Dynamic Models of Neighborhood Change

(Extended Abstract)

Elizabeth Bruch

September 23, 2004

Introduction

Trends and causes of residential patterns continue to be a major social issue in the United States. The characteristics of neighborhoods in which individuals grow up may be important determinants of their lifetime success or failure (Brooks-Gunn et al. 1997; Crane 1991; Garner and Raudenbush 1991). Many commentators (e.g., Herrnstein and Murray 1994; Reich 1991) point to increased segregation in the form of gated communities and isolated poor neighborhoods as a source of growing income inequality. Place of residence remains a barrier to upward social mobility and, for some groups, may be even more of a barrier today than in the past (Borjas 1999; Durlauf 1996).

The goal of this research is to better understand the interdependence of racial and economic factors in the formation and maintenance of segregated neighborhoods. There is a large literature that uses decennial Census data to describe patterns of race and income segregation over time and across cities. However, the interaction between residential sorting by race and residential sorting by income, and how this relationship is conditioned by economic inequalities among race groups, is not understood. It has been well documented that race segregation remains high, but has been declining over the past thirty years (Farley and Frey 1994; Massey and Denton 1993; Glaeser and Vigdor 2001). As racial segregation declined, economic inequality and the geographic concentration of poverty increased (Wilson 1987; Abramson and Vandergroot 1995; Jargowsky 1996a; Jargowsky 1996b; Jargowsky 1994; Levy

1995; Danziger and Gottschalk 1995; Karoly 1993). Some past research suggests that income inequalities among race groups and segregation by income may explain observed patterns of race segregation (Yinger 1995; Harris 1999; Clark 1991, 1986, 1988; Galster 1988). But the overwhelming consensus in the literature is that economic factors cannot explain racial segregation (e.g., Taueber and Taeuber 1969; Denton and Massey 1988; Massey and Denton 1987; Massey and Eggers 1993; Massey and Fischer 1999). However, these studies all rely on cross-sectional data to make their claims. Cross-sectional data reveal the extent of socioeconomic segregation but not the underlying dynamics of neighborhood formation and change.

A more recent and promising line of research has been to use panel survey data on geographic mobility to measure movement among neighborhoods of varying economic and racial composition (e.g., Gramlich et al. 1992; Massey and Eggers 1993; Quillian 1999). While providing valuable information on patterns of neighborhood mobility, this work has not yet yielded plausible models of neighborhood dynamics. The neighborhood changes implied by the turnover rates estimated in these studies are unrealistic because they assume fixed mobility rates across neighborhood types. This assumption is unsatisfactory because it ignores a crucial feature of residential mobility, namely that changes in the characteristics of neighborhoods bring about changes in rates of movement in and out of these neighborhoods. Thus, these studies have yet to yield a model that captures the dynamic relationship between residential mobility and neighborhood change.

Schelling (1978, 1972, 1971) laid the conceptual groundwork for understanding the dynamics of neighborhood evolution. Using rudimentary computer models applied to artificial agents, he showed how the preferences of autonomous individuals about where to live give rise to (often unanticipated) aggregate patterns of residential segregation. Although Schelling's model is well known to students of residential mobility and segregation, it is seldom used to analyze neighborhood change in real populations. While simple models are crucial for developing a theoretical understanding of the mechanisms that produce segregation, Schelling's model is so abstract that it is difficult to gauge the extent to which the relationships he observed hold in the real world.

This project combines the theoretical appeal of agent (microsimulation) modeling with empirically based choice models and a realistic neighborhood context. I develop a dynamic, agent-based model of neighborhood sorting by race and income and use this model to understand how overall trends in inequality and households' mobility behavior interact to produce and maintain segregated neighborhoods. I simulate mobility behavior in Los Angeles County from 1990-2000, and examine how segregation outcomes vary under different assumptions about economic inequality within and among race groups.[1]

Analysis

This study consists of two parts. First, I estimate models of residential choice using data from the Los Angeles Family and Neighborhood Survey (LA FANS). These models describe the mobility behavior of Los Angeles County residents. Second, I implement an agent-based model of residential mobility and neighborhood change. I assign the agents mobility behaviors estimated from the LA FANS data in the first portion of the analysis, and simulate what segregation outcomes unfold.

Neighborhood Choice. I estimate discrete choice models (McFadden 1973, 1978) of housing unit choice using the LA FANS.[2,3] These models describe the probability that a household moves into a given housing unit, conditional on characteristics

[1]Segregation is characterized by race (using the Index of Dissimilarity), income (using Jargowsky's [1996a] Neighborhood Sorting Index), and the prevalence of high poverty neighborhoods (defined as neighborhoods with poverty rates greater than 40%).

[2]The data used in the analysis come from the Household Survey portion of the 2000-2001 Wave 1 LA FANS. The LA FANS is a multi-stage probability sample of 65 census tracts in Los Angeles County. Residential mobility is recorded in a two-year history that is obtained from a randomly selected adult (RSA). The survey makes it possible to study the mobility of families, households, and/or individuals. There are approximately 3,750 completed interviews with RSAs in the survey. The response rate for sampled and eligible RSAs is 85 percent.

[3]Los Angeles is an important locale in which to study residential mobility, as it is the largest newer multiethnic city and has been the focus of studies of residential segregation patterns and racial attitudes (e.g., Clark 1992 and 1996; Bobo and Zubrinsky 1996) but has not been studied with high quality longitudinal data. The LA FANS provides rich, micro-level data for studying residential mobility and neighborhood selection. Because these mobility data are from a community study (rather than a national sample), it is possible to study the impact of mobility on specific neighborhoods, and to specify the residential opportunity structure available to the LA FANS respondents.

of both the household and the housing unit, as well as the characteristics of the other housing units contained in the choice set. I examine the effects of housing prices and neighborhood race and economic composition, and their interactions with individuals' own ethnic and economic characteristics, on residential choice. The choice models show the extent to which economic differences among race groups explain the apparent effects of race composition on residential choice (Harris 1999; Estrada and Mare 2003). They also reveal whether households below a given income threshold are barred from entering certain neighborhoods because they cannot afford the prices (or qualify for mortgages) in that area.

Neighborhood Change. In the second section of the paper, I present results from an agent-based model of residential mobility and neighborhood change in Los Angeles. This model corresponds closely to real world space and time. It uses map (Geographic Information Systems, or GIS) data at the Census block level for Los Angeles County to create a simulated city in which the "agents" (households) move about. Agents are characterized by their race/ethnicity (white, black, Asian, or Hispanic) and income. The model is designed such that, at the beginning of the simulation, the distribution of agents by race and income and the distribution housing units by price across tracts in the model matches the distribution of households and housing units across LA County Census tracts at a given point in time. The model can also be initialized using assumed population characteristics. The agents move according to the behavioral models estimated from the LA FANS data. As agents move, the opportunity structure each agent confronts changes over subsequent moves. Thus, the race-ethnic and economic composition of neighborhoods available to agents as they make their mobility decisions is altered by all the previous moves of the other agents. Housing prices are endogenous to the neighborhood formation process, and I use a market mechanism to update prices. This model produces output, which can be summarized by standard measures of race and income segregation (Jargowsky 1996; Massey and Denton 1988; White 1987).

I simulate mobility in Los Angeles over a ten year period (1990-2000), initializing the model with 1990 decennial Census data and using the choice models estimated from the LA FANS data in the first portion of the analysis. I then compare the race

and income segregation produced from these simulations with segregation statistics computed from the 2000 Census. The model also allows me to perform a number of thought experiments that reveal the additive or interactive nature of race and income segregation. For example, I implement models assuming that individuals select neighborhoods based on only their income or race composition, and compare the segregation produced by these models to the outcomes that occur when individuals select neighborhoods based on both race and income composition. These simulations address the question of whether neighborhood sorting by race exacerbates segregation by income, or whether it has an attenuating effect (as suggested by Wilson 1987). Finally, I examine what segregation outcomes occur under alternative assumptions about income inequality within and among race groups (e.g., segregation outcomes under the assumption that households sort by both race and income, but minorities' incomes are at parity with whites). These simulations explore how the residential sorting process is conditioned by income inequality both among and within race groups.

References

Abramson, Alan, Mitchell Tobin and Matthew Vandergroot. 1995. "The Changing Geography of Metropolitan Opportunity: The Segregation of the Poor in U.S. Metropolitan Areas, 1970-1990." *Housing Policy Debate* 6:45–72.

Borjas, George. 1999. *Heavens Door: Immigration Policy and the American Economy*. Princeton: Princeton University Press.

Brooks-Gunn, Jeanne, Greg Duncan, and Lawrence Aber. 1997. *Neighborhood Poverty: Context and Consequences for Children*. New York: Russell Sage.

Clark, William. 1986. "Residential segregation in American cities: a review and interpretation." *Population Research and Policy* .

Clark, William. 1988. "Understanding Residential Segregation in American cities: interpreting the evidence, a reply to Galster." *Population Research and Policy* 8:193–97.

Clark, William. 1991. "Residential Preferences and Neighborhood Racial Segregation: A Test of the Schelling Segregation Model." *Demography* 28:1–19.

Crane, Jonathan. 1991. "The Epidemic Theory of Ghettos and Neighborhood Effects on Dropping out and Teenage Childbearing." *American Journal of Sociology* 96:1226–59.

Danziger, Sheldon and Peter Gottschalk. 1995. *America Unequal*. Cambridge, MA: Harvard University Press and the Russell Sage Foundation.

Denton, Nancy and Douglas Massey. 1988. "Residential Segregation of Blacks, Hispanics, and Asians by Socioeconomic Status and Generation." *Social Science Quarterly* 69:797–817.

Durlauf, Steven. 1996. "A Theory of Persistent Income Inequality." *Journal of Economic Growth* 1:75–93.

Farley, Reynolds and William Frey. 1994. "Changes in the Segregation of Whites from Blacks during the 1980s: Small Steps Toward a more Integrated Society." *American Sociological Review* 59:23–45.

Galster, George. 1988. "Residential Segregation in American Cities: A Contrary Review." *Population Research and Policy* 7:93–112.

Garner, C. and Steven Raudenbush. 1991. "Neighborhood Effects on Educational Attainment: A Multilevel Analysis." *Sociology of Education* 64:251–62.

Glaeser, Edward and Jacob Vigdor. 2001. "Racial Segregation in the 2000 Census: Promising News." Technical report, Washington DC: Brookings Institution.

Gramlich, Edward, Deborah Laren, and Naomi Sealand. 1992. "Moving Into and Out of Poor Urban Areas." *Journal of Policy Analysis and Management* 11:273–87.

Harris, David. 1999. "Property Values Drop When Blacks Move in, Because...: Racial and Socioeconomic Determinants of Neighborhood Desirability." *American Sociological Review* 64:461–79.

Herrnstein, Richard and Charles Murray. 1994. *The Bell Curve: Intelligence and Class Structure in American Life*. New York: Free Press.

Jargowsky, Paul. 1994. "Ghetto Poverty among Blacks in the 1990s." *Journal of Policy Analysis and Management* 13:288–310.

Jargowsky, Paul. 1996a. *Poverty and Place: Ghettos, Barrios, and the American City*. New York: Russell Sage.

Jargowsky, Paul. 1996b. "Take the Money and Run: Economic Segregation in U.S. Metropolitan Areas." *American Sociological Review* 61:984–98.

Karoly, Lynn. 1993. *Uneven Tides: Rising Inequality in America*, chapter The Trend in Inequality Among Families, Individuals, and Workers in the United States: A Twenty-Five Year Perspective. New York: Russell Sage Foundation.

Levy, Frank. 1995. *Incomes and Income Inequality*, pp. 1–58. New York: Russell Sage.

Massey, Douglas and Nancy Denton. 1987. "Trends in the Residential Segregation of blacks, Hispanics, and Asians." *American Sociological Review* 52:802–25.

Massey, Douglas and Nancy Denton. 1993. *American Apartheid: Segregation and the Making of the Underclass*. Cambridge, MA: Harvard University Press.

Massey, Douglas and Mitchell Eggers. 1993. "The Spatial Concentration of Affluence and Poverty during the 1970s." *Urban Affairs Quarterly* 29:299–315.

Massey, Douglas and Mary Fischer. 1999. "Does Rising Income Bring Integration? New Results for Blacks, Hispanics, and Asians in 1990." *Social Science Research* 23:316–26.

Quillian, Lincoln. 1999. "Migration Patterns and the Growth of High Poverty Neighborhoods, 1970-1990." *American Journal of Sociology* 105:1–37.

Reich, Robert. 1991. *The Work of Nations: Preparing Ourselves for 21st-Century Capitalism*. New York: Alfred A. Knopf.

Schelling, Thomas. 1971. "Dynamic Models of Segregation." *Journal of Mathematical Sociology* 1:143–86.

Schelling, Thomas. 1972. "A Process of Residential Segregation: Neighborhood Tipping." In *Racial Discrimination in Economic Life*, edited by A. Pascal, pp. 157–184. Lexington, MA: D.C. Heath.

Schelling, Thomas. 1978. *Micromotives and Macrobehavior*. New York: Norton and Co.

Taueber, Karl and Alma Taeuber. 1969. *Negroes in Cities*. New York: Atheneum.

Wilson, William Julius. 1987. *The Truly Disadvantaged: The Inner City, the Underclass, and Public Policy*. Chicago: University of Chicago Press.

Yinger, John. 1995. *Closed Doors, Opportunitie Lost: The Continuous Costs of Housing Discrimination*. New York: Russell Sage.