# SEGREGATION AND THE PROVISION OF SPATIALLY DEFINED LOCAL PUBLIC GOODS*

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## Abstract

Racial separation may be the result of many factors: variation in income, occupational differences, and individual preference come to mind immediately. Indeed, Thomas Schelling argued in 1969 that even mild individual preference for like neighbors could produce dramatic segregation in neighborhoods. This paper examines the robustness of his conclusion in two slightly more realistic environments. One adds the complication of vacant lots and more diverse utility-based agents. Each of the cases simulated here produced equilibria with some degree of racial segregation. The results therefore sustained Schelling's conjecture that individual intent is not necessarily related to the collective result of neighborhood segregation. In all of the simulations, each individual would have been content with a local neighborhood in which approximately half of the residents were of the same race; but all individuals acting together with this motive seemed to produce segregated neighborhoods. The Schelling conjecture was undermined to some degree by inclusion of local public goods, but only if they were highly valued. In those cases, proximity to the public goods worked against the disutility of mixed neighborhood so integrated neighborhoods became more likely. If the public goods were not highly valued, though, the segregation persisted or unstable and chaotic neighborhoods persisted.

Despite all efforts and statements to the contrary, American cities were still quite segregated at the turn of the 21st century. Massey and Denton (1987), for example, estimated that the likelihood that black and white individuals shared a common neighborhood in 60 Standard Metropolitan Statistical Areas of the United States was 5%. Even more recently, Yinger (1998), Darity and Mason (1998), and Ladd (1998) all noted evidence that little had changed since then. Yinger, in particular, observed that "housing agents sometimes discriminate to take advantage of perceived weaknesses in the bargaining positions of blacks" (pg. 38). Meanwhile, Ladd underscored a variety of techniques that lenders can use to discriminate in mortgage markets despite the Fair Housing Act of 1968 and the Equal Credit Opportunity Act of 1974. The question to be posed at the end of the twentieth century is, quite simply, not whether discrimination still makes American cities segregated, but why?

Racial separation may be the result of many factors: variation in income, occupational differences, and individual preference come to mind immediately. Indeed, Schelling (1969) argued that even mild individual preference for like neighbors could produce dramatic segregation in neighborhoods. He conjectured that "the interplay of individual choices, where unorganized segregation is concerned, is a complex system with collective results that bear no close relation to individual intent (pg 488)." He may be right, but he confined his examination of the conjecture to a simple linear model with a simple decision-rule. This paper examines the robustness of his conclusion in two slightly more realistic environments. One adds the complication of vacant lots and more diverse utility-based agents. Utility maximizing agents are then left to form neighborhoods

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as they want, but their neighborhoods have people or vacant lots next door, across the street, down the street, and on the other side of the backyard fence. The second extension is more substantive. It investigates the degree to which adding spatially defined local public goods to individuals' utility functions can undermine the strength of Schelling's segregation result.

Section I provides a very brief review of the Schelling linear environment. The second section describes our agent-based theoretical structure before Section III reports the results of the initial geographic extension of the Schelling environment. Racial segregation still emerges as the collective result of mild individual preferences for homogeneity even in a two dimensional context. Section IV then adds local public goods to the mix. The tendency toward segregation persists, but it is diminished somewhat in circumstances in which individuals value proximity to the public good. A final section offers some brief conclusions.

## I. The Schelling Model

Schelling (1969) created a simple model of a neighborhood and individual behavior. In order to demonstrate the relationship between collective results and individual intent, his neighborhoods were represented as lines, with black residents represented by the symbol "+" and whites by the symbol "0." An arbitrary selected neighborhood with 9 blacks and 10 whites might then, for example, be represented by:

0+000++0+00++00+++0

Schelling equipped the actors in his neighborhoods with a simple decision rule about where they wanted to live. If fewer than half of any resident's nearest 4 neighbors were of the same race, then the resident would move to the nearest point for which half of his eight nearest neighbors would be of the same race. Applying this rule to the neighborhood displayed above, an equilibrium neighborhood within which nobody would have any further incentive to move given observed location of other individuals would be:

0000+++++000000++++

Schelling's simple linear model confirmed his conjecture with the resulting Nash equilibrium displaying complete segregation. Although each individual would have been satisfied to live in an area in which half of his neighbors were of the opposite race, complete segregation was the collective result of a simple decision rule consistent with those preferences.

## II. Extending the Schelling Model with Artificial Neighborhoods

The current work described here was designed to explore the robustness of the Schelling result within a dynamic, agent-based model. It was rooted within an "artificial society" in which the interaction of agents who live within simple social and economic environments were simulated over time. In general, artificial societies have (1) agents with internal states and preferences, (2) an environment that serves as "the medium over which agents interact" (Epstein and Axtell, 1996), and (3) rules that determine the behavior of the agents and how they interact with the environment. The variant exploited here considered a 2 dimensional environment within which residents could decide whether or not to move on the basis of a set of behavioral rules designed explicitly to mimic the Schelling environment. Neighborhoods were to be represented by grids of a known size; and each square in the grid represented one of 4 things: a black resident, a white resident, an uninhabited space in a neighborhood, or (eventually) a public good. We let residents' preferences be represented by a utility function of the form:

$$U_j = \sum_{i=0}^{n} 2^{-(d(i)-1)} - \sum_{k=0}^{n} 2^{-(d(k)-1)} \qquad (1)$$

In writing equation (1), we represented the distance of a neighbor of individual j's own race by $d(i) \geq 1$, the distance of a neighbor of a different race by $d(k) \geq 1$, and the number of neighbors within a range of vision by n. More specifically, the $d(\cdot)$ parameters in equation (1) indexed the distance between the residence of individual j and a neighbor's according to a convention that assigned the value 1 to neighbors living in the 8 blocks immediately adjacent to individual j, and the value 2 to neighbors living in the 16 blocks immediately adjacent to the first "concentric circle" of 8, and so on. The parameter n meanwhile reflected "vision" in the sense of how individual j defined his or her immediate neighborhood So n = 8 if individual j considered only the 8 blocks that were immediately adjacent to his residence so that $d(\cdot) = 1$. Of course, n = 24 if individual j considered all of the blocks within the nearest two concentric circles with $d(\cdot) = 1$ or $d(\cdot) = 2$; and so on, again.

The functional representation of equation (1) depicted the case in which residents' utilities were dependent solely on the racial composition of their neighborhoods. The specific form was chosen so that neighbors of same race would improve utility, but the marginal utility of a same-race neighbor would depreciate exponentially with distance. Indeed, if distance were a continuous variable, then the "marginal utility" of a like neighbor with respect to distance would be:

$$\{d(U_j) / d(d(i))\} = -2^{-(d(i)-1)} < 0, \text{ while}$$

$$\{d^2(U_j) / d(d(i))^2\} = 2^{-(d(i)-1)} > 0.$$

Equation (1) similarly shows that neighbors of the different race reduced utility, but that their marginal disutility also depreciated exponentially with distance. The integer 2 played no specific role other than attributing equal weight to the utility values of like and different race neighbors, any positive integer greater than one would have served the same purpose.

Residents were assumed to move to a better location if their utility at their present location fell below some specified threshold. A resident who was surrounded by equal numbers of opposite-race and own race neighbors would, for example, achieve a utility value of zero at his or her present location according to equation (1). Given a moving threshold value of zero, he or she and would not want to move; but a resident with threshold of more than 0 would be so inclined. Such an individual, with a threshold of say 10, would require a much greater percentage of own-race neighbors in the surrounding squares to be satisfied with a current location. The role of the vision parameter should now be clear. The vision parameter defined the size of a "local neighborhood" under consideration when moves were contemplated. A large range of vision meant that neighbors who lived relatively far away affected residents' utilities; of course, a small vision parameter focused residents' attention on only their closest neighbors. The careful reader may have also thought, and correctly so, that choosing an "anchoring" parameter greater than 2 for the utility function in equation (1) would allow for differences in the intensity of racial preference. The practical implications of these differences were, however, captured and examined by adjusting the moving threshold, instead.

We now turn to show how decisions to move were implemented and how they supported a workable definition of equilibrium. Suppose that the utility of some resident j at his or her current location were calculated to lie above some specified threshold. This resident would then not want to move. If the character of his or her neighborhood were later influenced by the moves of others, however, then resident j could have a change of heart and want to move, and this complication will eventually be accommodated. Before describing how, though, suppose that the utility of some other resident κ at his or her current location were calculated to fall below the moving threshold. He or she would then relocate to the square within his or her vision that maximized utility. If this move displaced a current resident, then that resident would simply move to an open square found in the direction of resident κ's initial location.

The moving criterion was applied to every resident in sequence until the moving decisions of all had been examined. Since any move made late in this sequence could change the decisions of residents whose decisions had already been contemplated, however, the entire process had to be repeated as long as one move was observed at any point in the sequence. Equilibrium was ultimately defined as a location pattern for all residents such that the location grids for two successive and complete rounds across all residents were identical. In other words, a neighborhood was deemed to be in equilibrium if no single resident displayed any further inclination to move. Notice that this equilibrium concept was entirely consistent the convention for a weak Nash equilibrium because it achieved a condition in which nobody would want to change behavior (i.e., move) *given the observed location of all neighbors within his or her field of vision.*

The authors constructed original computer code to simulate this environment; it is available upon request from the authors. Visual displays of the neighborhoods were produced to illustrate the results, but only initial and equilibria grids will be highlighted for a few cases here to illustrate the effects of changing the model's parameters. Initial conditions were produced in each case by randomly assigning a zero, one or "plus" to each grid square (pluses represented uninhabited squares). Each assignment was produced as an independent draw from a distribution that gave relatively likelihood weights of 0.25, 0.25 and 0.5 to white residents, black residents, or no inhabitants, respectively. The resulting pseudo-randomly generated array of zeros, ones, and pluses were therefore expected to display an equal number of white and black residents scattered among a twice as many uninhabited locations.

The left side of the top panel in Figure 1 displays such an initial neighborhood. The bottom panel of Figure 1 shows a Nash equilibrium for the same neighborhood that was established after 21 complete iterations that considered the incentive to move of each resident because nobody chose to move after the 20th round. Finally, the grids portrayed on the right sides of the two panels of Figure 1 display utility levels for each of the residents. The initial distribution is shown on the top, and the equilibrium distribution is shown on the bottom. Notice that a visual pattern of segregation is clear in the equilibrium neighborhood, and that total utility is higher across the equilibrium neighborhood than it was in the initial random configuration. We used these patterns to draw conclusions about the power of personal preferences in creating segregate neighborhoods by comparing initial patterns with their associated equilibria configurations and the size of the resulting gains in aggregate utility.

## III: The Role of Individual Preferences on Racial Composition Alone

We begin by reporting results from two artificial neighborhoods in which residents' utility functions took the form portrayed in equation (1) so that their utilities depend only on the racial composition of their neighborhoods. Both represent variants of the Schelling case in which residents decide to move if utility falls below a threshold of 0; i.e., residents move unless at least 50% of the residents in their neighborhoods are of the same race; Small and large vision parameters define two cases of initial interest.

The first case simulated a neighborhood of residents with Schelling-type low utility thresholds for (not) moving utility and relatively small neighborhood vision; i.e., a relatively small collection of locations formed the effective local neighborhoods upon which residents' utilities were generated. The vision parameter was, more specifically, set so that residents effectively defined their "local neighborhoods" in terms of the surrounding 36 grid-cells. In a small town, this area could be a block or perhaps a single apartment building. Figure 2 displays initial conditions and equilibrium results in two dimensions. Note that Schelling's segregation conjecture was clearly supported. Although every resident would have been content with a neighborhood containing an equal number of own-race and opposite-race neighbors, the collective action of all residents taken together created segregated neighborhoods. Indeed, the equilibrium grid of Figure 2 shows strong segregation. Clusters of zeros and ones are obvious, and few zeros are adjacent to a 1. The mean utility level rose from 1.41 in the initial neighborhood to 5.64 in the equilibrium neighborhood.

The second case expanded residents' vision so that the size of a neighborhood rose from 36 to 80, and Schelling's conjecture continued to hold. The segregation in the equilibrium neighborhood was, in fact, even more obvious than before. Indeed, the equilibrium grid broke into two areas: the middle, dominated by a huge cluster of ones and the outer edges, where smaller clusters of zeros were gathered. This result suggests that segregation is positively correlated to the vision parameter—an observation that is also consistent with Schelling's hypothesis. If segregation were a function of the aggregate preferences of a neighborhood, then a larger collection of individuals should be expected to produce a larger degree of segregation; i.e., residents who are concerned with far-away neighbors will tend to live in more segregated neighborhoods.

Cases 1 and 2 strongly support Schelling's hypothesis *in the absence of any other influences on utility.* The next section addresses this obvious shortcoming by introducing site-specific local public goods that also provide utility.

## IV. The Effect of Local Public Goods on Racial Composition

We next considered residents who faced a trade-off between utility provided by a spatially explicit

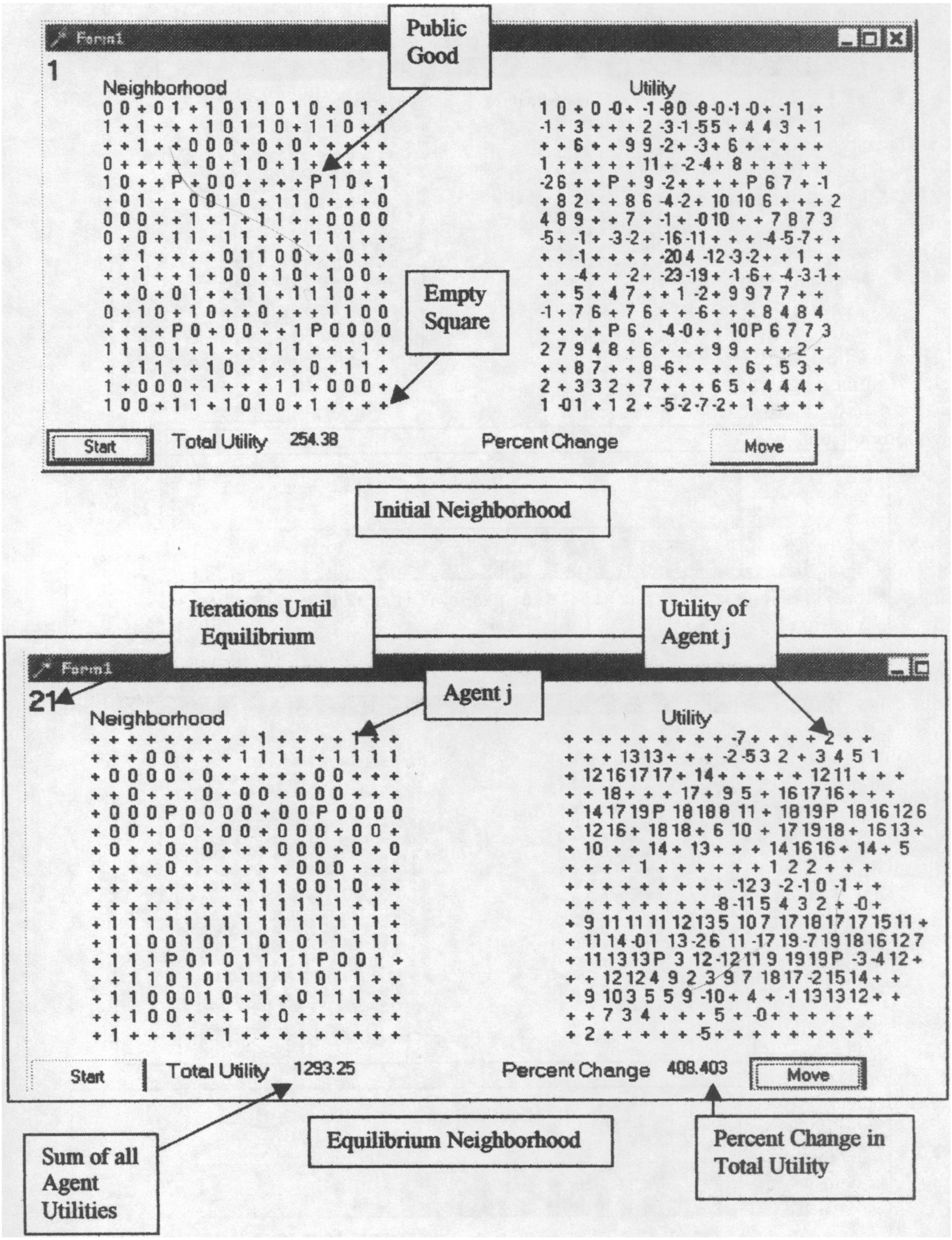
Public Good
Form1
1
Neighborhood
Utility
Empty Square
Start
Total Utility
254.38
Percent Change
Move
Initial Neighborhood
Iterations Until Equilibrium
Utility of Agent j
Form1
21
Agent j
Neighborhood
Utility
Start
Total Utility
1293.25
Percent Change
408.403
Move
Sum of all Agent Utilities
Equilibrium Neighborhood
Percent Change in Total Utility

FIGURE 1.

**CASE 1:** *low threshold, low vision (threshold=0, vision=3)*

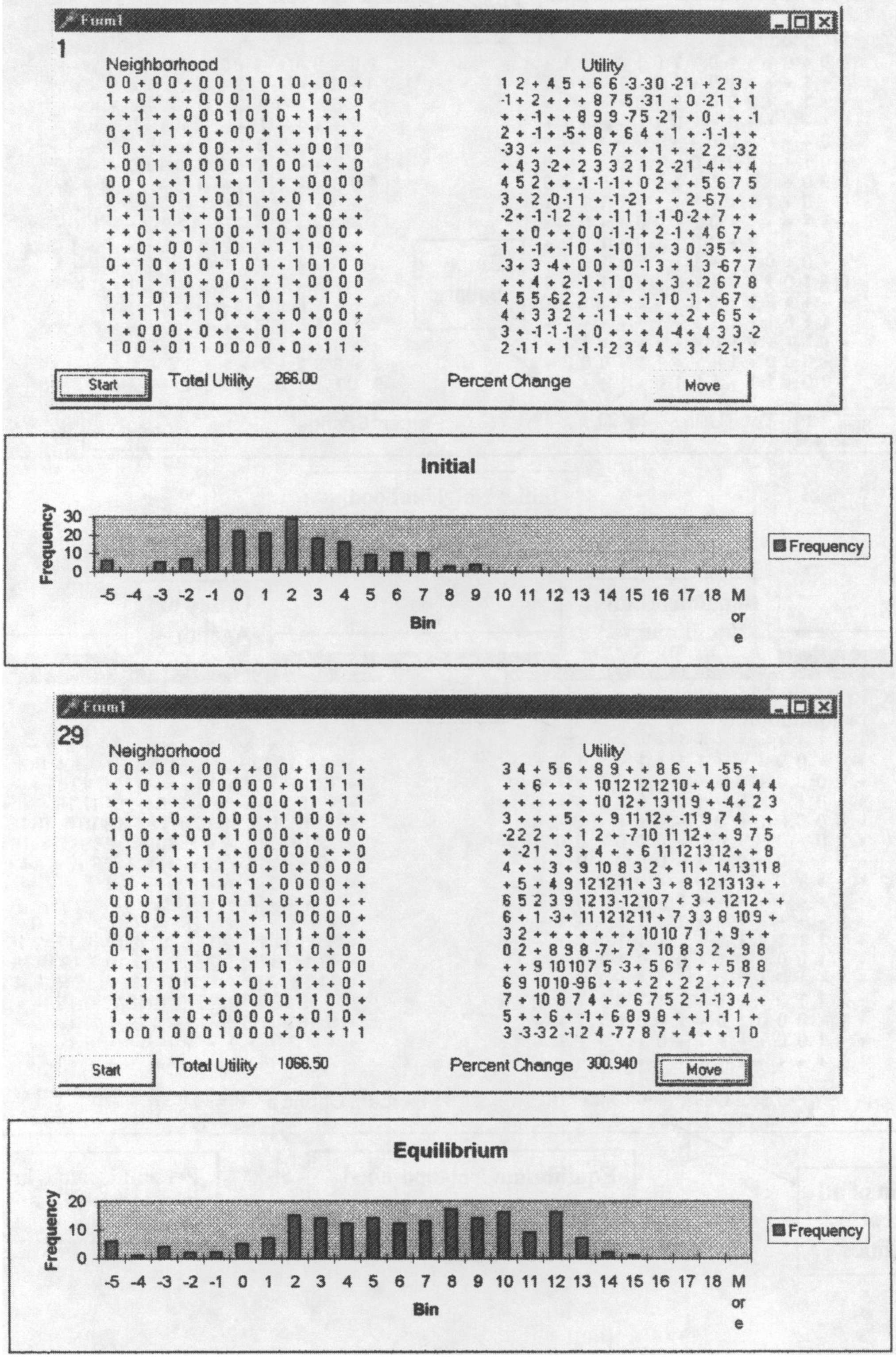


FIGURE 2.

public good and the utility provided by the racial composition of their specific neighborhoods. If the public good were extremely valuable, then residents might see their utilities exceed the moving threshold regardless of the racial composition of the local neighborhood. If the public good were less valuable (or farther away), though, then residents' decisions would be dominated by the racial considerations explored above. This section explores the dimensions of this obvious tension between two motives for choosing a place to live.

The trade-off between public goods and racial preference was incorporated within a utility function that explicitly reflected the relative value of a public good. More specifically, utility for each individual in the artificial society now took the form:

$$U_j = \sum_{i=0}^{n} 2^{-(d(i)-1)} - \sum_{k=0}^{n} 2^{-(d(k)-1)} + \alpha(\beta - 2^{d(j)-1}) \qquad (2)$$

where d(j) was the distance of resident j from the nearest public good, $\alpha$ represented the overall value of the public good, and $\beta$ represented the importance of being close to the public good. Notice that the marginal utility of the public good, as depicted in equation (2), declined exponentially with distance in exactly the same way as the utility or disutility of neighbors of the same or different race. The public good's overall ability to influence utility was, however, defined by the $\alpha$ and $\beta$ as well as vision. It is helpful to think of $\alpha$ as a "power" parameter and $\beta$ as a proximity parameter. To see why, notice that $\alpha$ worked as a multiplier so that doubling $\alpha$ doubled the amount of utility a resident receives from a public good. Meanwhile, $\beta$ reflected the significance of being located close to or far away from the public good. While $\alpha$ and $\beta$ directly affected the strength of a public good, though, be clear that vision had only an indirect effect. Only residents who could "see" the public good could receive utility from its "consumption." If vision were set so that the nearest 36 grid squares were "in sight," then the only the nearest 36 residents to the public good could receive any value. And if vision were expanded to include two more "concentric circles" of grids, then nearest 80 neighbors would receive utility from the good. The cases explored below were defined by various combinations of these three critical parameters with the moving threshold set at 0 and again at 10.

### *IV.1. The Effect of Weak Public Goods*

Two cases located 4 weakly valued public goods at specific points in the simulated neighborhood. Case 3, for example, simulated a neighborhood where the value of the public goods was relatively small for residents with limited vision a low utility threshold for moving (i.e., $\alpha = 1$, $\beta = 8$, threshold = 0 and vision = 3). Notice that $\alpha = 1$ and $\beta = 8$ meant that a resident adjacent to a public good would receive 8 utils from the use of that good, a relatively small amount when one considers that the resident could receive the same amount of utility if she were surrounded by own-race neighbors. The low threshold value meant, though, that residents were easily content with a low-level of utility.

The grids in Figure 3 show that this environment produced little in the way of support for the Schelling hypothesis. Residents did not move towards public goods, either; and so the result that racial clustering was not evident was more a reflection of low-utility expectations than the power of the public good. The histogram of initial utility helps to explain this lack of movement. Since the threshold value was set at zero, residents moved only when their utilities fell below zero; but few residents fell below the threshold even in the initial, random configuration.

Case 4 increased the moving threshold to 10 so that more people would be inclined to move from the beginning; everything else was the same. An extremely dynamic neighborhood resulted; residents dramatically increased their utility, on average, by flocking to public goods or by creating obvious racial clusters. Indeed, the equilibrium grid displayed two types of clustering—a Schelling-type racial clustering, *and* an equally tight clustering around public goods. Comparing the initial neighborhood to the equilibrium neighborhood, it was evident that residents at the outer edge shifted towards the center in order to enjoy the utility resulting from consumption of the public goods. To see why, consider an imaginary square whose corners were defined by the location of the public goods. In the initial neighborhood, approximately the same number of residents might live outside of the square as inside it. In the equilibrium neighborhood, though, hardly any residents would live outside the square. The inside of the square would, as a result, be densely populated with clusters of zeros and ones. The dense populations "inside the public

**CASE 3:** *Weak public good (alpha=1, beta=8), low threshold (threshold=0), low vision (vision=3)*

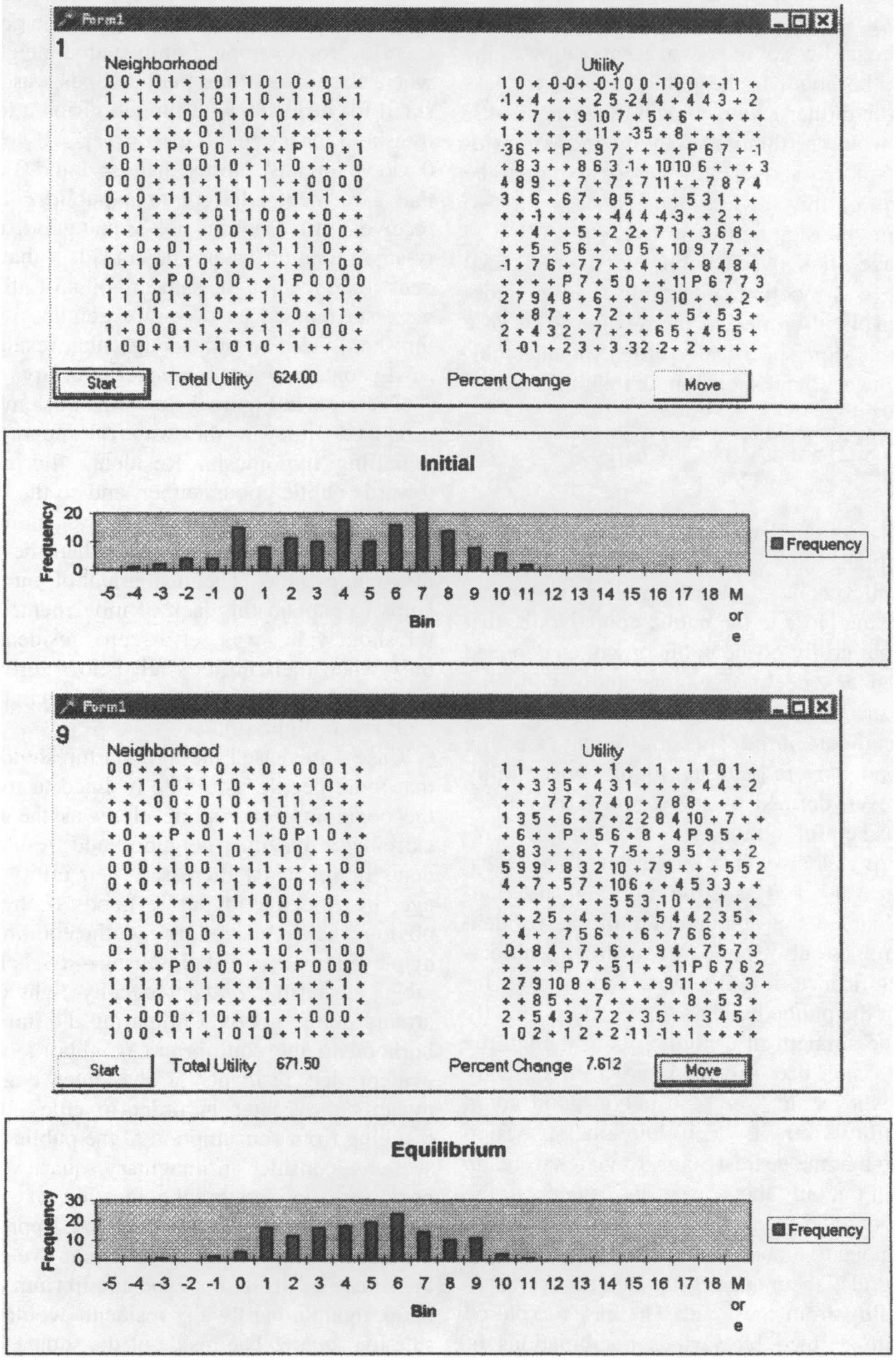


FIGURE 3.

good boxes" in the equilibrium neighborhood for this case suggested that residents could be satisfied in integrated neighborhoods as long as they are able to consume a public good. However, these "integrated neighborhoods" were really single-race clusters that were forced to be to each other by the power of the public good.

The histogram for this case showed that this clustering produced large changes in utility. The initial, randomly generated neighborhood supported utility levels that were mostly between 0 and 9; indeed, only a few residents fell below 0 and a similarly small number of residents rose above 9. In equilibrium, though, residents with much higher utilities were abundant. The modal level of utility was now 8, and there were approximately the same number of residents with utility greater than 9 as those with utility less than 9. This distribution supported a 76% increase in the mean utility across the community. The histogram also showed that more than half the residents were unable to reach the threshold level of utility; i.e., they did not move because there were no locations within their vision for which utility would be higher than where they were. The relative weakness of the public good seemed to set a relatively low limit on potential resident utility.

Before moving on to other cases in which either vision or the utility value of the public goods were increased, it is worthwhile to pause briefly to discuss the robustness of the results reported thus far. Each case was examined across multiple randomized runs of the model to assess the stability of at least the qualitative results. Testing stability was, of course, difficult because the results could only be examined visually and were extremely path dependent. The model was, more specifically, designed to create visual representations of equilibrium neighborhoods derived from a specific initial geographical distribution; and so there was no reason to expect that any given equilibrium would match another. Segregation was easily visible for Case 4, for example, but was it a robust conclusion derived from the parameterization of utility or an idiosyncratic manifestation of the initial conditions?

The most efficient test of robustness looked at the distribution across the population of the percentage increases in utility generated as the neighborhood moved from its initial configuration to its ultimate equilibrium. Convergence in these distributions across multiple runs would suggest that they were generated by similar patterns of movement because this sort of convergence would suggest relatively comparable significance between racial composition of the immediate neighborhood and proximity to the public goods for all residents. To see this point, consider the results of 25 runs performed on 25 different initial neighborhoods with rules and utility identical to those in Case 4. Consider, in particular, a distribution of the percentage increase in utility for each and every resident utility as he or she moved into the equilibrium neighborhood. Figure 4 displays a histogram of the resulting 25 t-statistics for each distribution. It portrays a remarkable degree of consistency across the runs. Indeed, seventy-six percent of the runs resulted in a t-statistic between 1.5 and 1.6. The distributions of utility gains across the population were, therefore, remarkably similar in more than three-quarters of the runs. It is, nonetheless, impossible at this point to assign any degree of statistical confidence to the results. Future research designed to test the sensitivity of the qualitative results reported here by simulating across ranges of behavioral parameters would go a long way toward shedding light on their robustness and perhaps indicate how pervasive coherence might be translated into statistical significance.

### *IV.2. Weak Public Goods with Extended Vision*

Case 5 was identical to Case 4 except for the vision parameter; residents could now "see" up to 5 (rather than 3) concentric squares away. Extended vision had three effects on resident utility. First of all, the utility of any individual was now affected by up to 80 neighbors instead of 36. Secondly, each resident could now move to any of 80 houses or lots instead of 36. And finally, public goods now provided utility for residents up to 5 squares away. As a result, extended vision increased the maximum possible level of utility and made the moving threshold value more easily obtainable. As expected, extended vision produced "happier" neighborhoods in which the majority of residents were above the moving threshold utility value; but two types of clustering persisted in equilibrium. The equilibrium grid exhibited extreme own-race clustering in addition to clustering around public goods. On the whole, though, segregation was stronger than in the equilibria depicted for Case 4.

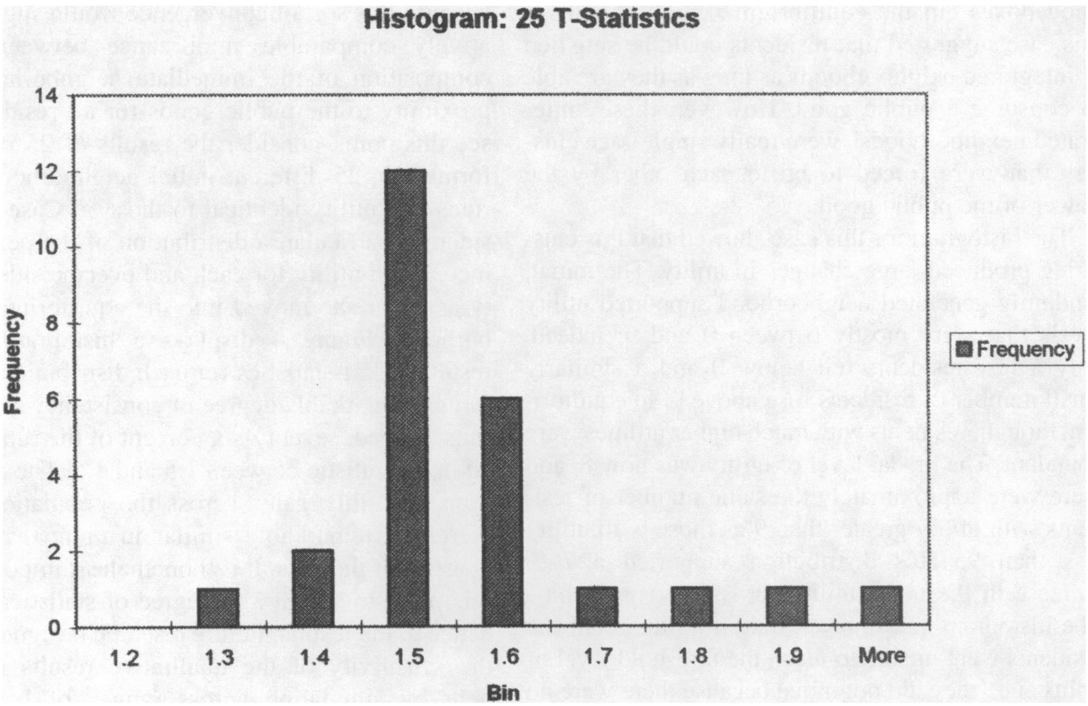


FIGURE 4.

Extended vision apparently increased segregation and clustering around even weakly valued public goods. This observation suggested that a local optimum might be less segregated than a global optimum. Why? An analysis of the utility distribution made the correlation between vision and utility clear. Extended vision meant that the utility distribution for the original neighborhood had a much smaller mean than in previous cases. Residents' utilities in Case 5 were affected by the nearest 80 residents (> 36 residents) so that there was a higher likelihood that average utility approximated zero (the law of large numbers at work). As a result, potential increases in utility generated by moving were, in percentage terms, higher than in earlier cases. In fact, utility increased by 408%—an amount that exceeded the 76% increase of the Case 4 example by nearly 6 times. Comparison of the histograms offered more insight. The histogram for the equilibrium neighborhood in Case 5 suggested that it became a neighborhood of extremes. The mode was 18 utils but a large number of residents had utility values of –5. These extreme values fulfilled the expectation that increased vision increases the range of utility. The greater number of choices offered by the increase in vision in Case 5 resulted in a neighborhood in which residents were more likely to be extremely happy or relatively unhappy; and few were simply "content."

### *IV.3. The Effect of Strong Public Goods*

Two cases investigated the effect of a strongly valued public good on segregation. Case 6 returned vision to 3 (36 squares) but changed $\alpha$ and $\beta$. The value of $\beta$ was smaller than in previous cases, signifying an increase in the importance of a resident's proximity to a public good. The importance of proximity was further increased by the increase in the value of $\alpha$. As a result, residents adjacent to a public good could now receive a utility bonus of 6 utils, while residents living two squares away from the good gained only 1.5 utils by consuming the good. It was expected that these changes would give the public goods a magnet-like effect and produce residents who would fight for spots adjacent to public goods.

Competition for spots next to public goods was fierce in this case. Residents did not "settle-down" even after 30 rounds, and movement continued especially in proximity to the public goods. Churning in these areas resulted in utility values that were below the threshold level, but it also eventually produced relatively integrated neighborhoods. Integration prevented residents from achieving high levels of utility, though, and residents tried to find small clusters of own-race residences near the public goods

Case 7 duplicated Case 6 except that $\alpha$ was set equal to 2. This made the value of the public good twice as high as it was in Cases 3, 4, and 5 (ceteris paribus) and 25% stronger than it was in Case 6. Did this change exaggerate the "magnetic effect" of the public good and finally overcome Schelling-type segregation? Yes, to a large degree. The areas surrounding public goods were not significantly segregated and that the highest utility values flowed to the residents who were located closest to the public goods. Unlike Case 6, where the majority of residents continued to try to move because they were below the moving threshold level and opportunities still existed, most Case 7 residents achieved utility values that exceeded the threshold Indeed, the increased power of the public good pushed the residents near public goods above the threshold level despite the racial diversity of their neighborhoods. The result was a stable, relatively integrated, and happy equilibrium neighborhood. This stability could not be achieved in Case 6 where the public good was not strong enough to overpower the disutility of integration.

It is important to note that Cases 6 and 7 produced different results, but that the differences were not as visually apparent as they were in earlier comparisons. The levels of segregation depicted in Cases 6 and 7 were really quite similar. Indeed, given the qualitative character of the visually displayed results, it was difficult to make a robust claim that the neighborhoods depicted in Case 7 were more or less integrated than the neighborhoods depicted in Case 6. The real difference between the two cases lay in the dynamics of residents' desires to move or stay put. Case 7, with its very strong public good, portrayed a stable, equilibrium neighborhood inhabited by relatively happy people; but Case 6, with its slightly less valued public good, could not sustain a stable equilibrium of satisfied residents. Between the stability of segregated neighborhoods clustered around weakly valued public goods and the stability of more integrated neighborhoods clustered around strongly valued public goods must lie cases of instability and unrest.

## V. Concluding Remarks

Each of the cases simulated here produced equilibria with some degree of racial segregation. The results therefore sustained Schelling's conjecture that individual intent is not necessarily related to the collective result of neighborhood segregation. In all of the simulations, each individual would have been content with a local neighborhood in which approximately half of the residents were of the same race; but all individuals acting together with this motive seemed to produce segregated neighborhoods. The Schelling conjecture was undermined to some degree by inclusion of local public goods, but only if they were highly valued. In those cases, proximity to the public goods worked against the disutility of mixed neighborhood so integrated neighborhoods became more likely. If the public goods were not highly valued though, the segregation persisted or unstable and chaotic neighborhoods persisted.

The high degree of segregation exhibited here was clearly dependent on residents' utility functions. The functions employed here assumed that individuals value living near people who are like them. However, a myriad other real-world variables (like public goods) could also play a role. Social status, class, income and proximity to work quickly fill a list of variables that were ignored. Clearly, these omitted variables could easily play a bigger role in resident utility than race or proximity to public goods. Nonetheless, this work perhaps offers a partial explanation for why American cities continue to be segregated and/or unstable.

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