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Measuring the Effect of Subprime Lending on Neighborhood Foreclosures: Evidence from Chicago

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Since the early 1990s, there has been a very large growth in mortgages made by so-called subprime lenders, which specialize in lending to borrowers with credit history problems. One reason for concern about this trend is that it has been associated with a large and simultaneous rise in foreclosures, which can entail significant costs not just for those directly affected but also for surrounding neighborhoods and larger communities. This study uses multivariate estimations to quantify the impact of subprime lending on neighborhood foreclosure levels. After controlling for neighborhood demographics and economic conditions, the authors find that subprime loans lead to foreclosures at far greater rates than do prime loans. Moreover, subprime lending appears to account for a substantial share of foreclosure activity in high-foreclosure neighborhoods.

Keywords: *mortgage lending; foreclosures; predatory lending; subprime lending; lending discrimination*

Since the early 1990s, there has been a very large growth in mortgage loans made by firms called *subprime lenders*, which specialize in lending to borrowers with credit history problems (U.S. Department of the Treasury and U.S. Department of Housing and Urban Development 2000). Many fair lending advocates and policy makers have expressed concerns about this trend. There have been at least three sources of concern. First, because the market for home loans is significantly segmented by race, with minority neighborhoods served excessively by subprime lenders, homeowners in minority communities may be effectively steered toward higher-cost products (Calem,

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Gillen, and Wachter, forthcoming; Immergluck 2004; National Committee Reinvestment Coalition [NCRC] 2003). If minority communities are targets of higher-cost lenders and receive little attention from prime lenders, the odds of minority borrowers with good credit histories receiving higher-cost loans may be higher than that of White borrowers with good credit. A second concern—and a key component of recent policy debates—has to do with the rise in abusive or predatory practices that have been associated with the subprime industry (U.S. Department of the Treasury and U.S. Department of Housing and Urban Development 2000). A third reason to be concerned about the growth of subprime lending is that the sector has been associated with a simultaneous rise in foreclosures. Moreover, the spatial concentration of subprime lending appears to have led to concentrations of foreclosures in minority and modest-income neighborhoods, which in turn can have negative effects on their stability and development prospects.

This article primarily focuses on the third concern. In particular, we seek to measure the impact of subprime lending on neighborhood foreclosures. Although other studies have presented simple, comparative change data to suggest a link between subprime lending and foreclosures, to our knowledge no multivariate studies have been published to date. We seek to inform the policy debates on subprime and predatory lending by providing a better quantitative sense of the impact of subprime loans on foreclosure levels. To this point, much of the research receiving the most attention in predatory lending policy debates has focused either on issues of whether subprime loans are fairly priced and any associated steering between prime and subprime products (Phillips-Patrick et al. 2000; Calem, Gillen, and Wachter, forthcoming; Pennington-Cross, Yezer, and Nichols 2000), the extent of predatory practices (Stein and Libby 2001; Stock 2001), or the effects of antipredatory lending laws on credit availability (Quercia, Stegman, and Davis 2003). The latter research in particular has focused on the degree to which regulation might restrict access to credit, if at all, while generally not taking into account the cost side of the status quo. Less research has been helpful in quantifying the magnitude of the negative effects of subprime lending, in its present state, on families and neighborhoods. To fully weigh the benefits and costs of policy alternatives, more information is needed on the cost side of an essentially deregulationist approach. One important aspect of the costs of subprime lending is the impact on neighborhood foreclosure levels.

Defaults and especially foreclosures can entail significant costs and hardships not just for the families most directly affected but also for surrounding neighborhoods and even for larger communities. McCarthy, VanZandt, and Rohe (2000) describe how foreclosures can involve losing not only accumu-

lated home equity and the costs associated with acquiring the home but also access to stable, decent housing. Moreover, foreclosures can damage credit ratings, hurting the owners' prospects not only in credit markets but also in labor and insurance markets and in the market for rental housing. Moreno (1995) estimated average losses to a foreclosed family of $7,200. In addition to the direct costs in dealing with abandoned properties and the public safety costs associated with them, there are potential spillovers on the values of, and tax receipts from, nearby properties. These spillover effects can be significant. Simons, Quercia, and Maric (1998) estimated that average sales prices fell $788 for each 1% increase in tax delinquencies within a one- to two-block area of a residence. Cities, counties, and school districts lose tax revenue from abandoned homes. In examining Federal Housing Administration foreclosures, for example, Moreno (1995) estimated average city costs of $27,000 and neighborhood costs of $10,000. Moreover, these figures do not account for all of the social and psychic costs of foreclosures, either to the family or the community.

THE GROWTH AND SPATIAL CONCENTRATION OF SUBPRIME LENDING

The explanation for the growth and spatial concentration of subprime lending involves the confluence and interaction of a number of economic and social conditions and policy changes. One major structural factor in the growth of subprime activity has been the increasingly specialized and segmented nature of financial services markets. Financial institutions have sought to market credit products more aggressively to consumer markets and to maximize profits through price discrimination. Borrowers who are willing to pay more, due perhaps to their inferior understanding of financial products, desperate financial situations, or other conditions, are identified and offered higher costs and less advantageous products. Borrowers who are expected to shop more for financial products and are actively courted by mainstream financial institutions are offered lower prices and better terms. This trend creates a cross-subsidization, where borrowers in financial difficulty are generally targeted by higher-cost providers, and the strong profits in those sectors may compensate the more competitively priced business of the financial conglomerate.

The dual market in mortgage credit is also facilitated by a system of dual consumer regulation. Banks and thrifts are subject to the Community Reinvestment Act, fair lending, and consumer compliance regulation implemented by a cadre of thousands of bank examiners in four federal bank regu-

latory agencies. But the finance companies that tend to dominate the subprime market generally undergo no regular examinations by federal regulators, and state regulators generally have much less capacity than their federal counterparts. The Federal Trade Commission has some minimal resources to address lenders, but the states are the principal source of regulatory oversight.

Another factor in the growth and concentration of subprime lending has been the growth in the elderly population, including many relatively isolated homeowners—especially in minority neighborhoods—who are generally unfamiliar with mortgage products. Seniors in minority neighborhoods are often especially isolated. Many older Blacks purchased their homes in an era when financial institutions, especially banks, were not at all interested in making loans to them. Elderly homeowners tend to have substantial equity in their homes, making them ideal targets for lenders wishing to extract large amounts of fees via "equity stripping" practices. In 1993, 78% of U.S. homeowners ages sixty-five to seventy-five had no housing debt, and 90% of those older than seventy-five had no mortgage debt (American Association of Retired Persons 1997). Walters and Hermanson (2001) found that mortgage borrowers sixty-five years or older were three times more likely to hold a subprime mortgage than borrowers less than thirty-five years old.

Changes in the supply and the delivery of credit have been important factors in the growth and segmentation of the subprime industry. Outstanding asset-backed securities tripled from $33 billion in 1995 to $90 billion 1997 and grew to $286 billion by 2002, for an annual growth rate of 36% (Immergluck 2004). Much of the lending funded by these securities is subprime in nature (Canner, Durkin, and Luckett 1998). These securities can be broken out into higher- and lower-risk segments, which further aids the ability of high-risk lenders to penetrate various markets and enables lenders to tolerate higher default and foreclosure rates. Moreover, although a relatively small portion of subprime loans have been directly purchased by Fannie Mae or Freddie Mac, the large government-sponsored secondary market firms, these companies—especially Freddie Mac—have played a significant role in facilitating the securitization process by offering credit enhancements or what is called "wrapping" the securities for easier financing and sale (Skillern 2000).

Another critical factor in the explosion of subprime lending has been the growth in the number of independent mortgage brokers during the last ten to twenty years. From 1991 to 1998, the number of brokers grew at an annual rate of 14% (Kim-Sung and Hermanson 2003). In 2000, 30,000 mortgage brokerage firms employed an estimated 240,000 workers and accounted for approximately 55% of all mortgage originations. Moreover, broker origi-

nated loans are twice as likely to be subprime than lender-originated loans. Among older borrowers, brokers are also more likely to lend to divorced, female, and non-White borrowers. Of older non-White borrowers, 62% received loans via brokers, whereas only 38% of older White borrowers did.

Brokers are heavily associated with aggressive "push marketing." Kim-Sung and Hermanson (2003) found that 56% of older borrowers with brokered loans reported that contact was initiated by the broker, whereas other older borrowers reported that lenders initiated contact only 24% of the time. Borrowers with brokered loans were generally less satisfied with their loans and were less likely to feel that they received honest information.

Increasing market segmentation has been facilitated by advances in information technology that have enabled banks and prime mortgage lenders to mine sophisticated databases in an effort to identify higher-income segments of the market (Gale 2001; Immergluck 2004). This plays out by race and geography, especially for banks, which continue to expand branch operations in White, affluent neighborhoods (Avery et al. 1997). As banks and prime mortgage firms compete more furiously for more affluent customers, they leave the minority and lower-income neighborhoods ripe for penetration by subprime lenders. And because the marketing and sales efforts of prime lenders are often tied to branch locations and mail solicitations, segmentation takes on a particularly geographic nature.

The result of these and other forces is that the subprime market is profoundly segmented across race and space. Moreover, the segmentation does not appear to be substantially accounted for by credit history. In an analysis of subprime lending in Chicago and Philadelphia, Calem, Gillen, and Wachter (forthcoming) found that after controlling for education, credit score, income, and housing stock characteristics, Black neighborhoods still had much higher levels of subprime lending than White neighborhoods. For refinance loans, an all-Black neighborhood was expected to have a subprime share that was 24 percentage points higher than an otherwise equivalent White neighborhood, even after controlling for the credit history of neighborhood residents. A larger study of ten metropolitan areas found similar results (NCRC 2003). Even after controlling for housing turnover, age of housing stock, median income, percentage of residents age sixty-five and older, and the percent of residents with high-risk credit scores, the percentage of residents who were Black was a consistently strong determinant of subprime lending activity.

This dual market can create a sense of futility among minority homeowners in considering banks and other prime lenders as potential sources of mortgage credit. Even among borrowers who do have impaired credit, the subprime market does not appear to be functioning in a way that serves the

interests of borrowers well. In Fannie Mae's 2001 National Housing Survey, only 34% of credit-impaired respondents were confident that they got the lowest cost mortgage available, as compared to 68% of all homeowners surveyed (Fannie Mae 2001). Moreover, more subprime than prime respondents reported not knowing anything about their credit rating. With such inefficiencies, high default and foreclosure rates may be expected, even higher than those that might be explained by the average weaker credit histories among borrowers. Moreover, the spatial concentration of subprime lending is likely to result in spatial concentrations of high foreclosure levels.

SUBPRIME LOANS AND FORECLOSURES

A number of studies show high foreclosure rates among subprime loans. Subprime loans appear to lead to delinquency and foreclosure at relatively high rates, especially within the higher-risk segment of the industry. Subprime lenders may make "A–," "B," "C," or some lower grade of loan, signifying higher risk. (Prime loans are considered "A" grade.) A late 1990s industry survey of 27 larger subprime lenders indicated that ninety-day delinquency rates for C- and D-grade loans were 10% and 22%, respectively, compared to a rate of 0.25% for prime refinance loans (Phillips-Patrick et al. 2000). Even FHA loans, which have been persistently tied to foreclosure and property abandonment problems in minority communities, had ninety-day delinquency rates of less than 2% for refinance loans during the same period. The foreclosure rate for all subprime loans in this sample (including the 55% that were A– grade) was more than four times the FHA rate. The foreclosure rate for C and D loans is expected to be much higher. In this voluntary survey, almost 20% of subprime loans were C and D grade. However, the source of these data appears to be biased toward substantially underepresenting higher-risk loans. Even more concerning is the fact that problems among subprime loans worsened considerably beginning in 2000 (Crews-Cutts and Van Order 2003). Rates of serious delinquency for subprime loans (of all grades) increased from less than 5% in early 2000 to more than 8% by late 2001. Prime loan delinquencies were almost constant during this period, at around 1%, and FHA delinquencies rose much more slowly from about 3.5% to about 4.5%.

Because subprime lending—especially the higher-risk segments known as B, C or D lending—is highly concentrated in certain types of neighborhoods, these neighborhoods are likely to bear a disproportionate share of subprime foreclosures. Foreclosures—particularly those leading to abandonment and blight—can have negative spillover effects, or externalities,

that can be a key source of market failure. Because the negative social costs of these spatially concentrated foreclosures (abandonment, blight, and lower neighborhood property values) are not captured in market transactions, the high foreclosure numbers suggest that lending levels may be excessive even from an efficiency perspective. Moreover, foreclosures in struggling, low- or moderate-income, and minority neighborhoods might be expected to have more negative effects than those in middle- and upper-income areas. In the latter case, the foreclosures are less likely to lead to abandoned buildings and neighborhood blight.

SUBPRIME LENDING AND FORECLOSURES IN URBAN AREAS

At least eight recent studies have identified some relationship between subprime lending and foreclosures at the neighborhood level (Burnett, Herbert, and Kaul 2002; Collins 2003; Gruenstein and Herbert 2000a, 2000b; National Training and Information Center 1999; Newman and Wyly 2004; U.S. Department of Housing and Urban Development 2000; Zimmerman, Wyly, and Botein 2002). In Baltimore, for example, while the subprime share of mortgages in the city was 21% in 1998 (presumably higher than in previous years), 45% of foreclosure petitions in that year were tied to subprime loans (U.S. Department of Housing and Urban Development 2000). Subprime foreclosures accounted for 57% of all foreclosures in Black Baltimore neighborhoods. In Atlanta, Abt and Associates found that foreclosures attributed to subprime lenders accounted for 36% of all foreclosures in predominantly minority neighborhoods in 1999, whereas their share of loan originations was between 26% and 31% in the preceding three years (Gruenstein and Herbert 2000a). In Essex County, New Jersey, researchers found that the percentage of foreclosures attributed to subprime lenders increased from 19% in 1995 to 30% in 2000, although they also admitted that these figures substantially underestimated the subprime share of foreclosures (Zimmerman, Wyly, and Botein 2002). By mapping foreclosures, they were also able to identify that foreclosures were disproportionately concentrated in predominantly Black neighborhoods.

These studies generally tend to underestimate the proportion of foreclosures due to subprime originators and overestimate the proportion due to prime originators. Many subprime loans are sold to financial institutions identified by the U.S. Department of Housing and Urban Development as "prime" lenders or are held in trusts at prime lending institutions (usually banks). Thus, foreclosures of subprime loans sold to prime lenders or trusts would list only the prime lender who currently holds the loan, not the originating subprime lender. The reverse does not tend to be the case. That is,

subprime lenders do not often buy loans from prime lenders and generally do not have trust capacity.

In the previous studies of Chicago foreclosures, the authors were plagued by the same problem but did obtain pricing data on a portion of the foreclosures. The National Training and Information Center (1999) found that foreclosures on loans with interest rates above comparable treasury rates plus four percentage points (clearly subprime-priced loans) increased by 500% from 1993 to 1998. Collins (2003) found that loans by subprime lenders increased by 32% from 1996 to 2001, while foreclosures on loans priced 300 basis points or higher increased by 260% during the same period.

A BETTER MEASURE OF THE RELATIONSHIP BETWEEN SUBPRIME LENDING AND FORECLOSURES

Subprime loans are expected to entail at least marginally higher risks than prime loans, so somewhat higher foreclosure rates are expected. At the heart of many policy debates regarding subprime and predatory lending, however, is a question of how much additional risk should be tolerated. To inform this debate, better measures are needed of the effect that subprime loans of various types (home purchase vs. refinance, for example) have on neighborhood foreclosure levels. To do this, we acquired computerized foreclosure data for the five-county metropolitan Chicago area, geocoded it to the Census tract level, and compared it to lending data in the same area.[1]

We geocoded and analyzed foreclosure data from 1995 and 2002. Rather than completed foreclosures, these data represent foreclosure starts.[2] In many ways, this is a superior indicator of homeowner distress than completed foreclosures. Moreover, because property may be lost through offering deed in lieu of foreclosure, the number of completed foreclosures may underestimate the loss of homes due to loan distress. We also aggregated Home Mortgage Disclosure Act (HMDA) data in various ways for the years 1996 through 2001. Most important, conventional mortgages were defined as prime or subprime based on characteristics of the originating lender. Although HMDA data do not capture all mortgages, they capture a large segment of the mortgage market.[3]

Before developing some relatively precise measures of the relationship between subprime lending and foreclosures, we first examine the broader patterns of the foreclosures. From 1995 to 2002, the Chicago area experienced tremendous growth in foreclosure starts (the initial filings of foreclosure notices). The total number of starts went from 7,433 in 1995 to 25,145 in 2002, an increase of 238%. A disproportionate segment of this increase was

due to conventional loans, which are merely those loans not guaranteed by the federal government (including the Federal Housing Administration or the Veterans Administration). Historically, FHA loans, which account for the bulk of government-guaranteed loans, have had substantially higher foreclosure rates than conventional loans and have accounted for a very large and disproportionate share of foreclosures. Of course, as subprime loans (which comprise a portion of conventional loans) increased, conventional loan foreclosure rates would be expected to increase to some degree. However, the nature of urban foreclosure problems has been fundamentally transformed during the mid-to-late 1990s and into the new century. It is now the conventional mortgage market that accounts for the bulk of foreclosures.

Although government-guaranteed foreclosures in the Chicago area rose significantly during this period, from 3,387 to 6,932, conventional foreclosures skyrocketed from 4,046 to 18,213. The conventional foreclosures increased at a rate (350%) more than three times the government-guaranteed rate (105%). As a result, although conventional loans accounted for only slightly more than half of foreclosures in 1995, they accounted for almost three out of four just seven years later.

FORECLOSURES AND NEIGHBORHOOD RACIAL COMPOSITION

It is well established that subprime lending increased much more in minority than nonminority neighborhoods in the 1990s (Immergluck 2004). Moreover, individual lenders may experience large spatial variations in loan performance within a metropolitan area. These two phenomena suggest that one might expect disproportionate increases in subprime foreclosures in minority neighborhoods.

In fact, Figure 1 shows that there were large differences in the growth of foreclosures by neighborhood racial and ethnic composition from 1995 to 2002 in the five-county Chicago area. Whereas conventional foreclosures increased dramatically in all neighborhood types, they increased considerably faster in neighborhoods with larger minority populations. Neighborhoods with minority populations of less than 10% in 2000 saw an increase in foreclosures of 215%, and neighborhoods with 90% or greater minority populations experienced an increase of 544%. Neighborhoods with 90% or more minority residents in 2000 accounted for 40% of the 1995–2002 increase in conventional foreclosures.[4] These same tracts represent only 9.2% of the owner-occupied housing units in the region. Tracts with 50% or greater minority populations accounted for more than 61% of the increase in conventional foreclosures.

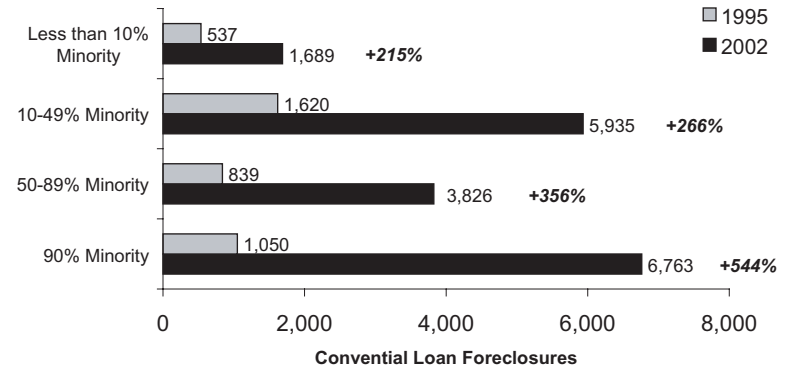

Figure 1: Increases in Conventional Foreclosures by Neighborhood Racial Composition in 2000, Chicago Area (1995–2002)

Figures 2 and 3 illustrate the pattern of increased foreclosures across the metropolitan area. Although foreclosures increased everywhere, these figures show the concentration of the increase on the city's west and south sides, as well as in suburban communities with significant minority populations such as parts of southern and western Cook County; Elgin and Aurora in northeast and southeast Kane County, respectively; Waukegan and North Chicago in eastern Lake County; and Joliet in west central Will County.

Figure 4 plots the number of foreclosures in 2002 divided by the number of all types of conventional loans (home purchase, refinance, and home improvement loans) made between 1996 and 2001. The loans in the six years preceding 2002 are expected to be a substantial source of foreclosures in 2002. The more loans in a neighborhood, other things equal, the more foreclosures one would expect. Figure 4 shows that neighborhoods on the city's west and south sides, as well as in large parts of southern Cook County, had high foreclosure levels even when compared to preceding lending levels. In addition, pockets of high foreclosure activity are present in older, outer suburban communities with significant minority populations such as Elgin, Waukegan, and Joliet.

ANALYZING THE LINK BETWEEN SUBPRIME LENDING AND FORECLOSURES

The availability of comprehensive foreclosure filing data at a neighborhood level allows us to relate subprime lending flows to increases in foreclosures. We have a prior expectation that neighborhoods in which a higher share of home loans are made by subprime lenders during the 1996 to 2001

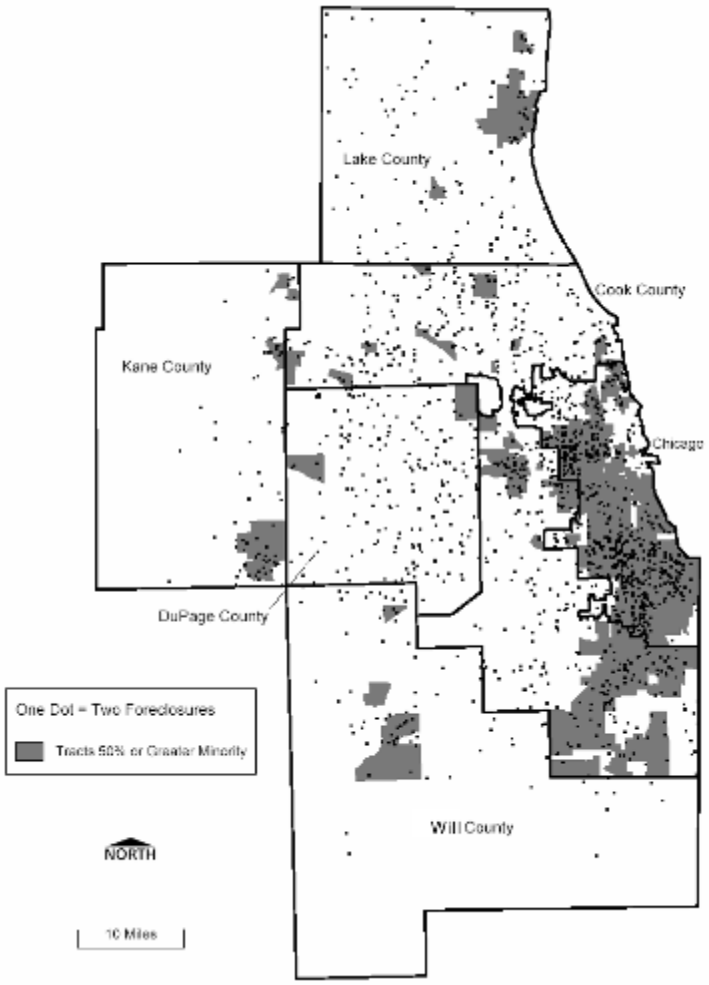

Figure 2: 1995 Conventional Foreclosure Starts

period would have higher increases in foreclosures from 1995 to 2002. We also expect, other things equal, that neighborhoods with larger numbers of prime loans would also have larger raw increases in foreclosures, although we expect the effect to be smaller than for subprime loans. Besides the level of subprime and prime lending, other factors that might be expected to affect foreclosure rates include the neighborhood unemployment rate and any change in unemployment, median income and change in income, population

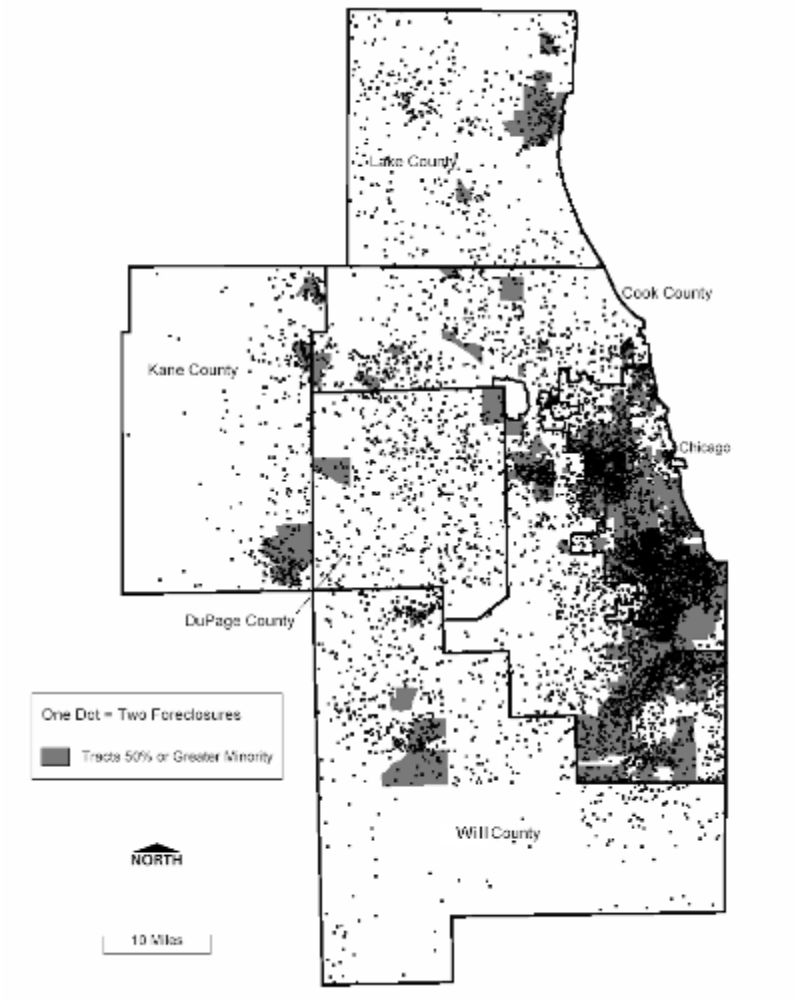

Figure 3: 2002 Conventional Foreclosure Starts

and change in population, and median home value and change in value. The theoretical rationale for including racial or ethnic variables in a model for determining foreclosure rates is contestable. However, some observers may argue that without controlling for race and ethnicity, any effect of subprime lending on foreclosures is partly due to the repayment behavior of minority households. Therefore, we incorporate race and ethnicity variables to provide a conservative measure of the effect of subprime lending on foreclo-

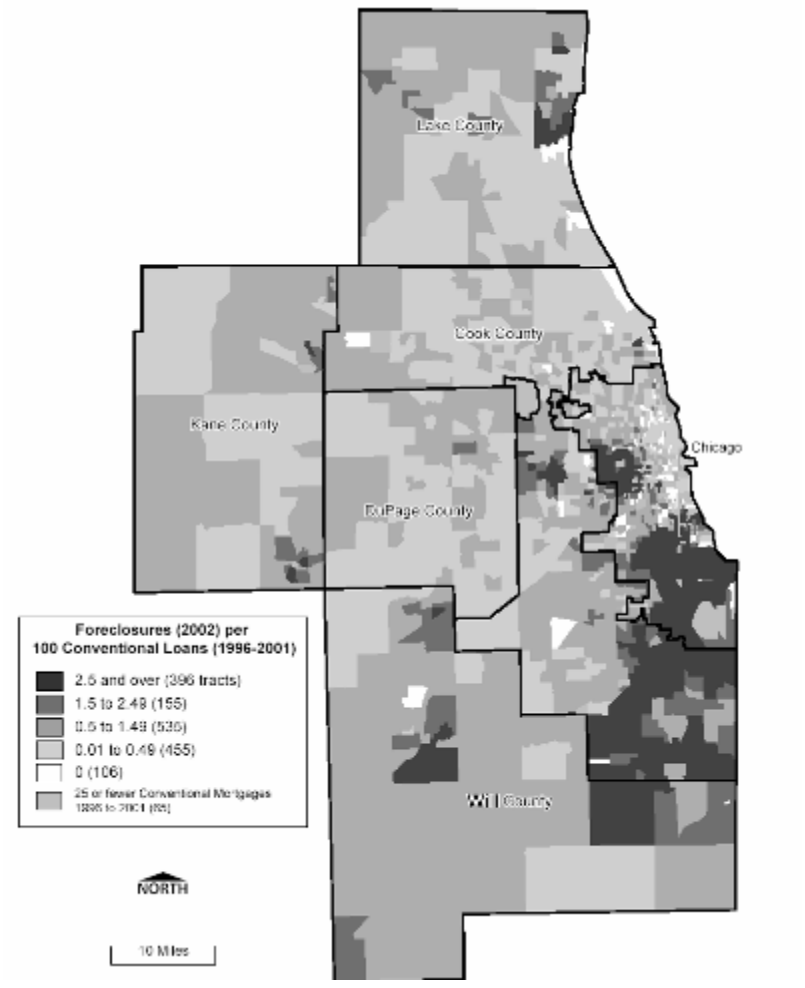

Figure 4: 2002 Conventional Foreclosure Starts Divided by 1996–2001 Number of Conventional Loans

sures—after controlling for neighborhood race and ethnicity.[5] We also incorporate variables indicating changes in racial and ethnic composition.

To better understand the sorts of loans that are contributing to large foreclosure increases, we also break out the loans by purpose. This also allows us to compare the effect of subprime prime lending on foreclosures while controlling for loan purpose. This is important because the purposes of subprime loans tend to be quite different from those of prime loans. For example, the

portion of subprime loans that are refinance loans tends to be higher, at least in higher interest rate environments, than is the case for prime loans. The composition of prime loans is much more sensitive to interest rates because low rates have a strong positive effect on prime refinancings.

To measure the effect of different neighborhood-level factors on the number of foreclosures in the neighborhood in 2002, we begin with the following basic model:

$$F_{2002} = F_{1995} + OOPHP_{1996–2001} + OOSHP_{1996–2001} + OOPHI_{1996–2001} + OOSHI_{1996–2001} + OOPREF_{1996–2001} + OOSREF_{1996–2001} + NOOPL_{1996–2001} + NOOSL_{1996–2001} + Zj_{1990} + \Delta Zj_{1990/2000} \quad (1)$$

Variables are defined as follows:

F_{2002} is the number of foreclosures in the tract in 2002, the ending year.
F_{1995} is the number of foreclosures in the tract in 1995, the initial year.
$OOHP_{1996–2001}$ is the number of owner-occupied prime home purchase loans made in the intervening period, 1996 to 2001.
$OOSHP_{1996–2001}$ is the number of owner-occupied subprime home purchase loans made in the intervening period, 1996 to 2001.
$OOHI_{1996–2001}$ is the number of owner-occupied prime home improvement loans made in the intervening period, 1996 to 2001.
$OOSHI_{1996–2001}$ is the number of owner-occupied subprime home improvement loans made in the intervening period, 1996 to 2001.
$OOPREF_{1996–2001}$ is the number of owner-occupied prime refinance loans made in the intervening period, 1996 to 2001.
$OOSREF_{1996–2001}$ is the number of owner-occupied subprime refinance loans made in the intervening period, 1996 to 2001.
$NOOPL_{1996–2001}$ is the number of non-owner-occupied prime loans made in the intervening period, 1996 to 2001.
$NOOSL_{1996–2001}$ is the number of non-owner-occupied subprime loans made in the intervening period, 1996 to 2001.
Zj_{1990} is a set of other independent variables providing important characteristics of the neighborhood derived from 1990 Census data, including the unemployment rate, population, median home value, median income, percentage Black and Hispanic.
$\Delta Zj_{1990/2000}$ is a set of independent variables indicating changes in the Z variables from 1990 to 2000, again from Census data.

Table 1 gives summary statistics, including mean and standard deviation, for each of the independent variables as well as the dependent variable, F_{2002}. It also provides the simple Pearson correlation coefficient between each in-

TABLE 1: Summary Statistics and Correlations with Dependent Variable for Regressions Explaining 2002 Foreclosure Levels

	M	SD	*Correlation versus Conventional Foreclosures 2002*
Conventional foreclosures, 2002[a]	11.39	12.55	1.000
Conventional foreclosures, 1995[a]	2.55	2.55	0.597**
OO prime conventional home purchase loans, 1996–2001	341.65	456.26	0.138**
OO subprime conventional home purchase loans, 1996–2001	24.79	23.84	0.660**
OO prime conventional home improvement loans, 1996–2001	84.07	67.11	0.489**
OO subprime conventional home improvement loans, 1996–2001	12.51	15.73	0.864**
OO prime conventional refinance loans, 1996–2001	446.08	483.01	0.169**
OO subprime conventional refinance loans, 1996–2001	77.17	72.75	0.888**
NOO prime loans, 1996–2001	36.02	36.15	0.287**
NOO subprime loans, 1996–2001	7.84	11.26	0.719**
Unemployment rate, 1990 (%)	5.48	4.41	0.188**
Change in unemployment rate (%)	–0.52	3.47	–0.001
Population, 1990	4,325.11	2,371.96	0.404**
Change in population (%)	12.20	79.55	0.026
Median home value, 1990	$113,700	$79,424	–0.249**
Change in median home value[b] (%)	76.21	92.23	–0.168**
Median family income, 1989	$41,231	$19,638	–0.091**
Change in median family income[b] (%)	51.68	76.94	–0.122**
% Black, 1990	24.44	37.44	0.362**
Change in % Black	1.72	7.97	0.269**
% Hispanic, 1990	12.69	20.34	–0.206**
Change in % Hispanic	5.27	11.80	–0.036*

NOTE: N = 1,578. OO = owner-occupied; NOO = non-owner-occupied.
a. Conventional means all foreclosures on non-government-guaranteed loans. Foreclosures of unknown type (conventional vs. government guaranteed) were allocated to the conventional category based on the distribution of known government and conventional foreclosures in the tract.
b. Nominal changes, not adjusted for inflation.
* = significant at .05 to .10. ** = significant at less than .01.

dependent variable and the dependent variable. Notice that, as one might expect, there is a substantial correlation between the initial and ending levels of foreclosures. However, there is an even stronger correlation between 2002 foreclosures and the number of owner-occupied subprime home purchase, refinance, and home improvement loans (from .660 to .888) and non-owner-

occupied subprime loans (.719). Prime lending activity is also positively related to the extent of foreclosures. Again, this is somewhat expected because foreclosures occur on loans. That is, you cannot have a foreclosure unless you have a loan. Moreover, both loans and foreclosures are related to the number of mortgageable properties in an area. The simple correlations between 2002 foreclosures and the other independent variables are not very strong, although many are statistically significant, and generally with expected signs, including median family income (negative), race (positive), and ethnicity (negative).

Table 2 presents the results of ordinary least squares (OLS) regressions of partial and full model estimations of Equation 1. The left-hand portion of the table presents the results when the lending data are excluded. The right-hand portion presents the results of the estimation of the full model. The left-hand columns show that, without regressing on the lending data, a number of demographic characteristics appear to have significant impacts on foreclosures, including percentage Black (positive), change in percentage Black (positive), median property value (negative), and median family income (positive). For example, going from a tract that saw no change in percentage Black from 1990 to 2000 to one that saw its Black population increase by 10%, other things equal in the restricted model, would result in 3.6 more foreclosures in 2002, a significant amount compared to the average of 11.39 foreclosures. However, this model omits any information on lending volume or type of lending. Note that in this model, the coefficient estimate for population is positive because population is essentially proxying for the number of homes, which in turn limits the number of loans that may be go into foreclosure.

The full model incorporates both the volume and type of lending occurring in the neighborhood in the intervening period. Consistent with intuition, the regression results show that tracts with larger numbers of prime home purchase and prime home improvement loans do have somewhat higher foreclosure levels, other things equal. With home purchase loans, for example, as more people buy homes in an area and turnover rates increase, one would expect, other things equal, to see foreclosure rates increase. Long-time residents of the neighborhood have lower loan-to-value ratios and may have even paid off their homes.

The results in Table 2 show that the volume and type of mortgage lending are crucial determinants of foreclosure activity and affect the coefficients on the demographic variables. After the lending variables are added into the model, the adjusted R^2 increases from .599 to .867, suggesting a substantial increase in explanatory power. Moreover, the coefficients on the demographic variables are generally reduced, so that some of them are no longer

TABLE 2: Estimating the Impact of Subprime and Prime Lending on Neighborhood Foreclosures through OLS Regression

	Coefficient	SE	*Significance Level*	*Coefficient*	*Standardized* SE	*Coefficient*	*Significance Level*
Constant	–3.281699***	1.223875***	.007***	–0.947688	0.735210		.198
Conventional foreclosures, 1995	1.760640***	0.101704***	.000***	0.182822***	0.066249***	0.037171***	.006***
Unemployment rate, 1990	0.054120	0.102486	.598	0.129968**	0.060274**	0.045623**	.032**
Change in unemployment rate (%)	–0.099732	0.074616	.182	0.038196	0.043263	0.010552	.377
Population, 1990	0.001408***	0.000111***	.000***	–0.000228***	8.43 E-05***	–0.043060***	.007***
Change in population (%)	0.013713***	0.002555***	.000***	0.000749	0.001573	0.004749	.634
Median home value, 1990	–4.08 E-05***	4.48 E-06***	.000***	–5.5 E-06*	2.99 E-06*	–0.034807*	.066*
Change in median home value (%)	–0.011718***	0.002468**	.000***	–0.001573	0.001445	–0.011556	.277
Median family income, 1989	0.000117***	2.19 E-05***	.000***	3.02 E-05**	1.42 E-05**	0.047284**	.034**
Change in median family income (%)	0.002729	0.002947	.355	0.001082	0.001729	0.006635	.532
% Black, 1990	0.143069***	0.011737***	.000***	0.005798	0.007535	0.017298	.442
Change in % Black	0.362286***	0.027643***	.000***	0.121623***	0.017967***	0.077218***	.000***
% Hispanic, 1990	0.007050	0.013769	.609	–0.025740***	0.008244***	–0.041709***	.002***
Change in % Hispanic	–0.015966	0.019476	.412	–0.005458	0.011580	–0.005130	.638
OO prime conventional home purchase loans, 1996–2001				0.003097***	0.000987***	0.112589***	.002***
OO subprime conventional home purchase loans, 1996–2001				0.089114***	0.009281***	0.169269***	.000***

OO prime conventional home improvement loans, 1996–2001		0.017565***	0.005440***	0.093918***	.001***
OO subprime conventional home improvement loans, 1996–2001		0.095488***	0.020380***	0.119733***	.000***
OO prime conventional refinance loans, 1996–2001		–0.005429***	0.001073***	–0.208928***	.000***
OO subprime conventional refinance loans, 1996–2001		0.078215***	0.005462***	0.453386***	.000***
NOO prime loans, 1996–2001		–0.000929	0.004627	–0.002675	.841
NOO subprime loans, 1996–2001		0.265033***	0.018444***	0.237739***	.000***
Adjusted R^2	.599	.867			

NOTE: N = 1,578. The dependent variable was Conventional Foreclosures, 2002. OO = owner-occupied; NOO = non-owner-occupied.
* = significant at .05 to .10. ** = significant at .01 to .05. *** = significant at less than .01.

significant and others have significantly smaller magnitudes. (For two variables, unemployment rate and percentage Hispanic, the coefficient estimates become statistically significant.) In particular, the coefficient on the change in the percentage Black variable is reduced by approximately two-thirds, to .122. Thus, using the full model, going from a neighborhood that saw no increase in percentage Black to one that saw a 10% increase, other things being equal, is expected to increase 2002 foreclosures by only about 1.2 foreclosures rather than 3.6, reducing the effect of racial change on foreclosures by two-thirds. Importantly, the 1990 percentage Black variable now becomes insignificant. Thus, the OLS results, at least, suggest that higher foreclosure rates in Black neighborhoods are generally explained by higher subprime lending activity. It is interesting to note, however, that the coefficient on the 1990 percentage Hispanic variable goes from being positive and insignificant to negative and significant, so that Hispanic neighborhoods, other things equal, are expected to have lower foreclosure levels even compared to otherwise similar White neighborhoods.

The results in Table 2 also reveal that the propensity for subprime loans of the same purpose to result in foreclosures is many orders of magnitude greater than is the case for prime loans. In the case of home purchase loans, the subprime coefficient is more than 28 times as large as the prime coefficient. Whereas a tract with 100 additional prime home purchase loans from 1996 to 2001, other things equal, is expected to have only 0.3 additional foreclosures in 2002, a tract with 100 more subprime home purchase loans is expected to have 8.9 additional foreclosures. When looking at home improvement loans, a tract with 100 more subprime loans, other things equal, is expected to have an additional 9.5 foreclosures in 2002, and the corresponding effect for refinance loans is 7.8. Even though most research to this point has focused on the refinance market, these figures suggest that the effect of subprime home purchase loans is similar to that in the refinance market.

However, even though the per-loan foreclosure effects are similar, because there are so many more subprime refinance loans than home purchase or improvement loans, the subprime refinances contribute much more in the aggregate to foreclosures. A standard deviation increase in owner-occupied subprime refinance loans is expected to result in a .453 standard deviation increase in 2002 foreclosures, or about 5.7 foreclosures. A standard deviation increase in subprime home purchase loans, by contrast, is expected to result in an increase of about 2.1 foreclosures, whereas a standard deviation increase in subprime home improvement loans is expected to result in 1.5 foreclosures.

In the case of refinance loans, the number of owner-occupied prime loans is actually expected to lead to somewhat lower foreclosure levels. A tract

with 100 more owner-occupied prime refinance loans during the 1996 to 2001 period, other things being equal, is expected to have 0.55 fewer foreclosures in 2002. The standardized coefficient is substantial at –.209, so that a standard-deviation higher level of prime refinance loans corresponds to 2.6 fewer foreclosures in 2002. This finding, combined with the large standardized coefficient on owner-occupied subprime refinance loans (.453), might be explained by a substitution effect between prime and subprime refinance loans. That is, as prime loans increase, the potential market for subprime lenders may be diminished, crowding out such lenders. This hypothesis is consistent with the evidence that substantial numbers of subprime loans go to borrowers worthy of prime loans as well as the related research showing that credit scores do not explain the very high rates of subprime lending in minority neighborhoods (Freddie Mac 1996; Phillips-Patrick et al. 2000; Calem, Gillen, and Wachter, forthcoming; NCRC 2003).

AN ALTERNATIVE ESTIMATION: NEGATIVE BINOMIAL REGRESSION

Because foreclosure data are nonnegative count data and because there is a significant, albeit relatively small, number of tracts (6%) with zero foreclosures, the data are not normally distributed, so ordinary least squares is not ideally suited for estimating Equation 1 or its variations. Typically, the most appropriate methods for modeling count data, where one seeks to model the number of occurrences of an event of interest as a function of some independent variables, are either Poisson or negative binomial regression techniques. Poisson regression is not appropriate in this case because the data are overdispersed. That is, the variance of the dependent variable significantly exceeds the mean. (Additional diagnostics not shown here also confirm that the Poisson technique is not appropriate.) Negative binomial regression is appropriate for this case, however. The disadvantage of negative binomial estimation is that the interpretation of the coefficients is less straightforward than that of OLS, and the results are not easily translated into raw number effects because negative binomial coefficients yield proportional effects. Moreover, because the results do not relate a raw change in loan volume to a raw change in foreclosures, the method is less intuitively appealing.

Notwithstanding the limitations of the method, Table 3 gives the results of a negative binomial estimation of the relationship in Equation 1. As in Table 2, the left-hand portion of the table gives results for a limited model in which lending variables are omitted. Again, in most cases, the effect of adding the lending variables is to reduce the magnitude of the coefficient estimates of the demographic variables.

TABLE 3: Estimating the Impact of Subprime and Prime Lending on Neighborhood Foreclosures through Negative Binomial Regression

	Coefficient	SE	*Exponentiated (Coefficient)*	*Significance Level*	*Coefficient*	SE	*Exponentiated (Coefficient)*	*Significance Level*
Constant	1.010739**	0.108789**	2.74763**	.000**	1.152792**	0.095852**	3.167023**	.000**
Conventional foreclosures, 1995	0.063103**	0.007710**	1.065136**	.000**	0.007371	0.007043	1.007398	.295
Unemployment rate, 1990	0.006385	0.008702	1.006405	.463	0.005841	0.007537	1.005858	.438
Change in unemployment rate (%)	–0.00284	0.006880	0.997159	.679	0.002763	0.005823	1.002766	.635
Population, 1990	0.000175**	9.88 E-06**	1.000175**	.000**	0.000045**	0.000010**	1.000045**	.000**
Change in population (%)	0.002683**	0.000379**	1.002687**	.000**	0.000177	0.000252	1.000177	.481
Median home value, 1990	–5.3 E-06**	4.3 E-07**	0.999995**	.000**	–0.000004**	0.000000**	0.999996**	.000**
Change in median home value (%)	–0.002130**	0.000254**	0.997871**	.000**	–0.001796**	0.000228**	0.998206**	.000**
Median family income, 1989	1.37 E-05**	2.05 E-06**	1.000014**	.000**	0.000008**	0.000002**	1.000008**	.000**
Change in median family income (%)	0.000389	0.000249	1.000389	.119	0.000150	0.000229	1.000150	.512
% Black, 1990	0.011596**	0.000960**	1.011663**	.000**	0.007557**	0.000911**	1.007585**	.000**
Change in % Black	0.024100**	0.002030**	1.024393**	.000**	0.017202**	0.001960**	1.017351**	.000**
% Hispanic, 1990	–0.004170**	0.001167**	0.995837**	.000**	–0.003234**	0.001053**	0.996771**	.002**
Change in % Hispanic	0.004146	0.001673	1.004155	.013	0.007220**	0.001471**	1.007246**	.000**
OO prime conventional home purchase loans, 1996–2001					–0.000248*	0.000118*	0.999752*	.036*

OO subprime conventional home purchase loans, 1996–2001		0.006204**	0.001038**	1.006223**	.000**
OO prime conventional home improvement loans, 1996–2001		0.002793**	0.000593**	1.002797**	.000**
OO subprime conventional home improvement loans, 1996–2001		–0.000165	0.002107	0.999835	.938
OO prime conventional refinance loans, 1996–2001		0.000152	0.000125	1.000152	.224
OO subprime conventional refinance loans, 1996–2001		0.001514**	0.000574**	1.001515**	.008**
NOO prime loans, 1996–2001		0.003736**	0.000533**	1.003743**	.000**
NOO subprime loans, 1996–2001		0.012072**	0.001959**	1.012145**	.000**
Deviance degrees of freedom	1.1289	1.1518			
Pearson chi squared degrees of freedom	1.0496	0.950			
Log likelihood	32,301.29	32,534.12			

NOTE: N = 1,578. The dependent variable was Conventional Foreclosures, 2002.
* = significant at .01 to .05. ** = significant at less than .01.

In negative binomial regression, one way to interpret the results is to recognize that the exponentiated coefficients are the proportional increase in the expected value of the dependent variable due to a one-unit increase in the independent variable. For example, in the results of the full model, an increase of one subprime home purchase loan from 1996 to 2001 is expected to result in 0.6223% more foreclosures in 2002. Although it is difficult to compare the magnitudes of the OLS and negative binomial coefficient estimates, the results of Tables 2 and 3 are generally consistent. More variables are statistically significant in Table 3 than in Table 2. However, eleven of the seventeen variables have the same sign. Of the six variables that have coefficients with different signs in the two regressions, only two are statistically significant in both results. One notable difference in the results is that the negative binomial results show that both the 1990 percentage Black and the change in percentage Black variables have a positive and significant effect on foreclosures, even after controlling for subprime lending activity. The 1990 percentage Black variable did not remain significant in the OLS results in Table 2.

More important, both the OLS and negative binomial regression results suggest that an increase in subprime lending—with some inconsistency in the results for home improvement loans—has a very substantial, positive effect on foreclosures, whereas prime lending has very modest effects. In the case of home purchase lending, a tract with 100 more subprime loans in the 1996 to 2001 period, other things equal, corresponds to 85.96% more foreclosures in 2002.[6] Conversely, a tract with 100 more prime home purchase loans, other things equal, corresponds to 2.45% fewer foreclosures. In the OLS results from Table 2, the difference in magnitudes of the subprime and prime effects was similar (a factor of twenty-eight), although the sign of the effect in Table 2 is positive. Thus, the effect of subprime home purchase loans on foreclosures is consistently positive and very large, whereas the effect of prime home purchase loans is consistently small but of ambiguous sign.

In the case of refinance loans, the negative binomial results are also generally consistent with the OLS results. In the OLS results, prime refinance loans had a small negative effect on foreclosures. In the results in Table 3, the effect is positive but very small and not significant. In both cases, the effect of subprime refinance loans on foreclosures is positive, statistically significant, and of substantial magnitude. From Table 3, 100 additional prime home improvement loans in a tract during the 1996 to 2001 period are associated, other things equal, with 16.3% more foreclosures in 2002. As was the case in interpreting the OLS results, it is important to keep in mind the larger variation in subprime refinance lending across tracts. The standard deviation in subprime refinance loans is more than three times the standard deviation in

subprime home purchase loans (73 vs. 24) and more than four times the standard deviation in subprime home improvement loans (73 vs. 16).

In the case of home improvement loans, the effect of prime home improvement loans on foreclosures is positive and statistically significant in both regressions. However, whereas the OLS results suggest that subprime home improvement loans have a substantially larger, positive impact on foreclosures as compared to prime home improvement loans, the negative binomial results do not. The coefficient on subprime home improvement loans in Table 3 is actually negative, though very small and not statistically significant. Moreover, in the results in Table 3, prime home improvement loans have a relatively substantial, positive effect on foreclosures, which is not expected. A 100 additional prime home improvement loans is associated, other things equal, with a 32.2% increase in foreclosures. We should point out here that the HMDA significantly undercounts loans made for home improvement purposes because it does not require lenders to report most open-ended home equity lines of credit. Because lines of credit borrowers are likely to be disproportionately prime borrowers, this could be a source of omitted variable bias. Tracts with more "prime" closed-end home improvement loans (as reported under the HMDA) might actually receive fewer open-ended home equity loans because of a substitution between the two types of loans. This problem is complicated by the fact that some lenders identified by HUD as "prime" make significant numbers of subprime loans. For example, it may be that many "prime" lenders are serving substantial numbers of subprime borrowers via closed-end home improvement loans while serving prime borrowers more through open-ended home equity loans that are generally not reported to the HMDA.

RECOGNIZING THE COSTS OF CONCENTRATED FORECLOSURES

The findings of this study indicate that subprime lending is a very strong determinant of neighborhood foreclosure levels. Responsible subprime lending may indeed bring important benefits to families that have difficulty obtaining credit elsewhere. However, the results here show that after controlling for neighborhood demographics and economic conditions, subprime loans lead to foreclosures at far greater rates than do prime loans.

Prime lending, on the other hand, has minimal impact on the foreclosure level, at least in the case of home purchase and refinance lending. If anything, this analysis is likely to underestimate the impact of subprime lending on neighborhood foreclosures in neighborhoods that are particularly vulnera-

ble. Residents of lower-income and minority communities are less likely to be able to avoid foreclosure via borrowing from friends and relatives or by increasing working hours. Interactions between subprime lending and neighborhood demographic variables are possible. Unfortunately, the data set used here is not robust enough to test for such interdependencies. This is certainly an important area for further research.

This study has a number of implications for regulatory policy in the arena of home lending. First, it makes a strong case that the magnitude of the effect of subprime lending on neighborhood foreclosures is very large. It suggests, for example, that subprime lending explains roughly two-thirds of the greater levels of foreclosures in neighborhoods undergoing greater racial change (greater increases in percentage Black). Given the impact of foreclosures on neighborhood vitality and stability, especially in modest-income neighborhoods where foreclosures more often lead to abandonment and blight, this cost of high-risk lending should be given more weight in policy discussions. This is especially true because much of this cost is borne by entire communities, not just by the lender or borrower.

Foes of increased regulation of the subprime mortgage market often argue that increased regulation will result in higher costs of borrowing for many borrowers and perhaps even reduce credit access for some. However, the social costs involved in substantially higher foreclosures in many struggling neighborhoods might not be easily outweighed by marginally lower borrowing costs spread thinly across a broad set of borrowers. Even if some worthy borrowers are prevented from obtaining credit because of increased regulation, the benefits of reduced foreclosures may justify such action. Moreover, foreclosures are hardly the entire costs of overly risky and irresponsible subprime lending. Financial and emotional stress, excessive charges and fees, and other harms to borrowers must be considered. Certainly, many borrowers benefit from responsible subprime lending. The findings of this study, however, suggest that the negative spillovers occurring in the existing marketplace are substantial and that such spillovers must be more clearly considered in policy making.

NOTES

1. This includes Cook, DuPage, Lake, Kane, and Will Counties. These are the counties for which complete foreclosure data were available from the firm; foreclosure report of Chicago complete data were not available for McHenry County, the "sixth" county in the traditional six-county metropolitan definition. For each year, the foreclosure data were cleaned by removing certain multiple foreclosure entries at the same address during a very short period of time. For a number of foreclosure records, especially for those in DuPage, Kane, and Lake Counties in 2002,

there were no recorded property types (i.e., single family, multifamily, commercial). In Cook and Will Counties, where the vast majority of property types were known, the unknown property types were estimated based on the distribution of known properties. For DuPage, Kane, and Lake Counties, it was assumed that the vast majority of properties were single-family dwellings based on the data from 1995, where property type information was available. For these counties, a small percentage of foreclosures (typically less than 1%) were allotted as nonsingle family. Foreclosure data is available only at the individual property level. Each record had to be geocoded to determine its census tract. For each year, roughly 98% of addresses were able to be geocoded. The remaining 2% had addresses that could not be found.

2. Collins (2003) found that 36% of foreclosures starts resulted in completed foreclosures in 2001. He also found the completed portion to be higher in a sample of lower-income neighborhoods.

3. The largest incomplete segment in the Home Mortgage Disclosure Act (HMDA) is the home equity loan market. Home equity loans that are used for home improvement may be reported to the HMDA, but not necessarily. Moreover, other home equity loans are generally not reported under the HMDA. The bulk of home purchase loans and a large majority of refinance loans are reported under the HMDA, however. Lenders are identified as specializing in subprime loans by the U.S. Department of Housing and Urban Development. Some "prime" lenders do originate some subprime loans and visa versa. Although classifying loans by originating lender rather than loan characteristics has some limitations, it is a reasonable method of measuring subprime versus prime loan shares in the analysis below.

4. The HMDA data used in this study are reported according to 1990 Census tract boundaries. Therefore, it was necessary to obtain 2000 Census data recalculated to 1990 tract boundaries for the purposes of matching the data with the 1990 boundaries. This data was procured from PCI Services, Inc., which provides this product for its CRA Wiz product, a commonly used loan analysis software used by federal bank regulators and banks.

5. Controlling more directly for the race and ethnicity of borrowers would be another way of measuring individual demographic effects on foreclosure. However, the substantial underreporting of race and ethnicity data in HMDA data makes this impractical, especially at the neighborhood level.

6. To determine the impact of 100 loans on foreclosures, we multiply the coefficient by 100 and then exponentiate it. Conversely, one can compound the impact of an increase of one loan (the exponentiated value of the coefficient) 100 times.

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