of Housing and Urban Development (HUD) as underserved versus not underserved for purposes of loan purchase by the GSEs (details are provided later in the paper).

Results of the analysis are consistent with our priors. Evidence from the pooled 1994–2008 models is consistent with the idea that urbanization enhances access to credit: agglomeration is positively associated with larger loan size requests by borrowers (indicative of lower loan rates) and also higher origination rates. The elasticities with respect to size of the county population are 1.4% and 0.8% for loan size and origination rates, respectively. These findings are reinforced in the year-by-year cross-sectional models but with important temporal patterns. For the year-by-year models, urbanization effects on access to mortgage credit peak in the late 1990s, diminish thereafter, and are close to zero after roughly 2003. This temporal pattern is consistent with the view that expansion of the secondary mortgage market along with proliferation of electronic and internet-based technologies has allowed lenders in smaller local markets to supply credit at a cost similar to that of their counterparts in more heavily developed areas. In that regard, our findings suggest that there has been a leveling out in access to credit between lightly versus heavily developed locations, and a related increase in the efficiency with which credit is made available in the U.S.

The paper proceeds as follows. Section 2 provides a simple conceptual framework that motivates our testable hypotheses and helps to clarify discussion to follow. Section 3 discusses the data, Section 4 provides results, and Section 5 concludes.

2. Model

2.1. Overview

This section provides a simple conceptual framework that motivates our primary testable hypotheses and helps to interpret the empirical work to follow. Recall that we measure access to credit using the census tract level share of loan applications that are originated and median size of tract-level loans requested. In both cases our focus is on whether urbanization enhances borrower access to credit. We consider this question under two market regimes, one in which loan rates clear the market and one in which credit rationing results in excess demand for credit at equilibrium loan rates. We begin with the market clearing model.

2.2. Market clearing equilibrium

Note first that demand for mortgage credit in a given community n and year t depends on local mortgage rates and attributes of the local applicant pool that affect tastes and preferences. Demand is reflected in the number of applications for mortgage credit. The supply of credit in a given community is assumed to depend on the risk free cost of funds which is invariant across locations, attributes of the local applicant pool that affect lender exposure to risk, and agglomeration economies associated with the scale of nearby economic activity.

It is also important to recognize that equilibrium mortgage rates in a given community depend on all of the arguments of the demand and supply functions. This suggests that even holding constant the attributes of the local applicant pool, if mortgage lending in larger areas benefits from agglomeration economies, loan rates will be lower in such areas because the loan supply function will be outward shifted. With downward sloping demand curves, this also implies that the size of loans requested will be larger in agglomerated areas. We do not observe loan rates in our data, but we do observe the loan size requested. Accordingly, in the empirical work to follow we test whether the size of loan requested is larger in more developed areas (controlling for other factors, including local house values).

2.3. Credit rationing equilibrium

When loan rates clear the market, denial rates should be quite low and there should be no role for loan origination rates as an indicator of access to credit. This is in contrast to summary measures from Table 1 which, as discussed earlier, indicate that mortgage loan denial rates have been between 20 and 25% in most years between 1994 and 2008. Partly for that reason, we now relax the assumption that loan rates clear the market by modifying a model of equilibrium credit rationing from Stiglitz and Weiss (1981). To anticipate, under this modeling paradigm, a likely outcome is that efficiency gains associated with urbanization economies would lower loan rates, increase loan size requested, and increase loan origination rates. The model is described in Fig. 1.

Fig. 1 displays a four quadrant model of the demand and supply for credit in the primary mortgage market. The defining feature of the model is the shape of the two return functions in the lower right quadrant, one for loans originated in small cities (A) and one for loans originated in large cities (B). The functions describe the expected return to mortgage investors (on the vertical axis) as a function of the loan interest rate (on the horizontal axis). A mortgage investor could be thought of as the primary lender that holds the loan in portfolio, or secondary market investors that hold all or a portion of the mortgage in their portfolios (possibly in the form of mortgage backed securities). Notice also that the expected return from mortgage investments is assumed to initially increase with the loan rate, reach a peak, and then decline. This is because higher loan rates entail both benefits and costs for investors. On the one hand, higher mortgage rates generate higher interest payments which is good for mortgage investors, *ceteris paribus*. But higher loan rates also increase investor exposure to costly sources of risk. These risks include the possibility that borrowers may exercise their call option to refinance at some point in the future, or that borrowers may make late loan payments or default if they suffer a negative income or equity shock.⁵ It is likely that these potential costs increase at a nonlinear rate with the loan rate while interest payments increase linearly. Under that assumption, the expected return from investing in a given loan will display a humped shape pattern as in the lower right quadrant.

The lower left quadrant of the figure maps the expected return functions into the number of loans supplied per capita. The key assumption in the lower left quadrant is that higher expected returns increase the supply of credit. This is then translated into the upper right quadrant as the loan supply function, expressed in per capita terms. Notice that the supply function has a defining humped shape that mirrors the shape of the expected return function in the lower right quadrant.

In the upper right quadrant, we express loan demand in per capita terms and to simplify discussion assume that per capita demand is alike in cities A and B (small and large, respectively). As described in detail by Stiglitz and Weiss (1981), for a humped-shaped loan supply function, a credit rationing equilibrium will arise if loan demand intersects supply on the downward sloping portion of the supply function. In that instance, lenders maximize their expected returns by charging a loan rate equal to r^* at a point associated with the peak in the supply function and to the left of the market clearing rate (as determined by the intersection of supply and demand). In this instance, excess demand exists in equilibrium and some loan applications will be denied. If instead the demand function intersects the upward sloping portion of the supply

⁵ Default would typically imply that the borrower was in a negative net equity position as is the case for many families since the 2007 financial crash. Note also, that Stiglitz and Weiss (1981) motivate a similarly shaped expected return function by arguing that asymmetric information between borrowers and lenders contributes to adverse selection and moral hazard. In their modeling framework, as loan rates rise, borrowers who recognize that they may not be able to afford the higher loan payments drop out. In addition, with higher loan rates, investors favor higher risk investments as only such investments can generate expected returns high enough to offset the high borrower costs.

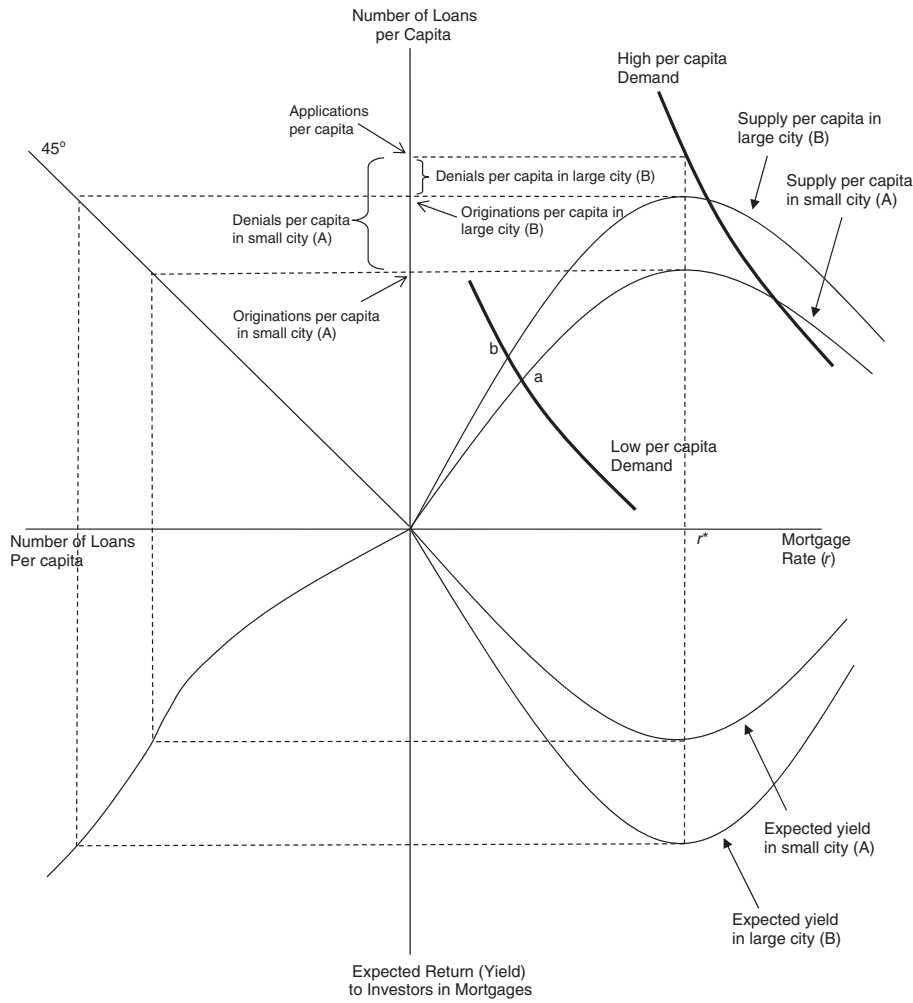


Fig. 1. Mortgage markets in small and large cities allowing for urbanization economies and credit rationing.

function, then the loan rate clears the market and all loan applications are originated. In Fig. 1, we display both scenarios by drawing two demand functions, one high and the other low. As in Stiglitz and Weiss (1981), we emphasize that the model in Fig. 1 allows for the possibility of credit rationing but does not require that a credit rationing equilibrium will prevail: the nature of the equilibrium depends on the relative level of demand. In addition, we have drawn Fig. 1 so that the peaks in the loan supply functions for cities A and B are alike. This prevents Fig. 1 from becoming overly cluttered but does not restrict the ideas discussed below and the empirical work to follow.

Suppose now that mortgage markets operate more efficiently in heavily agglomerated locations. This would cause the return function in city B to shift down in the lower right quadrant relative to the corresponding return function in city A. That in turn would cause city B's supply function in the upper right quadrant to shift up. If loan demand is low, loan rates clear the market and equilibrium occurs at points *a* and *b* for the small and large cities, respectively. Notice that at point *b* loan rates are lower which implies that the equilibrium level of lending activity will be larger. Moreover, because the equilibrium loan rate clears the market all loan applications are originated. This is the scenario described in the previous subsection.

Consider now a market environment in which loan demand is high and intersects the downward sloping portion of the supply functions. Under these conditions a credit rationing equilibrium will be in force and three cases could arise. They are as follows.

In the first case, which is drawn in Fig. 1, the peaks in the loan supply functions occur at the same loan rate for cities A and B. Under

these conditions, the equilibrium loan rate will be the same in both cities. With a common demand function, this implies that the per capita number of loans demanded and loan size requested will be alike in both cities. On the other hand, the share of loan applications that are originated is clearly higher in city B given the higher peak in its supply function relative to the common demand curve.

In the second case (which is not drawn to simplify Fig. 1) suppose that the peak of city B's loan supply function shifted to the left of city A's (which remains at r^*). Then loan rates would be lower in B while the per capita level of applications would be higher. Provided that the leftward shift in B's supply function was relatively modest, origination rates would be higher than in A (based on perturbation arguments). However, if the leftward shift in the peak of B's supply function was substantial, it is possible that origination rates could actually be lower in B than in A. For this to occur, urbanization economies would have to draw forth a larger number of additional applications because of lower loan rates than the corresponding increase in the willingness of lenders to originate new loans. Although in principle this could occur the empirical results reported later in the paper suggest that it does not. Note also that if agglomeration lowers the equilibrium loan rate, then loan size requested will be larger in agglomerated areas irrespective of the change in origination rates.

In the third case, if the peak in B's loan supply function was shifted to the right (beyond r^*), then loan rates would be higher and origination rates would increase as the loan rate approaches the market clearing level. With the higher loan rate loan size requested should be smaller.

Summarizing, if loan rates clear the market, urbanization economies should lower loan rates, increase the size of loans requested by borrowers, and have no systematic effect on origination rates. Loan application denial rates should also be quite low, but that seems inconsistent with the 20 to 25% denial rates that typified the market between 1994 and 2008 as discussed earlier. If instead a credit rationing equilibrium prevails, then denial rates should be higher and the impact of urbanization on access to credit varies with effects on equilibrium loan rates. If urbanization causes loan rates to rise – which seems unlikely – then loan size requested will fall and origination rates would rise. If instead urbanization lowers loan rates by a large amount – which also seems unlikely – then loan size requested will increase but origination rates could either rise or fall depending on the elasticity of demand for loans relative to the shift in the supply function. Finally, if urbanization causes equilibrium loan rates to fall by a relatively modest amount – which strikes us as the most plausible scenario – then loan size requested and origination rates will both be higher in more heavily developed locations.

In the empirical work to follow, we display various patterns with respect to the effect of agglomeration on loan size requested and origination rates. The scenarios above will help in interpreting those patterns.

3. Data and summary measures

3.1. Data

As noted earlier, the primary data for the analysis were obtained from the Home Mortgage Disclosure Act (HMDA). Specifically, we drew upon the HMDA data files for 1994, 1996, 1998, 2000, and every year thereafter through 2008. These data were obtained at the individual loan level and were aggregated to census tract values, the most refined level of geography identified in the data. Prior to 2003, HMDA data are reported based on 1990 census tract boundaries. From 2003 through the end of our analysis in 2008, HMDA data are reported based on year-2000 census tract boundaries. We converted the earlier data to year-2000 boundaries to ensure that we follow the same neighborhood boundaries over time. Census tract data for 1990 and 2000 were then obtained from the neighborhood change data base produced by Geolytics, Inc. These data are all coded by Geolytics to year-2000 census tract geography and were merged with the HMDA data.

To further clean the data, certain loan records were dropped. When calculating tract-level mortgage outcomes (e.g. originations), individual loan records from the HMDA data were dropped if the type or purpose of the loan could not be determined. In addition, throughout the analysis, we retained only conventional, GSE conforming size, home purchase loans.

When measuring tract-level loan origination rates, we divide the number of loan originations by the sum of originations and denials. This excludes loan applications that were withdrawn, incomplete, or approved but not originated. We drop those loan records when calculating origination rates because it seems likely that either the loan applicants decided that they did not want to seek mortgage credit, or that they secured a mortgage loan from an alternate lender.

Finally, we restrict our samples to just those census tracts located in metropolitan statistical areas (MSAs). For each sample year, this yields roughly 50,000 tract-level observations. As noted in the Introduction, we also use two different strategies to stratify the sample into high- and low-risk locations. In the first instance, we focus on tracts with unusually high and unusually low unemployment rates. These groups are defined as those with unemployment rates in the top and bottom quartiles as of the year 2000: specifically, unemployment above 7.8% and below 3.0%. The sample sizes for these groups are 13,210 census tracts and 13,072 census tracts, respectively. Our second approach is to stratify census tracts into those characterized by Congress (under the 1992 GSE Act) as underserved in 1992 versus those not classified

as underserved. The sample sizes for these two groups are 21,031 and 27,659, respectively.

3.2. Sample means

Table 1, Panel A presents summary measures for all conventional, home purchase loans below the conforming size limit for each sample year. As described in the Introduction, the level of mortgage activity increased sharply over the 1994–2006 period and then declined precipitously in 2007. Originations, for example, rose from 38.95 per tract in 1994 to a peak of 105.63 per tract in 2005, and then fell to 33.55 in 2008. The ratio of purchases to originations also moved up from roughly 60% in the early 1990s to roughly 100% by 2004. Notably, with the government takeover of the GSEs in 2008 – ostensibly to assure ongoing provision of liquidity in mortgage markets – purchase–origination ratios remain close to 1 even after the onset of the financial crisis (see Gabriel and Rosenthal (2010) for related discussion based on HMDA data).

Table 2, Panels A and B, provides analogous summary measures for high- and low-unemployment rate census tracts, while Table 3, Panels A and B, displays analogous measures for tracts that were classified as underserved and not underserved as of 1992. As expected, origination rates are lower in the high-unemployment (Table 2, Panel A) and underserved tracts (Table 3, Panel A). This is consistent with the idea that applications from these tracts are perceived as high risk. In 2000, for example, the origination rate among high unemployment tracts was 63%. For the low unemployment rate tracts (Table 2, Panel B), the corresponding value was 84%. Apart from these differences, the patterns in Tables 2 and 3 are similar to those in Table 1, Panel A.

4. Estimation results

4.1. Pooled regressions 1994–2008

We begin in Table 4 with regressions based on pooled data from across the survey years 1994–2008. Regressions are presented for

Table 2

Origination rates and secondary market activity for conventional, home purchase loans high and low unemployment census tracts.

Year	Originations per tract	Denials per tract	Originations/ (orig + denials)	Secondary market purchases per tract	Purchases/ originations
<i>Panel A: High unemployment census tracts in 2000 (top quartile: tract unemployment > 7.8%)</i>					
1994	17.18	5.63	0.75	8.93	0.50
1996	18.02	10.68	0.67	11.59	0.63
1998	21.81	14.80	0.64	17.74	0.81
2000	26.25	15.93	0.63	20.71	0.75
2001	27.04	12.02	0.67	22.96	0.82
2002	31.80	10.66	0.72	29.80	0.89
2003	39.06	13.04	0.72	37.46	0.91
2004	52.86	18.41	0.72	52.88	0.96
2005	65.63	25.61	0.70	67.32	0.97
2006	62.93	29.48	0.70	68.49	1.04
2007	34.73	18.29	0.64	37.74	1.03
2008	16.37	7.67	0.67	16.42	0.96
<i>Panel B: Low unemployment census tracts in 2000 (bottom quartile: tract unemployment < 3.0%)</i>					
1994	54.67	6.33	0.89	35.55	0.63
1996	61.31	11.16	0.85	45.11	0.72
1998	76.29	15.20	0.84	68.29	0.87
2000	76.95	15.17	0.84	67.94	0.86
2001	84.40	11.69	0.87	77.44	0.89
2002	87.87	10.13	0.89	83.956	0.93
2003	98.37	11.69	0.88	96.04	0.96
2004	111.39	15.83	0.87	114.18	1.00
2005	128.15	20.93	0.85	133.52	1.01
2006	122.40	21.71	0.85	137.57	1.09
2007	87.74	15.24	0.85	100.23	1.08
2008	47.38	7.86	0.85	51.79	1.06

Table 3

Origination rates and secondary market activity for conventional, home purchase loans underserved and not underserved census tracts.

Year	Originations per tract	Denials per tract	Originations/ (orig + denials)	Secondary market purchases per tract	Purchases/ originations
<i>Panel A: Underserved census tracts in 1992</i>					
1994	23.77	7.03	0.77	13.03	0.53
1996	26.09	13.40	0.70	17.26	0.65
1998	32.22	18.53	0.66	26.42	0.81
2000	37.42	19.46	0.66	30.09	0.77
2001	38.35	14.63	0.70	32.67	0.82
2002	43.59	12.34	0.75	40.34	0.89
2003	52.95	14.49	0.76	50.57	0.92
2004	68.41	19.92	0.75	68.67	0.97
2005	84.68	27.36	0.73	87.11	0.98
2006	80.11	30.17	0.71	87.79	1.05
2007	47.80	19.19	0.69	52.53	1.04
2008	22.67	8.38	0.70	22.91	0.97
<i>Panel B: Not underserved census tracts in 1992</i>					
1994	52.07	7.38	0.87	32.89	0.62
1996	57.03	12.87	0.83	41.32	0.71
1998	70.87	17.88	0.81	62.72	0.87
2000	72.16	17.58	0.81	62.99	0.85
2001	78.22	13.37	0.85	71.12	0.89
2002	82.79	11.44	0.87	79.17	0.93
2003	92.93	13.38	0.87	91.05	0.96
2004	106.31	18.03	0.85	108.93	1.01
2005	123.67	24.05	0.83	128.90	1.01
2006	116.64	25.18	0.82	130.75	1.09
2007	80.26	17.08	0.82	91.20	1.09
2008	42.05	8.44	0.82	45.41	1.05

each of our dependent variables – the log of the census tract origination rate and the log of the tract median size of loans requested. In all cases our primary control variable is the log number of census tracts in the county in which the census tract was situated in 2000. This variable increases with the level of nearby urbanization. Given the double log specifications, the urbanization coefficients can be interpreted as elasticities.

Two regressions are presented for each dependent variable, with and without MSA fixed effects. Inclusion of MSA fixed effects entails tradeoffs. On the one hand, MSA fixed effects control for unobserved time-invariant metro-level factors that might bias estimates of urbanization effects in ways that are difficult to sign. These include such things as the metropolitan-level composition of employment, local government policy, and location. But MSA fixed effects also difference out the size of the metropolitan area which complicates identification of urbanization effects. It is for this reason that we rely on county-level within-MSA variation in the scale of development to identify the relationship between agglomeration and access to credit. If the effect of county-level agglomeration on access to credit is positive, then metropolitan-level effects likely are as well. Under that assumption, estimates of positive county-level agglomeration effects (as are found below) are probably best thought of as lower bounds.

Other controls in Table 4 are as follows. All of the regressions include survey year fixed effects that capture year-specific macroeconomic attributes common to all locations (e.g. business cycle effects and shifts in lending standards). Controls are also included for several attributes of the census tract applicant pool that are obtained from HMDA data. These variables vary with the survey year and include the log of the median income of loan applicants, the log percent of loan applicants in the tract that are African American or Hispanic, and also the log percent of loan applicants that are female. For the origination rate regressions, the log of the median loan size requested by applicants is also included as a control. A variety of 1990 census tract socioeconomic attributes (e.g. age, education, race, income, unemployment) are included in the model and are reported in Table 4. Importantly, we also control for census tract population density and the average value of owner-occupied homes in the tract in 1990.

Table 4

Pooled regressions 1994–2008 with and without MSA fixed effects (t-ratios in parentheses based on standard errors clustered at the MSA level).

	Dependent variable: log origination rate		Dependent variable: log median loan size requested	
	(1)	(2)	(3)	(4)
Log number census tracts in the county	0.0020 (0.56)	0.0079 (20.47)	0.0236 (2.67)	0.0140 (42.04)
Log survey year tract median loan size application	0.0990 (7.74)	0.1072 (71.09)	–	–
Log survey year tract median income of applicants	–0.0011 (–0.06)	0.0324 (15.45)	1.0749 (31.39)	0.8146 (557.45)
Log survey year tract % app. Af. Amer. or Hispanic	–0.1296 (–2.75)	–0.1079 (–32.55)	0.1255 (3.45)	0.0185 (6.49)
Log survey year tract % applicants female	–0.2428 (–5.68)	–0.1984 (–38.32)	0.2696 (3.59)	–0.2037 (–45.80)
1990 tract average age of population	0.0032 (9.66)	0.0037 (59.06)	–0.0031 (–3.70)	–0.0019 (–35.51)
1990 tract % population African American	–0.1158 (–6.11)	–0.1286 (–60.54)	–0.0884 (–2.45)	0.0004 (0.22)
1990 tract % population Hispanic	–0.1242 (–5.10)	–0.0107 (–3.35)	0.1180 (1.70)	0.2641 (96.38)
1990 tract % of age 25 + with high school diploma	0.3498 (8.32)	0.1520 (25.06)	0.0206 (0.19)	0.2822 (54.18)
1990 tract % of age 25 + with some college	–0.0050 (–0.13)	0.3245 (57.22)	0.3538 (3.89)	0.3549 (73.04)
1990 tract % of age 25 + with college degree or more	0.4447 (14.85)	0.2999 (65.67)	–0.4485 (–6.06)	0.0161 (4.11)
1990 tract 25th percentile family income	1.56E–03 (7.45)	7.09E–04 (13.53)	2.71E–03 (5.66)	1.37E–03 (30.41)
1990 tract 50th percentile family income	–8.39E–04 (–6.45)	–5.57E–04 (–12.06)	–9.90E–04 (–3.00)	–8.46E–04 (–21.27)
1990 tract 75th percentile family income	–1.01E–03 (–10.64)	–7.86E–04 (–29.63)	–1.31E–03 (–6.42)	–7.22E–04 (–31.67)
1990 tract % of age 16 + in labor force and unemployed	–0.3375 (–5.19)	–0.3442 (–40.13)	–0.6088 (–3.90)	–0.6722 (–91.69)
1990 tract population density (pop/sq. mi. land area)	1.08E–06 (1.68)	1.33E–06 (35.90)	5.01E–06 (4.68)	1.06E–06 (33.28)
1990 tract log (house value)	0.0355 (5.02)	0.0462 (71.26)	0.1668 (9.27)	0.0967 (178.01)
Year fixed effects	12	12	12	12
MSA fixed effects	–	331	–	331
Observations	594,458	594,458	594,458	594,458
R-squared	0.35	0.32	0.84	0.83

Consider now models (1) and (3) in Table 4 which omit the MSA fixed effects. We focus our discussion on the county size coefficients which appear in the top row. For the origination rate regression (1), the coefficient on county size is small (0.2%) and not significant (the t-ratio is 0.56). For the loan size regression (3), the corresponding elasticity is positive 2.36% with a t-ratio of 2.67. Given the discussion in Section 2, in principle this pattern could arise if loan rates clear the market and agglomeration lowers local loan rates. That would cause loan size requested to increase but without much systematic effect on origination rates. While such an outcome is certainly possible, the high rate at which loan applications are denied as discussed earlier for Table 1 is seemingly inconsistent with that view.

For an alternative perspective, we next consider the MSA fixed effect regressions in models (2) and (4) of Table 4. In those models, notice that the county size elasticities are positive 0.79% and 1.4% for the origination rate and loan size regressions, respectively (with t-ratios of 20.5 and 42). This pattern is consistent with the credit rationing equilibrium described in Section 2 in which agglomeration lowers local loan rates while causing both the size of loans requested and origination rates to increase. It is also potentially consistent with other mechanisms outside of the model in Section 2. As an example, it is possible that agglomeration may lower loan rates while increasing the quality of information available to prospective borrowers. This would cause loan size requested to increase but might also convince

Table 5
Year-by-year regressions with MSA fixed effects (t-ratios in parentheses based on standard errors clustered at the MSA level).^a

Dependent variable	1994	1996	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008
Log origination rates	0.0080 (3.09)	0.0246 (6.17)	0.0291 (5.95)	0.0219 (4.96)	0.0178 (4.48)	0.0107 (3.33)	0.0050 (1.84)	0.0048 (1.68)	0.0002 (0.09)	0.0036 (1.49)	0.0040 (1.42)	0.0042 (1.21)
Log median loan size	0.0253 (4.79)	0.0215 (3.67)	0.0142 (2.34)	0.0130 (3.17)	0.0120 (2.55)	0.0088 (1.77)	0.0107 (2.09)	0.0110 (2.07)	0.0063 (1.02)	0.0025 (0.39)	0.0065 (1.00)	0.0130 (1.84)

^a Each coefficient is drawn from a separate regression for a total of 24 regressions. Each regression includes the additional socioeconomic and other controls in Table 4. Coefficients on those variables are not reported to conserve space.

unqualified borrowers to refrain from submitting loan applications which would cause origination rates to increase. In this regard, we do not view the evidence in Table 4 as necessarily being indicative of a credit rationing equilibrium. The patterns do, however, suggest that urbanization enhances access to credit.

As noted earlier, a limitation of the models in Table 4 is that they restrict the model coefficients to be alike across years. To relax that constraint, we focus next on year-by-year regressions in which separate regressions are run for each survey year. These models implicitly interact the survey year fixed effects with all of the other controls in the model and allow for a much richer assessment of the influence of urbanization on access to credit.

4.2. Year-by-year regressions 1994–2008

This section repeats the MSA fixed effect models from Table 4 but runs the models separately for each survey year. This produces a large number of coefficients since 12 regressions are run for each of our dependent variables for a total of 24 regressions. Given the large number of regressions we report only the county size coefficients in Table 5. Coefficients on the other model controls are not reported to conserve space. To further

simplify the presentation, the county size elasticities in Table 5 are plotted in Fig. 2A and B along with their 95% confidence bands.

Fig. 2A and B provides a compelling picture of changes in the effect of urbanization on access to credit between 1994 and 2008. For the origination rate (Fig. 2A), the estimated elasticity with respect to county size is small in 1994, rises to about 3% in 1998, and then declines monotonically to an approximate asymptote close to zero for the years after 2003. For the median loan size requested (Fig. 3B), the agglomeration coefficient is roughly 2 1/2% in 1994, but declines over time in an approximately monotonic fashion, varying in a narrow range and approaching zero in 2006. The elasticity then increases somewhat with the onset of the financial crisis, moving back up to roughly 1.3% in 2008. Both plots are suggestive that urbanization economies enhanced borrower access to conforming size mortgage loans in the 1990s and both suggest that this effect largely dissipated by 2003 (with some minor caveats). This pattern is consistent with the growing role of secondary mortgage markets and information technology throughout the 1994–2008 period. Both of those mechanisms would have enhanced access to information and lending opportunities from afar and should have reduced locally based advantages including the influence of nearby agglomerations of credit-market activity.

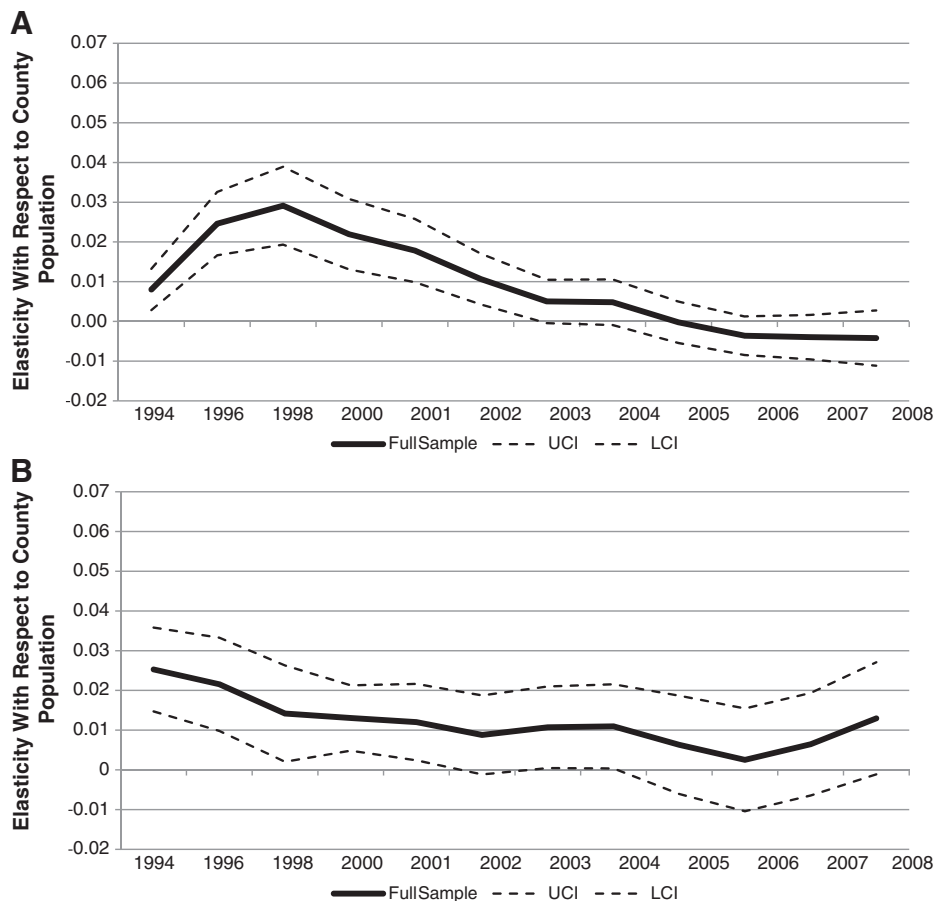


Fig. 2. A: Log origination rates. B: Log loan size requested.

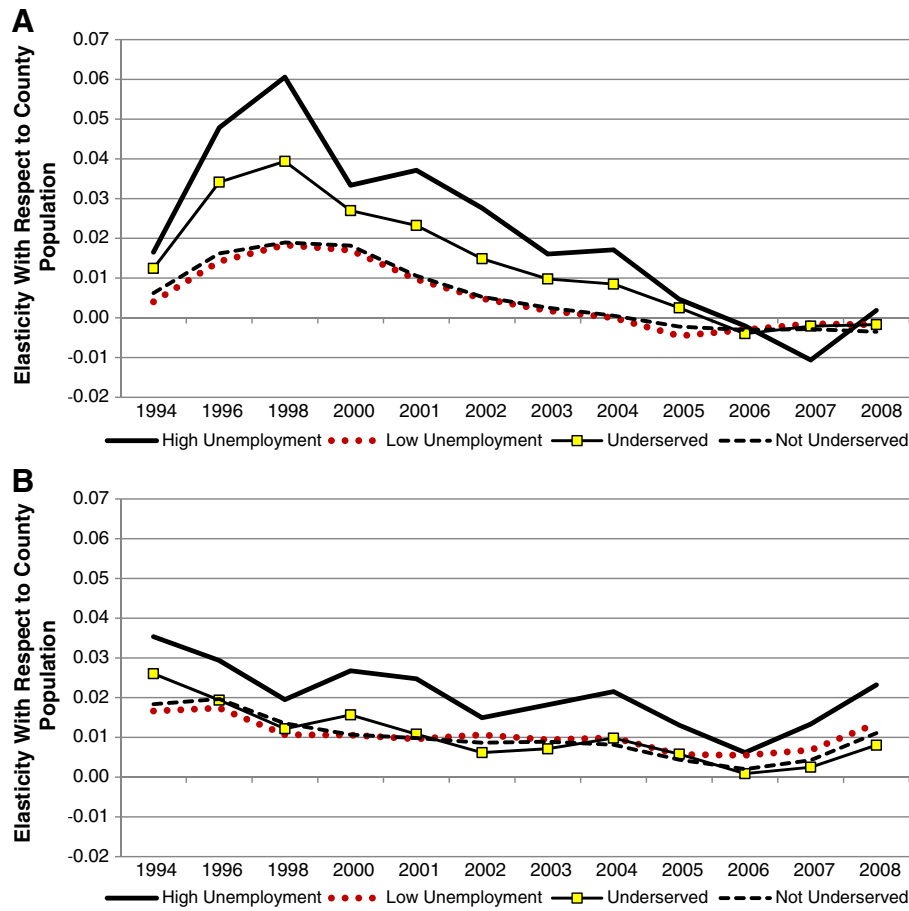


Fig. 3. A: Log origination rates by tract economic status. B: Log loan size requested by tract economic status.

4.3. High and low-risk census tracts

If agglomeration enhances efficiency in the mortgage lending process, it is likely that access to credit would improve most for individuals at risk of having their loan applications denied. We consider this idea here by examining whether urbanization economies disproportionately enhance access to credit in high-risk as compared to low-risk

census tracts. We do this in two ways. First, for each survey year, we stratify our sample of census tracts into those that had high- versus low-unemployment rates in the year 2000. Then in a separate stratification scheme, we divide tracts into those identified as underserved and not underserved by HUD in 1992 as part of its oversight of GSE purchase activity. High unemployment and underserved tracts are both viewed as high-risk lending locations, while the reverse is true

Table 6

Year-by-year regressions with MSA fixed effects stratified by high and low risk census tracts (t-ratios based on standard errors clustered at the MSA level in parentheses).^a

Sample composition	1994	1996	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008
<i>Panel A: Dependent variable—log origination rates</i>												
Underserved	0.0165 (2.66)	0.0478 (4.28)	0.0606 (5.10)	0.0334 (3.21)	0.0371 (3.53)	0.0276 (2.97)	0.0160 (2.20)	0.0171 (2.57)	0.0047 (0.79)	-0.0020 (0.30)	-0.0106 (1.53)	0.0019 (0.22)
Not underserved	0.0040 (2.02)	0.0142 (4.79)	0.0183 (5.00)	0.0170 (4.22)	0.0097 (2.84)	0.0049 (1.72)	0.0018 (0.81)	0.0000 (0.01)	-0.0046 (2.17)	-0.0030 (1.53)	-0.0015 (0.60)	-0.0018 (0.52)
High unemployment (top quartile; >7.8%)	0.0124 (2.77)	0.0341 (4.59)	0.0394 (4.40)	0.0270 (3.59)	0.0233 (3.58)	0.0149 (2.92)	0.0098 (1.98)	0.0085 (1.99)	0.0025 (0.57)	-0.0040 (1.04)	-0.0021 (0.44)	-0.0017 (0.35)
Low unemployment (bottom quartile; <3.0%)	0.0062 (3.75)	0.0162 (6.44)	0.0190 (5.87)	0.0181 (5.24)	0.0106 (3.82)	0.0053 (2.45)	0.0025 (1.42)	0.0005 (0.27)	-0.0022 (1.35)	-0.0030 (1.73)	-0.0028 (1.20)	-0.0035 (1.28)
<i>Panel B: Dependent variable—log median loan size requested</i>												
Underserved	0.0354 (4.25)	0.0294 (3.29)	0.0195 (2.37)	0.0268 (3.60)	0.0248 (2.71)	0.0150 (2.02)	0.0182 (2.40)	0.0215 (3.00)	0.0131 (1.07)	0.0062 (0.44)	0.0134 (0.99)	0.0232 (2.15)
Not underserved	0.0166 (3.82)	0.0174 (3.89)	0.0107 (2.03)	0.0106 (2.40)	0.0096 (2.63)	0.0106 (2.40)	0.0094 (2.13)	0.0099 (2.12)	0.0057 (1.09)	0.0055 (1.13)	0.0068 (1.54)	0.0135 (2.81)
High unemployment (top quartile; >7.8%)	0.0260 (4.29)	0.0194 (3.15)	0.0122 (2.10)	0.0157 (3.32)	0.0108 (2.03)	0.0062 (0.98)	0.0071 (1.19)	0.0098 (1.58)	0.0058 (0.72)	0.0009 (0.11)	0.0025 (0.31)	0.0081 (0.96)
Low unemployment (bottom quartile; <3.0%)	0.0183 (4.03)	0.0197 (4.14)	0.0135 (2.42)	0.0107 (3.14)	0.0098 (2.76)	0.0087 (2.20)	0.0089 (2.25)	0.0081 (1.92)	0.0044 (0.88)	0.0020 (0.38)	0.0043 (0.83)	0.0111 (2.23)

^a Each coefficient is drawn from a separate regression for a total of 96 regressions. Each regression includes the additional socioeconomic and other controls in Table 4. Coefficients on those variables are not reported to conserve space.

for low unemployment tracts and tracts that are not defined as underserved. As discussed earlier, origination rates are notably higher (and denial rates lower) for low unemployment tracts and those not designed as underserved by HUD (see [Tables 2 and 3](#)). Accordingly, using these sample stratifications, we re-estimated the models in [Table 5](#). Results are reported in [Table 6](#) with the county size elasticity estimates plotted in [Fig. 3A and B](#).

In viewing [Fig. 3A and B](#), notice that we refrain from plotting the confidence bands for the different estimates so that the figures do not become overly cluttered. Standard errors for the estimates are displayed in [Table 6](#). Two key features of [Fig. 3A and B](#) then stand out. First, once again the predominant pattern is that urbanization effects are large in the 1990s and then decline. Second, as anticipated, the effect of agglomeration is most pronounced for high-risk census tracts that would seem to have the most to gain from an increase in inefficiency in the mortgage lending process.

5. Conclusion

This paper provides some of the first evidence ever of the impact of urbanization and the scale of local development on access to mortgage credit. In doing so, it extends an existing and expansive literature on the productivity effects of urbanization — so called urbanization economies (see, for example, [Glaeser and Gottlieb, 2009](#); [Rosenthal and Strange, 2004](#) or [Duranton and Puga, 2004](#); [Combes et al., 2012](#) to name a few). Central to the agglomeration literature is the idea that spatial concentration of economic activity improves access to information, skilled workers, and intermediaries, all of which serve to enhance productivity. Mortgage lending is replete with specialized workers that share information pertinent to the loan application and origination process (e.g. real estate agents, appraisers, underwriters, secondary market entities). This makes mortgage lending a natural candidate to benefit from urbanization. However, structural changes to mortgage lending, including development of secondary mortgage markets and diffusion of information technology, may have mitigated agglomeration benefits by increasing access to credit and information from afar.

We consider these issues using Home Mortgage Disclosure Act (HMDA) data from 1994 to 2008. Findings confirm that heavily developed areas enjoyed enhanced access to credit in the 1990s based both on the likelihood that an application is originated and also the size of the loan. Evidence also indicates that urbanization disproportionately improved access to credit in high risk communities populated with individuals most at risk of having their loan applications denied. However, agglomeration effects appear to have peaked in the late 1990s and largely dissipated by 2003. This temporal pattern coincides with the expansive growth of the secondary mortgage market in the 1990s along with the concurrent explosion in information technology.

Overall, our findings indicate that urbanization has at times enhanced productivity in mortgage lending, but that those same agglomeration economies play less of a role today than in the past. Indeed, the temporal patterns in our data suggest that there has been a welcome geographic leveling in access to credit across communities that coincides with the expansion of secondary mortgage markets and development of information technology.

References

Henderson, J.V., Arzaghi, Muhammad, 2008. Networking off Madison Avenue. *Review of Economic Studies* 75 (4), 1011–1038.

- Berkovec, James A., Canner, G.B., Gabriel, S.A., Hannan, T.H., 1998. Discrimination, competition, and loan performance in FHA mortgage lending. *The Review of Economics and Statistics* 241–250.
- Bleakley, Hoyt, Lin, Jeffrey, 2011. Thick-market effects and churning in the labor market: evidence from US cities. *Journal of Urban Economics* 72 (2–3), 87–103.
- Canner, Glenn, Gabriel, Stuart, 1992. Market segmentation and lender specialization in the primary and secondary mortgage markets. *Housing Policy Debate* 3 (2).
- Ciccone, Antonio, Hall, Robert E., 1996. Productivity and the density of economic activity. *American Economic Review* 86 (1), 54–70.
- Combes, Pierre-Phillippe, Duranton, Gilles, Gobillon, Laurent, Puga, Diego, 2012. The productivity advantages of large cities: distinguishing agglomeration from firm selection. *Econometrica* 80 (6), 2543–2594.
- Costa, Dora L., Kahn, Matthew E., 2000. Power couples: changes in the locational choice of the college educated, 1940–1990. *Quarterly Journal of Economics* 115 (4), 1287–1315.
- Deng, Yongheng, Gabriel, S., 2006. Risk-based pricing and the enhancement of mortgage credit availability among underserved and higher credit-risk populations. *Journal of Money, Credit, and Banking* 38 (6), 1431–1460 (September 2006).
- Di Addario, Sabrina, 2011. Job search in thick markets. *Journal of Urban Economics* 69 (3), 303–318.
- Drucker, Joshua, Feser, Edward, 2012. Regional industrial structure and agglomeration economies: an analysis of productivity in three manufacturing industries. *Regional Science and Urban Economics* 42 (1–2), 1–14.
- Duca, John, Rosenthal, Stuart S., 1993. Borrowing constraints, household debt, and racial discrimination in loan markets. *Journal of Financial Intermediation* 3, 77–103.
- Duranton, Gilles, Puga, Diego, 2004. Microfoundations of urban agglomeration economies. In: Henderson, Vernon, Thisse, Jacques (Eds.), *Handbook of Regional and Urban Economics*, vol. 4. Elsevier, pp. 2063–2117.
- Ellison, Glenn, Glaeser, E.L., Kerr, W.R., 2010. What causes industry agglomeration? Evidence from coagglomeration patterns. *American Economic Review* 100 (3), 1195–1213.
- Gabriel, Stuart, Rosenthal, Stuart, 2010. Do the GSEs expand the supply of mortgage credit? New evidence of crowd out in the secondary mortgage market. *Journal of Public Economics* 94, 953–966.
- Glaeser, Edward L., Gottlieb, Joshua D., 2009. The wealth of cities: agglomeration economies and spatial equilibrium in the United States. *Journal of Economic Literature* 47 (4), 983–1028.
- Glaeser, Edward L., Kallal, H.D., Scheinkman, J.A., Shleifer, A., 1992. Growth in cities. *Journal of Political Economy* 100 (6), 1126–1152.
- Henderson, J. Vernon, 1986. Efficiency of resource usage and city size. *Journal of Urban Economics* 19 (1), 47–70.
- Henderson, Vernon, Kuncoro, A., Turner, M., 1995. Industrial development in cities. *Journal of Political Economy* 103 (5), 1067–1090.
- Holmes, Thomas J., 1999. Localization of industry and vertical disintegration. *The Review of Economics and Statistics* 81 (2), 314–325.
- Jofre-Monseny, Jordi, Marín-López, Raquel, Viladecans-Marsal, Elisabet, 2011. The mechanisms of agglomeration: evidence from the effect of inter-industry relations on the location of new firms. *Journal of Urban Economics* 70 (2–3), 61–74.
- Martin, Philippe, Mayer, Thierry, Mayneris, Florian, 2011. Spatial concentration and plant-level productivity in France. *Journal of Urban Economics* 69 (2), 182–195.
- Moomaw, Ronald L., 1981. Productivity and city size? A critique of the evidence. *Quarterly Journal of Economics* 96 (4), 675–688.
- Munnell, Alicia H., Tootell, G.M.B., Browne, L.E., McEneaney, J., 1996. Mortgage lending in Boston: interpreting HMDA data. *The American Economic Review* 86 (1), 25–29.
- Nakamura, Ryohei, 1985. Agglomeration economies in urban manufacturing industries: a case of Japanese cities. *Journal of Urban Economics* 17 (1), 108–124.
- Petersen, M.A., Rajan, R.G., 2002. Does distance still matter? The information revolution in small business lending. *Journal of Finance* 57, 2533–2556.
- Rosenthal, Stuart, Ross, Amanda, 2010. Violent crime, entrepreneurship, and cities. *Journal of Urban Economics* 67 (1), 135–149.
- Rosenthal, Stuart S., Strange, William, 2001. The determinants of agglomeration. *Journal of Urban Economics* 50 (2), 191–229.
- Rosenthal, Stuart, Strange, William, 2003. Geography, industrial organization, and agglomeration. *The Review of Economics and Statistics* 85 (2), 377–393.
- Rosenthal, Stuart S., Strange, William, 2004. Evidence on the nature and sources of agglomeration economies. In: Henderson, Vernon, Thisse, Jacques (Eds.), *The Handbook of Urban and Regional Economics*. Elsevier, pp. 2119–2172.
- Rosenthal, Stuart, Strange, William, 2005. The geography of entrepreneurship in the New York metropolitan area. *Economic Policy Review*, 11. New York Federal Reserve Bank, pp. 29–54 ((Special Issue on “Urban Dynamics in New York City”), December).
- Rosenthal, Stuart, Strange, William, 2008. The attenuation of human capital spillovers. *Journal of Urban Economics* 64 (2), 373–389.
- Stiglitz, J., Weiss, A., 1981. Credit rationing in markets with imperfect information. *American Economic Review* 71 (3), 393–410.