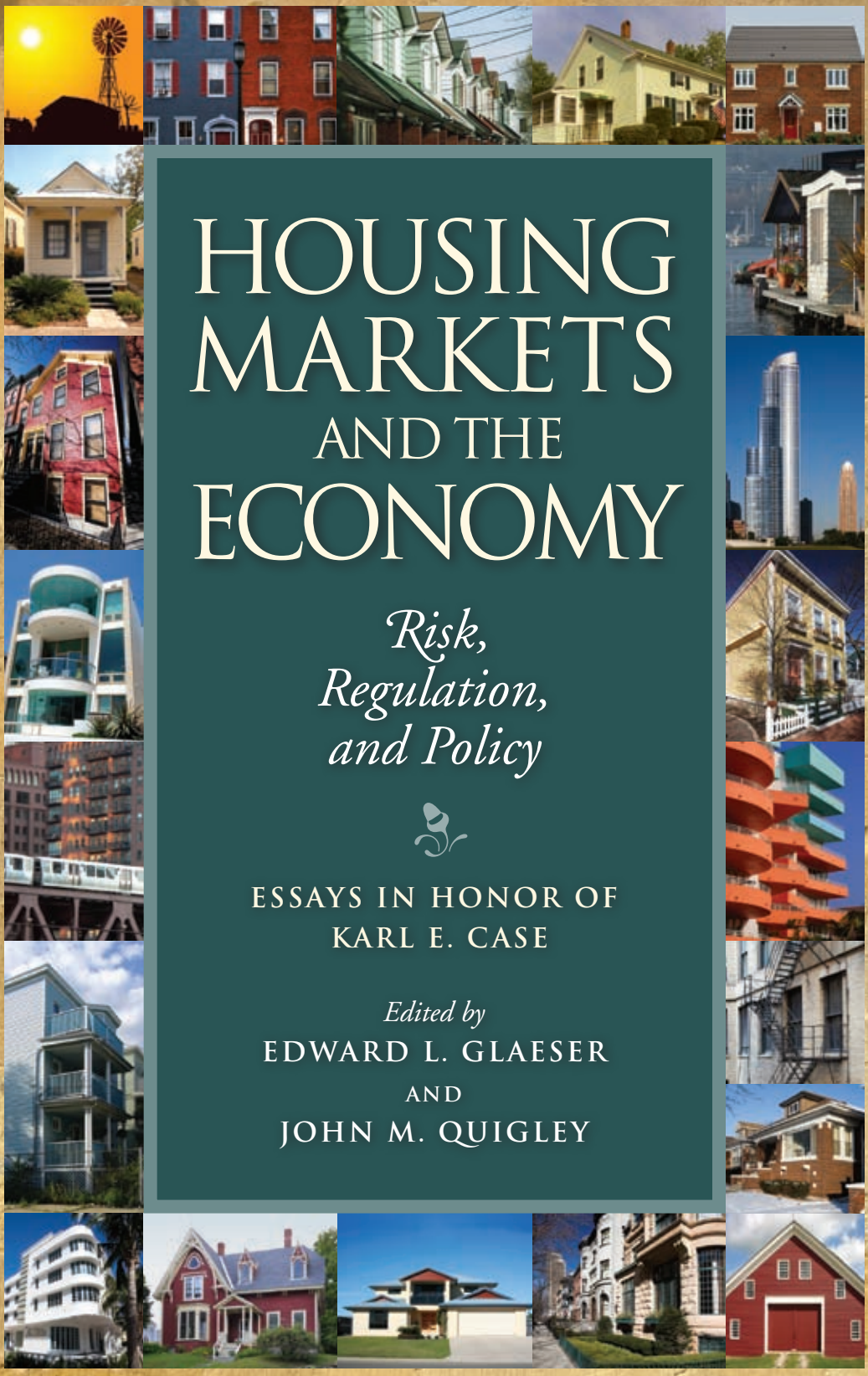

HOUSING MARKETS AND THE ECONOMY

Risk, Regulation, and Policy

ESSAYS IN HONOR OF KARL E. CASE

Edited by

EDWARD L. GLAESER

AND

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Contents

Foreword

The Lincoln Institute of Land Policy sponsored and supported the conference "Housing and the Built Environment: Access, Finance, Policy," held in December 2007, and the subsequent publication of this volume, for several reasons. First, the scope of the chapters in this volume is fittingly wide, ranging from useful empirical studies to policy-relevant theoretical conjectures while still addressing mainly housing market issues. Second, the timing of the conference and this volume is opportune, taking place during the ongoing deflation of the U.S. housing bubble and associated financial crisis linked to the remarkable contagion effects of subprime mortgages and their securitized investment vehicles. Third, Chip Case, the honoree of this conference, has many long-standing ties to the Lincoln Institute. Many years ago the Institute wisely supported Chip's dissertation on the property tax in Boston, and more recently the Institute benefited from Chip's service as a distinguished member of the Institute's Board of Directors.

As noted by the editors in their introductory chapter, while Chip's interests are wide ranging, much of his work has been strongly linked to the housing market and associated issues such as price measurement, market efficiency, housing market behavior and its macroeconomic linkages, capitalization of local public services in housing prices, and property taxation. It is difficult to overstate Chip's contributions to the analysis of housing markets, particularly his formulation (along with Robert Shiller) of the repeat sales price index for housing. Indeed, the development of this price index and its growing coverage across locations and over time underpins most serious quantitative work on U.S. housing markets today, including the work reported in this volume. More accurate information about housing prices has improved our ability to measure housing market volatility and the effects of policy interventions in the housing market.

Perhaps the next challenge for housing market analysts is to assess the causes of the recent housing bubble. While much attention has been given to its financial sector causes, such as low interest rates and extension of credit to poorly qualified customers, land and housing policy at the local level—particularly restrictions on housing supply—seems also to have played a role. Housing market restrictions may have contributed to the widespread miscon-

ception that housing prices "could not go down." Ironically, those metropolitan housing markets that had the strongest restrictions on land and housing supply seem to be faring better during the post-bubble correction than metropolitan markets with few restrictions and rapid increases in supply. Analyses such as those in this volume provide the foundation needed to increase our understanding of how land and housing policy—both national and local—affects housing markets.

Gregory K. Ingram
President and CEO
Lincoln Institute of Land Policy

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Subprime Mortgages: What, Where, and to Whom?

Chris Mayer
Karen Pence

The housing market has turned sharply throughout the country since 2006. Home prices have swung from steady rates of appreciation to outright declines, while sales and construction of new homes have dropped steeply. Much of this turmoil appears related to the boom and bust in mortgage markets over the last five years.

It was not supposed to work out this way. Securitization and other innovations in mortgage markets led to new loan products with the potential to make home ownership easier and more accessible to buyers who could not access credit previously through conventional means. These so-called subprime and near-prime mortgage products allowed buyers with lower credit scores, smaller down payments, little documentation of income, or all of these to purchase homes. These new products not only allowed new buyers to access credit, but also made it easier for homeowners to refinance loans and withdraw cash from homes that had appreciated in value.

Despite the economic implications of the credit boom and bust, there have been only a handful of studies on who received subprime loans during

The authors wish to thank Alex Chinco, Erik Hembre, Rembrand Koning, Christy Pinkston, and Julia Zhou for extremely dedicated research assistance. We thank Bob Avery, Ken Brevoort, Brian Bucks, Glenn Canner, Karen Dynan, Andreas Lehnert, Kristopher Rengert, Shane Sherlund, Dan Sokolov, and participants at the Homer Hoyt Institute, the American Real Estate and Urban Economics Association Mid-Year Meeting, and the Lincoln Land Institute Conference in honor of Karl (Chip) Case for many helpful comments and thoughts. Chris Mayer especially wishes to thank Chip Case for his friendship and mentorship throughout his career. The chapter represents the opinions of the authors and does not represent the views of the Federal Reserve Board or its staff.

this most recent housing cycle, where these loans were made, and what the loans were used for. In part, the lack of studies is due to data limitations. Timely industry sources of data on subprime loans, such as LoanPerformance (LP), is not freely available to researchers. In addition, there is no consensus among either lenders or researchers about what types of mortgages should be considered subprime.

In this chapter, we begin to fill this void, focusing our empirical analysis in two areas. First, we describe the strengths and weaknesses of three different sets of data on subprime mortgages. These data sets embody different definitions of subprime mortgages. We show that estimates of the number of subprime originations are somewhat sensitive to which types of mortgages are categorized as subprime. Second, we describe what parts of the country and what sorts of neighborhoods had more subprime originations in 2005, and how these patterns differed for purchase and refinance mortgages.

We believe that we are the first researchers to examine this second question—the geographic dispersion of subprime lending—with the LP data, although previous studies have examined this question with other data sets (Avery, Canner, and Cook, 2005; Brooks and Ford, 2007; Calem, Gillen, and Wachter, 2004; Center for Responsible Lending, 2006; Consumer Federation of America, 2006; Scheessele, 2002; U.S. Department of Housing and Urban Development [HUD], 2000). However, analyses of other mortgage topics have also used the LP data (Brooks and Simon, 2007; Demyanyk and Van Hemert, 2008; Gerardi, Shapiro, and Willen, 2007; Keys et al., 2008; Pennington-Cross and Ho, 2006).

Turning to our first focus, we examine three sources of data on subprime mortgages: LP, for mortgages in securitized pools marketed as subprime by the securitizer; the Home Mortgage Disclosure Act (HMDA) for higher-priced mortgages with high interest rates; and HMDA HUD for mortgages originated by lenders specializing in subprime mortgages. The three measures paint quite different pictures of the number of subprime originations. In 2005, the most recent year all three measures are available, the average number of originations per 100 housing units in zip codes in metropolitan statistical areas (MSAs) ranges from 3.6 (LP) to 5.4 (HMDA higher-priced).

The measures also portray the growth in subprime originations differently. The LP measure implies that subprime originations grew seven-fold from 1998 to 2005, whereas the HMDA HUD measure implies that originations tripled during this period. The difference between the two measures appears to stem from growth in subprime securitization during these years. If we restrict the HUD measure to originations that were securitized, the two series track each other closely in most years. These findings suggest that which

measure captures the subprime market best may vary as the market structure evolves.

Turning to our second focus, we explore what areas of the country and what types of neighborhoods experienced the most subprime originations. Here, the three measures tell a consistent story. As has been reported in the press, metropolitan areas in Nevada, Arizona, California, and Florida had large concentrations of subprime originations: 10, eight, seven, and six subprime originations, respectively, in 2005 per 100 housing units. These rates, which are based on the LP data, are two to three times the national average in metropolitan areas of 3.6 subprime loans per 100 housing units. Yet, large numbers of subprime mortgages were also originated in other places, including the Washington, DC area, Atlanta, Chicago, Providence, Rhode Island, and parts of Texas.

When we map these origination patterns, three intriguing possibilities emerge. First, subprime originations appear to have only a partial correlation with home price appreciation. Some locations in the Northeast, like New York and Boston, had relatively high home price appreciation, but relatively few subprime mortgages. Second, subprime mortgages were concentrated not only in the inner cities, where lower-income households are more prevalent, but also on the outskirts of metropolitan areas where new construction was more prominent. Third, economically depressed areas in the Midwest do not appear to have high rates of subprime originations, despite their weak housing markets.

When we delve more deeply into this third finding, we find that economically depressed areas in the Midwest had low rates of originations relative to total housing units, but high rates relative to total originations. All previous studies have used total originations as the benchmark. We use total housing units because we think that the option to take out a subprime loan may affect a household's choice to take out a loan at all, as well as its decision on what type of loan to take out. We interpret the difference between the "housing units" and "originations" results as indicating that both prime and subprime originations are elevated in areas with hot housing markets. In contrast, less lending activity occurs in depressed housing markets, and what occurs is more likely to be subprime.

Next, by running cross-sectional regressions on zip code–level data, we explore what types of neighborhoods had the most subprime originations in 2005 and come up with several key results. First, subprime mortgages are concentrated in locations with high proportions of black and Hispanic residents, even controlling for the income and credit scores of these zip codes. Areas with black and Hispanic shares 50 percent higher than the mean are associated with

8 percent and 7 percent, respectively, larger proportions of subprime loans. However, zip codes containing large numbers of minorities appear to have a much higher concentration of these originations. The ninetieth percentile zip code ranked by the share of black residents appears to have 42 percent more subprime loans than the corresponding median zip code, and the ninetieth percentile zip code ranked by the share of Hispanic residents appears to have 33 percent more subprime originations than the median. These results remain relatively consistent whether we compare zip codes across cities or within a given city.

Second, subprime loans appear to provide credit in locations where credit might be more difficult to obtain. Subprime loans are heavily concentrated in zip codes with more mid-level credit scores. They are also more prevalent in counties with higher unemployment rates. The latter result suggests that subprime loans have the potential to be an additional source of credit when economic conditions deteriorate.

Finally, the regressions confirm the correlation suggested by the maps between subprime lending and areas with more new construction and with high home price appreciation in the previous year. These results suggest that subprime lending played a role in the recent housing cycle, although we cannot determine the extent to which subprime mortgages were a cause or a consequence of housing activity.

When we split the sample between refinancing and purchase originations, the results are consistent with our earlier findings. For example, subprime purchase and refinance loans are more prevalent in zip codes with a high share of minorities. The only substantive difference between the samples is that purchase originations are more pronounced than refinancing originations in areas with substantial amounts of new construction.

Data Summary

LoanPerformance

First American LoanPerformance, a subsidiary of First American CoreLogic, Inc., provides information on securitized mortgages in subprime pools.[1] The data do not include mortgages held in portfolio; securitized mortgages in prime, jumbo, or alt-A pools; or loans guaranteed by government agencies

1. FirstAmerican also has a product based on data obtained from loan servicers. We do not use these data, as FirstAmerican does not provide the underlying micro data. We also do not use FirstAmerican's data on loans in securitized jumbo and Alt-A pools because we focus on subprime loans.

such as the Federal Housing Administration and the Veterans' Administration or by government-sponsored enterprises such as Fannie Mae, Freddie Mac, or Ginnie Mae. The data also exclude loans securitized by lenders that do not report to LoanPerformance. Comparing the LP subprime totals to the subprime mortgage-backed securities totals published by Inside Mortgage Finance (Inside Mortgage Finance, 2006) suggests that LP captured around 90 percent of the subprime securitized market from 1999 to 2002 and nearly all of the market from 2003 to 2005.[2]

The guidelines for what type of mortgage can be sold into a subprime pool vary across securitizers. In general, borrowers in subprime pools tend to have low credit scores and high loan-to-value ratios, but a smaller number of borrowers have higher credit scores. On occasion, securitizers include a handful of near-prime or prime loans in these pools.

The data contain extensive information on the characteristics of the loan, such as the mortgage type, the interest rate, the loan purpose (purchase or refinance), and whether the loan has a prepayment penalty. Data on fees are not included. LP has less detailed information about the borrower, reporting the FICO credit score, the borrower's reported debt-to-income ratio, and the extent to which that income is documented. There is relatively little information about the property beyond the sale or appraised price, the type of property, and its state and zip code.

For a few observations, the reported state in which the property is located does not match the zip code. In these cases, we retain the observations for statistics based on the nation as a whole, but drop the observations when we create zip code–level observations. This restriction drops less than 0.4 percent of observations.

HMDA Higher-Priced

Under HMDA, most originators must report basic attributes of the mortgage applications that they receive in MSAs to the Federal Financial Institutions Examination Council. These data are considered the most comprehensive source of mortgage data, and cover an estimated 80 percent of all home loans nationwide (Avery, Brevoort, and Canner, 2007a) and a higher share of loans originated in MSAs. Depository institutions that are in the home lending business, have a home or branch office in an MSA, and have assets over a certain threshold ($35 million in 2006) are required to report these data to the

2. Two exceptions are 1998, when LP captured 46 percent of the market, and 2001, when its share was 78 percent.

regulator. Mortgage and consumer finance companies that extend 100 or more home purchase or refinancing loans a year are also required to report for any MSA in which they receive five or more applications. In total, nearly 8,900 lenders reported in 2006.

The share of mortgages covered under HMDA has fluctuated over time with changes in the definitions of MSAs and in the depository asset threshold. The most substantive recent change occurred when new MSA boundaries were drawn in 2004 to reflect the 2000 U.S. Census. These new boundaries added 242 counties to the HMDA coverage area, and the number of reporting lenders correspondingly increased by 9 percent. Although the LP data are reported at the zip code level, HMDA data are reported by U.S. Census Bureau tracts. We describe in the appendix to this chapter how we map Census Bureau tracts to zip codes.

Since 1990, HMDA has contained borrower characteristics such as income, race, and gender, as well as loan characteristics such as the balance, purpose (purchase, home improvement, refinancing), and type (conventional or government-backed) plus the census tract in which the property is located. As suggested in Avery, Brevoort, and Canner (2007b), we classify home improvement loans as refinancings. In 2004, information was added on the spread to the rate on the comparable-maturity Treasury for first-lien mortgages with an annual percentage rate (APR) three percentage points over the Treasury benchmark and for junior liens with an APR five percentage points over the benchmark. Mortgages with a reported spread are commonly called "higher-priced" loans.

Although "higher-priced" is generally considered to be a proxy for "subprime," this definition may capture different shares of fixed- and adjustable rate mortgages (ARMs) because of the "comparable maturity" definition. "Comparable maturity" corresponds to the maturity in the loan contract, not the expected maturity. Thus, an ARM with a contract maturity of 30 years is compared to the rate on a long-term Treasury security, even though the ARM's interest rate may be based on a shorter-term security. As short-term rates are generally below long-term rates, subprime ARMs are likely to be underreported in the data relative to subprime fixed-rate mortgages.

The extent of this bias shifts over time as the slope of the yield curve changes. When the yield curve is flatter and short-term rates are closer to long-term rates, subprime ARMs will be more represented in the data. Avery, Brevoort, and Canner (2007b) suggest that at least 13 percent of the increase in the number of higher-priced loans in the HMDA data between 2004 and 2005 is attributable to a flattening of the yield curve.

An additional possible source of bias is the fact that the spread of mortgage rates relative to Treasuries changes over time. As this spread fluctuates, the

three-percentage-point threshold will capture a varying share of the near-prime—and perhaps even some of the prime—market in addition to the subprime market.

Finally, the APR definition is susceptible to whether the loan cost comes primarily from interest rates or fees. The calculation assumes that fees are paid over the full maturity of the loan, although most loans—especially subprime loans—are repaid after a shorter period. As a result, some loans that are expensive for the borrower may not be captured under the HMDA higher-priced definition.

"Higher-priced" appears to be a problematic measure in 2004 for reasons beyond the shift in the yield curve slope. Some lenders may have had difficulty complying with reporting the new information in the first year that reporting was required (Bostic et al., 2008). In addition, higher-priced originations are artificially low in 2004 because price information was not required for loans whose application process began in 2003 but concluded in 2004.

HMDA HUD Lender

Before the APR data were added to the HMDA data, researchers typically labeled a loan in the HMDA data as subprime if it was originated by a lender on the Subprime and Manufactured Home Lender list maintained by HUD.[3] The list identifies lenders that specialize in subprime or manufactured home lending. It is designed to be used as a companion to the HMDA data and is available by year from 1993 to 2005. HUD dropped lenders specializing in manufactured housing in 2004 when HMDA added a variable that identified loans backed by manufactured homes. HUD continued the subprime lender list, however, because of concerns that HMDA's higher-priced variable might prove an insufficient proxy for subprime loans.

HUD bases its initial search for subprime lenders by reviewing each lender's HMDA filings. Lenders that have higher denial rates, higher shares of mortgage refinancings, few loan sales to the government-sponsored enterprises, or more higher-priced loans are considered more likely to be subprime lenders. HUD then contacts possible subprime lenders to determine definitively their area of specialization. The list is updated and revised annually on the basis of feedback from lenders, policy analysts, and housing advocacy groups. In 2005, the list contained 210 lenders.

Because not all lenders specialize solely in prime or subprime loans, defining loans as subprime based on the HUD list will inherently misclassify prime

3. These data are available at http://www.huduser.org/datasets/manu.html.

loans originated by subprime lenders as subprime and, likewise, subprime loans originated by prime lenders as prime. A few lenders on the list are also primarily near-prime rather than subprime specialists. Gerardi, Shapiro, and Willen (2007) suggest that lenders on the HUD subprime list originate only a few prime loans, so this source of bias should be minor.[4] In addition, we prune many of these nonsubprime loans from the HUD lender measure by dropping loans that were later sold to Fannie Mae, Freddie Mac, the Federal Housing Administration, or Farmer Mac; any mortgages sold to these institutions are likely not subprime. However, we are not able to add subprime loans originated by prime lenders to the HUD measure, which Gerardi, Shapiro, and Willen suggest are a larger source of bias. As a result, we expect the HUD measure to understate the number of subprime originations.

For all three measures, we limit our sample to first-lien, closed-end mortgages collateralized by one-to-four-family properties and originated in zip codes that are in MSAs in the 48 contiguous states and Washington, DC. We exclude loans collateralized by manufactured housing, unless otherwise noted, as some of these loans are underwritten in a manner more similar to automobile loans than mortgages. As the HMDA data do not identify lien status until 2004, we drop from the HMDA data, in all years, mortgages with balances below $25,000 in 2006 dollars, as we suspect that these loans are junior liens.[5]

Other Data Sources

We extract from the 2000 Census the share of residents in each census tract who are black or Hispanic, the number of properties that are owner-occupied, the median income of each tract, and the number of housing units. We define black individuals as those who report being black and not Hispanic. Hispanic individuals are any persons who report being Hispanic. We map these counts to the zip code level as described in the appendix to this chapter. Based on these counts, we calculate a zip code's home ownership rate as the share of owner-occupied properties relative to all housing units. We categorize a zip code's median income relative to other zip codes within its MSA: we sort zip codes within each MSA on the basis of their median income, and then split the zip codes into quintiles. We create dummy variables that indicate the quintile in which each zip code's median income falls.

4. See appendix C of Gerardi, Shapiro, and Willen (2007).

5. We do not impose a similar restriction on the LP data, as lien status is reported in all years. About one-half of 1 percent (0.05 percent) of mortgages in our LP sample have balances below $25,000.

We also obtain data on the share of tract residents with high, medium, and low credit scores according to a file provided by Equifax Inc. An individual's credit is assessed with the VantageScore created jointly by the three national credit reporting agencies (Equifax, Experian, and TransUnion). VantageScores range from 501 to 990, with higher scores signifying better credit. The VantageScore was developed so that individuals with identical data across agencies would receive the same credit score. (Because of differences in how the agencies define certain variables, the better-known FICO score developed by Fair Isaac Corporation may take on different values across credit bureaus.) The VantageScore modelers also paid particular attention to generating a reliable credit score for "thin-file" individuals (those with few credit transactions on record).

We consider an individual as having high credit if the VantageScore exceeds 700; medium credit if the score falls between 640 and 700; or low credit if the score lies below 640. Broadly speaking, the high category includes the prime credit market and the upper end of the near-prime market; the middle category includes the lower end of the near-prime market and the upper end of the subprime market; and the low category includes the lower end of the subprime market and those generally ineligible for any mortgage credit. As with the census data, we map these counts to the zip code. When we calculate the shares of individuals in each category, we include all individuals in the zip code except the approximately 10 percent without VantageScores.

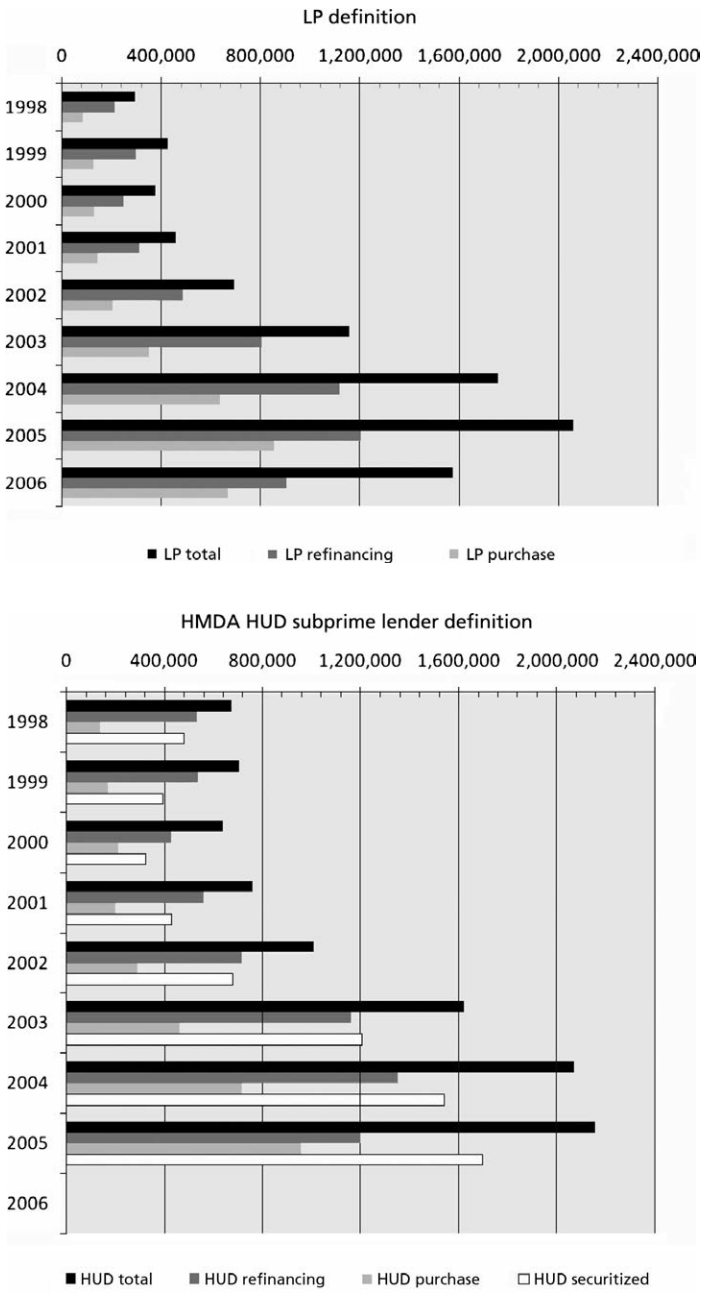
We obtain annual county-level data on unemployment rates from the Bureau of Labor Statistics' Local Area Unemployment program; MSA-level data on home price changes from the Office of Federal Housing Enterprise Oversight (OFHEO) all-transactions housing price index; and county-level data on permits for the construction of residential one-to-four-family housing units from the U.S. Census Bureau.

LoanPerformance, Higher-Priced HMDA Mortgages, and Mortgages by HUD Subprime Lenders

Time Trends, 1998–2006

We begin by showing the rise in subprime lending from 1998 to 2006 as depicted by the LP and HUD subprime lender measures (figure 6.1a). Both measures show a substantial increase in subprime originations over this period and a marked acceleration from 2003 to 2005. However, the measures differ in the

FIGURE 6.1A Subprime Originations by Year



SOURCES: Authors' calculations using data from LoanPerformance and HMDA.

number of originations they record in the late 1990s and early 2000s and thus in how much they suggest that subprime lending increased over the period.

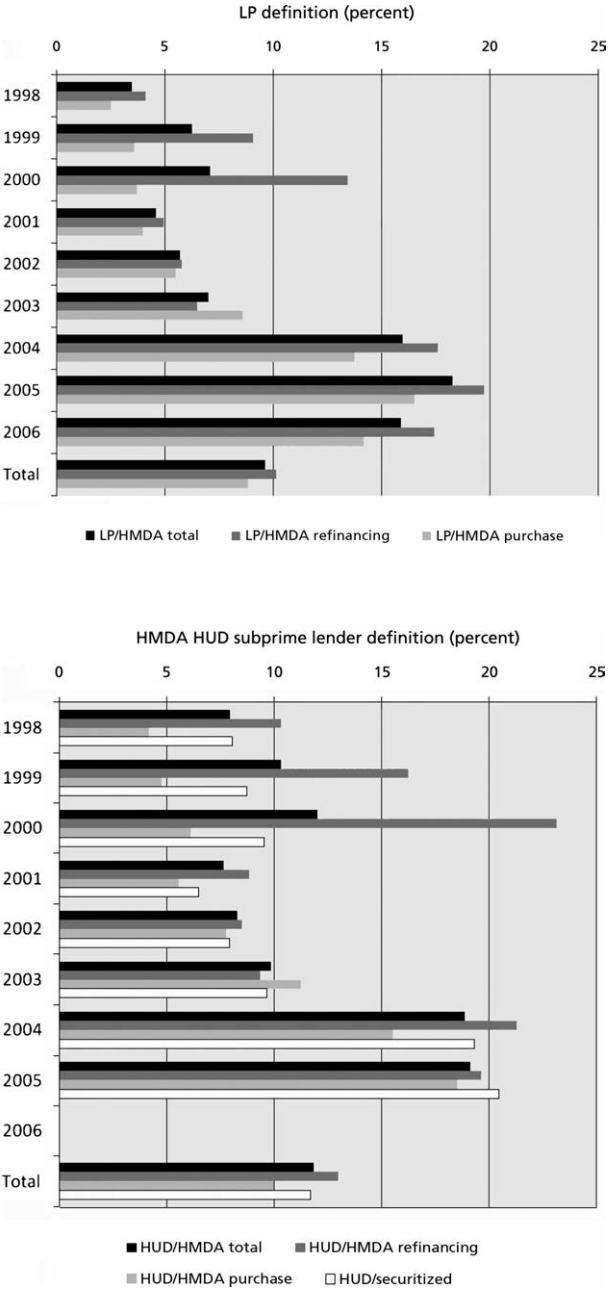
The LP data show around 300,000 subprime originations in MSAs in 1998, with a gradual increase to around 700,000 originations in 2002, a sharp increase to around 2 million in 2005, and then a drop to 1.5 million in 2006. In contrast, the HUD lender measure shows 750,000 subprime mortgage originations in 1998—two and a half times the LP level for that year—and subsequently a moderate rise to 1 million in 2002 and a steep rise to 2.2 million in 2005 (data for 2006 are not available).[6] Although total originations in 2005 are about the same under both measures, the difference in the 1998 levels implies that subprime lending increased nearly seven-fold under the LP measure, but only tripled under the HUD measure. Measuring LP and HUD originations in relation to all mortgage originations in HMDA (figure 6.1b) underscores that the HUD measure captures more subprime originations than the LP measure in the early years of the data.

The difference between the LP and HMDA time trends seems to reflect primarily an increase in the share of subprime mortgages that are securitized, although the share of securitizers that report to LP may change over time as well. To show this, we add the share of HUD subprime mortgages that are securitized to the lower panel of figure 6.1a. We define a subprime mortgage as securitized if the originator does not hold it in portfolio. Thus, we assume that mortgages that an originator sells to another institution are eventually securitized. In the prime market, where more lenders buy and hold whole loans, we would be less comfortable with this assumption. This assumption biases upward our estimate of the number of securitized loans, but it is partially offset by the fact that we miss subprime mortgages that were originated at the end of one year and sold in the next.

The HUD-securitized measure tracks the total LP measure fairly closely for all years except 1998 (when the HUD-securitized measure is larger than the LP measure) and 2004 and 2005 (when the HUD-securitized measure is smaller). The difference between the HUD total and the HUD-securitized bars indicates that about three-fourths of mortgages originated by these lenders were securitized in recent years. The discrepancy in 1998 is consistent with our earlier finding that the LP data appear to be less representative in that year; the fact that the LP measure begins to exceed the HUD-securitized

6. The data in this figure, unlike that in all other figures and tables in this chapter, include manufactured housing units for the HUD subprime lender measure. We include these units to make the series consistent over time, as HMDA did not include a way to identify these units until 2004.

FIGURE 6.1B Subprime Originations as a Share of HMDA Originations



SOURCES: Authors' calculations using data from LoanPerformance and HMDA.

measure in 2004 suggests that prime lenders around that time became more active in the subprime market.

Figure 6.1a also suggests that the match between the HUD total and the LP measures in 2005 may be coincidence rather than an indication that the measures are capturing the same pool of mortgages. These measures may match because the number of subprime originations held in portfolio by HUD lenders in 2005 was about the same as the number of subprime mortgages securitized by prime lenders. This conclusion assumes that we are measuring the HUD securitization share accurately.

Time Trends, 2004–2006

For the 2004–2006 period, we also have data from the HMDA higher-priced measure (table 6.1). The higher-priced measure confirms the LP finding that the peak of subprime lending occurred in 2005. For that peak year, the higher-priced measure shows nearly 3 million mortgages, 800,000 to 900,000 more than shown by the LP or HUD lender measures.

The time series pattern for these three years differs across subprime measures. The higher-priced measure nearly doubles between 2004 and 2005, reflecting in part the flattening of the yield curve. The LP measure also shows large gains over these two years. The HUD measure, however, is flat, perhaps because prime lenders—who are not reflected in the HUD data—became more active in the subprime market in the last couple of years. Between 2005 and 2006, the higher-priced measure indicates a slight dip in the number of subprime originations, whereas the LP data report a drop of about 20 percent. The discrepancies across these three measures suggest the difficulties in relying on any single measure to gauge the prevalence of subprime lending.

Trends in Purchase and Refinance Mortgages

All three measures suggest that subprime mortgages are used a bit more for refinancing than for home purchase, as refinancings represent a majority of subprime originations in all years. For example, in 2005 the LP data show 1.2 million refinance mortgages (figure 6.1a and table 6.1), or 58 percent of all LP subprime; the HUD data also show 1.2 million refinance mortgages, or 56 percent of all HUD lender subprime; and the HMDA higher-priced data show 51 percent.

The data also indicate that over the past decade subprime refinance mortgages were a greater share of total refinancings, as reported in HMDA, than subprime purchases were of total purchases (figure 6.1b). As we show later in

Table 6.1 Subprime Originations in the LP and HMDA Data, 2004–2006

Year	HMDA total	LP total	HMDA higher-priced total	HMDA HUD subprime total
2004	10,959,872	1,725,466	1,575,342	2,070,631
2005	11,245,059	2,022,038	2,987,451	2,154,212
2006	9,887,994	1,547,155	2,855,954	—
Total	32,092,925	5,294,659	7,418,747	4,224,843

Year	HMDA refinance	LP refinance	HMDA higher-priced refinance	HMDA HUD subprime refinance
2004	6,347,590	1,100,609	949,030	1,353,115
2005	6,089,788	1,182,615	1,521,854	1,197,396
2006	5,176,485	888,783	1,486,475	—
Total	17,613,863	3,172,007	3,957,359	2,550,511

Year	HMDA purchase	LP purchase	HMDA higher-priced purchase	HMDA HUD subprime purchase
2004	4,612,282	624,857	626,312	717,516
2005	5,155,271	839,423	1,465,597	956,816
2006	4,711,509	658,372	1,369,479	—
Total	14,479,062	2,122,652	3,461,388	1,674,332

NOTES: Observations are loan originations. The sample is restricted to first-lien mortgages on properties located in a metropolitan statistical area that are not backed by manufactured housing or by buildings with more than four units. LP are loans that were packaged into subprime mortgage pools. HMDA higher-priced are mortgages with an APR of 3 or more percentage points above Treasury securities. HMDA HUD subprime are loans in the HMDA data originated by lenders on the HUD subprime lender list. HMDA HUD data are not available for 2006. LP = LoanPerformance; HMDA = Home Mortgage Disclosure Act; HUD = Department of Housing and Urban Development.

the chapter, almost all subprime refinances are cash-out refinances, although, in some cases, subprime borrowers may be extracting cash solely to pay their mortgage closing costs. In periods when interest rates are low—such as 2003, when interest rates hit a 30-year low—prime borrowers refinance *en masse* to lower their payments, and subprime borrowers represent a relatively small share of total refinances. In times when interest rates are relatively higher, such as 2000 and 2004 to 2006, fewer prime borrowers refinance, and subprime borrowers play a larger role. From 2004 to 2006, subprime refinance originations, as measured by both the LP and HUD measures, represented 15 percent to more than 20 percent of total refinance originations in HMDA.

Originations per Zip Code

Next, we consider the number of subprime loans originated in 2005 as a percentage of the housing units in that zip code according to the 2000 Census (table 6.2). Depending on the measure, subprime loans were originated on between 3.6 percent and 5.4 percent of housing units in the typical zip code. The geographic dispersion is also quite pronounced. At the ninetieth percentile, anywhere from 7.9 to 10.9 subprime loans were originated in the typical year for every 100 housing units. At the tenth percentile, fewer than 2 subprime loans were originated for every 100 housing units.

TABLE 6.2 Subprime Originations by Zip Code, 2004–2006

		Subprime/100 units			
Variable	**Year**	**Mean**	**10th percentile**	**Median**	**90th percentile**
LP	2004	3.1	0.8	2.2	6.6
	2005	3.6	0.9	2.5	7.8
	2006	2.8	0.7	1.9	5.9
	Total	3.2	0.8	2.2	6.8
HMDA	2004	2.8	1.0	2.3	5.4
higher-priced	2005	5.4	1.7	3.9	10.9
	2006	5.2	1.7	3.7	10.3
	Total	4.5	1.3	3.2	9.0
HMDA HUD	2004	3.7	1.2	2.7	7.5
subprime	2005	3.9	1.1	2.6	8.3
	2006	—	—	—	—
	Total	3.8	1.1	2.7	7.8
		Subprime purchases/100 units			
Variable	**Year**	**Mean**	**10th percentile**	**Median**	**90th percentile**
LP	2004	1.1	0.2	0.7	2.5
	2005	1.5	0.3	1.0	3.4
	2006	1.2	0.2	0.8	2.6
	Total	1.3	0.2	0.8	2.8
HMDA	2004	1.3	0.4	0.9	2.6
higher-priced	2005	2.9	0.7	1.9	6.2
	2006	2.7	0.7	1.8	5.7
	Total	2.3	0.5	1.5	4.8
HMDA HUD	2004	1.3	0.2	0.8	3.0
subprime	2005	1.7	0.3	1.0	4.1
	2006	—	—	—	—
	Total	1.5	0.3	0.9	3.6

(*continued*)

TABLE 6.2 (*continued*)

Subprime refinances/100 units					
Variable	**Year**	**Mean**	**10th percentile**	**Median**	**90th percentile**
LP	2004	2.0	0.5	1.4	4.1
	2005	2.1	0.6	1.4	4.5
	2006	1.6	0.4	1.1	3.4
	Total	1.9	0.5	1.3	4.0
HMDA higher-priced	2004	1.6	0.6	1.3	2.9
	2005	2.5	0.9	1.9	5.0
	2006	2.5	0.9	1.9	4.8
	Total	2.2	0.7	1.7	4.2
HMDA HUD subprime	2004	2.3	0.8	1.8	4.4
	2005	2.1	0.7	1.5	4.2
	2006	—	—	—	—
	Total	2.2	0.7	1.6	4.3

NOTES: Observations are zip codes. The sample is restricted to first-lien mortgages on properties located in a metropolitan statistical area that are not backed by manufactured housing or by buildings with more than four units. LP are loans that were packaged into subprime mortgage pools. HMDA higher-priced are mortgages with an APR of 3 or more percentage points above Treasury securities. HMDA HUD subprime are loans in the HMDA data originated by lenders on the HUD subprime lender list. HUD data are not available for 2006. LP = LoanPerformance; HMDA = Home Mortgage Disclosure Act; HUD = Department of Housing and Urban Development.

By the Maps: Where Are Subprime Loan Shares the Highest?

Subprime Originations Relative to Housing Units

To explore the geographic dispersion of subprime lending, we examine maps of the largest 100 MSAs in 2005, as ranked by population (figures 6.2–6.4). Subprime loans were originated throughout the country in this year. We divide zip codes into quintiles based on the number of subprime originations in 2005 relative to housing units in the 2000 census. The patterns described below are similar across the three subprime measures.

The most striking pattern is the extent to which subprime lending was more prevalent in some locations than others. The cutoffs for the quintiles in figure 6.2, based on the LP measure, range from 1.1 subprime originations per 100 housing units and below for the lowest quintile (shaded in light gray) to

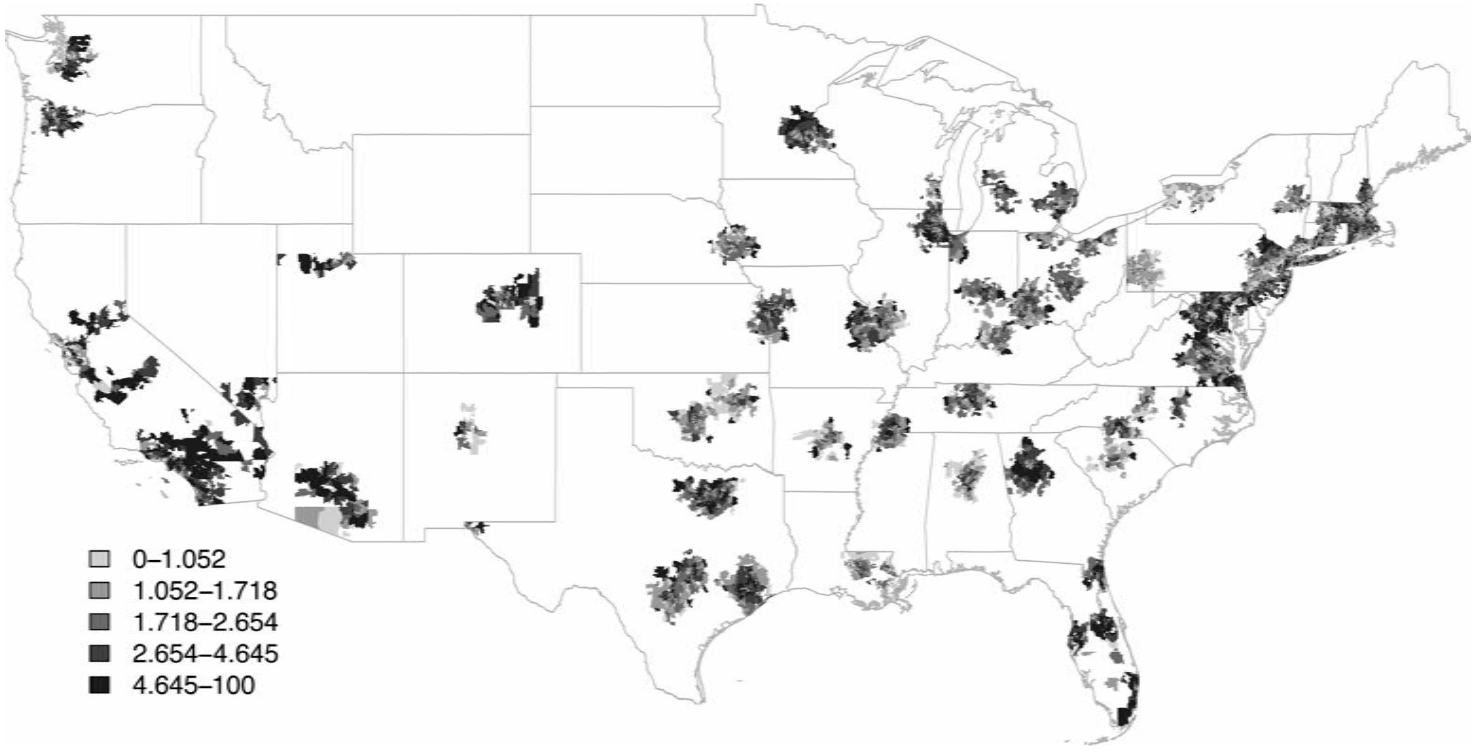
4.6 and above for the highest quintile (shaded in dark gray).[7] Concentrations in dark gray are especially pronounced in the West, with Los Angeles (especially Riverside County), Las Vegas, Phoenix, Fresno, Denver, and Salt Lake City showing high concentrations of subprime loans. In the south, much of Florida and Atlanta also exhibit high concentrations of subprime lending. Cities in the Midwest and the Northeast experienced less subprime lending, although even markets less traditionally linked with subprime lending, such as Chicago, Providence, Minneapolis, Norfolk, and Washington, DC, have somewhat high portions of dark gray shading. In tables 6.3 and 6.4, we list the subprime concentrations using the LP measure for all 50 states and the top 100 MSAs by population.

The maps and tables suggest a couple of findings regarding the dispersion of subprime lending. We establish these correlations more conclusively in the later regression analyses. First, subprime loans are prevalent in locations with large amounts of new construction; this is consistent with a link between construction and the expansion of credit. Fast-growing metropolitan areas in states such as Nevada, Arizona, California, and Texas appear to have many subprime originations. Even within metropolitan areas, exurbs often have the highest subprime concentrations. This pattern is especially apparent in California, where the outlying Los Angeles suburbs and the so-called "Inland Empire" of Riverside and San Bernardino counties show large dark gray concentrations (figure 6.5). Although not readily apparent from the national map, a similar—although more muted—pattern exists in other areas, such as the ring at the edge of the Boston metropolitan area and outlying parts of New Jersey.

Second, there is an apparent link between home price appreciation in the previous year and subsequent subprime lending, but the correspondence is certainly not one-for-one. Whereas California, Las Vegas, and Miami saw high rates of appreciation and a great concentration of subprime lending, parts of the Northeast had high rates of home price appreciation but moderate numbers of subprime originations. Similarly, Atlanta had a high concentration of subprime lending in 2005 but relatively little home price appreciation, when compared with other locations. Third, some locations, such as Ohio or Michigan, that have received widespread attention because of large numbers of

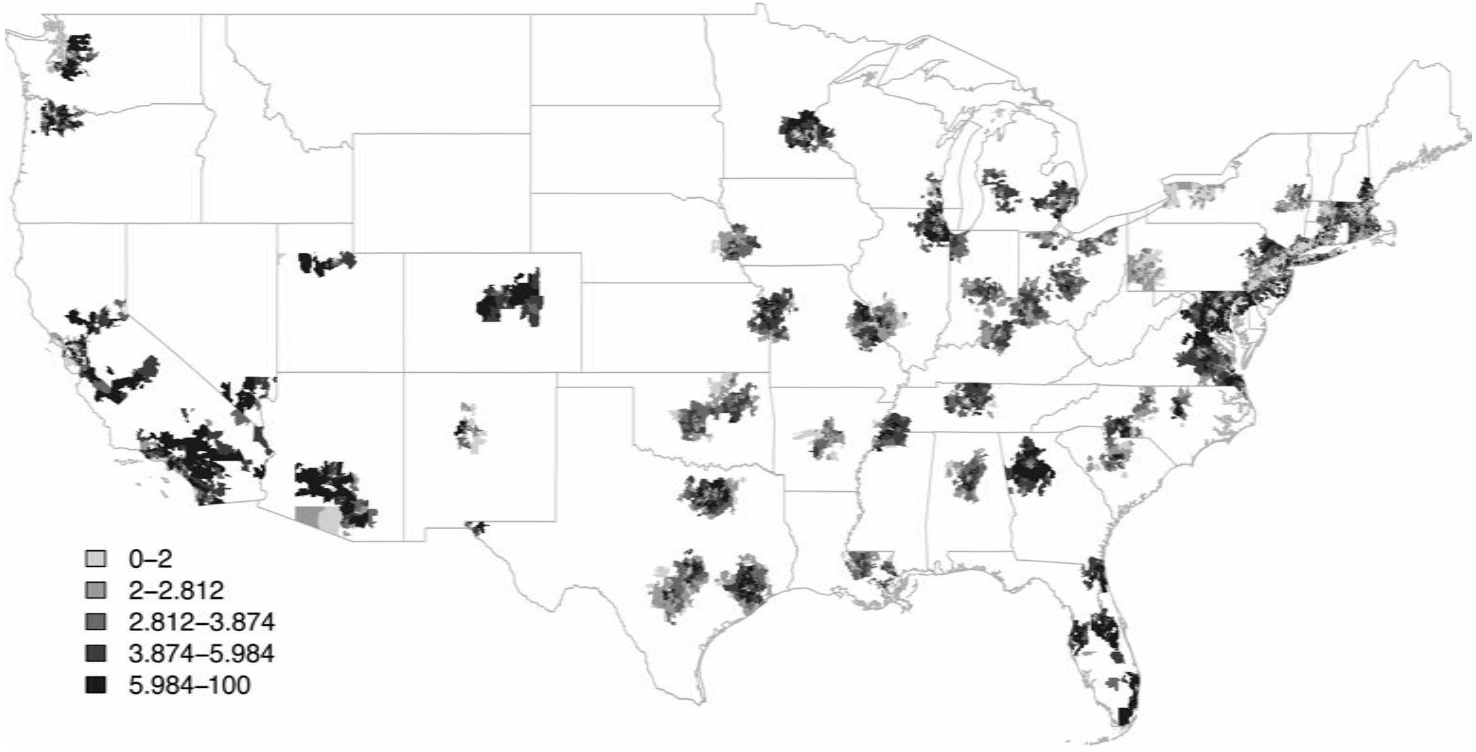
7. The distribution of subprime originations across zip codes in the maps differs from the distributions described in the section "Loan Performance, Higher-Priced HMDA Mortgages, and Mortgages by HUD Subprime Lenders," because the maps are limited to the top 100 MSAs whereas the section describes our entire sample. The maps are available on the Internet in an interactive fashion at http://www4.gsb.columbia.edu/realestate/research/SubprimeMaps.

FIGURE 6.2 Percentage of Housing Units with Subprime Loan Originations in 2005, LP



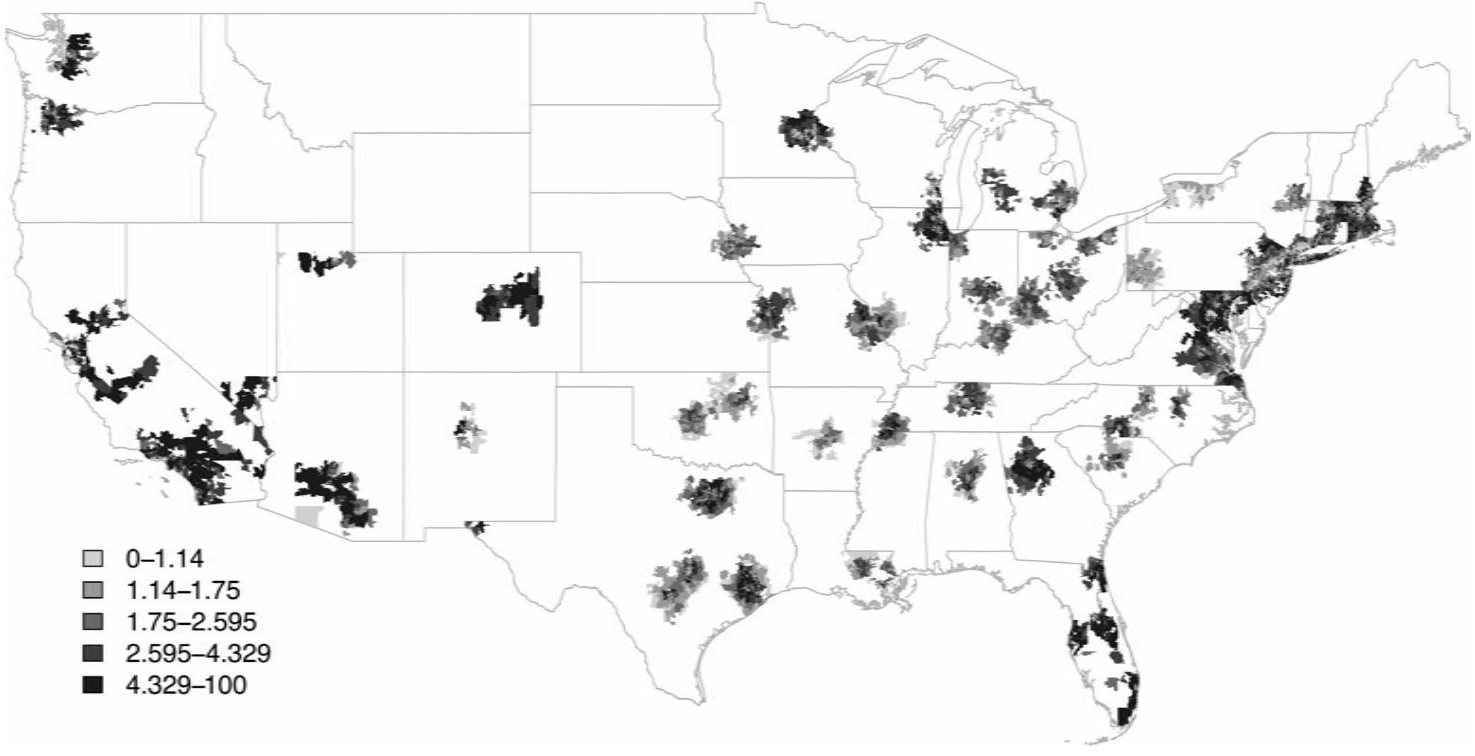
SOURCES: Authors' calculations using data from HMDA, LoanPerformance, and 2000 U.S. Census.

FIGURE 6.3 Percentage of Housing Units with Subprime Loan Originations in 2005, HMDA Higher-Priced



SOURCES: Authors' calculations using data from HMDA and 2000 U.S. Census.

FIGURE 6.4 Percentage of Housing Units with Subprime Loan Originations in 2005, HUD Subprime Lender



SOURCES: Authors' calculations using data from HMDA, HUD Subprime Lender List, and 2000 U.S. Census.

TABLE 6.3 LP Subprime Originations as a Share of Housing Units by State, 2005

State	Number of subprime loans/ number of units	State	Number of subprime loans/ number of units
Nevada	0.100	Wisconsin	0.030
Arizona	0.077	New Hampshire	0.029
California	0.071	Maine	0.028
Florida	0.062	Ohio	0.026
Rhode Island	0.062	Wyoming	0.026
Maryland	0.061	Indiana	0.025
District of Columbia	0.052	Kansas	0.021
Illinois	0.048	Mississippi	0.021
New Jersey	0.043	New Mexico	0.021
Georgia	0.040	North Carolina	0.021
Utah	0.039	Oklahoma	0.021
Connecticut	0.038	South Carolina	0.020
Colorado	0.037	Iowa	0.019
Virginia	0.036	Kentucky	0.019
Washington	0.035	Nebraska	0.019
Massachusetts	0.034	Pennsylvania	0.019
Michigan	0.034	Alabama	0.018
Minnesota	0.034	Louisiana	0.018
Missouri	0.034	Arkansas	0.017
Idaho	0.033	South Dakota	0.014
Oregon	0.033	Vermont	0.014
Delaware	0.032	Montana	0.012
New York	0.032	North Dakota	0.012
Texas	0.031	West Virginia	0.009
Tennessee	0.030		
Total		0.041	

NOTES: Sample is restricted to first-lien mortgages on properties located in a metropolitan statistical area that are not backed by manufactured housing or by buildings with more than four units. LP subprime loans are loans that were packaged into subprime mortgage pools. LP = LoanPerformance.

foreclosures, do not appear to have particularly large concentrations of subprime loans as compared with other parts of the country.

Subprime Originations Relative to Total Origination

Our finding about the low prevalence of subprime originations in Ohio and Michigan turns out to depend on our choice of housing units rather than on total originations as the denominator. All previous papers in this literature have used total originations. We use housing units as the denominator because the

TABLE 6.4 LP Subprime Originations as a Share of Housing Units by MSA, 2005

	MSA	Number of subprime loans/number of units		MSA	Number of subprime loans/number of units
1	Riverside, CA	0.14	39	Seattle, WA	0.04
2	Bakersfield, CA	0.13	40	Lakeland, FL	0.04
3	Stockton, CA	0.12	41	Boise City, ID	0.04
4	Las Vegas, NV	0.12	42	San Francisco, CA	0.04
5	Modesto, CA	0.11	43	Springfield, MA	0.04
6	Fresno, CA	0.10	44	Minneapolis St Paul,	
7	Visalia, CA	0.09		MN–WI	0.04
8	Phoenix, AZ	0.09	45	Bridgeport, CT	0.04
9	Cape Coral, FL	0.09	46	Dallas, TX	0.04
10	Orlando, FL	0.08	47	Kansas City, MO–KS	0.04
11	Miami, FL	0.08	48	Ogden, UT	0.04
12	Sacramento, CA	0.08	49	St Louis, MO-IL	0.03
13	Los Angeles, CA	0.07	50	Hartford, CT	0.03
14	Washington		51	Richmond, VA	0.03
	DC, DC–VA–MD–WV	0.06	52	Boston, MA-NH	0.03
15	Chicago, IL–IN–WI	0.06	53	San Jose, CA	0.03
16	Providence, RI–MA	0.05	54	Cleveland, OH	0.03
17	Tampa, FL	0.05	55	Nashville, TN	0.03
18	New Haven, CT	0.05	56	Grand Rapids, MI	0.03
19	Baltimore, MD	0.05	57	Charlotte, NC-SC	0.03
20	Atlanta, GA	0.05	58	Charleston, SC	0.03
21	Jacksonville, FL	0.05	59	Indianapolis, IN	0.03
22	San Diego, CA	0.05	60	Columbus, OH	0.03
23	Milwaukee, WI	0.05	61	Spokane, WA	0.03
24	Palm Bay, FL	0.05	62	Santa Rosa, CA	0.03
25	Virginia Beach, VA–NC	0.04	63	San Antonio, TX	0.03
26	Oxnard, CA	0.04	64	Akron, OH	0.03
27	Detroit, MI	0.04	65	Philadelphia,	
28	Houston, TX	0.04		PA–NJ–DE–MD	0.03
29	Tucson, AZ	0.04	66	Allentown, PA–NJ	0.03
30	Worcester, MA	0.04	67	Portland, ME	0.03
31	Memphis, TN–MS–AR	0.04	68	Dayton, OH	0.03
32	New York, NY–NJ–PA	0.04	69	Knoxville, TN	0.03
33	Salt Lake City, UT	0.04	70	Des Moines, IA	0.03
34	Denver, CO	0.04	71	Austin, TX	0.03
35	Poughkeepsie, NY	0.04	72	Chattanooga, TN–GA	0.03
36	Sarasota, FL	0.04	73	Cincinnati, OH–KY–IN	0.03
37	Colorado Springs, CO	0.04	74	Raleigh, NC	0.03
38	Portland, OR–WA	0.04	75	Jackson, MS	0.02

(*continued*)

TABLE 6.4 (*continued*)

	MSA	Number of subprime loans/number of units		MSA	Number of subprime loans/number of units
76	Birmingham, AL	0.02	92	New Orleans, LA	0.02
77	Albuquerque, NM	0.02	93	Scranton, PA	0.02
78	McAllen, TX	0.02	94	Greensboro, NC	0.02
79	El Paso, TX	0.02	95	York, PA	0.02
80	Oklahoma City, OK	0.02	96	Little Rock, AR	0.02
81	Albany, NY	0.02	97	Wichita, KS	0.02
82	Ann Arbor, MI	0.02	98	Harrisburg, PA	0.02
83	Baton Rouge, LA	0.02	99	Durham, NC	0.02
84	Omaha, NE–IA	0.02	100	Madison, WI	0.02
85	Columbia, SC	0.02	101	Greenville, SC	0.02
86	Louisville, KY–IN	0.02	102	Lancaster, PA	0.02
87	Corpus Christi, TX	0.02	103	Augusta, GA–SC	0.01
88	Toledo, OH	0.02	104	Pittsburgh, PA	0.01
89	Lexington-Fayette, KY	0.02	105	Rochester, NY	0.01
90	Youngstown, OH–PA	0.02	106	Syracuse, NY	0.01
91	Tulsa, OK	0.02	107	Buffalo, NY	0.01
Total				0.041	

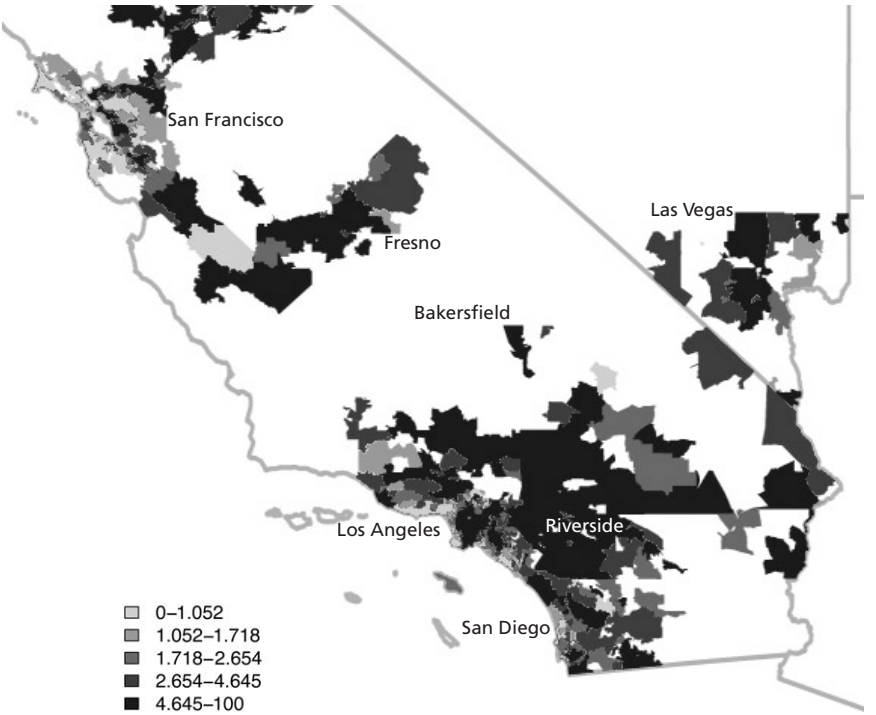
NOTES: The sample is restricted to first-lien mortgages that are not backed by manufactured housing or buildings with more than four units. Subprime loans are loans that were packaged into subprime mortgage pools. We restrict our sample to loans in the top three deciles of MSAs by population. MSA = metropolitan statistical area.

availability of subprime loans may affect the decision to take out a loan as well as the decision of what type of loan to choose. For example, subprime loans may allow some individuals who would have otherwise stayed renters to become homeowners. Subprime loans may also allow some homeowners who would otherwise be liquidity constrained to extract cash from their properties.

When we measure subprime originations in relation to total originations (tables 6.5 and 6.6), states and cities with depressed housing markets move up in the distribution. For example, home prices in Michigan appreciated 3 percent in 2005; Michigan ranked seventeenth among states in subprime originations in terms of housing units, but fifth in terms of originations.[8] In the same year, home prices in California rose 21 percent; California ranked third among

8. Home price appreciation estimates are calculated by the authors and based on the change in the OFHEO all-transactions house price index between fourth quarter 2004 and fourth quarter 2005.

FIGURE 6.5 Percentage of Housing Units in Southern California with Subprime Loan Originations in 2005, LP



SOURCES: Authors' calculations using data from LoanPerformance and 2000 U.S. Census.

states in subprime originations as related to housing units, but sixteenth as related to originations. Likewise, Memphis, Detroit, and Cleveland have a higher relative share of subprime originations related to all originations than to housing units. However, some areas rank high under both measures. Nevada has the highest share of subprime loans relative to both housing units and originations, and Bakersfield, California ranks second among cities under both measures.

We hypothesize that areas with high home price appreciation and more new construction may have more mortgage activity of all kinds than do areas with more depressed housing markets. More new residents may move to rapidly growing areas and purchase homes; more renters may transition to home ownership, and more investors may purchase properties; more homeowners may extract their recent home price gains through cash-out refinancings. Because mortgage activity is elevated among both prime and subprime borrow-

TABLE 6.5 LP Subprime Originations as a Share of All Originations by State, 2005

State	Number of subprime loans/ number of loans	State	Number of subprime loans/ number of loans
Nevada	0.25	Pennsylvania	0.16
Florida	0.24	South Carolina	0.16
Michigan	0.24	Utah	0.16
Texas	0.24	Wisconsin	0.16
Tennessee	0.23	Arkansas	0.15
Ohio	0.22	Colorado	0.15
Arizona	0.21	Kansas	0.15
Illinois	0.21	Kentucky	0.15
Indiana	0.21	Nebraska	0.15
Maryland	0.21	Wyoming	0.15
Mississippi	0.21	Idaho	0.14
Missouri	0.21	Iowa	0.14
Rhode Island	0.21	Massachusetts	0.14
California	0.19	North Carolina	0.14
Georgia	0.19	Oregon	0.14
New York	0.19	Virginia	0.14
Oklahoma	0.19	Washington	0.14
Connecticut	0.18	New Mexico	0.13
Louisiana	0.18	New Hampshire	0.12
New Jersey	0.18	South Dakota	0.10
Alabama	0.17	Montana	0.09
District of Columbia	0.17	Vermont	0.08
Delaware	0.16	North Dakota	0.08
Maine	0.16	West Virginia	0.08
Minnesota	0.16		
Total		0.19	

NOTES: The sample is restricted to first-lien mortgages on properties located in a metropolitan statistical area that are not backed by manufactured housing or by buildings with more than four units. LP subprime loans are loans that were packaged into subprime mortgage pools. LP = LoanPerformance.

ers, subprime originations may be high in connection with housing units, but not necessarily as a share of mortgage activity.

In contrast, mortgage activity is likely subdued in depressed housing markets: these markets do not attract new homeowners or investors, and existing homeowners have no home price gains to cash out in refinancings. As depressed housing markets often reflect difficult local labor market conditions, more residents of these areas may have trouble qualifying for prime mortgages. As a result, we expect subprime originations to be low with regard to housing units, but

TABLE 6.6 LP Subprime Originations as a Share of All Originations by MSA, 2005

	MSA	Number of subprime loans/number of loans		MSA	Number of subprime loans/number of loans
1	Memphis, TN–MS–AR	0.34	40	Atlanta, GA	0.20
2	Bakersfield, CA	0.34	41	Oklahoma City, OK	0.19
3	Visalia, CA	0.32	42	Providence, RI–MA	0.19
4	Fresno, CA	0.31	43	Tulsa, OK	0.19
5	Detroit, MI	0.29	44	Palm Bay, FL	0.19
6	Miami, FL	0.29	45	Toledo, OH	0.19
7	Houston, TX	0.28	46	Sacramento, CA	0.19
8	Riverside, CA	0.28	47	Columbus, OH	0.19
9	Jackson, MS	0.27	48	Grand Rapids, MI	0.19
10	Las Vegas, NV	0.27	49	New York, NY–NJ–PA	0.19
11	McAllen, TX	0.27	50	Springfield, MA	0.19
12	Cleveland, OH	0.27	51	Knoxville, TN	0.19
13	San Antonio, TX	0.26	52	Virginia Beach, VA–NC	0.19
14	Stockton, CA	0.26	53	Scranton, PA	0.19
15	Orlando, FL	0.25	54	New Orleans, LA	0.18
16	Cape Coral, FL	0.24	55	Sarasota, FL	0.18
17	Jacksonville, FL	0.24	56	Albany, NY	0.18
18	Milwaukee, WI	0.24	57	Philadelphia,	
19	Dayton, OH	0.23		PA–NJ–DE–MD	0.18
20	Tampa, FL	0.23	58	Nashville, TN	0.18
21	Lakeland, FL	0.23	59	Columbia, SC	0.17
22	Akron, OH	0.23	60	Tucson, AZ	0.17
23	Chicago, IL–IN–WI	0.23	61	Little Rock, AR	0.17
24	Dallas, TX	0.23	62	Worcester, MA	0.17
25	New Haven, CT	0.22	63	Cincinnati, OH–KY–IN	0.17
26	Kansas City, MO–KS	0.22	64	Hartford, CT	0.17
27	Phoenix, AZ	0.22	65	Omaha, NE–IA	0.17
28	El Paso, TX	0.22	66	Louisville, KY–IN	0.17
29	Chattanooga, TN–GA	0.22	67	Augusta, GA–SC	0.17
30	Youngstown, OH–PA	0.22	68	Charlotte, NC–SC	0.17
31	Baltimore, MD	0.22	69	Salt Lake City, UT	0.17
32	Corpus Christi, TX	0.22	70	Minneapolis St Paul,	
33	Indianapolis, IN	0.21		MN–WI	0.17
34	Modesto, CA	0.21	71	Charleston, SC	0.16
35	St Louis, MO–IL	0.21	72	Pittsburgh, PA	0.16
36	Birmingham, AL	0.21	73	Richmond, VA	0.16
37	Baton Rouge, LA	0.21	74	Des Moines, IA	0.16
38	Los Angeles, CA	0.21	75	Spokane, WA	0.16
39	Poughkeepsie, NY	0.20	76	Buffalo, NY	0.15

(*continued*)

TABLE 6.6 (*continued*)

	MSA	Number of subprime loans/number of loans		MSA	Number of subprime loans/number of loans
77	Colorado Springs, CO	0.15	92	Albuquerque, NM	0.14
78	Ogden, UT	0.15	93	Lexington, KY	0.14
79	Austin, TX	0.15	94	Portland, ME	0.14
80	Denver, CO	0.15	95	Seattle, WA	0.13
81	Rochester, NY	0.15	96	Boston, MA–NH	0.13
82	Wichita, KS	0.15	97	Syracuse, NY	0.13
83	Greensboro, NC	0.15	98	Harrisburg, PA	0.12
84	Washington DC, DC–VA–MD–WV	0.15	99	Raleigh, NC	0.12
			100	Ann Arbor, MI	0.11
85	Boise City, ID	0.15	101	San Francisco, CA	0.11
86	Allentown, PA–NJ	0.14	102	York, PA	0.11
87	Bridgeport, CT	0.14	103	San Jose, CA	0.10
88	Oxnard, CA	0.14	104	Santa Rosa, CA	0.10
89	Greenville, SC	0.14	105	Lancaster, PA	0.10
90	Portland, OR–WA	0.14	106	Durham, NC	0.10
91	San Diego, CA	0.14	107	Madison, WI	0.09
Total				0.20	

NOTES: The sample is restricted to first-lien mortgages that are not backed by manufactured housing or by buildings with more than four units. Subprime loans are loans that were packaged into subprime mortgage pools. We restrict our sample to loans within the top three deciles of MSAs by population.
MSA = metropolitan statistical area.

perhaps higher with regard to loan originations. In regression analyses presented later in this chapter, we present evidence consistent with these hypotheses.

However, we cannot rule out the possibility that subprime originations are high relative to housing units in fast-growing cities because of a timing issue: our loan measures are from 2005, whereas our measure of housing units is from 2000. In fast-growing cities, the number of housing units in 2000 may be significantly less than the number of units in 2005, and subprime loan originations will seem more prevalent than they really are.

Regression Analysis: Where Are Subprime Loan Shares the Highest?

Next, we formalize the analysis in the maps, using regressions that examine the factors correlated with the prevalence of subprime loans in MSA zip codes.

Our goal is to describe the types of neighborhoods that saw the highest incidence of subprime lending; we are not asserting a causal relationship between these factors and these originations.

Summary Statistics

As we described the subprime measures earlier, we highlight here the other variables in our analysis (table 6.7). As already noted, we measure zip code income with dummy variables that indicate the quintile within the MSA that each zip code's median income falls into. Although we use these dummy variables in the regressions, we show the distribution of the zip code median income by quintile in table 6.7 to give a sense of the variability in the quintiles across MSAs. Whereas the mean of the bottom income quintile is $15,300, the tenth percentile is $11,300 and the ninetieth percentile is $19,300. The highest income quintile averages $34,000, but ranges from $21,900 to $50,000. The variability of each income quintile rises with the income quintile.

Zip codes exhibit great skewness in the percentage of black and Hispanic residents. Although blacks and Hispanics on average represent 10.7 percent and 10.8 percent, respectively, of the zip code residents, the medians are only 3.6 percent and 4.1 percent. The standard deviations of both variables exceed 16 percent.

The mean and median home ownership rates are 65.2 percent and 67.1 percent in our sample, slightly below the national 2005 home ownership rate of 68.9 percent. Once again, this measure is quite variable, with the tenth and ninetieth percentiles of the distribution of home ownership rates ranging from 45 percent to 83 percent.

The mean unemployment rate is 5.0 percent, quite close to the national average of 5.1 percent, with relatively low variability across counties. However, the amount that home prices appreciated in 2004, the year preceding our data, ranges from 0.5 percent to 17.1 percent, with a median of 5 percent. The variance (7.0 percent) is nearly as high as the mean (7.5 percent). Our measure of new home construction, permits per 100 housing units, also exhibits skewness. The mean number of permits (1.6) is above the median (1.1), with a tenth percentile to ninetieth percentile range of 0.3 to 3.5.

Base Regressions Using LoanPerformance Data

We show first regressions that use LP subprime originations per 100 housing units as the dependent variable (table 6.8). The specification in column one

TABLE 6.7 Sample Characteristics, 2005

Variable	Mean	Standard deviation	10th percentile	Median	90th percentile
LP subprime/100 units	3.6	3.8	0.9	2.5	7.8
LP subprime purchases/ 100 units	1.5	1.8	0.3	1.0	3.4
LP subprime refinances/ 100 units	2.1	2.3	0.6	1.4	4.5
LP subprime refinances for cash-out/100 units	1.9	2.1	0.5	1.2	4.2
LP subprime refinances not for cash-out/100 units	0.2	0.2	0.0	0.2	0.5
HMDA higher-priced subprime/100 units	5.4	5.0	1.7	3.9	10.9
HMDA higher-priced subprime purchases/ 100 units	2.6	3.1	0.6	1.7	5.9
HMDA higher-priced subprime refinances/ 100 units	2.7	2.3	1.0	2.1	5.4
HMDA HUD subprime/ 100 units	3.9	3.9	1.1	2.7	8.4
HMDA HUD subprime purchases/100 units	1.7	2.2	0.3	1.0	4.1
HMDA HUD subprime refinances/100 units	2.2	2.0	0.7	1.6	4.4
Income in zip codes in bottom income quintile	15.3	3.2	11.3	15.3	19.3
Income in zip codes in second income quintile	19.2	3.5	15.2	18.7	23.9
Income in zip codes in third income quintile	21.9	4.2	17.1	21.2	27.7
Income in zip codes in fourth income quintile	25.3	6.0	18.6	24.4	32.9
Income in zip codes in top income quintile	34.0	12.9	21.9	31.1	49.8
Percent with low VantageScore	24.5	12.4	10.4	22.4	41.9
Percent with mid-VantageScore	12.8	3.1	8.6	12.9	16.5
Percent of population black	10.7	17.7	0.4	3.6	30.5
Percent of population Hispanic	10.8	16.3	0.9	4.1	30.1
Percent ownership rate	65.2	14.8	45.3	67.1	82.6

(*continued*)

TABLE 6.7 (*continued*)

Variable	Mean	Standard deviation	10th percentile	Median	90th percentile
Percent unemployment	5.0	1.3	3.7	4.9	6.4
HPI appreciation in previous year	7.4	7.0	0.5	5.0	17.1
Lagged permits in county/ 100 units	1.6	1.5	0.3	1.1	3.5

NOTES: Observations are zip codes. The sample is restricted to first-lien mortgages on properties located in a metropolitan statistical area that are not backed by manufactured housing or by buildings with more than four units. LP denotes loans that were packaged into subprime mortgage pools. HMDA higher-priced are mortgages with an APR of 3 or more percentage points above Treasury securities. HMDA HUD subprimes are loans in the HMDA data originated by lenders on the HUD subprime lender list.
LP = LoanPerformance; HMDA = Home Mortgage Disclosure Act; HUD = Department of Housing and Urban Development; HPI = house price index.

compares total subprime originations in each zip code to originations in other zip codes across the country.

Zip codes in the bottom income quintile and zip codes with higher shares of households in the middle credit category had the highest proportion of subprime loans. A one standard deviation increase in the percentage of households with a VantageScore of 640 to 700 (3.1 percentage points) is associated with a 0.86 increase in the number of subprime originations per 100 housing units, which is a 24 percent increase over the sample average of 3.63. Borrowers with credit scores in this range are the typical market for subprime mortgages. The share of households in the lowest credit category appears to be less related to the number of subprime loans, possibly because the credit of households in this category was below the lending standards of many subprime lenders.

The positive and significant coefficient on the unemployment rate suggests that subprime originations were more prevalent in communities with adverse economic conditions. However, the order of magnitude is moderate: a one standard deviation increase in the unemployment rate (1.3 percentage points) is associated with an 0.22 increase in the number of subprime originations per 100 housing units, or a 6 percent increase relative to the sample mean. Locations with higher home ownership rates also had more subprime loans, with an elasticity close to one-for-one: a 1 percent increase in home ownership rate is associated with an increase of 0.04 additional subprime loans per 100 housing units, about 1 percent of the sample mean.

Even controlling for credit scores and other zip code characteristics, race and ethnicity appear to be strongly related to the proportion of subprime loans

in a statistically significant way. A 5.4 percentage point increase in the percent of non-Hispanic blacks—a 50 percent increase relative to the mean—is associated with an 8.3 percent increase in the share of subprime originations in the zip code.[9] A similar 5.4 percentage point increase in the percent of Hispanics—also a 50 percent increase relative to the mean—is associated with a 6.8 percent increase in the proportion of subprime loans. However, skewness in the racial composition of zip codes suggests that subprime originations are much more prevalent in zip codes with large shares of minority residents. Moving from the median to the ninetieth percentile zip code share of black and Hispanic residents (an increase from 3.6 percent to 30.5 percent and from 4.1 percent to 30.1 percent of residents, respectively) suggests an increase in subprime originations of 41.5 percent and 32.9 percent. However, without more information on borrowers' credit constraints and borrowing options, we cannot assess whether these subprime loans displaced lower-cost conventional loans in minority communities or provided additional credit where lending was not previously available.

We believe that we are the first researchers to use LP data to document these differences in the incidence of subprime lending by neighborhood racial composition, although several researchers have found similar results with the HMDA data. Avery, Canner, and Cook (2005), the Center for Responsible Lending (2006), and the Consumer Federation of America (2006) show that minorities are more likely than whites to take out HMDA higher-priced mortgages. The U.S. Department of Housing and Urban Development (2000), Scheessele (2002), and Calem, Gillen, and Wachter (2004) document that subprime loans, as measured by the HUD lender list, are more prevalent in minority neighborhoods. The differences across races generally persist in these studies even after controlling for borrower characteristics, although no study can control fully for all relevant variables. Our results are particularly striking given that they are the first to control, in a consistent manner, for the distribution of credit scores in a given zip code. Avery, Canner, and Cook (2005) find that the racial gap decreases substantially after controlling for the lending institution, but this result raises the further question of why minorities are served disproportionately by higher-priced lenders. The extent to which these differences across races represent steering, discrimination, or unobserved characteristics correlated with race remains an unsettled question.

9. We benchmark the impact of race on zip code lending, using a 50 percent increase in the mean instead of a one standard deviation increase, because of the skewness in racial composition. The standard deviation in percent of residents who are black or nonblack Hispanics is about 60 percent larger than the mean.

TABLE 6.8 Incidence of LP Subprime Originations in MSA Zip Codes, 2005

	Subprime loans/100 units		Subprime purchases/100 units		Subprime refinances/100 units	
	(1)	(2)	(3)	(4)	(5)	(6)
Median income is in bottom quintile	1.15**	−0.54**	0.23**	−0.41**	0.91**	−0.13*
	(9.86)	(−4.44)	(3.94)	(−6.60)	(13.72)	(−1.88)
Median income is in second quintile	0.52**	−0.69**	0.030	−0.47**	0.48**	−0.22**
	(6.33)	(−7.59)	(0.71)	(−9.92)	(9.93)	(−4.26)
Median income is in third quintile	0.30**	−0.60**	0.017	−0.35**	0.28**	−0.25**
	(3.89)	(−7.28)	(0.45)	(−8.23)	(6.19)	(−5.31)
Median income is in fourth quintile	0.07	−0.39**	0.013	−0.18**	0.059	−0.21**
	(1.21)	(−5.96)	(0.41)	(−5.32)	(1.62)	(−5.66)
Percent with low VantageScore	−0.002	0.056**	0.010**	0.035**	−0.012**	0.020**
	(−0.28)	(7.37)	(3.19)	(9.34)	(−2.99)	(4.71)
Percent with mid-VantageScore	0.28**	0.41**	0.11**	0.17**	0.17**	0.24**
	(16.01)	(22.80)	(13.18)	(18.32)	(15.81)	(22.97)
Percent of population black	0.056**	0.045**	0.018**	0.011**	0.038**	0.034**
	(17.25)	(13.97)	(12.65)	(7.33)	(17.04)	(16.03)
Percent of population Hispanic	0.046**	0.051**	0.022**	0.018**	0.025**	0.032**
	(13.47)	(13.21)	(13.23)	(10.04)	(12.46)	(14.19)

Percent ownership rate	0.036**	0.053**	0.013**	0.021**	0.023**	0.032**
	(15.16)	(22.82)	(11.22)	(17.55)	(16.27)	(23.63)
Percent unemployed	0.17**	—	0.06**	—	0.11**	—
	(6.28)	—	(4.61)	—	(6.96)	—
HPI appreciation in previous year	0.21**	—	0.071**	—	0.14**	—
	(28.37)	—	(19.17)	—	(32.81)	—
Lagged permits in United States/100 units	0.51**	—	0.29**	—	0.22**	—
	(18.24)	—	(18.98)	—	(15.39)	—
Constant	−6.94**	−6.94**	−2.79**	−2.93**	−4.18**	−4.03**
	(−21.44)	(−24.16)	(−17.50)	(−19.78)	(−21.96)	(−23.97)
MSA fixed effects	No	Yes	No	Yes	No	Yes
Observations	15,281	15,611	15,281	15,611	15,281	15,611
R- squared value	0.45	0.57	0.33	0.43	0.46	0.60
Mean of dependent variable	3.63		1.51		2.13	

NOTES: Dependent variable: LP subprime loans as a percentage of total housing units in 2000. Observations are zip codes. The sample is restricted to first-lien mortgages on properties located in an MSA that are not backed by manufactured housing or by buildings with more than four units. LP subprime denotes loans that were packaged into subprime mortgage pools. For the specifications without MSA fixed effects, we drop 330 zip codes with missing unemployment rate or permit data. LP = LoanPerformance; HPI = house price index; MSA = metropolitan statistical area; * = statistically significant at the .10 level; ** = statistically significant at the .05 level. T-statistics are shown in parentheses.

Finally, the positive and statistically significant coefficients on lagged home price appreciation and new housing permits suggest an interrelationship between subprime lending and the housing boom. A one standard deviation increase in home price appreciation in the previous year is associated with a 39 percent increase in subprime loans, whereas a one standard deviation increase in lagged construction is associated with a 21 percent higher proportion of subprime loans. Other research has documented a relationship between subprime lending and the housing cycle. Mian and Sufi (2008) show that zip codes where previously constrained borrowers subsequently received mortgage credit had higher rates of home price appreciation. Mayer and Sinai (2007) demonstrate that metropolitan areas with higher subprime originations had greater "excess" appreciation in price-to-rent ratios above fundamental values. The extent to which subprime lending either helped cause this housing boom or was a consequence of it remains an open question.

When we compare zip codes within an MSA in our MSA fixed-effects specification (column two), the results are similar to the across-MSA specification. The main exception is the coefficients on the various income quintiles, which suggest that subprime lending was most prevalent in zip codes in the top income quintile, and was lower by about the same amount in zip codes in the bottom four quintiles. As our income quintiles are defined relative to each MSA's distribution, it is a bit surprising that the income coefficients differ so much across the specifications with and without MSA fixed effects. However, the fact that the "percent with low VantageScore" coefficient is so much larger in the specification with MSA fixed effects than in the specification without fixed effects suggests that a correlation between income and credit score may underlie these results.[10] The coefficient on "percent with mid-VantageScore" is about the same in the two specifications—large and statistically significant.

Coefficients on the percent of black and Hispanic residents remain nearly the same as in column one. This result is striking, given that racial and ethnic concentrations vary substantially across MSAs. We drop the controls for home price appreciation, housing permits, and unemployment in this specification, as these effects are primarily identified across MSAs.

The next four columns report the results from separate analyses for purchases and refinancings. In 2005, the year of our analysis, subprime purchases

10. Indeed, when we run the fixed-effects specification with only the income variables, the coefficients are almost identical to the equivalent specification without fixed effects. When we then add the credit score variables to the fixed-effects specification, the income coefficients change to values that are similar to the coefficients in the full fixed-effects specification.

represent about 42 percent of originations in the LP data. Because purchases are a smaller share in the LP data, we expect the coefficients in the purchase regressions to be proportionately smaller than the coefficients in the refinancing regression if the correlation between the subprime measure and the covariates was the same for both purchases and refinancings. (Notice that the number of purchase loans plus refinancings sum to total originations, so that the sum of the coefficients in columns three and five adds to the coefficients in column one, and similarly the sum of columns two and four equals column 6.)

Overall, the pattern of subprime lending appears roughly similar for purchase loans as for refinancing. Although the income and credit score variables change a bit across the two mortgage purposes, the general pattern is similar. The race coefficients remain statistically and economically significant in all four specifications, as do those for home ownership rate and unemployment.

The major difference between purchase and refinance mortgages is that lagged construction has a stronger correlation with purchases than with refinancings. The coefficient on lagged construction is larger for purchase loans, even though refinancings represent the bulk of the sample. It is interesting, however, that locations with more new construction still appear to exhibit some additional refinancing activity, possibly because new units provide an additional base for refinancings.

Table 6.9 segments refinancing into "cash-out" and "not for cash-out" categories. Strikingly, cash-out refinancings dominate the sample, with about nine in 10 mortgage borrowers receiving some type of cash back. Even so, the coefficients appear to show similar patterns as in the other regressions.

Regressions with the HMDA Higher-Priced and HUD Subprime Lender Measures

We next use the higher-priced and HUD lender measures of subprime originations relative to housing units as the dependent variables (tables 6.10 and 6.11). Although the choice of subprime measure affects the estimates of the number of originations, as shown in tables 6.1 and 6.2, this choice does not appear to affect the regression results substantively. The factors associated with the incidence of subprime lending are similar across all three measures. However, patterns may diverge more in other years of the data, when the number of subprime originations differs more across measures.

The regressions in table 6.10 use HMDA higher-priced originations in 2005 per 100 housing units in 2000 as the dependent variable. Considerably more HMDA higher-priced loans than LP subprime loans were originated in 2005, so we expect the coefficients in table 6.10 to be, on average, 50 percent

TABLE 6.9 Incidence of LP Subprime Refinancings in MSA Zip Codes, 2005

	Subprime refinances for cash-out/100 units		Subprime refinances not for cash-out/100 units	
	(1)	(2)	(3)	(4)
Median income is in bottom quintile	0.85**	−0.088	0.063**	−0.042**
	(13.70)	(−1.34)	(8.93)	(−6.24)
Median income is in second quintile	0.44**	−0.20**	0.048**	−0.028**
	(9.59)	(−4.02)	(9.14)	(−4.80)
Median income is in third quintile	0.24**	−0.23**	0.039**	−0.019**
	(5.73)	(−5.26)	(8.19)	(−3.75)
Median income is in fourth quintile	0.032	−0.20**	0.027**	−0.0082*
	(0.95)	(−5.86)	(6.91)	(−1.93)
Percent with low VantageScore	−0.011**	0.017**	−0.0012*	0.0039**
	(−3.04)	(4.13)	(−1.80)	(9.20)
Percent with mid-VantageScore	0.15**	0.21**	0.016**	0.024**
	(15.43)	(22.34)	(15.07)	(21.15)
Percent of population black	0.035**	0.032**	0.0031**	0.0021**
	(16.85)	(16.12)	(14.75)	(10.01)
Percent of population Hispanic	0.023**	0.031**	0.0018**	0.0014**
	(12.32)	(14.45)	(10.75)	(6.57)
Percent ownership rate	0.021**	0.028**	0.0033**	0.0035**
	(15.38)	(22.32)	(19.61)	(26.91)
Percent unemployed	0.10**	—	0.0093**	—
	(6.87)	—	(5.60)	—
HPI appreciation in previous year	0.14**	—	−0.00012	—
	(34.69)	—	(−0.47)	—
Lagged permits in United States/no. units	0.19**	—	0.029**	—
	(14.45)	—	(19.59)	—
Constant	−3.87**	−3.61**	−0.31**	−0.42**
	(−21.66)	(−22.99)	(−18.18)	(−23.97)
MSA fixed effects	No	Yes	No	Yes
Observations	15,281	15,611	15,281	15,611
R-squared value	0.48	0.61	0.21	0.34
Mean of dependent variable	1.9		0.22	

NOTES: Dependent variable: LP subprime cash-out or non–cash-out refinances as a percent of units in 2000. Observations are zip codes. The sample is restricted to first-lien mortgages on properties located in an MSA that are not backed by manufactured housing or by buildings with more than four units. LP subprime denotes loans that were packaged into subprime mortgage pools. For the specifications without MSA fixed effects, we drop 330 zip codes with missing unemployment rate or permit data. LP = LoanPerformance; HPI = house price index; MSA = metropolitan statistical area; * = statistically significant at the .10 level; ** = statistically significant at the .05 level. T-statistics are shown in parentheses.

TABLE 6.10 Incidence of HMDA Higher-Priced Subprime Originations in MSA Zip Codes, 2005

	Subprime loans/100 units		Subprime purchases/100 units		Subprime refinances/100 units	
	(1)	(2)	(3)	(4)	(5)	(6)
Median income is in bottom quintile	1.59**	−0.67**	0.57**	−0.59**	1.02**	−0.09
	(9.83)	(−3.92)	(5.34)	(−5.22)	(15.54)	(−1.24)
Median income is in second quintile	0.88**	−0.72**	0.26**	−0.62**	0.62**	−0.11**
	(7.56)	(−5.44)	(3.35)	(−7.04)	(12.50)	(−1.99)
Median income is in third quintile	0.59**	−0.60**	0.18**	−0.47**	0.42**	−0.12**
	(5.14)	(−4.85)	(2.36)	(−5.65)	(8.63)	(−2.46)
Median income is in fourth quintile	0.18**	−0.44**	0.05	−0.30**	0.14**	−0.14**
	(2.09)	(−4.79)	(0.78)	(−4.89)	(3.68)	(−3.83)
Percent with low VantageScore	−0.023**	0.063**	−0.012**	0.035**	−0.012**	0.027**
	(−2.49)	(5.99)	(−2.03)	(5.11)	(−2.83)	(6.29)
Percent with mid-VantageScore	0.49**	0.64**	0.27**	0.37**	0.21**	0.27**
	(20.30)	(25.95)	(17.92)	(22.01)	(19.52)	(25.76)
Percent of population black	0.065**	0.043**	0.030**	0.016**	0.036**	0.028**
	(14.57)	(9.53)	(11.70)	(5.59)	(14.96)	(12.61)
Percent of population Hispanic	0.058**	0.066**	0.043**	0.041**	0.015**	0.025**
	(12.67)	(12.84)	(14.53)	(12.29)	(8.15)	(11.84)
Percent ownership rate	0.058**	0.082**	0.028**	0.043**	0.031**	0.040**
	(17.40)	(25.42)	(12.80)	(19.74)	(21.68)	(29.67)

(*continued*)

TABLE 6.10 (*continued*)

	Subprime loans/100 units		Subprime purchases/100 units		Subprime refinances/100 units	
	(1)	(2)	(3)	(4)	(5)	(6)
Percent unemployed	0.19**	—	0.11**	—	0.09**	—
	(5.17)	—	(4.38)	—	(5.56)	—
HPI appreciation in previous year	0.26**	—	0.14**	—	0.12**	—
	(25.27)	—	(20.53)	—	(29.76)	—
Lagged permits in United States/100 units	0.83**	—	0.56**	—	0.28**	—
	(20.47)	—	(19.59)	—	(18.14)	—
Constant	−10.13**	−10.32**	−5.60**	−5.72**	−4.57**	−4.65**
	(−22.49)	(−25.95)	(−18.70)	(−21.45)	(−24.93)	(−27.61)
MSA fixed effects	No	Yes	No	Yes	No	Yes
Observations	15,281	15,611	15,281	15,611	15,281	15,611
R-squared value	0.45	0.58	0.37	0.49	0.48	0.63
Mean of dependent variable	5.38		2.84		2.54	

NOTES: Dependent variable: higher-priced subprime loans as a percentage of total housing units in 2000. Observations are zip codes. The sample is restricted to first-lien mortgages on properties located in an MSA that are not backed by manufactured housing or by buildings with more than four units. Higher-priced are mortgages in the HMDA data with an APR of 3 or more percentage points above Treasury securities. For the specifications without MSA fixed effects, we drop 330 zip codes with missing unemployment rate or permit data. HPI = house price index; MSA = metropolitan statistical area; ** = statistically significant at the .05 level. T-statistics are shown in parentheses.

TABLE 6.11 Incidence of HMDA HUD Subprime Originations in MSA Zip Codes, 2005

	Subprime loans/100 units		Subprime purchases/100 units		Subprime refinances/100 units	
	(1)	(2)	(3)	(4)	(5)	(6)
Income in bottom quintile	1.39**	−0.53**	0.48**	−0.45**	0.92**	−0.08
	(10.67)	(−4.21)	(6.03)	(−6.02)	(15.26)	(−1.33)
Income in second quintile	0.77**	−0.63**	0.21**	−0.51**	0.56**	−0.11**
	(8.46)	(−6.35)	(3.87)	(−8.70)	(12.51)	(−2.41)
Income in third quintile	0.47**	−0.54**	0.11**	−0.41**	0.36**	−0.13**
	(5.52)	(−6.04)	(2.25)	(−7.69)	(8.54)	(−3.14)
Income in fourth quintile	0.15**	−0.40**	0.04	−0.25**	0.11**	−0.15**
	(2.21)	(−5.80)	(1.01)	(−6.07)	(3.30)	(−4.45)
Percent with low VantageScore	−0.04**	0.03**	−0.02**	0.02**	−0.02**	0.01**
	(−5.75)	(3.58)	(−5.42)	(3.42)	(−5.24)	(3.34)
Percent with mid-VantageScore	0.35**	0.49**	0.17**	0.25**	0.18**	0.24**
	(19.58)	(27.15)	(16.63)	(23.23)	(19.16)	(26.46)
Percent of population black	0.06**	0.04**	0.03**	0.02**	0.03**	0.03**
	(16.56)	(12.47)	(13.94)	(8.22)	(15.77)	(14.14)
Percent of population Hispanic	0.06**	0.06**	0.04**	0.04**	0.02**	0.03**
	(15.18)	(15.91)	(16.61)	(15.02)	(11.63)	(14.66)
Percent ownership rate	0.04**	0.06**	0.02**	0.03**	0.03**	0.03**
	(15.50)	(24.28)	(10.02)	(17.98)	(19.74)	(28.05)

(*continued*)

TABLE 6.11 (*continued*)

	Subprime loans/100 units		Subprime purchases/100 units		Subprime refinances/100 units	
	(1)	(2)	(3)	(4)	(5)	(6)
Percent unemployed	0.17**	—	0.09**	—	0.08**	—
	(5.44)	—	(4.81)	—	(5.50)	—
HPI appreciation in previous year	0.23**	—	0.10**	—	0.13**	—
	(28.97)	—	(22.23)	—	(34.05)	—
Lagged permits in United States/100 units	0.52**	—	0.31**	—	0.21**	—
	(18.11)	—	(17.74)	—	(16.52)	—
Constant	−7.37**	−7.71**	−3.45**	−3.76**	−3.92**	−3.95**
	(−21.07)	(−25.89)	(−16.73)	(−21.40)	(−23.46)	(−26.84)
MSA fixed effects	No	Yes	No	Yes	No	Yes
Observations	15,281	15,611	15,281	15,611	15,281	15,611
R-squared value	0.48	0.62	0.39	0.54	0.50	0.65
Mean of dependent variable	3.88		1.72		2.15	

NOTES: Dependent variable: HUD subprime loans as a percentage of total housing units in 2000. Observations are zip codes. The sample is restricted to first-lien mortgages on properties located in an MSA that are not backed by manufactured housing or by buildings with more than four units. HMDA HUD subprime are loans on the HMDA data originated by lenders on the HUD subprime lender list. For the specifications without MSA fixed effects, we drop 330 zip codes with missing unemployment rate or permit data. HPI = house price index; MSA = metropolitan statistical area; ** = statistically significant at the .05 level. T-statistics are shown in parentheses.

larger than those in table 6.8. Indeed, most of the coefficients are somewhat larger in the first column of table 6.10 than in that column in table 6.8. Smaller differences persist. For example, higher-priced loans are slightly overrepresented over the securitized subprime loans in the middle credit score category, but are relatively less prevalent in zip codes with higher black and Hispanic populations. This latter result suggests that studies based on the LP data might show a larger incidence of subprime lending in minority neighborhoods than studies based on the higher-priced data. Higher-priced loans are also somewhat less represented in locations with higher unemployment rates and higher past home price appreciation.

We show regressions with the HUD measure of subprime lenders in table 6.11. The mean number of loans originated by HUD subprime lenders is 3.93, about 8 percent more overall than in LP. Thus, coefficients in table 6.11 would be only slightly larger than those in table 6.8 if the measures of lending were closely comparable. In the first column, the only appreciable differences are that HUD subprime lenders seem more likely to lend in lower-income zip codes and less likely to lend in the worst credit score districts. Given the correlation between these two measures, such offsetting changes may well be due to random variation. Coefficients on other variables are quite similar.

Regressions with LP Originations in Relation to All HMDA Originations

Finally, we consider how our results would differ if we normalized LP subprime originations by all HMDA originations in 2005 (table 6.12).[11] The demographic factors associated with subprime originations are consistent with the earlier regressions: zip codes with more residents who are low-income, minorities, owner-occupants, or unemployed, or who have poor credit, have more subprime originations. Adjusting for the fact that subprime mortgages are about 7.5 times more prevalent as a share of loan originations than of housing units, the magnitudes of the coefficients are about the same as in earlier regressions.

However, home price appreciation and construction permits play a small role in these regressions. A one standard deviation increase in home price appreciation is associated with a 5 percent increase in subprime originations as a

11. We get similar results when we use HMDA higher-priced originations relative to all HMDA originations and HUD lender originations relative to all HMDA originations as the dependent variables in these regressions.

TABLE 6.12 Incidence of LP Subprime Originations in MSA Zip Codes, 2005

	Subprime loans/ 100 total loans		Subprime purchases/ 100 total loans		Subprime refinances/ 100 total loans	
	(1)	(2)	(3)	(4)	(5)	(6)
Median income is in bottom quintile	5.64**	3.16**	0.88**	0.20	4.75**	2.96**
	(19.29)	(10.81)	(5.49)	(1.21)	(25.62)	(16.17)
Median income is in second quintile	3.40**	1.60**	0.41**	−0.27**	3.00**	1.87**
	(15.70)	(6.88)	(3.50)	(−2.00)	(20.59)	(12.86)
Median income is in third quintile	2.38**	1.03**	0.38**	−0.11	2.00**	1.15**
	(12.74)	(5.42)	(3.76)	(−1.05)	(16.25)	(9.73)
Median income is in fourth quintile	1.36**	0.62**	0.39**	0.09	0.96**	0.53**
	(8.73)	(4.15)	(4.52)	(1.06)	(9.41)	(5.67)
Percent with low VantageScore	0.44**	0.51**	0.26**	0.29**	0.18**	0.22**
	(25.78)	(27.17)	(24.37)	(24.18)	(18.66)	(21.00)
Percent with mid-VantageScore	−0.09**	0.14**	−0.07**	0.02	−0.02	0.12**
	(−1.98)	(3.38)	(−2.69)	(0.82)	(−0.62)	(4.93)
Percent of population black	0.18**	0.20**	0.05**	0.05**	0.13**	0.15**
	(18.75)	(21.62)	(9.37)	(8.36)	(22.94)	(29.43)

Percent of population Hispanic	0.09**	0.08**	0.06**	0.02**	0.04**	0.06**
	(14.77)	(11.67)	(14.78)	(6.15)	(9.59)	(11.92)
Percent ownership rate	0.11**	0.12**	0.04**	0.04**	0.07**	0.08**
	(19.96)	(23.19)	(11.38)	(14.02)	(20.88)	(23.52)
Percent unemployed	0.67**	—	0.23**	—	0.45**	—
	(9.17)	—	(5.57)	—	(10.26)	—
HPI appreciation in previous year	0.21**	—	−0.01	—	0.21**	—
	(17.55)	—	(−1.01)	—	(26.44)	—
Lagged permits in United States/100 units	0.14**	—	0.28**	—	−0.14**	—
	(2.78)	—	(10.22)	—	(−4.65)	—
Constant	−9.49**	−8.252**	−3.53**	−3.521**	−5.96**	−4.730**
	(−14.28)	(−14.68)	(−9.32)	(−10.44)	(−14.39)	(−13.28)
MSA fixed effects	No	Yes	No	Yes	No	Yes
Observations	15,281	15,611	15,281	15,611	15,281	15,611
R-squared value	0.37	0.43	0.35	0.42	0.33	0.40
Mean of dependent variable	27.95		10.61		17.33	

NOTES: Dependent variable: LP subprime originations as a percent of all HMDA originations in 2005. Observations are zip codes. The sample is restricted to first-lien mortgages on properties located in an MSA that are not backed by manufactured housing or by buildings with more than four units. LP subprime denotes loans that were packaged into subprime mortgage pools. For the specifications without MSA fixed effects, we drop 330 zip codes with missing unemployment rate or permit data. HPI = house price index; MSA = metropolitan statistical area; ** = statistically significant at the .05 level. T-statistics are shown in parentheses.

share of all originations, as opposed to a 39 percent increase as a share of housing units. Likewise, a one standard deviation increase in housing permits is associated with a less than 1 percent increase in subprime originations relative to all originations, as opposed to a 21 percent increase relative to housing units. When we break out purchases and refinances separately, home price appreciation is positively associated only with refinances, whereas permits are positively associated only with purchase mortgages. We observed a similar but less dramatic pattern in the housing units specifications.

These regression results are consistent with our earlier conclusion, based on tables 6.3–6.6, that subprime originations as a share of housing units appear to be more prominent in hot housing markets, whereas subprime originations as a share of all originations appear to be more prominent in depressed housing markets. In areas with hot housing markets, both prime and subprime originations may be elevated, and so subprime mortgages are high in relation to housing units but not necessarily in relation to originations. However, subprime originations may also appear high in relation to housing units in hot housing markets because our 2000 measure of housing units understates, by a greater degree, the true 2005 level.

Conclusions and Future Research

We explore a number of thought-provoking patterns in the geographic dispersion of subprime lending. Subprime originations appear to be heavily concentrated in fast-growing parts of the country with considerable new construction, such as Florida, California, Nevada, and the Washington, DC area. These locations saw home prices rise at faster-than-average rates relative to their own history and relative to the rest of the country. However, this link between construction, home prices, and subprime lending is not universal, as other markets with high home price growth, such as the Northeast, did not see especially high rates of subprime usage. Subprime loans were also heavily concentrated in zip codes with more residents in the moderate credit score category and more black and Hispanic residents. Areas with lower income and higher unemployment had more subprime lending, but these associations are smaller in magnitude.

The measure that provides the most reliable estimate of subprime originations appears to differ over time. From the 1990s through the early 2000s, most subprime loans were originated by subprime specialists, and fewer of these loans were securitized. For these years, the HUD measure appears to gauge subprime

originations most reliably. Later, more subprime loans were originated by lenders that traditionally operated in the prime market, and more of these loans were securitized. For this period, the LP data may be the best choice. At the moment, both the HUD lender and the LP measures are likely to miss large shares of subprime originations—the LP data because securitization of subprime loans has dried up, and the HUD measure because many subprime specialists have gone out of business. For the time being, the HMDA higher-priced measure may provide the most comprehensive coverage.

Our results provide only hints of answers to many of the most important questions about the subprime crisis, leaving much room for future research. We find that subprime originations are more prevalent in black and Hispanic zip codes, but we do not, at this point, have data that allow us to confidently determine why that occurred. Some previous work has suggested that minorities have been underserved by mortgage markets in the past and are more likely to be credit constrained (Charles and Hurst, 2002; Gabriel and Rosenthal, 2005; Ladd, 1998). To the extent that subprime loans provided credit to underserved areas, either to obtain cash back on homes or to purchase new homes, such credit may have been a positive development for some borrowers. However, it is also possible that subprime loans were substituted for conventional loans, leaving some minority borrowers with higher-cost credit than they might have otherwise received. Disentangling these two effects is an important task for future studies.

The link between subprime lending and new construction and home price appreciation is also intriguing. Although we do not make any causal claim in this chapter, Mian and Sufi (2008) suggest that greater securitized subprime usage leads to home price appreciation. Mayer and Sinai (2007) find a correlation between subprime lending and higher price-to-rent ratios. However, neither analysis fully explains the puzzle of some MSAs having high subprime concentrations, such as Las Vegas and Miami, where both new construction and home prices rose rapidly, while other MSAs with high subprime concentrations, such as Houston and Atlanta, saw high construction but not high rates of home price appreciation.

Finally, unlike previous studies, we focus on subprime originations as a share of housing units, not of total mortgage originations. Economically stressed states such as Michigan and Ohio had low rates of subprime lending in relation to the number of housing units, but high rates in relation to the number of originations. This finding suggests that the relatively small volume of lending that occurred in these states was disproportionately subprime. It is also consistent with our regression result that subprime originations were more

prevalent in areas with higher unemployment rates. However, it does not resolve the question of whether subprime mortgages provided valuable credit to credit-constrained households in these areas or actually amplified the existing economic stress.

Appendix: Merging Census Tract and Zip Code Data

This appendix describes how we merged tract-level data from HMDA and the census to zip code–level data from LP.

We based the merge on a zip code tabulation area (ZCTA) to census tract crosswalk from the Missouri Census Data Center (http://mcdc2.missouri.edu/websas/geocorr2k.html). ZCTAs are generalized representations of zip codes developed by the U.S. Bureau of the Census to facilitate census tract–zip code matches. Each ZCTA is composed of the census blocks (subunits of census tracts) that correspond to a given zip code. If a census block spans zip codes, some residents of that block may be assigned to the wrong zip code. The file also excludes zip codes created after January 2000 as well as changes made to zip code boundaries after that date. We use the ZCTA tabulation designed for the 2000 census.

To carry out this merge, we aggregated the relevant HMDA variables to the census tract level, and then merged on the ZCTA definitions for each tract. If a census tract corresponded to more than one ZCTA, we created one observation for each census tract–ZCTA pair. For each observation, we also included a weight, provided by the Missouri Census Data Center, that indicates what share of households in a given tract lived in each ZCTA. Using this weight, we aggregated the census tracts to the ZCTA level, and merged on the zip code–level LP data by the ZCTA variable. Because HMDA data are comprehensive only for counties within MSAs, we dropped zip codes that straddled MSA lines or lay entirely outside of an MSA.

We calculated the census-tract-level variables that are percentage variables (such as the percent of residents with low VantageScores) at the zip code level once we created the final data set. That is, we aggregated the number of residents with low VantageScores and the number of total residents to the zip code level, and then calculated the share. We believe that this procedure is more robust to outliers than calculating these percentage variables at the census tract level and then aggregating to the zip code level.

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Commentary

C. F. Sirmans and Kerry D. Vandell

It is a basic tenet of policy analysis that in order to prescribe an appropriate set of policies responsive to an identified policy issue, one must first be able to define the issue. Such has been the problem with analysis of the recent credit crisis that has gripped the capital markets in the United States and spread internationally. "Subprime" mortgages frequently have been blamed in the press, and have pervaded public consciousness, as being the prime cause of the recent rapid run-up in house prices, as well as the ensuing "bust" (already in excess of 30 percent in some jurisdictions) and a spike in defaults.

Chris Mayer and Karen Pence make one of the first serious attempts at trying to address a major omission in the search for a policy solution to this crisis: not only do we not know where subprime loans have been made and who has gotten them or why, we do not even know what a subprime loan is. Mayer and Pence consider several alternatives and settle on the Department of Housing and Urban Development's (HUD's) survey of loans made by subprime lenders and reported in the Home Mortgage Disclosure Act (HMDA) as the most complete estimate of the population of subprime loans over the period of the rapid spread of alternative private mortgage products—from the late 1990s to 2007. They recognize that this may include some loans that are actually prime, but made by subprime lenders, and that it may exclude some subprime loans made by prime lenders. Nonetheless, they consider it to be the best estimate available, representing about 12 percent of total HMDA loans made between 1998 and 2005, with slightly more used for refinancing (about 13 percent) than for purchase (about 10 percent). They decide to use the metric of subprime loans per 100 housing units, rather than subprime loans per total loans made, as the basis for measuring subprime origination density, because they assert that the availability of subprime loans may affect the decision to take out a loan as well as the decision of what type of loan to choose. Only first-lien mortgages that originated in zip codes within metropolitan statistical areas (MSAs) in the 48 contiguous states and Washington, DC are included in the sample, excluding manufactured home loans and those written on properties with five or more units. Loans below $25,000 are also dropped because they are likely junior liens that have been miscoded.

Next, the authors turn to the geographic dispersion of subprime lending. They find concentrations especially pronounced in the fastest-growing MSAs in the West and South, with fewer in the Midwest and Northeast, with the

exceptions of certain cities in these areas such as Washington, DC, Chicago, and Providence. The exurbs and fastest-growing affordable first-time home-buyer communities on the fringes of these metropolitan areas—including Riverside County and the fringes of the San Francisco Bay Area, as well as suburban areas of other cities, such as Boston—saw the most use of subprime mortgages. Only in a few central cities, such as Atlanta, Houston, and Chicago, was subprime lending very apparent. Stagnant industrial areas in the Midwest, such as Cleveland and Detroit, saw little concentration of subprime lending (based on the number of housing units), even though they saw high rates of default on such loans. Clearly, there was a disconnect between viewing subprime lending on the basis of total housing units versus the number of totals loans made.

First, we comment on the definitional aspects of Mayer and Pence's analysis, its scope, and their basic observations of the volume, purpose, and location of lending according to their definitions. Then we examine their regression analysis, which seeks to isolate various correlates with subprime lending activity.

Although we applaud their rigorous definitional criteria, empirical analysis, and interpretation of the results, we have two primary concerns with the Mayer-Pence analysis as it stands. First, their primary reliance on the number of housing units as the normalization standard for subprime presence is flawed in a couple of ways, to a degree that renders its selection questionable.

The first of these flaws is the fact that the denominator is the number of housing units, not the number of owner-occupied housing units. This clearly biases the results toward underestimation of subprime impact in largely renter-occupied areas, as rental stock would not generally be considered relevant for consideration, hence should be excluded from the analysis.[1]

The second flaw is already recognized by the authors: the use of a per-housing-unit denominator tends to bias the apparent density of subprime loan activity upward in high-growth areas with high house price appreciation, as compared with a per-loan originated denominator.

To decide on the proper basis for normalizing subprime loan origination activity, one must recognize that the ultimate question is the extent to which

1. There are two conditions that would cause an exception to this statement. The first is that, at the margin, subprime lending could encourage rental stock to become owner-occupied. However, most of the evidence points to the fact that the preponderance of the new home ownership in the subprime market was generated through new construction and not conversion of an existing unit from rental occupancy to ownership. The second condition is that investor loans could be intended to make units available for rental occupancy as well as home ownership through "flipping." However, it is not clear that the HUD data from subprime lenders includes investor (i.e., non–owner-occupant) loans. Thus, the preponderance of evidence suggests that Mayer and Pence should have excluded the existing rental stock from the per-housing-unit denominator.

the availability of subprime lending made a difference in the market. This difference could reference any of several conditions: the level of home ownership, price changes (up or down), default rates, and so forth. Thus, the appropriate denominator would depend on the dimension of housing market impact in which policy makers are interested.

In the case of changes in home ownership and house prices, we would argue that the most appropriate denominator is per loan origination for the purpose of purchase and owner occupancy (for home ownership) or purchase and either owner or renter occupancy (for house prices). Changes in the level of home ownership and house prices come exclusively from actual sales that establish comparables for use in estimating future house price levels. Subprime lending for the purpose of cash-out or lowering the interest rate or monthly payment provides greater consumption and investment potential to the household but does not directly influence house prices or the level of home ownership. Default rates are a somewhat different matter, however, in that the contemporaneous loan-to-value ratio (LTV) is the dominant variable, and this could be exacerbated through refinancing as well as purchase. Thus, if one is interested in addressing the causes of increased default rates, the most appropriate denominator may be per total loan origination for all purposes.

The second primary concern has to do with Mayer and Pence's narrow (if carefully drawn) perception of "subprime" as the appropriate indicator of credit newly available to households that would otherwise have been excluded from (or forced to pay significantly more for) it. As indicated before, they confine their sample to HUD-reported first-lien mortgages only. Thus, their sample would omit many of the other novel private-market instruments introduced during the early 2000s that may not be subprime in the sense of making credit available to lower-credit-quality borrowers, but that may still affect the availability or cost of credit otherwise unavailable to borrowers for the purpose of purchase or refinancing. These include such novelties as Alt-As (sometimes called no-docs or low-docs), option-ARMs, teaser-rate ARMs, interest-only (IO) mortgages, 2-28s, high loan-to-value ratio loans (HLTVs, sometimes called 125s), and others. Furthermore, by considering only first-lien mortgages, they miss another set of loan structures that make use of structured finance vehicles, including second and (sometimes) third liens. An example is the 80-10-10 arrangement, which substituted subordinate liens for private mortgage insurance (PMI) and could even require no down payment. To examine fully the anatomy of the impact of the new array of alternative mortgage designs on the housing and mortgage markets, one must move beyond the subprime, however the term is defined, to explore in much greater detail the full spectrum of products available on the market.

Next, we turn our attention to the regression results reported in the chapter. What variables are correlated with the higher subprime loan shares? What are the implications of observed variations in subprime lending? Does the analysis reveal potential benefits (or costs) of subprime lending that might have policy implications?

To examine these questions, the authors estimate a series of cross-sectional regression models to examine the correlation between various measures of subprime lending at the MSA zip code level (a total sample of about 15,000 geographic areas) and a set of independent variables representing various characteristics of the zip codes. Three measures of subprime lending are used as the dependent variable: the number of LoanPerformance subprime mortgages, HMDA high-cost loans, and mortgages by HUD-reported subprime loans in HMDA per 100 housing units based on the 2000 census. In addition, analysis is done on the pooled sample as well as on disaggregated samples consisting of purchase loans and refinancings. As a further robustness check, Mayer and Pence estimate the regressions with and without MSA fixed effects. The results are not qualitatively different across purpose of the loan or with the fixed effects.

The independent variables used include the percentage minority, a measure of credit score, the level of unemployment, the amount of new construction, and house price appreciation trends. The summary statistics for their sample, reported in table 6.7, appear to be reasonable. As might be expected, zip codes exhibit skewness in the percentage minority. The other variables are consistent with national averages.

What do we learn from their regressions? First, the proportion of subprime mortgages goes up with increases in the percentage minority. Second, the proportion of subprime mortgages is higher in zip codes with mid-level credit scores. Third, zip codes in the bottom of the income distribution have the highest proportion of subprime mortgages. Fourth, higher unemployment rates result in a greater proportion of subprime mortgages. Fifth, zip codes with high (past) house price appreciation have a greater proportion of subprime mortgages. Sixth, higher proportions of subprime loans are in zip codes with higher construction activity.

What are some implications of their analysis for policy decisions related to the subprime "problem"? As Mayer and Pence note, the positive correlation with the unemployment rate suggests that subprime loans are an additional source of credit when economic conditions turn down and thus may offer some advantages in terms of stabilizing declining housing markets. The positive correlation with construction suggests that subprime lending probably contributed to the housing boom. It is interesting to note that potential policies

leading to higher credit scores would significantly reduce the proportion of subprime mortgages. Mayer and Pence's results also suggest that policies that make it more difficult to originate subprime mortgages may limit the effects these mortgages could have in stabilizing declining local markets.

Clearly, understanding the what, who, and where aspects of the subprime mortgage market are important. Subprime mortgages represent a critical segment of the overall housing finance system and serve a major role in making home ownership, and its accompanying social benefits, possible for underserved households. Policies about subprime underwriting will have substantial benefits if implemented correctly and potentially harmful effects if not carefully analyzed. In spite of our suggestions for refinement of their analysis, however, we commend Chris Mayer and Karen Spence for their careful initiation of an important line of investigation that can have significant implications for mortgage credit policy.