A Challenge to the Ownership Society: Does Home Ownership Alone Improve Relative Neighborhood Quality?

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ABSTRACT

In this paper we use agent-based modeling to explore what we identify as the housing policy paradox: that individuals are encouraged to use ownership as a mechanism for escaping low quality neighborhoods while policy designs depend upon ownership as a catalyst to improve neighborhoods and communities under the logic of the ownership society. This apparent contradiction would suggest that if policy depends upon ownership to drive quality improvement in communities, then it is likely that high-quality areas will improve at greater rates than low-quality areas thereby widening the gap. We specify our model in order to understand this policy construct and find that, indeed, the gap widens when individuals seek to own in higher quality areas and when renters are considered to be detrimental to the quality of the community. We explore further by limiting the information available to agents in the model to determine if this has any influence upon relative quality change. While limiting the options for agents does reduce the difference in relative change between high and low quality communities, it does not close the gap in neighborhood quality between high status and low status communities.

Key Words: housing, ownership, agent-based simulation, neighborhood, homeownership

Introduction

In this paper we explore housing policy assumptions through the use of a simple agent-based model. Agent-based models are very useful in the policy field for the purpose of explicitly engaging the outcomes of commonly held assumptions that are not easily verified through traditional empirical methods. We discuss what we see as a paradox in housing policy involving neighborhood quality and homeownership. Underlying many individual-based policies for community development is the belief that ownership enables households to move to higher quality neighborhoods and that ownership itself influences the quality of neighborhoods. Much of the discussion about this dynamic is derived from ex post analyses of neighborhood composition. In this model, we intend to show how this assumption of upward mobility is expressed through strategic movements of households and what this means for the changing composition of neighborhoods, particularly focusing on those neighborhoods at the lower end of the quality spectrum.

We will begin the discussion by reviewing the method of agent-based simulation followed by a brief explication of what we call the housing policy paradox. We will then present our model and discuss how modifications to the assumptions underlying the behavior of the model explain different dynamics in changing quality composition and settlement patterns of renters and owners. We will conclude with a brief discussion about how this model can be expanded.

Agent-Based Modeling and Simulation as Method

It is not necessary for us to outline the use of simulation as a technique for social inquiry, as its utility for these purposes has been aptly demonstrated elsewhere (Axelrod, 1997b; Axtell, 2000; Bonabeau, 2002; Gilbert and Terna, 2000; Smith and Conrey, 2007; Tesfatsion, 2006). It is important, however, to consider where simulation and, particularly, agent-based modeling (ABM), stands as a methodological approach to policy analysis. Axelrod refers to simulation as a "third way of doing science" that "can be used as an aid" and as "a way of doing thought experiments" in which we expect that, despite simple assumptions, we observe non-obvious consequences (Axelrod, 1997a).

The classic example is Schelling's exposition on sorting in which he demonstrates that, despite relatively benign preferences about the similarity of our neighbors to ourselves, it is likely that segregatory settlement patterns will result from interactive sorting behaviors (Schelling, 1971, 1978). Moreover, Axelrod extols simulation as an alternative to the rational choice paradigm that has dominated economics (and vicariously public affairs) by permitting researchers to explore adaptive behavior. This ability of researchers to avoid the simplifying assumption of *homo economicus* opens many avenues for research since, as Axelrod explains, "simulation is often the only viable way to study populations of agents who are adaptive rather than fully rational" (Axelrod, 1997a 18).

Researchers recently have attributed many virtues to simulation as a mode of inquiry. Janssen and Ostrom (2006) discussed the challenges that social science researchers face in designing and conducting experiments. We face both ethical and practical constraints, and indeed we are inquiring into the actions and behavior of subjects who are able to reflect upon their condition and have expectations based upon their experiences. Simulation techniques have a role in allowing us to create artificial worlds in order to conduct experiments when we would otherwise be unable for practical or ethical reasons. For inquiry into neighborhood and community development, ABM is a very powerful tool that allows researchers to directly engage their assumptions and algorithmically explore interrelations.

Nevertheless, ABMs have a very apparent limitation as an experiment, namely that in order to construct the simulation environment, we must know beforehand something about the agents. This suggests that simulation, and ABM in particular, is limited as a standalone technique for inquiry, and that we should explore the limitations as well as the advantages. If we intend to use ABM as an experiment, it is perhaps useful to couple it with empirical information about the population or the environment.

For example, we can simply validate our behavioral models through ABM by using the simulation environment to test various behavioral assumptions. But, conversely, we can also introduce controlled laboratory experiments that provide insight into the behavior of individuals in a particular context as an input into the ABM (Poteete, Janssen, Ostrom, 2010). As a tool of this type (experimentation), ABM is best situated along with other approaches to inquiry and not as a standalone procedure of simulation. This will be discussed in more detail below, but note that the model itself must be considered in the context of some intent, otherwise we are apt to misconstrue the evidence that the model provides. The former use in which we validate our behavioral assumptions is what we call exploration. The latter example in which the model is

used with the previous research as an input is an experiment. In this paper we are more concerned with the exploration of the assumptions that form the basis of policies that encourage ownership as a tenure choice.

The Housing Policy Paradox

The basis of our inquiry is recognition that there is, within national housing policy, a paradox in which two objectives are clearly at odds. On the one hand, policy is designed to make homeownership affordable based upon the belief that ownership is good for individuals and families. Low-income households are encouraged to enter homeownership, and in doing so they are typically urged to purchase in high-quality neighborhoods: ownership is seen as a step toward financial security and social stability, although it is not always the case that low-income households enjoy such benefits (Newman, 2008; Reid, 2007; Shlay, 2006). Ownership is also correlated with positive neighborhood characteristics such as reduced crime, better schools, and higher-quality amenities. Consequently, policy encourages community development through strategies to increase local ownership levels under the assumption that high levels of ownership will improve the quality of the neighborhood or community (Belsky, Retsinas, and Duda, 2005; Galster and Killen, 1995; DiPasquale and Glaeser, 1999). So, to be clear, at the individual level, families are encouraged to enter ownership in order to escape the low-quality neighborhoods in which they resided as renters while, at the social level, ownership is itself a catalyst for neighborhood improvement. At the individual level, households seek to optimize their opportunities through moving to the best area possible, while in aggregate policies are designed with the expectation that ownership itself will improve neighborhoods. We encourage families to move out of the very neighborhoods that we seek to improve.

In order to gain insight into this paradox, our model presents a world consisting of areas with varying levels of quality and heterogeneous agents (households), some of which are renters and some of which are owners, seeking to settle in a location that satisfies a randomly assigned threshold of satisfaction. The simple construction of our world is based upon the rule that owners improve the quality of neighborhoods, which ties directly into the precept adopted in policy designs that homeowners and ownership in general improve neighborhoods. Our model also includes contingencies, including the rule that renters reduce quality, which relates to the construct that being a renter is equivalent to being a lower-grade citizen (Shlay, 2006; DiPasquale and Glaeser, 1999). Neighborhoods themselves are a function of the inhabitants. This is the basic construction of our model, a simple explication of housing policy in which there is a world with renters and owners vying for a position in the best possible place.

Adding complexity is an important dimension of ABM, and we do this by assigning agents with wealth, income, and satisfaction-thresholds (a way of assessing how difficult it is to please the person). Neighborhoods are also dynamic, changing with each new inhabitant. Also, areas have varying levels of value, so we can also explore how income inequality potentially influences the spatial sorting (which also enables us to explore affordability policies more directly). We do not, in this paper, engage the multitude of questions that can be related to ownership and community composition, but our model is designed to do so in future research. In the case of this paper, however, we are focused upon the issue of ownership and rentership as it relates to changing neighborhood quality. In the next section we will explain in more detail the specifications of the model.

Model Parameters

Our model posits a variable number of housing units with different preferences about renting and owning seeking to locate in the best area possible. Table 1 outlines our basic model characteristics.

Table 1. Parameters and Characteristics of Agent-Based Modelof Housing Policy and Sorting

Agent Characteristics	**Initial value**	**Dynamic value**
satisfaction	random assignment	function of patch quality, proximity to other owners and renters
satisfaction-threshold	random assignment	constant once assigned
wealth	random based upon initial location	changes with income and move
income	random assignment	constant once assigned
dislike-of-renting	random assignment	constant once assigned
happy?	binary	1 if satisfaction-threshold is less than satisfaction
Location (patch) Characteristics		
quality	Assigned according to constructed map of values	changes based upon renter effect and owner effect
value		changes according to value of neighbors
category	1,2,3 based upon initial quality	constant once assigned
Model parameters		
renter effect	variable	influences the effect of renters on the quality of the nearby households
owner effect		influences the effect of owners on the quality of nearby households
neighborhood effect		influences the quality of patches only if the mean of nearby patch quality is higher than quality of individual patch
initial homeowner rate		constant once assigned

For the model developed as part of this project, our interests were in explicating some of the key assumptions structured into housing policy in order to assess the extent to which these assumed behaviors of individuals help explain underinvestment and/or disinvestment (in terms of ownership levels and how it feeds into changing quality) in low quality communities, where presumably investment is most needed. Regarding the behavior of individual agents, therefore, we assume that, *ceteris paribus*, households:

- Prefer owning in a *relatively* "higher quality" community
- Prefer investing in communities with a larger concentration of owners versus renters

In the context of present policy, these assumptions about households are taken for granted, and our model seeks to uncover the logical consequences of individuals interacting within a framework of these particular rules of behavior. This is the arena of ABM for policy analysis – policies have been directed at individuals and communities with explicit assumptions about behavior, and our role as analysts is to reveal the consequences of these assumptions on social systems.

Agent-based models are especially useful in policy analysis because they enable researchers to explore more deeply the consequences of assumptions driving policy, a use of simulation analysis that can be equated with experimentation.The key difference between evaluation, the traditional arena of policy analysis, and experimentation, as we conceive of it, is the temporal nature of the analysis. Evaluation has an *ex post* perspective, assessing the effects after a policy has been implemented and the rules of behavior have been established in the model. We view experimentation as an *ex ante*exercise, offering policy analysts the ability to explore scenarios in a controlled setting when such social experimentation is impractical or ethically problematic due to the potential effects on actual participants and communities. The use of agent-based models for purposes of experimentation is similar to evaluation in that experimentation involves the comparison of counterfactual scenarios. The difference with experimentation is that we can reasonably relax the behavioral assumptions applied to the evaluation model in order to investigate the consequences of altering the social decision-making apparatus or the rules themselves.

While most would agree that Americans favor homeownership (Aaronson, 2000; Engelhardt et al., 2010), it may not be the most appropriate tenure option for some individuals, and this recognition is noticeably missing in actual policy (Shlay, 2006; Reid, 2007; Van Zandt and Rohe, 2006). It is simply impractical to adjust suddenly the preferences of households not to prefer ownership (or even, in some circumstances, prefer renting: a Fannie Mae National Housing Survey found that, in 2004, 63% of respondents noted that owning a home is "something that I have always dreamed of doing" and over 84% saw it as a good long-term investment, even the best among mutual funds, IRAs, stocks, and bonds: ownership was well-ingrained through policies that emphasized it – even after the housing crash two-thirds of respondents prefer ownership (Fannie Mae National Housing Survey, 2010). This social construct in which ownership is regarded as a national goal has very real impacts upon not only citizens but also communities and policy designs.In the following model we seek to explicitly engage this construct which suggests that ownership is itself a cause of improvement in order to explore what this national goal means for those communities that need improvement most.

Policy and Model Framework

American tenure policy has been based upon the notion that enabling residents to become homeowners has societal-level benefits. This idea, a common facet of the "ownership society," is a hallmark of housing tenure policy in the United States and, as we have outlined, has become an important social construct. We explore the logical consequences of this policy goal by honing in on two core assumptions: that owners are inherently good for a community because they improve the quality of the neighborhood and that renters as not-owners are detrimental to a community. These ideas are defined in our model as renter-effect and owner-effect.

The housing policy paradox that we identify provides the context for our model. We expect, given the behavioral assumptions inherent in housing policy constructs, that the quality divide between high and low quality neighborhoods will widen if we accept these core premises of policy:

1. That neighborhood improvement is primarily driven by ownership (the so-called "ownership society")

2. That prospective owners seek to move to the highest quality area that they can

3. That high concentrations of renters diminish the quality of neighborhoods (as they are considered to be less committed citizens to the community)

We include reasonable limits in our assessment of agent-behavior. We vary the information made available to those seeking to move by varying the distance that agents can "see" so as to limit what they consider to be available options for moving(Brown, Page, Riolo, Zellner, & Rand, 2005). Additionally, we include purchase behavior in the model so that individuals are not able to move constantly from place to place. If the agent moves to own, then it must wait an indeterminate number of turns before it can move again; its wealth and a randomly assigned income level determine wait-time. We also test explicitly the higher-level patterns emerging from considerations of whether or not renters adversely affect a neighborhood and the magnitude by which owners positively affect the area.

We also include a temporal dimension to the model. In our case, we modeled each tick as a year under the assumption that individuals do not move more than once a year. Our model is run under a limit of 40 ticks, which in our view is 40 years.

Model Specifications

Residents have varying levels of satisfaction and varying thresholds of satisfaction. When their satisfaction drops below their satisfaction threshold, they are no longer happy and seek to move. Their ability to move is limited by both their available wealth and distance. Residents can only see as far as we dictate in the model, and we also model very simple logical procedures that dictate the dynamics of satisfaction and quality. At each iteration, residents' satisfaction levels are reassessed according to the logic in statement 1. In statement 2, we provide the logic for the changing quality of the neighborhood.

Logic statement 1

An agent's satisfaction is a function of the quality of its present location, the number of neighbors that are owners (influenced by the variable owner effect) and the number of neighbors that are renters (influenced by the variable renter effect). If an agent is a renter, then the presence of other renters has less of an effect than it does upon owners.

Logic statement 2

If the number of *renters is greater than or equal to the number of owners* in the surrounding neighborhood, the quality decreases by a variable factor multiplied by the present quality. So, if the renter factor is 4 and the present quality is 10, then the new quality will be 10 – (0.04*10) = 9.6. Consequently, the higher the quality of the area beforehand, the greater is the impact of renters.

If the number of *owners is greater than the number of renters* in the surrounding neighborhood, the quality increases by a variable factor multiplied by the present quality. So, if the owner factor is 4 and the present quality is 10, then the new quality will be 10 + (0.02*10) = 10.2. Consequently, the higher the quality of the area beforehand, the greater is the impact of owners.

This suggests that the relationship is exponential – that as a neighborhood improves, the presence of owners improves the area even greater up to a limit that we arbitrarily set.

A very important consideration is the temporal scheme of the logic in the model. In our case, at each moment the patches first update quality and then the agents assess their satisfaction based upon the new quality levels.

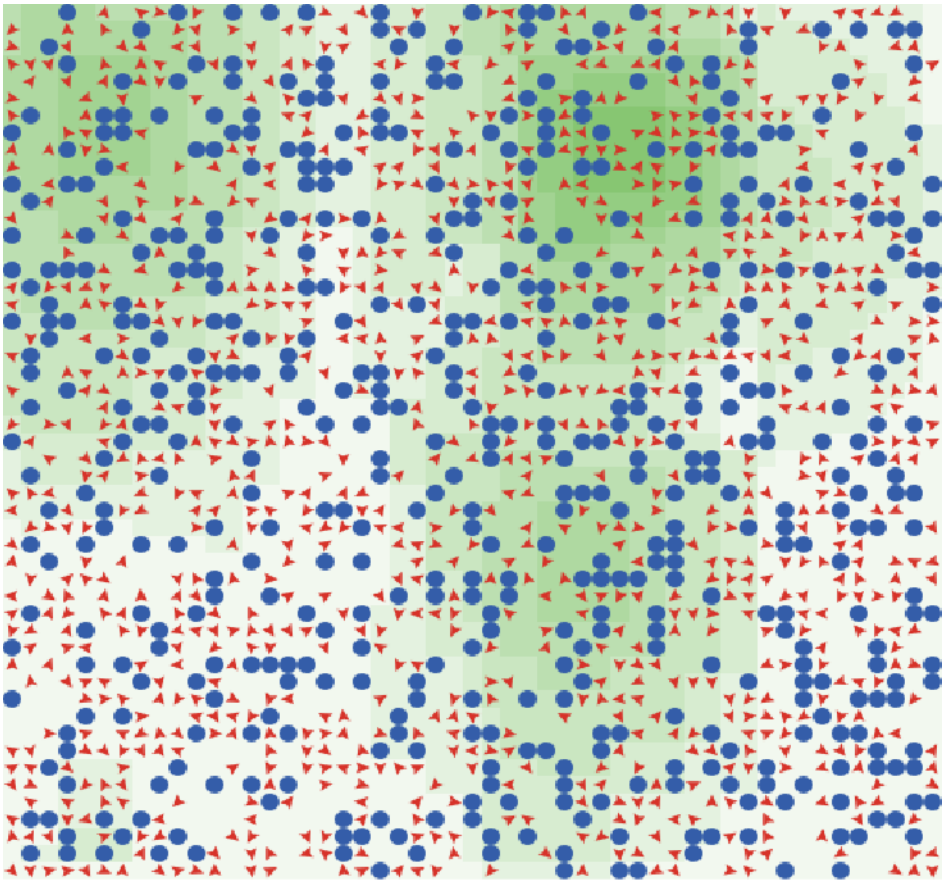
Initial values for patches in the model are provided in Table 2. To build the space for the model, we first assigned arbitrary patches with random values, and then built a gradient scale around those values to assign quality to other patches. The idea behind this procedure was that proximity to core areas of high quality increased the quality of certain patches. Figure 1 illustrates an initial setup. The darker regions are areas of higher quality; arrows are initial owners and circles are initial renters. All residents are initially assigned to a random location.

There are structural limits that we incorporate into the model. The quality of a single patch in a neighborhood can never exceed a value of 20, which is roughly three and a half times higher than the average of the highest quality neighborhoods at the outset of the model. Thus, we should not expect the relative change of the category 3 neighborhoods to exceed 3.5, while the category 1 neighborhoods could increase their quality fifteen-fold.

Table 2. Initial Values for Patches (Neighborhood Quality Measures)

	Initial number of patches		Initial average quality
Low-quality neighborhoods Category 1	1193	*45.87%*	1.335
Mid-quality neighborhoods Category 2	794	*30.53%*	3.457
High-quality neighborhoods Category 3	614	*23.61%*	5.979
Total Parcels	2601	*100%*	3.079

Figure 1. Example of a random initial setup



The blue circles represent initial renters, the red arrows represent initial owners. The quality of the patches is represented by the darkness – the darker the patch, the higher the quality.

As previously stated, housing policy is built upon two core precepts: that ownership is good for communities and that individuals buy homes in the best area possible. The latter point is highly dependent upon what options are considered in the agent's decision formula. The notion of "best" relates only to those options explicitly considered by the buyer. Consequently, if

individuals can only "see" around their neighborhood, then they are more likely to commit to that area through ownership. However, if they are able to compare other areas directly with the parcels available nearby, then they are more likely to encounter a "better" parcel distant from their present location. As mentioned above, we use vision as a proxy for information. We expect that the improvement gap will widen as the vision variable increases.

Model Runs

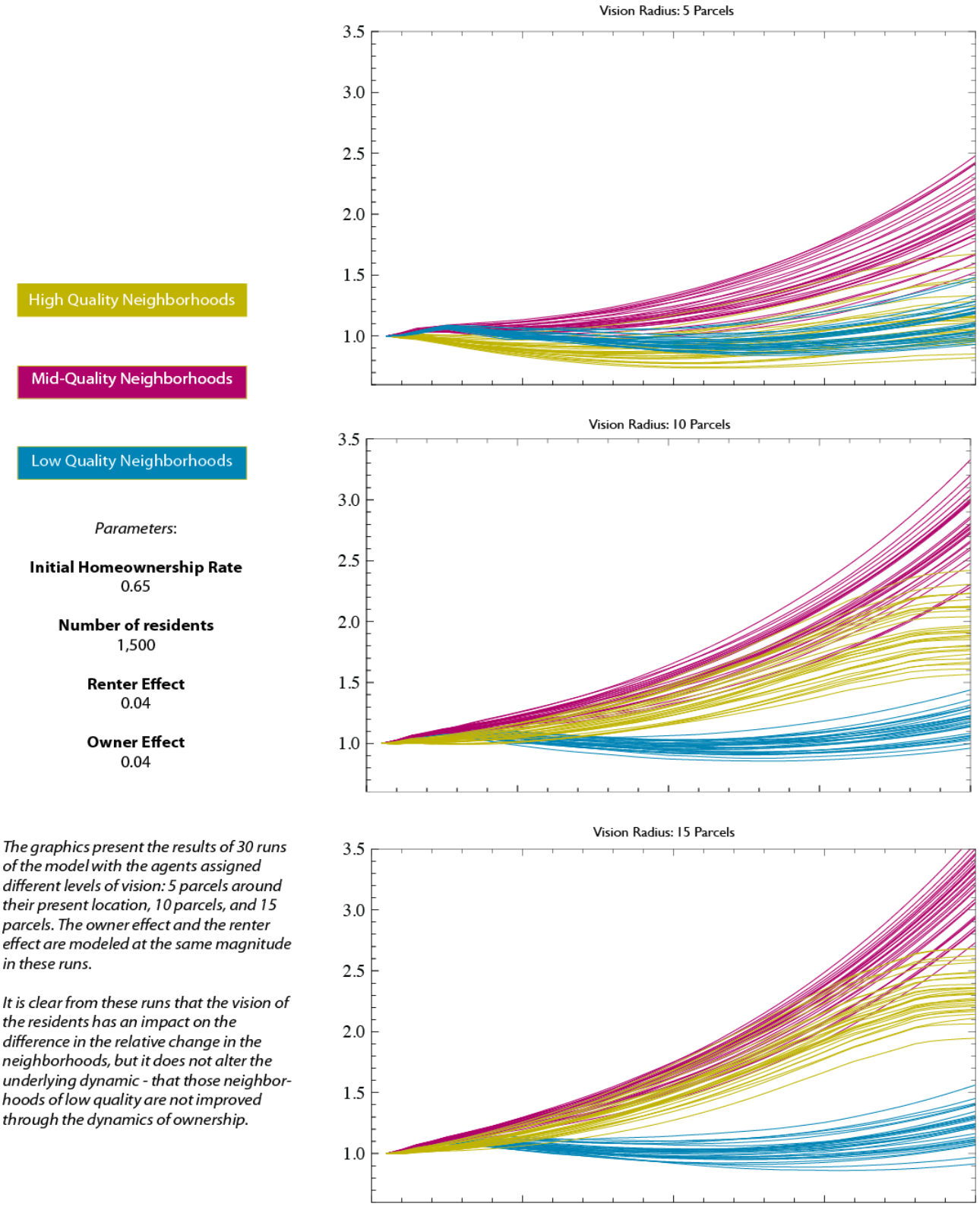
We ran the model over 30 iterations varying the information available to the agents by changing their vision. Before presenting the output from the model runs, let us revisit the purpose:

> We expect that, assuming ownership improves neighborhoods and rentership adversely effects neighborhood quality, neighborhoods that begin of higher quality will improve more rapidly than those of low quality, thereby widening the quality gap.
>
> Additionally, we expect that the information available to residents in the form of their ability to see and process other options will exacerbate the quality gap as information is more readily available.

Using the different parameterizations of the model, we are able to make particular claims about the consequences of our assumptions. We will focus upon what happens when the vision of the agents varies. To do this, we run the model 30 times on three different settings with everything else equal. For one set of runs, we compared the outcomes when the agents could see five parcels around their present location, a second run compared ten parcels, and a third run compared fifteen parcels. In none of the three sets of runs can the agents see the entire world, so information is never complete. The results from these 90 runs are presented in Figure 2.

The three graphics suggest that our intuition was correct – that given the structural limitations that we embedded, ownership as a catalyst for the improvement of communities benefits high quality neighborhoods more substantially. However, the limitations on information (in the form of vision) do appear to have an impact upon the growth of the divide. When we limited the agents' vision to five parcels, the high quality and low quality neighborhoods had roughly the same relative change. Nevertheless, this does not bode well for the low-quality neighborhoods. If the relative change is the same

Figure 2. Three Runs of Model Varying Information Available to Agents



The graphics present the results of 30 runs of the model with the agents assigned different levels of vision: 5 parcels around their present location, 10 parcels, and 15 parcels. The owner effect and the renter effect are modeled at the same magnitude in these runs.

It is clear from these runs that the vision of the residents has an impact on the difference in the relative change in the neighborhoods, but it does not alter the underlying dynamic - that those neighborhoods of low quality are not improved through the dynamics of ownership.

We find convincing evidence that depending upon ownership alone to drive community development is likely to be an ineffective measure since individuals will tend not to purchase in areas of low quality. This suggests that other efforts at community development, namely place-based policies, may play an important role. In future specifications of the model, we intend to explore how place-based policies reshape the development trajectory.

We also did not include variable preferences in our model. We viewed quality as being an exogenous constant across all individuals when in reality the quality of a neighborhood depends greatly upon the perceptions of residents and their local experiences. It could be the case that individuals experience a stronger attachment to their local communities and may be more inclined to purchase near their previous location. To a certain extent the limitation on vision captures this, but we would like to explore this more explicitly through networks in future models.

Conclusion

This essay used agent-based modeling in order to understand more deeply the rhetoric driving housing tenure policy in the United States and the assumptions underlying American housing policy. Our experiments were conducted in the tradition of Axelrod's third way of doing science in which simulation is used as a process of conducting thought experiments in the social sciences. We wanted to explore what we identify as an underlying paradox in housing policy in which individuals are encouraged to use ownership as a mechanism for escaping low quality neighborhoods while policy designs rely upon ownership as a catalyst to improve neighborhoods and communities under the logic of the ownership society. Our expectation of such a paradox is that the quality gap between neighborhoods is actually likely to widen over time, especially as households have increasingly greater access to information.

An interpretation of our model must consider that we modeled quality as being a constant across all agents, which is in fact unlikely to be the case. This simplifying assumption does not consider how deeply agents may be tied to their local communities through networks and resources, something that future specifications will consider. A more direct interest upon affordability will also improve the model, especially since this is the core concern of present housing policy. Nevertheless, the fact that we did not incorporate these variables does not discount the overall finding (with these variables effectively controlled for) – that indeed the quality gap expands if we depend upon ownership as the catalyst of community development and consider prospective owners to be calculating agents who seek the best quality for their residence.

With these findings in mind, we suggest that community development strategies that focus more locally upon place-based policies for development are likely to be more effective than policies that focus nearly exclusively upon individually-based outcomes. We further assert that the use of models of housing and settlement patterns to better understand how assumptions about individual behavior play out at higher levels can enable policymakers to shape better policies for community development. Finally, given the extraordinary complexity of dynamic housing environments, our results suggest that ABM is an extremely useful tool both to complement other forms of empirical research on housing policy as well as to explore the implications of the assumptions underlying one of the most important functions of government policy today.

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