Racial Prejudice in a Search Model of the Urban Housing Market: Lewis Team Notes

Map of Detroit, Michigan by race

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Map of Detroit, Michigan by race. Blue is blacks. Red is whites. Green is Asians. Orange is Hispanics. Yellow is all other racial/ethnic groups. The map was created using US 2010 Census data.
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1. Introduction and Summary

Empirical evidence reveals that blacks obtain housing in urban areas on inferior terms compared to whites. A number of models dealing with competitive markets, given white prejudice against living near blacks, show that a competitive equilibrium will only be established if blacks receive housing on more favorable terms than those obtained by whites.

Two explanations on this matter have received attention in previous literature. First, Becker\(^2\) and Haugen and Heins\(^3\) in their research suggest that a persistent disequilibrium exists due to the fact that the rate of growth of the black population has increased faster than that of the white population. Second, Kain\(^4\) and Kain and Quigley\(^5\) use premiums in the housing market to explain how whites charge blacks a premium to live in white neighborhoods.

This paper develops a model of the housing market in which the long-run competitive equilibrium may involve a segmented market with all blacks receiving housing on terms inferior to those obtained by whites if some whites are averse to living and dealing with blacks. This paper only deals with the market for owner-occupied single family housing.

This paper presents the first buyer-search model of urban economics. The model establishes the basic building blocks of a search model. With 103 citations\(^6\), this paper has recently been cited in The Microstructure of Housing Markets: Search, Bargaining, and Brokerage by Han and Strange\(^7\).

\(^3\) R. Haugerr and A. Heins, A market separation theory of rent, differentials in metropolitan areas, Quart. J. Econ. (November 1969).
\(^6\) The figure for citation is taken from Google Scholar.
## 2. The Housing Search Model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>vector of annual house rental prices</td>
</tr>
<tr>
<td>$H_i$</td>
<td>vector of characteristics for house $i$</td>
</tr>
<tr>
<td>$V$</td>
<td>utility derived from housing</td>
</tr>
<tr>
<td>$f(V)$</td>
<td>a buyer’s distribution of utilities for different houses in the market</td>
</tr>
<tr>
<td>$F(V)$</td>
<td>cumululative distribution of $f(V)$</td>
</tr>
<tr>
<td>$\bar{V}$</td>
<td>value of the utility function found under the utility maximization</td>
</tr>
<tr>
<td>$V$</td>
<td>the lowest utility associated with any house</td>
</tr>
<tr>
<td>$V^*$</td>
<td>optimal utility at which a buyer ceases searching</td>
</tr>
<tr>
<td>$V_0$</td>
<td>the utility associated with the best house that has been found thus far</td>
</tr>
<tr>
<td>$c$</td>
<td>constant of looking at one house</td>
</tr>
<tr>
<td>$\gamma_j$</td>
<td>probability that whites in neighborhood $j$ will be unwilling to sell to blacks at current market prices.</td>
</tr>
<tr>
<td>$\alpha_j$</td>
<td>$\gamma_j$ times the fraction of sellers in neighborhood $j$ who are white</td>
</tr>
<tr>
<td>$D_j$</td>
<td>the utility of the difference in price</td>
</tr>
<tr>
<td>$D^*_j$</td>
<td>optimal price differential where buyer stops searching</td>
</tr>
<tr>
<td>$D_w$</td>
<td>price differential between black and white neighborhoods</td>
</tr>
<tr>
<td>$D^*_w$</td>
<td>optimal price differential between black and white neighborhoods</td>
</tr>
<tr>
<td>$\alpha_w$</td>
<td>value of $\alpha$ in all white neighborhoods</td>
</tr>
</tbody>
</table>
2.1 Buyer Search in a Housing Market without Racial Prejudice

<table>
<thead>
<tr>
<th>Properties/Assumptions of the Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Houses are characterized by a joint distribution of a multitude of characteristics. No explicit functional form for this distribution is assumed. (Examples of housing characteristics: size, quality, features, proximity to schools, crime, age, etc.)</td>
</tr>
<tr>
<td>Prices of all house characteristics are in perfect hedonic(^8) equilibrium and are known to all. Hedonic equilibrium ensures that we are comparing similar houses to each other.</td>
</tr>
<tr>
<td>The yearly value of the house will be ( P \cdot H ). This price will be posted and it is at the capitalized value of this price that the seller will sell.</td>
</tr>
<tr>
<td>Buyers have utility functions defined on a consumption commodity and the vector of housing characteristics ( H ). On entering the market, they compute the utility that they would obtain if they found a house with just the vector ( H ) which maximizes their utility at prices ( P ) and their incomes. The result of this utility maximization is represented by ( \overline{V} ). This is the utility associated with the best house that the buyer can afford.</td>
</tr>
<tr>
<td>Buyers also know the multivariate distribution of housing units as a function of the characteristics. Knowing their utility functions, knowing this distribution, and assuming that they have prior information sufficient to screen out houses below some positive utility level, they compute a distribution of utilities which would be derived from purchasing houses in the market. This distribution is denoted ( f(V) ), where ( V ) is utility derived from housing. It meets the standard conditions</td>
</tr>
<tr>
<td>[ \int_v f(V) dV = 1 ]</td>
</tr>
<tr>
<td>where ( V ) is the lowest utility associated with any house to be looked at, and ( \overline{V} ) is the value of the utility function found under the maximization procedure described in assumption 3. The cumulative distribution of ( f(v) ) is ( F(v) ).</td>
</tr>
<tr>
<td>There are enough houses “on the market” at any given time so that the issue of waiting for more houses to appear does not arise.</td>
</tr>
<tr>
<td>There is a constant cost of looking at one house denoted ( c ).</td>
</tr>
</tbody>
</table>

\(^8\) Because no two houses are the same, we need to estimate a value index that controls for different housing characteristics. Then, the coefficients of the regression equation will give you the average impact that one more unit of a particular characteristic has on the value of a house. See Professor Becker’s lecture notes on *Hedonics*. 

Each buyer faces a nondegenerate $f(v)$. That is, one buyer purchasing a house does not significantly impact another buyer’s purchase options.

The buyer’s decision to search for another house can be represented by the following decision tree:

When the buyer is deciding to undergo an additional search for a house, he can choose either to search or not to search. If he doesn’t search, then he must either purchase the best house he’s seen thus far from a past search or remain in his current house. If he does decide to search, then he will incur the cost of searching and will either find a better house or not find a better house. Therefore, his utility function when contemplating one more search is given by:

$$V = \max \left\{ V_0, -c + (1 - F(V_0))E(V | V \geq V_0) + V_0F(V_0) \right\}.$$

The table below explains the mathematical expressions contained in this equation:

<table>
<thead>
<tr>
<th>Mathematical Expression</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_0$</td>
<td>Utility from the best house seen thus far</td>
</tr>
<tr>
<td>$E (V</td>
<td>V \geq V_0)$</td>
</tr>
</tbody>
</table>
The buyer’s overall utility will be either the utility received from searching or the utility received from not searching depending on whichever is higher.

In order to find the optimal $V_0$ where a buyer stops searching for a house, equate the first and second lines of this equation. The two lines are equal when:

$$c = \int_{V_0}^{V} (V - V_0) dF.$$  

That is, a buyer ceases searching when the cost of searching becomes greater than the expected gain in utility from an additional search. This optimal $V_0$ is denoted as $V^*$. The value of $V^*$ for a specific buyer will depend upon the form of $f(V), \bar{V}_i$ and $V_i$.

An example: Assume utils are measured in dollars. Suppose there is a buyer where the best house that he can afford is worth $3000 (\bar{V})$ in annual prices. Therefore, it is reasonable to assume that the cheapest house that he would be willing to look at is worth $2000 (V)$ in annual prices. (If he looks at a house worth less than $2000$, it will not have the same combination of characteristics as a house in the $2000$-$3000$ range). Let’s assume that the cost of searching is $30$ and that the buyer has a rectangular distribution over his different utilities for the houses in the market (see below graph).

Using the equation above to find the optimal utility where he will stop searching, we discover that his $V^*$ is $2755$. That is, he will stop $245$ short of his dream house of $3000$!

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9 Edgeworth Group Handout on Racial Prejudice in a Search Model of the Urban Housing Market By Paul Courant, Econ 605 Duke University (2011).  
We used the Edgeworth Team Notes on this paper to understand the rectangular distribution in this example.
Key Insights

- Buyers stop searching short of their “dream house” even when it is affordable. If they searched up until they found their dream house, the cost of searching would outweigh the gains of searching.

2.2 Seller’s Aversion in the Model

<table>
<thead>
<tr>
<th>Assumptions of the Model (Averse Seller Model)</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are $n$ neighborhoods in a city, indexed $(j=1,\ldots,n)$.</td>
</tr>
</tbody>
</table>

For each neighborhood in the city where whites have houses for sale, blacks perceive that there is a nonzero probability ($\gamma_j$) that whites in the neighborhood will be unwilling to sell to them at the current market price. The probability that blacks will be unwilling to sell to other blacks at current prices is assumed to be zero.

The probability that a black person searching in neighborhood $j$ will find an averse seller is $\gamma_j$ times the fraction of sellers in neighborhood $j$ who are white. This is denoted by $\alpha_j$.

There is variation in $\alpha_j$ across the $n$ neighborhoods.

Without loss of generality, we may order the neighborhoods $j$ by their values of $\alpha$, such that $\alpha_1 \leq \alpha_2 \ldots \leq \alpha_n$, and $\alpha_1 \leq \alpha_n$. 
The above flow chart depicts the buyer’s decision to search with seller aversion. Once the buyer decides to search, he would incur $c$ cost of search. The buyer can then either find a better house or not a better house. In the latter case, they will select the best house seen thus far ($V_0$). On the other hand, if they find a better house and the seller is averse, they would have to select the best house seen thus far because the seller will not sell to them. If the seller is not averse, then the buyer can purchase the better house.

Using the assumptions and the flow-chart presented above, the utility at any state of search can now be given as:

$$V = \max \left\{ \begin{align*} V_0 & \quad -c_1 + (1 - \alpha_1)(1 - F_1(V_0))E(V_1 | V_1 \geq V_0) + (1 - \alpha_1)V_0F_1(V_0) + \alpha_1 V_0 \\ -c_2 + (1 - \alpha_2)(1 - F_2(V_0))E(V_2 | V_2 \geq V_0) + (1 - \alpha_2)V_0F_2(V_0) + \alpha_2 V_0 \\ \vdots \\ -c_n + (1 - \alpha_n)(1 - F_n(V_0))E(V_n | V_n \geq V_0) + (1 - \alpha_n)V_0F_n(V_0) + \alpha_n V_0 \end{align*} \right\}$$

<table>
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<td>$V_0$</td>
<td>Utility from the best house seen thus far</td>
</tr>
<tr>
<td>$E(V_n</td>
<td>V_n \geq V_0)$</td>
</tr>
<tr>
<td>1 - $F_n(V_0)$</td>
<td>Probability of finding a better house in neighborhood $n$</td>
</tr>
<tr>
<td>F_n(V_0)</td>
<td>Probability of not finding a better house in neighborhood $n$</td>
</tr>
<tr>
<td>$\alpha_n$</td>
<td>Probability of finding an averse seller in neighborhood $n$</td>
</tr>
<tr>
<td>1- $\alpha_n$</td>
<td>Probability of not finding an averse seller in neighborhood $n$</td>
</tr>
<tr>
<td>$c_n$</td>
<td>Cost of search in neighborhood $n$</td>
</tr>
</tbody>
</table>

The buyer search is now dependent on cost of search, the probability of finding an averse seller and the probability of finding a better house. Like the previous model, the buyer will stop searching when the first line is equated with the last line:

$$V = \max \left\{ \frac{V_e}{c} + (1 - \alpha_i)(1 - F(V_e))E(V|V \geq V_e) + (1 - \alpha_i)V_e + \alpha_i V_e \right\}.$$  

To find the utility ($V^*$) at which a buyer would stop searching, we would solve for $c$ given $\alpha$.

Equating the first and last lines of the value function we get:

$$V_0 = -c + (1 - \alpha_n)(1 - F(V_0))E(V|V \geq V_0) + (1 - \alpha_n)F(V_0)V_0 + \alpha_n V_0$$
$$c = (1 - \alpha_n)(1 - F(V_0))E(V|V \geq V_0) + (1 - \alpha_n)F(V_0)V_0 + \alpha_n V_0 - V_0$$

$$\frac{c}{(1 - \alpha_n)} = (1 - F(V_0))E(V|V \geq V_0) - (1 - F(V_0))V_0$$

$$\frac{c}{(1 - \alpha_n)} = (1 - F(V_0))(E(V|V \geq V_0) - V_0)$$

Assuming that the distributions $f_i(V)$ are identical in all neighborhoods and that the cost of search is the same in all neighborhoods, blacks will never search for housing in neighborhoods where $\alpha$ is greater than $\alpha_1$. Using these assumptions the above model can be rewritten as:
\[
\frac{c}{1 - \alpha_j} = \int_{v^*_j}^{p} (V - V^*_j) dF \quad (j = 1, \ldots, n).
\]

Thus if housing prices are identical, blacks will only search in neighborhoods where \( \alpha \) is lowest. In all black neighborhoods, \( \alpha = 0 \). Using these assumptions, turnover in the housing market will lead to racially segregated neighborhoods.\(^{10}\) However, prices do not have to be constant in all neighborhoods.

**Propositions:**

Any nonzero value of \( \alpha \) greater than \( \alpha_1 \) will lead to a market equilibrium where:

1. Neighborhood housing prices are decreasing with \( \alpha \);
2. Blacks never search in neighborhoods where \( \alpha \) is greater than \( \alpha_1 \);
3. Nothing will equilibrate prices in different neighborhoods at a uniform level.

\[
V = \max \left\{ -c + (1 - \alpha_1) (1 - F(V_0)) E(V | V \geq V_0) + (1 - \alpha_1) V_0 F(V_0) + \alpha_1 V_0, \ldots, \right. \\
\left. \vdots \right. \\
- c + (1 - \alpha_n) (1 - F(V_0)) E(V | V \geq V_n) + (1 - \alpha_n) V_n F(V_0) + \alpha_n V_0 \right\}
\]

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**Key Insights**

* The cost of searching for black buyers is higher than that for their white counterparts. This leads to blacks stopping their search at a lower \( V^* \).

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**Utility Differentials**

Because of seller’s aversion, black buyers are forced to stop their search at a lower \( V^* \) than their white counterparts due to a higher cost of searching. In the next section of his paper, Courant explores how large the utility differential (the difference between the utility received from houses in a higher \( \alpha \) neighborhood and the utility received from houses in lower \( \alpha \) neighborhoods) must be in order for blacks to search the higher \( \alpha \) neighborhoods. The following steps outline the process of finding the maximum equilibrium price differential between neighborhood 1 and neighborhood \( j \):

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\(^{10}\) As is shown in Schelling’s model. T. Schelling, “Models of Segregation,” Rand Corp. (1969).
Step 1: Find $V^*$ that represents optimal stopping point for search in neighborhood 1 (neighborhood with lowest $\alpha$).

Step 2: Add to the distribution of utilities in neighborhood $j$ the utility of lower prices. (Re-write $f(v)$ in terms of utility of the price differential between $n = j$ and $n = 1$.) Assume that the distribution of utilities in the two neighborhood are the same (i.e. the neighborhoods offer comparable housing options).

Step 3: Substitute $V^*$ from step 1 into the $f(v)$ resulting from step 2.

Step 4: Solve for the value of $D_j$ at which $V^*_j$ will be equal in neighborhood $j$ and in neighborhood 1.

$$e = (1 - \alpha_j) \int_{V^*_1}^{V + D_j} (V - V^*_1) f(V + D_j) dV \quad (j = 2, \ldots, n).$$

This value of $D_j$ will be denoted as $D^*_j$ and now represents the price differential where $V^*_1$ and $V^*_j$ are equal. That is, blacks will search only in neighborhood 1 (or any neighborhood with an equivalent $\alpha$) as long $D_j < D^*_j$. It is important to note that $D^*_j$ is an increasing function of $\alpha_j$.

Three important propositions follow from this:

1. Seller’s aversion can lead to a price differential in which housing is purchased by blacks in black neighborhoods at higher prices than those obtained in white and integrated neighborhoods.

2. The maximum price differential is an increasing function of the fraction of white sellers in a neighborhood who are averse to dealing with blacks.

3. If the price differential obtained in a neighborhood is less than the maximum, blacks will never search in that neighborhood, so there will be nothing to eliminate market segmentation by neighborhood racial composition.

Assuming that there exist all white and all black neighborhoods and that the values of $\alpha$ in all white neighborhoods is $\alpha_w$, blacks will not search in white neighborhoods unless the price differential is greater than $D^*_w$. Hence, the housing market will be separated into two distinct racial submarkets.
<table>
<thead>
<tr>
<th>Mathematical Expression</th>
<th>Explanation</th>
</tr>
</thead>
</table>
| \( D_j < D^*_{j} \)  
| \( D_w < D^*_{w} \)  | Blacks will only search in neighborhoods with lowest \( \alpha \) values. If there are all-black neighborhoods, black buyers will only search in these neighborhoods. |
| \( D_j > D^*_{j} \)  
| \( D_w > D^*_{w} \)  | Blacks will start searching in higher \( \alpha \) neighborhoods. This leads to neighborhood tipping (discussed later in this handout). |

Black buyers only searching in low \( \alpha \) neighborhoods leads to increased demand for housing in all-black or mostly black neighborhoods which causes higher house prices in these neighborhoods. On the other hand, because blacks will not search in high \( \alpha \) neighborhoods, there is less demand for houses in white neighborhoods so these neighborhoods have lower house prices. The shifts of these demand curves are illustrated in the two graphs below 11. Neighborhood 1 represents the neighborhood with the lowest \( \alpha \), and Neighborhood 2 represents any arbitrary neighborhood with a higher \( \alpha \). \( D_B \) denotes the demand for houses by blacks and \( D_w \) is the demand for houses by whites. The supply curve for both of these neighborhoods is fixed at 100 houses. In the first graph, it can be seen that the demand curve is shifted to the right because of the higher demand from blacks, while the demand curve for neighborhood 2 is shifted to the left because of the lack of demand from blacks.

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Key Insights

- Black buyers lose in this model because they often end up paying more for comparable housing in low $\alpha$ neighborhoods given the cost of searching in neighborhoods with higher $\alpha$ values is greater than paying a price differential.
- Sellers in high $\alpha$ neighborhoods also lose because the prices for houses in those neighborhoods are lower than what they would be in a competitive market without racial prejudice. This is due to the fact that, in a model without aversion, blacks would search those neighborhoods and it would shift the demand curve to the right.

3. Implications And Extensions of The Model

3.1 The Rate of Growth Hypothesis and Neighborhood Tipping

The author describes two scenarios that can contribute to an equilibrium in which blacks pay more for housing.

1. **Rate of Growth Hypothesis**: As blacks migrated to northern cities, they had an option to search in either white or black neighborhoods. If originally $D_w < D^*_w$, blacks would only search for housing in black neighborhoods but would still pay more than whites for housing. The demand for housing in black neighborhoods increases due to population growth and migration which increases the prices of housing in these neighborhoods. This in turn results in $D_w > D^*_w$. As long as the differential remained, some blacks would purchase houses in white neighborhoods.

2. **Neighborhood “Tipping”**: As blacks start purchasing houses in a predominantly white neighborhood, $\alpha$ started decreasing. This decrease was mainly as a result of two reasons. First, those whites who are averse to dealing with blacks are likely to be averse to living with them. In order to leave their neighborhood, they will have a strong incentive to sell to blacks which would lower $\alpha$ in those neighborhoods. This lowers the cost of search for blacks, so the amount of search by other black families in this neighborhood will increase and more blacks will move in (lowering $\alpha$ more). Secondly, with additional search in the neighborhood, the prices of these homes will be driven up to the black submarket prices, providing greater incentives for white families to sell to blacks, which further drive down $\alpha$. Thus the neighborhood will “tip” to become a black neighborhood until the equilibrium is restored where $D_w = D^*_w$.

This pattern is noticed in locations adjacent to black neighborhoods as explained in
Bailey’s “Border Model.” According to the border model, houses in the border area are relatively cheaper than those in the black neighborhood \( D_w > D^*_w \), more black families will search and eventually move into the border regions. The migration from these black neighborhoods will cause expansion of the black neighborhoods. Courant argues that this will also perpetuate geographic segregation in the market in equilibrium.

The figure above depicts Bailey’s border model. The underlying assumption of this model is that blacks and whites face adjoining housing, where blacks want to live closer to white neighborhoods (for easy access to better facilities and services), whereas, whites would want to move away from black neighborhoods. The prices for black housing will fall as more and more blacks would want to move to neighboring white areas which increases the demand for white neighborhoods and hence their prices. So the buyers will tip until \( D_w = D^*_w \) and at which point the prices will be in equilibrium.

3.2 Self-Segregation vs. Rational Search

According to King and Mieszkowski, blacks would prefer self-segregation if they face identical distribution of utility in all three neighborhoods (all blacks, all whites and border neighborhoods) and if whites in border neighborhoods are no more averse than those in all white neighborhood. The value of \( D^* \) will be lower than \( D^*_w \) but greater than zero. Courant suggests an alternative explanation through the optimal search behavior of black buyers. Black families would maximize their utility subject to search cost. However, he reinforces that this explanation does not imply that blacks do not prefer self-segregation.

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12 The paper cites border model by Martin Bailey that is discussed in further detail in the Questions on Courant handout.
M. Bailey, A note on the economics of residential zoning and urban renewal, Land Economics (August 1959).
3.3 Different Utility Distribution

The assumption of identical distribution of $f_j(V)$ is relaxed in this section. The maximization problem looks like equation (4). The value of $D^*_j$ is not dependent on distribution of $f_j(V)$ and value of $\alpha$.

In an extreme case, blacks will have equilibrium values of $D^*_j \leq 0$. The blacks would search in neighborhoods where $D^*_j$ is lowest and will be willing to pay a higher price for housing as compared to whites. We can also see the difference in the value they get for their money, given whites and black have identical tastes and face identical distributions, by looking at the optimal stopping rule. Whites will stop search at $V^*$ given:

$$c = \int_{V^*}^{\bar{V}} (V - V^*)dF_j.$$ 

Whereas, blacks will face a different optimal value function:

$$\frac{c}{1 - \alpha_j} = \int_{V^*}^{\bar{V}} (V - V^*)dF_j.$$ 

If $\alpha > 0$, $V^*$ will be lower for the black buyer. Courant also suggests that while prejudice may or may not reflect in housing prices, it will affect the level of utility achieved by blacks.

In a less extreme case where $D^*_j > 0$, a positive $\alpha$, given some differences in distribution of utility, will limit black people searching for housing to black neighborhoods even though utility from housing in white neighborhoods would be more favorable for them.

In the special case, where the distribution of utility in a white neighborhood is equal to black neighborhood shifted to right by $D^*_j$ and multiplied by $1 - \alpha_j$, there will be no price differential, but whites would receive higher $V^*$. Since,

$$Distribution \ of \ Utility : \ F(V)_w = (F(V)_B + D_j)(1 - \alpha_j)$$

4. Institutions in The Market - Realtors and Arbitrageurs

Muth argues that in order for real estate agents or renters to increase their incomes, they must be willing to rent or sell to blacks without aversion\(^{15}\). By failing to do so, they will make fewer

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sales and earn lower incomes. However, Courant argues that there are market forces that prevent both real estate agents and arbitrageurs from profiting from arbitrage with black buyers.

4.1 Simple Arbitrage in the Search Model

There are at least two market forces that make arbitrage unprofitable in the owner-occupied market:

1. Transactions costs associated with buying and selling houses.
2. The cost to persuade blacks to search for houses in neighborhood with high $\alpha$ values.

Because blacks will not search in white neighborhoods when $D_w$ is less than $D^*_{w}$, an arbitrageur will incur high costs in the form of advertising and the social stigma associated with selling to black buyers in high $\alpha$ neighborhoods.

An arbitrageur’s profit from the process of buying, holding, and selling a house can be represented by the following equation:

$$\Pi = (1 - t_b)(P_w + D) \cdot H - P_w \cdot H \left(1 + \frac{rm}{12}\right)(1 + t_b),$$

where $t_b$ and $t_b$ are the transaction costs associated with buying and selling, $(P_w+D) \cdot H$ is the sale price when selling to a black buyer, $P_w \cdot H$ is the purchase price when a white arbitrageur buys a house from the white submarket, and $\frac{rm}{12}$ is the percentage of the value of the house lost during the holding period due to interest.

The value of $D \cdot H$ where profit equals zero is the minimum value at which arbitrage will take place. For example, if both $t$’s equal .03, $r$ is .12, and $m$ is one month, profit is zero when $D \cdot H / P_w \cdot H$ is 0.07. This means that, in this case, arbitrage is only profitable when the price differential between the black and white submarkets is at least 7% of the white housing prices. This is a rather high differential to maintain in long-run equilibrium; therefore, arbitrage in this context is rarely profitable.

4.2 Real Estate Agents in a Search Model

Real estate agents do not eliminate price differentials in the market because of both ideological/racist and economic reasons.

**Ideological/Racist Reason:**
A real estate broker may view selling houses in a white neighborhood to black buyers as a violation of professional ethics because all those living in the neighborhood will be unhappy with his or her neighbors.

**Economic Reasons:**
In order to fully explain the economic reasons, assume the following:

1. Realtors have good information about the distribution of housing characteristics and about the racial preferences of whites in particular neighborhoods.
2. \( D_w \) is not high enough to make arbitrage profitable and \( D_w < D^*_w \)
3. Information about the aversion of individual sellers in not coded into the multiple listing file.

Under these assumptions, there is no incentive for the listing agent or the selling agent to show houses in white neighborhoods to blacks. The listing agent would risk the loss of future business. The selling agent knows the probability that a sale can be made to his client, but does not know with certainty that such a sale can be made. That is, he risks showing a house in a white neighborhood to a black client, and, then, later discovering that the white seller will not allow his client to purchase the house. Additionally, the selling agent would be risking his reputation amongst other realtors and the reputation of realtors in general.

However, let’s suppose that the selling preferences of each individual seller is given in the multiple listings file. For high \( \alpha \) neighborhoods, the listing agent would either choose to code all listing as “white only” if he believes the selling agent will honor his wishes, or he will not code the listings at all. Either way, the end result is the same--the realtor will not be incentivized to show houses in white neighborhood to black buyers.

5. **Conclusions and Implications**

If some whites are averse to selling to blacks, then:

- There can exist a long-run equilibrium in which blacks pay more for housing than whites and do not search in white neighborhoods. This will lead to a racially segmented market.
- Price differentials will not be arbitrated away.
- Real estate agents will not eliminate price differentials.

These results give the following welfare implications:

- Blacks for whom the distribution of housing characteristics is relatively favorable in the white neighborhoods (more affluent blacks) will receive less utility from housing than identical whites.
- These blacks will remain in the black submarket, competing for housing better suited to less affluent blacks, unless the distribution of utilities in the white submarket is
substantially more favorable than in the black submarket. That is, these buyers receive housing less suited to their tastes, and they cause an increase in prices for the housing available to other blacks which, also, lowers the utility of the less affluent blacks.

6. Extensions

This paper deals with only owner-occupied housing; however, it would be interesting to extend this model to the rental housing market. Yinger presents a model of landlord behavior where both black and white tenants have racial prejudice\textsuperscript{16}. This could change the model because, instead of seller aversion at the individual level, you would have to include aversion on the behalf of the landlord where they would own more than one housing unit. In addition, the seller’s aversion model is based on the idea of whites being averse to living with blacks. If landlords do not actually reside in the buildings where they rent apartments, they may be more focused on profiting from renting to blacks than on aversion to living in close proximity to them.

In their paper titled \textit{Racial Discrimination and Redlining in Cities} published in 1999, Yves Zenou and Nicolas Boccard argue that it is a combination of residential location and labor market discrimination that leads to the economic disadvantages, like high unemployment rates, experienced by blacks\textsuperscript{17}. They use Courant’s model to explain the existence of cities segregated by neighborhood and then go on to state how these all-black or mostly-black neighborhoods are often not within close proximity to centers of employment growth.

Additionally, this model can be extended to any market where there exists some restriction on searching. This includes the marriage market, choosing a doctor, university admissions or getting your car repaired. This model is applicable to any market where searchers either have a lack of information or face outright discrimination.

This model has also been used to understand gender discrimination in the job market. As discussed in \textit{Sex Differences in Earning in the United States} (1989), aversion to hiring women in certain occupations can increase the cost of job search for women in those job markets. This inhibits their entrance in certain types of occupations. The paper also discusses how employers may face loss in business activities if they are willing to hire women in certain types of jobs by eliminating gender bias. However, evidence reveals that in these scenarios the entrepreneurs do not earn additional profits by hiring women. Women, on the other hand, are the only winners here as they expand the available job opportunities to them.


7. Bibliography

7. R. Haugerr and A. Heins, A market separation theory of rent, differentials in metropolitan areas, Quart. J. Econ. (November 1969).