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Abstract

This paper shows that information plays a key role in the coordination of white households' forward-looking expectations to leave an area in response to the entry of minority households. First, from the 1940s to the 1970s, real estate brokers earned substantial commission fees during white flight to the suburbs. Real estate agents, who have asymmetric information on potential buyers, have an incentive to strategically disclose information on potential minority buyers, to trigger white flight and increase profits. The prohibition of this type of disclosure in the 1968 Civil Rights Act is shown to increase white welfare and prevent the entry of black households. Second, households' behavior – whether to stay or leave – provides other households' with information about potential buyers. Baltimore and Philadelphia prohibited "Sold" signs to stem white flight.Prohibiting "Sold" signs benefits whites with strong racial preferences and hurts whites with weak racial preferences.

JEL Codes: J15, R31, D82

1 Introduction

The departure of white households from central city neighborhoods to suburban neighborhoods, also know as the white flight, profoundly reshaped U.S. cities in the middle of the 20th century. About 3.5 million African-Americans migrated from 1910 to 1940 (Collins 1997) to Northern cities, and this Great Migration of African-Americans increased demand for housing in city centers. From 1940 to 1970, the black share in northern and western cities increased from 4 to 16 percent. Recent estimates suggest that each black arrival led to 2.7 white departures; in 1980, 72% of urban African-Americans lived in city centers, whereas 67% of urban whites lived in the suburbs (Boustan 2010, Cutler, Glaeser & Vigdor 1999). Racial segregation has far-reaching implications for the outcomes of whites and minorities; on the labor market (Boustan & Margo 2009), health and education (Card & Rothstein 2007, Cutler & Glaeser 1997), crime (Glaeser, Sacerdote & Scheinkman 1996), and social interactions (Alesina & Ferrara 2000). White flight, as a sudden and major change in the racial composition of neighborhoods, has been modelled as the outcome of complementarities between white homeowners' decision to move (Becker & Murphy 2001, Schelling 1969, Schelling 1971, Benabou 1993, Benabou 1996, Card, Mas & Rothstein 2008).

This white flight led to a large number of real estate transactions and to substantial commission fees for the real estate industry. Census data indicates that annual turnover was 18% in 1950 in urban areas, with estimated annual aggregate commission fees totaling more than $2.8 million per census tract[1] in 2010 dollars. Historians and sociologists argue that real estate brokers triggered "panic selling" through fear tactics that are called "blockbusting" in this literature(Orser 1994, Seligman 2005, Gotham 2002).[2] Anti-blockbusting provisions, which were enacted by Congress in

[1] A census tract usually has about 1000 housing units, see table 1.

[2] Blockbusting is a practice that has been featured in the popular press, in TV shows, and in other

the Fair Housing Act of 1968 (Section 804 [e] of Title VIII of the Civil Rights Act), forbid real estate brokers to make representations regarding the prospective entry of racial minorities in a neighborhood.[3] This effect of real estate brokers cannot be explained in the seminal models of Becker & Murphy (2001) and Schelling (1969) as they feature a housing market with no frictions; in these models, transactions are costless and information is perfect.

This paper formalizes the role of real estate agents in white flight; the paper potentially contributes to the understanding of the process of racial change in neighborhoods. The key idea is that a profit-maximizing broker faces a conflict of interest: he profits from commission fees, and he can influence white households' perceptions of black buyers to induce or restrain white flight. The model presented in the paper involves an environment with three types of agents: white homeowners of an initially all-white neighborhood, prospective black buyers, and a broker who matches white homeowners and prospective black buyers. White households are identical, and derive utility from the presence of white neighbors [4]. Each white household is matched to one black buyer. Black buyers offer a variety of prices distributed normally with an unknown average. Each white homeowner observes only his particular offer and forms beliefs about other white homeowners' offered prices. The profit-maximizing real estate broker can disclose a message that gives white homeowners information on the average offered price (Jovanovic 1982). There is a small cost of disclosing the

media. In 1962, the Saturday Evening Post's front page was on the "Confessions of a Blockbuster". Also, *All in the Family*, one of the popular TV shows of the 1970s, had an episode entitled "The Blockbuster" in the 1971 season, where a black real estate agent tries to convince the family that it is better to sell at the offered price of $35,000 than stay in the neighborhood.

[3] A number of states enacted fair housing laws that include anti-blockbusting provisions, e.g. the Kansas Act Against Discrimination, 44-1016, Alexandria, Virginia, Code 17A-4, 1969, Md. Ann. Code art. 56, 230B (Supp, 1970); Teanneck, N.J. Ordinance 1274, 1966.

[4] Both subjectively stated preferences and structural estimations have shown that white households value the presence of white neighbors in an area (Krysan, Couper & Farley 2009, Bayer, Ferreira & McMillan 2007).

message. Each white household then rejects or accepts his particular offer.

It is important to emphasize at the outset that in the model the broker at no point owns a house. Consequently, the real estate broker's strategic decision is whether to provide information to white households.[5] Also, the information provided by the real estate broker is truthfully disclosed. It is not hard to find examples of real estate brokers using supporting evidence to make the case that a large number of minority buyers will enter the area.[6]

The paper establishes three central results. First, the real estate broker's strategic disclosure of information typically increases black entry into the neighborhood when racial preferences are strong or when black buyers' offer price is large. Second, the profit-maximizing broker discloses information to white homeowners as long as the message induces sufficiently black entry – and hence reduces white homeowners' welfare. Third and most interesting, forbidding information disclosure, as was done in the 1968 Fair Housing Act anti-blockbusting provisions, increases white homeowners' welfare.[7] The Anti-blockbusting provisions of the Fair Housing Act are one of the few provisions that protect white homeowners at the expense of minority buyers.

The last part of the paper also models the impact of "Sold" signs on the white flight. Municipalities across the United States – most notably Philadelphia and Baltimore – enacted statutes forbidding the posting of "Sold" signs [8] to stem white flight.

[5]Note that this departs from an alternative mechanism described by historians. Seligman (2005) describes a speculator with deep pockets that can trigger the white flight by buying from whites and reselling to blacks. The speculator buys a house from a white household. It then sells it to a black household at a loss. Subsequent sales generate a markup profit – when black households' valuation is higher than white households' reservation price. However, this strategy can only happen under very particular circumstances: first, the speculator needs deep pockets, and the speculator needs market power to be sure to gather profit once a sufficient number of black households has been introduced.

[6]See for instance Gotham (2002), Seligman (2005) and Orser (1994).

[7]The paper, from a theoretical point of view, contributes to the literature on global games (Morris & Shin 2002, Angeletos & Werning 2006), by endogenizing the disclosure of public information by a profit-maximizing third party.

[8]See *Linmark v. Willingboro. 431 U.S. 85 (1976),* a landmark case of the Supreme Court on "Sold" signs and freedom of commercial speech. The majority opinion in this case asserted that "Sold"

The model of "Sold" signs has three agents, as in the previous model: white homeowners, black buyers, and a real estate broker. The difference with the previous model is that brokers do not disclose a message. They post a "Sold" sign for each sold house. Each white homeowner observes his/her offered price, and observes "Sold" signs of the neighborhood. "Sold" signs give some additional information on the number of white neighbors who have decided to sell their house to prospective black buyers.

Notice that the posting of "Sold" signs is contemporaneous to the decisions of white households. "Sold" signs provide aggregate endogenous information on the decisions of white neighbors as in related literature (Angeletos & Werning 2006).

The model of "Sold" signs has three important implications. First, "Sold" signs amplify white flight; when white families have strong racial preferences, there is more white flight with "Sold" signs than without, and the welfare of white households is lower with "Sold" signs than without. Second, "Sold" signs are beneficial to whites with small racial preferences; in this case, the absence of "Sold" signs signals that the neighborhood is not changing. Finally, forbidding the use of "Sold" signs increases the welfare of white households. It increases it all the more that white households have strong racial preferences.

The rest of the paper proceeds as follows. Section 2 presents evidence suggests that there were above-average commission fees per census tract during the period of white flight and that blockbusting was a concern for judges and legislators. Section 3

signs are protected by the First Amendment. Also, "Sold" signs have been prohibited in Baltimore until April 1997 despite this decision ("Baltimore legalizing 'Sold' signs.", Washington Post, April 19, 1997). In 1970, the Philadelphia City Council in 1970 passed an ordinance banning 'sold' signs outside homes. Oak Park, Illinois, still prohibits the use of "For Sale" and "Sold" in its village code (Dixit & Nalebuff 1993), stating that "the use of these signs therefore tends to 'signal' that minorities may be more welcome in some areas of the Village than others and this tends to segregate areas contrary to the policy of the Village to maintain an integrated community." Political scientists and sociologists have studied the Oak Park strategy for maintaining racial balance (McKenzie & Ruby 2002, Logan & Stearns 1981).

presents the blockbusting model, its basic mechanisms and shows how the equilibrium fraction of black households in the neighborhood depends on the broker's strategic information disclosure. Strategic information disclosure increases the entry of blacks into the neighborhood and lowers whites' welfare. Section 6 develops the model of "Sold" signs, showing that "Sold" signs magnify movements out of a neighborhood; forbidding "Sold" signs lowers black welfare. Section 7 concludes.

2 Real Estate Brokers' Conflict of Interest

In this subsection, census data and decisions of federal courts shed light on the conflict of interest of real estate brokers during white flight. First, white flight generated above-average commission fees with substantially higher turnover with at worst only small declines in house prices. Second, brokers had privileged access to information on the state of the market. Multiple listing services were one major source of information. Brokers could trigger sales through tactics called "blockbusting."

2.1 An Estimation of Total Commission Fees during White Flight

Census tract files from 1950 to 1970 include variables that indicate when a household moved into its current dwelling, house prices by categories, and racial demographics. Only urban areas in the same consistent set of counties are considered. Finally, aggregate commission fees are computed using two variables at the census tract level: the estimate of turnover and an estimate of average house prices. Commission fees are assumed to be 5% of the transaction price (Bernheim & Meer 2008). All dollar amounts are in 1970 dollars.

The fraction of African-American households in urban areas increased from 1940 to 1970. The third line of Table 1 suggests that turnover in urban areas was at its highest point in 1950, at 18%, then it declined from 1950 to 1970 to 11.4%. House prices increased in real terms, but not enough to offset the drop in turnover after 1950. Hence, in 1970 dollars, average commission fees per 1,000 housing units dropped from $123,000 in 1950 to $101,573 in 1960.

Blockbusting in Edmonson village, Baltimore, was extensively described in Orser (1994). Baltimore followed the same pattern as the average urban area. From 1950 to 1970, the fraction of African Americans more than doubled, from 20% in 1950 to 41% in 1970. Turnover was at its highest point in 1950, at 17% of housing units sold per year. Prices declined mildly in real terms, from $13,125 in 1950 to $12,384 in 1960, hence commission fees per 1,000 housing units were at their highest at the height of white flight at $111,328 in 1950 and $65,652 in 1960.

Another example of blockbusting described in the literature is Chicago's west side (Seligman 2005). From 1950 to 1970, the fraction African American in Chicago was multiplied by 5, from 11.6% to 48.1%. Chicago did not experience a drop in house prices overall, with a more than twofold increase of house prices in real terms from 1950 to 1970, and turnover was at its highest point in 1950 (15%) and declined to 11% in 1970.

2.2 Brokers' Information on the Market

There is substantial evidence that homeowners do not accurately estimate the market value of their house , and that real estate brokers are better informed than homeowners (Levitt & Syverson 2008). Goodman & Ittner (1992) estimates that homeowners make a mean absolute error of 14% of the value.

	1940	1950	1960	1970
Urban Census Tracts - All U.S.				
Fraction African American	0.089	0.106	0.125	0.254
Housing units per census tract	1,481	1,330	1,517	715
Fraction of purchases/year*	-	0.181	0.115	0.114
Median house price**	8,888	13,107	17,687	22,513
Estimated commission fees***	-	321,548	253,194	160,326
Estimated commission fees per 1000 housing units***	-	148,298	121,888	128,361
Urban Census Tracts - Chicago				
Fraction African American	0.081	0.116	0.175	0.481
Housing units per census tract	1,058	1,255	1,506	666
Annual turnover	-	0.152	0.117	0.113
Median house price	7,030	12,192	22,179	27,116
Estimated commission fees	-	207,894	339,596	300,933
Estimated commission fees per 1000 housing units	-	98,891	155,134	183,380
Urban Census Tracts - Baltimore				
Fraction African American	0.193	0.200	0.266	0.410
Housing units	1,506	1,506	1,571	610
Annual turnover	-	0.170	0.106	0.092
Median house price	7,250	13,125	12,384	15,974
Annual commission fees	-	254,208	163,549	75,391
Annual commission fees per 1000 housing units	-	133,594	78,782	88,307

* Fraction of housing units bought/sold in the area every year. Estimated using a duration model and the length of stay in the area.
** In 1970 dollars.
*** Commission fees are computed with a flat 5% commission fee on transaction prices. Commission fees include purchases and sales only (i.e. not commission fees for rental).
Source: Elizabeth Mullen Bogue files for 1940, 1950, 1960, and Census 1970.

Table 1: Estimates of Commission Fees

Brokers who engage in blockbusting will typically approach a white household to let him know that "black families are entering the area" (Glassberg 1972) and provide him with information about black households' offer prices. In effect, they suggest that black households' valuation of housing is a higher than the price at which white neighbors are ready to leave. Real estate brokers get these information from a variety of sources, the most important of which is multiple listing services (Hendel, Nevo & Ortalo-Magné 2007).

2.3 Sale Solicitations

Blockbusters differ from traditional real estate brokers in that they engaged in unwanted solicitations, and because they relied on the racial fears of households to make the neighborhood's racial composition change dramatically and reap commission fees.

Title VIII of the 1968 Civil Rights Act, also known as the Fair Housing Act, section 804, prohibits blockbusting in addition to steering. Blockbusting is described as

> "(e) For profit, to induce or attempt to induce any person to sell or rent any dwelling by representations regarding the entry or prospective entry into the neighborhood of a person or persons of a particular race, color" (Section 804 [e])

A good example of real estate brokers' tactics is the *Zuch v. Hussey* Michigan blockbusting case.[9] "Mrs. Herrod testified that on a Sunday afternoon in April, 1972, she and her husband were visited by a man who identified himself as Irving Corley, a salesperson for Four Star Realty. [...] He [...] told her that a black community was

[9] *Zuch v. Hussey, 394 F. Supp. 1028 - Dist. Court, ED Michigan 1975*

being started in her neighborhood and that now was a good time to sell. Property values would go down, he said, and the schools would change."

On the basis of the Fair Housing Act, the Department of Housing and Urban Development receives civil rights complaints filed for alleged blockbusting practices. United States attorneys may also participate or take the lead in investigating and initiating enforcement of fair housing rights when a case of blockbusting is brought to the attention of the Housing and Civil Enforcement Section.

Federal courts have considered blockbusting cases from 1968 to now (Brown v. State Realty Company, 304 F. Supp. 1236 - Dist. Court, ND Georgia, Atlanta Div., 1969). Overall, since 1968, federal courts have considered alleged blockbusting practices in 123 decisions. Cases were brought to court as recently as in 2008 (US v. City of Euclid Dist. Court, ND Ohio, Eastern Div., 2008), and in 2003 (Mainstream Marketing Services, Inc. v. FTC, 284 F. Supp. 2d 1266 - Dist. Court, D. Colorado, 2003; Karhani v. Meijer, 270 F. Supp. 2d 926 - Dist. Court, ED Michigan, Southern Div., 2003).

The spirit of another decision of the Supreme Court, *Pearson v. Edgar, 965 F. Supp 1104, 1109 (N.D. Ill. 1997),* is similar to *Linmark v. Willingboro. 431 U.S. 85 (1976).* The Illinois General Assembly enacted a statute (720 ILCS 590/1-1(d)) to try to prevent blockbusting, or panic peddling, by real estate agents. The statute makes it unlawful, "To solicit any owner of residential property to sell or list such residential property at any time after such person or corporation has notice that such owner does not desire to sell such residential property. Solicitation of one of these homeowners by an agent who has notice of the homeowner's contrary wishes is a criminal offense." The Supreme Court stated that this statute violates the freedom of commercial speech protected by the first amendment.

The main model of this paper, in section 3, looks at the welfare implications of the

prohibition of information disclosure by the real estate broker. The model suggests that the prohibition of blockbusting was beneficial to white households.

2.4 "For Sale" and "Sold" signs

Another kind of restriction on information disclosure was the prohibition of "For Sale" and "Sold" signs by municipalities. In *Linmark v. Willingboro. 431 U.S. 85 (1976),* the Supreme Court considered the case of the municipality of Willingboro, NJ. The municipality prohibited "For Sale" and "Sold" signs "for the purpose of stemming what the township perceived as the flight of white homeowners from a racially integrated community." Testimony from two real estate agents showed they "agreed that a major cause in the decline in the white population was "panic selling" – that is, selling by whites who feared that the township was becoming all black, and that property values would decline." The full text of the decision of the Supreme Court suggests that households' strategic reasoning is affected by information coming from brokers as well as "For Sale" and "Sold" signs.

The Supreme Court decided that the prohibition of "For Sale" and "Sold" signs was not compatible with the freedom of commercial speech, and therefore violated the First Amendment. Interestingly this decision apparently contradicted the anti-blockbusting provisions of title VIII of the Civil Rights Act of 1968, since the former increased minority entry into neighborhoods whereas the latter reduced the probability of minorities entering the neighborhood.

Observing "For Sale" and "Sold" signs is typically observing the decision of other households to move or to stay in the neighborhood. This is modelled in section 6.

3 The Model

3.1 Basic Building Blocks

White homeowners are living in an initially all-white neighborhood. White homeowners decide whether to leave or stay in the neighborhood. The essential building blocks are (i) white homeowners have racial preferences (ii) households have forward-looking expectations (iii) white homeowners have imperfect information about black buyers' distribution of offer prices (iv) white homeowners get a specific offer, which gives them private information about the distribution of offer prices (v) the real estate broker discloses information strategically.

There are four essential mechanisms:

- **Racial preferences generate externalities and strategic complementarities:** A white household who leaves lowers the utility of other white households since white households have racial preferences (Schelling 1969, Becker & Murphy 2001). Racial preferences then generate strategic complementarities since individuals are more likely to leave if others decide to leave.

- **The evolution of the neighborhood is based on households' forward-looking expectations.** In two important models of the dynamics of segregation (Benabou 1993, Becker & Murphy 2001), the dynamics of the neighborhood are myopic. Thus, the neighborhood cannot instantaneously switch from one equilibrium to another. In the current paper, households are forward looking, and their decision to sell is based on their information.

- **Individual offers by black buyers provide private information:** There is a distribution of offer prices of prospective black buyers, hence an offer from a single buyer is informative about the overall distribution.

- **The information disclosed by the real estate broker coordinates white households' actions**: The real estate broker has a noisy signal of the mean offered price. He can disclose it at a small cost c. Disclosure has two effects: it increases the accuracy of white households' beliefs, and it coordinates their actions. In the model that is presented here, signals sent by the real estate broker to different white homeowners are perfectly correlated, but the model would be unchanged by allowing for a correlation lower than one. Information is truthfully disclosed (Jovanovic 1982). Thus brokers with information that sufficiently increases their commission fees will disclose information.

Overall this is a model of strategic complementarities with externalities, imperfect information, and private and public information. The central implications of the model are that, when white households have strong racial preferences or, alternatively, when prospective black buyers' offer prices are sufficiently high:

- **Disclosure of information by brokers increases** the fraction of black households at equilibrium.
- **Forbidding information disclosure** increases the welfare of white households and reduces the fraction black buyers who can enter the neighborhood.

3.2 The Model

The neighborhood has a density 1 of houses, indexed by $i \in [0, 1]$. All houses are initially owned by white households. White households derive utility from consumption and racial preferences.

$$u(c, b) = c + \rho(1 - b)$$

c is consumption, $b \in [0,1]$ is the fraction of black households in the neighborhood, and ρ are racial preferences. Housing costs for the current house have been fully incurred and income is fixed, so consumption is conventionally fixed to zero when the household stays in the neighborhood. White households can buy a house in another neighborhood, the suburb, at exogenous price p_s. [10] There is no black household in the suburb.

There is a density 1 of black households living in another area, the black neighborhood. There is a real estate broker who matches white homeowners and prospective black buyers. A black household offers p to a white household for his house in the neighborhood. The distribution of offer prices p is normal with mean μ and standard deviation σ_p, $p = \mu + \varepsilon$.

White homeowners do not know the mean of the distribution of offer prices μ. They have a flat prior for μ over $(-\infty, +\infty)$.

The timing of the model is as follows:

- **Period 1:** Nature selects a value of μ.
- **Period 2:** The broker matches each white household $i \in [0,1]$ to a single black buyer with offer price $p \sim N(\mu, \sigma_p^2)$.[11] σ_p^2 is common knowledge. The broker can disclose a message $m = \mu + \eta$ to all households, where $\eta \sim N(0, \sigma_m^2)$, at a cost c.[12] σ_m^2 is common knowledge and is assumed to be equal to σ_p^2. The message m

[10] Equivalently, the supply of housing in the suburb is perfectly elastic, and the price stays equal to the marginal cost of construction regardless of demand.

[11] Throughout the paper I assume that the distribution is exogenous. In an extension of the model however, black households' valuation is normally distributed and whites and blacks bargain using the Nash generalized bargaining solution. Formally, black buyers' valuation is $v_b \sim N(\mu, \sigma_v^2)$ and white households' valuation is v_w. Prices are then $p = \gamma v_b + (1-\gamma) v_w$ where γ is white homeowners' bargaining power.

[12] In this version of the model, the broker sends the same message to all households. In other words, the messages sent to different households are perfectly correlated. The model can also be written with messages that are not perfectly correlated across households. The implications are identical. Let $m_i = \mu + \eta_i$ the message given to household i, and assume that $Corr(m_i, m_j) = \rho$. Then $m_j | m_i \sim N(m_i, 2\sigma_m^2(1-\rho))$. If $\rho = 1$ the model is the model of the paper.

is an offer drawn from the set of offered prices. Each white homeowner accepts ($a_i = 1$) or rejects ($a_i = 0$) the offer.

- **Period 3:** White homeowners who sell their house ($a_i = 1$) pay a fraction $\kappa \in (0, 1)$ of the transaction price to the real estate broker as a commission fee.[13] If they sell their house, white homeowners buy a house in the suburb at price p_s, where the neighborhood is entirely white.

4 Analysis of the model

4.1 White Homeowners' Strategic Reasoning – the broker has disclosed the message m

Let's start with the strategic reasoning of a white household when the broker has disclosed the message m about prospective black buyers' average offer price. A white household in the neighborhood who has an offer p in period 2 should accept the offer p if the utility of living in the suburb, $(1 - \kappa)p - p_s + \rho$, where the neighborhood is entirely white, is greater than the utility $\rho(1 - E(b^*|\text{information}))$ of staying in the current neighborhood, where there may be black entry.

Consider first strategies in which a household thinks that other households will accept any offer above p^*. From the observation of offer p and from the message m given by the broker, the household believes that the average offer price in the neighborhood is distributed normally with mean $\delta p + (1 - \delta)m$ and with variance

[13] In the model, the role of the broker is to provide information to households, which a priori may be socially beneficial or detrimental. The welfare effects of the disclosure of public information is debated in the literature at least since Morris & Shin (2002). The welfare has been shown to be sensitive to the particular model. Angeletos & Pavan (2007) summarizes the welfare effects of public information when utilities are quadratic. In a model of white flight, utility is not quadratic, and we develop the analysis here.

$\alpha^{-1} = (\frac{1}{\sigma_p^2} + \frac{1}{\sigma_m^2})^{-1}$. $\delta = \frac{1/\sigma_p^2}{1/\sigma_p^2 + 1/\sigma_m^2}$ is the relative precision of the private information p, and $1 - \delta$ is the relative precision of the broker's message.

$$\mu | p, m \sim N(\delta p + (1 - \delta)m, \alpha^{-1})$$

From these information, the household believes that a fraction $E(b^*|p, m) = E[1 - \Phi(\frac{p^* - \mu}{\sigma_p})|p, m]$ of black neighbors will enter the neighborhood. Φ is the cumulative distribution function of the standard normal. Therefore the household will accept the offer p if:

$$(1 - \kappa)p - p_s + \rho \geq \rho \left[1 - E \left(\Phi(\frac{p^* - \mu}{\sigma_p}) | p, m \right) \right]$$

Hence if other white households accept any offer p above p^*, the household accepts any offer above p^{**} such that $p^{**} = \frac{1}{1-\kappa}[p_s - \rho E(\Phi(\frac{p^* - \mu}{\sigma_p})|p^{**}, m)]$. In any symmetric equilibrium, the minimum offer should be equal for different households $p^* = p^{**}$ so that the equilibrium threshold offer is

$$p^*(m) = \frac{1}{1 - \kappa}[p_s - \rho E \left(\Phi(\frac{p^*(m) - \mu}{\sigma_p}) | p^*(m), m \right)]$$

In an equilibrium of the neighborhood, households accept any offer above p^* and reject any offer below p^*.

Proposition 1. *There is a unique threshold offer price $p^*(m)$ as long as $\alpha_p < \left(\frac{(1-\kappa)\sqrt{2\pi}}{2\rho} \right)^2$.*

Interestingly, if the distribution of offer prices has small variance, white households are very close to a case where they have perfect information; in this case, there are

multiple equilibria (Morris & Shin 2002).[14] The paper assumes that the message of the broker is a randomly picked offer from the set of all offers.

Proposition 2. *The threshold offer price $p^*(m)$ is lower when the message m is higher.*

The intuition for this proposition is simple. A higher message m means that other households' offer prices is high, and hence the equilibrium number of black households will be higher. Hence the white homeowner accepts a lower price for his house.

Proposition 3. *The stronger the racial preferences ρ, the lower the threshold offer price $p^*(m)$.*

Racial preferences strengthen the aversion of white households for black neighbors. If there are no racial preferences, $\rho = 0$, and the decision of white households does not depend on other households' decision. If racial preferences are very large, $\rho = +\infty$ and all offers are accepted.

Proposition 4. *The higher the commission rate κ, the higher the threshold offer price $p^*(m)$.*

The commission rate κ increases the cost of moving to the suburb, thus the proposition.

4.2 White Homeowners' Strategic Reasoning – the broker has not disclosed the message

If white homeowners do not observe the message m, then it brings information on the message m that the broker could have delivered. In other words, households are not

[14] The conditions for the existence of a unique equilibrium in global games with public information have been discussed in the recent literature (Angeletos & Werning 2006, Angeletos & Pavan 2007).

naive and infer that the message must be lower than a threshold $\underline{m}$. $\underline{m}$ is the lowest message that is disclosed at equilibrium. It will be endogenously determined by the model in the analysis later on in the paper.

Thus, a white homeowner who is matched to a prospective black buyer with offer price p will believe that $m \leq \underline{m}$. The posterior is obtained by Bayes rule in the appendix. The household will sell if

$$(1-\kappa)p - p_s + \rho \geq \rho \left[1 - E\left(\Phi(\frac{p^* - \mu}{\sigma})|p, m \leq \underline{m}\right)\right]$$

Hence, if all other households accept an offer $p \geq p^*$, the best response is to accept the offer p if $p \geq p^{**} = \frac{1}{1-\kappa}[p_s - \rho E\left(\Phi(\frac{p^*-\mu}{\sigma_p})|p^{**}, m \leq \underline{m}\right)]$. In any symmetric equilibrium, households accept the offer p if it is greater than $\underline{p}^*$, where:

$$\underline{p}^* = \frac{1}{1-\kappa}[p_s - \rho E\left(\Phi(\frac{\underline{p}^* - \mu}{\sigma_p})|\underline{p}^*, m \leq \underline{m}\right)]$$

$\underline{p}^*$ is the threshold offer price when the message is not disclosed.

Proposition 5. *The threshold offer price $\underline{p}^*$ exists and is unique.*

The proof is presented in the appendix.

Proposition 6. *The threshold offer price is lower when the threshold message $\underline{m}$ is higher.*

The intuition is as follows. If the message is not disclosed, households believe that $m \leq \underline{m}$. The higher the $\underline{m}$ the higher households' beliefs about m.

Proposition 7. *The threshold offer price is lower when racial preferences are stronger, and higher when commission fees are higher.*

4.3 The Broker's Strategic Disclosure

We now turn to the broker's strategic thinking. For him, the strategic decision is whether to disclose the message or not. The broker weighs the cost and the benefit of disclosing the message.

Let $\Pi(m)$ be the profit of the broker when he releases the message m. It is assumed that the marginal cost of a transaction is negligible. The profit minus the cost of disclosure is graphed in figure 1. The higher the message, the more whites accept the offer, and the higher the profit.

Proposition 8. *The profit* $\Pi(m)$ *when disclosing message* m *is increasing with* m*.*

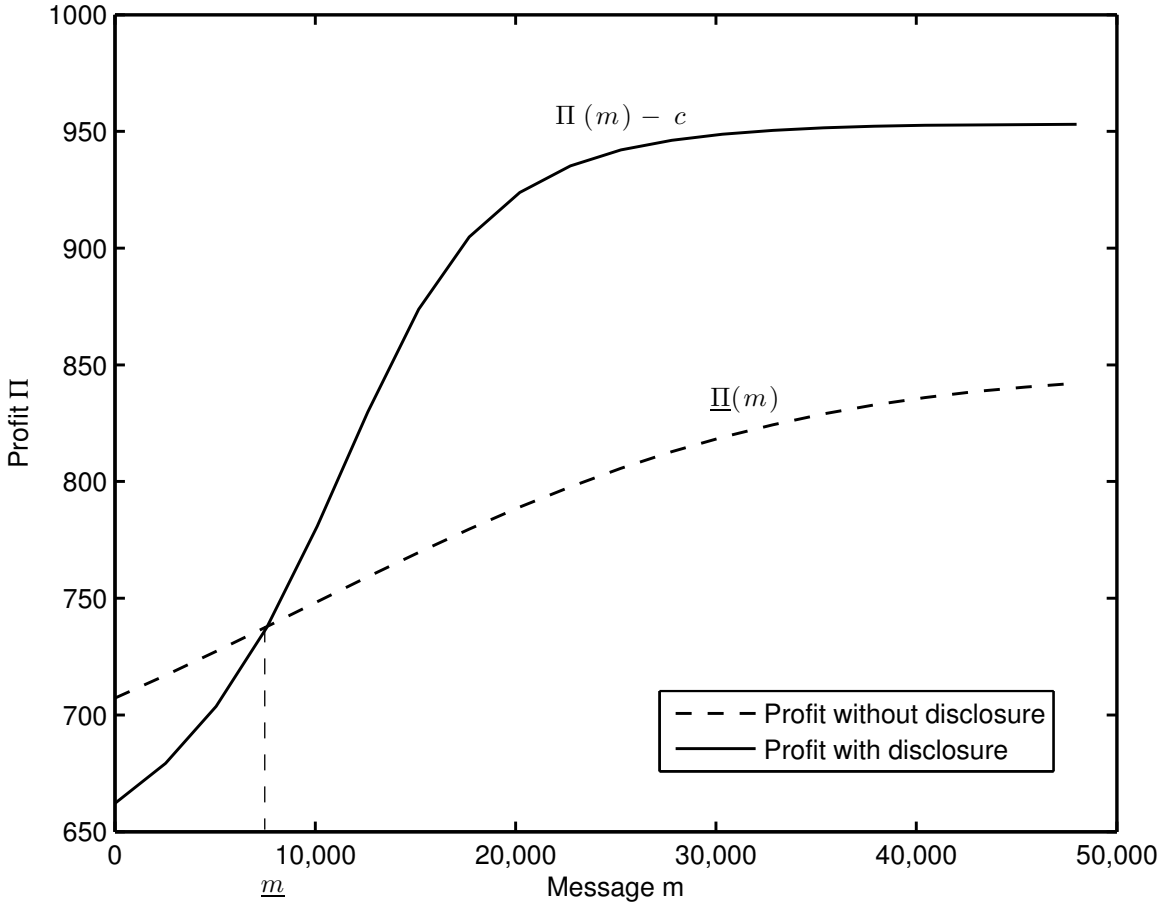
Now, what if the message is not disclosed? Let $\underline{\Pi}$ be the profit of the broker when he does not disclose the message. Since the profit is increasing in the message m, brokers will disclose if the message m is greater than a value $\underline{m}$. The broker discloses the message m if

$$\Pi(m) - c \geq \underline{\Pi} \tag{1}$$

$\underline{\Pi}$ is determined by calculating white households' threshold offer price $\underline{p}$ when the message is not disclosed, as in the previous subsection. Equation 1 defines the threshold message $\underline{m}$. Brokers disclose the message m if and only if $m \geq \underline{m}$.

Proposition 9. *The threshold message* $\underline{m}$ *exists and is unique. The threshold message* $\underline{m}$ *increases when the cost of disclosure* c *increases. The threshold decreases when the rate of commission fees* κ *increases.*

This is illustrated in figure 1. $\underline{m}$ is at the intersection of the profit of the broker when disclosing and the profit of the broker when not disclosing. The two profit curves interesect at a single point.



This figure illustrates the broker's strategic reasoning. $\Pi(m)$ is the broker's profit when the message m is disclosed. $\underline{\Pi}(m)$ is the profit of the broker when messages up to m are not revealed. The cost of disclosing the message is c. Hence, the broker reveals the message as long as the message $\Pi(m) - c \geq \underline{\Pi}(m)$.
The calculation of Π for this specific example is done using the parameters specified in figure 2.

Figure 1: Which messages will be revealed? – The Broker's Strategic Reasoning

4.4 Equilibrium

A monotone equilibrium with disclosure of information by the broker incorporates the optimal action of white households (whether to sell or not) and the optimal action of the real estate broker.

Definition 10. (Equilibrium with disclosure of information) An equilibrium of the game with disclosure of information by the broker is a threshold price $p^*(m) > 0$, a threshold price $\underline{p}^* > 0$, and an equilibrium fraction of black households $b^*(\mu, m)$, an equilibrium fraction of black households $\underline{b}^*(\mu)$ and a threshold message $\underline{m}$, such that:

- White households accept an offer p if the offer $p \geq p^*(m)$ if the broker discloses m, and white households accept an offer $p \geq \underline{p}^*$ if the broker does not disclose.
- $p^*(m)$ and $\underline{p}^*$ are households' best response to other households' strategies.
- The fraction of black households in the neighborhood is the fraction of black households with offer greater than $p^*(m)$, i.e. $b^*(\mu, m) = 1 - \Phi(\frac{p^*(m)-\mu}{\sigma_p})$ if the broker discloses m, and $\underline{b}^* = 1 - \Phi(\frac{\underline{p}^*-\mu}{\sigma_p})$ does not disclose.
- The broker discloses the message m if the profit of disclosure minus the cost of disclosure is greater than the profit when not disclosing, $\Pi(m) - c \geq \underline{\Pi}$.

The equilibrium number of black households depends on the information provided by the broker. The neighborhood changes dramatically for values of μ around $p^*(m)$. In this equilibrium, small changes in black households' incomes can trigger large changes in segregation at equilibrium, depending on the information provided by the broker.

Proposition 11. ***(Equilibrium with strategic disclosure)*** *Assume that the distribution of offer prices has a sufficiently large standard deviation, i.e. the precision of private information is small* $\alpha_p < \left(\frac{(1-\kappa)\sqrt{2\pi}}{2\rho}\right)^2$. *There exists a unique equilibrium.*

Proof See appendix. The proof is inspired by Angeletos & Werning (2006) in the case of disclosure, and by new derivations for the case of strategic disclosure of a message. □

4.5 Equilibrium When the Broker Cannot Disclose a Message

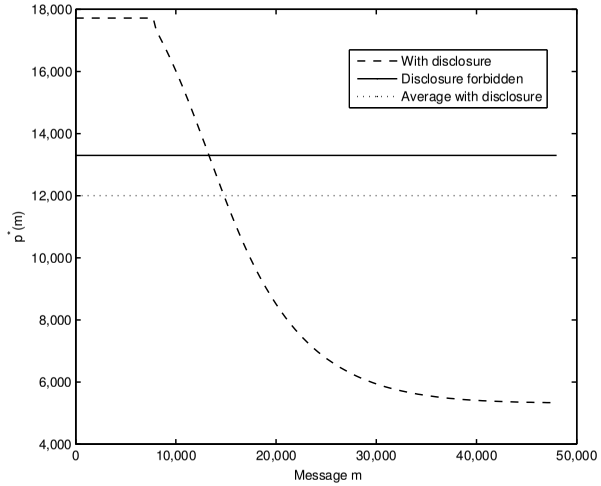
This section looks at the equilibrium of the neighborhood when there is no information disclosure. The equilibrium of the model is solved with no message m, and then is compared to the equilibrium of the full game.

Proposition 12. (Equilibrium when no message can be disclosed) *Consider the case where no message can be disclosed, $c = +\infty$ and $\underline{m} = +\infty$. In this equilibrium,*

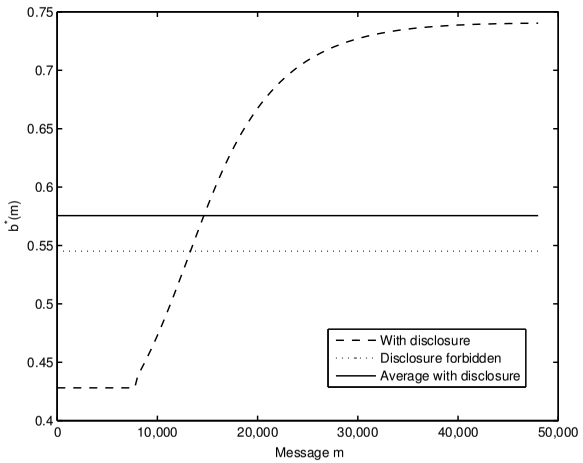
- *White households sell to a black buyer if and only if the black buyer's offer price is greater than $p^* = \frac{1}{1-\kappa}\left[p_s - \frac{\rho}{2}\right]$.*
- *The fraction of white households selling to a black buyer is $b^* = 1-\Phi(\frac{\frac{1}{1-\kappa}[p_s-\frac{\rho}{2}]-\mu}{\sigma_p})$.*
- *The broker's profit is $\Pi = \kappa E(p \geq p^*)P(p \geq p^*)$.*

Proof See appendix. The proof follows the argument of Angeletos (2004). □

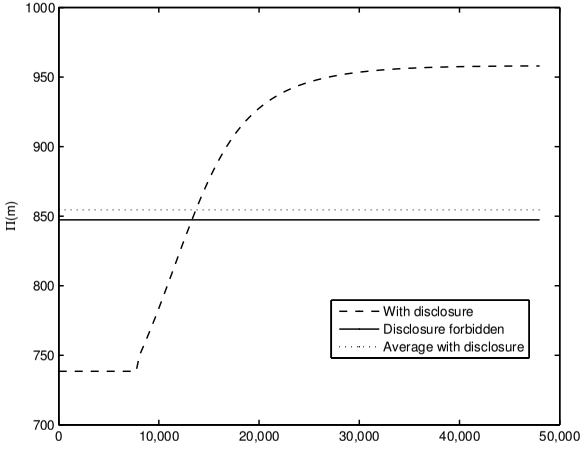
In a neighborhood with stronger racial preferences, the threshold price is lower and white homeowners leave the area at lower prices. The neighborhood's racial composition changes dramatically around $\mu = \frac{1}{1-\kappa}[p_s - \rho/2]$, and $b^* \to_{\mu\to+\infty} 1$, $b^* \to_{\mu\to-\infty} 0$. Small changes in black households' income can trigger large changes in segregation in neighborhoods.



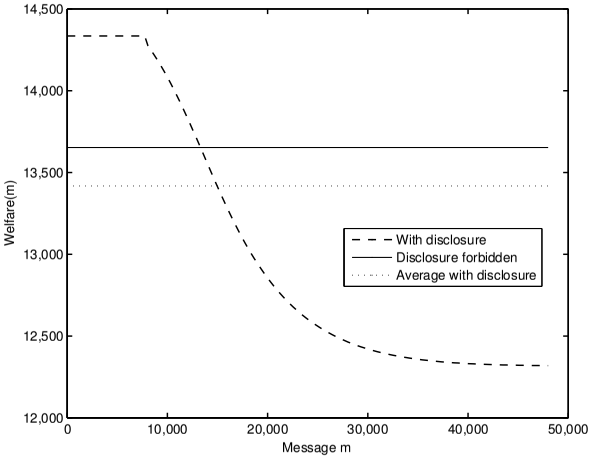
(i) Threshold offer price p^*.
White households accept an offer p if $p \geq p^*(m)$



(ii) Equilibrium fraction of blacks b^*



(iii) The broker's profit



(v) Welfare

Parameters of the model. Commission fees $\kappa = 6\%$ of house prices. Price of housing in the suburbs $p_s = \$20,000$. Average offer price from black buyers, $\mu = \$15,000$, Racial preferences $\rho = \$15,000$. Standard deviation of offer prices $\sigma_p = 15,000$. Cost of disclosure $c = 5$.

Figure 2: The Effect of the Real Estate Broker's Disclosure on the Equilibrium of the Neighborhood

5 Implications of the Model: Effects of the Broker's Message on White Flight and Welfare

The anti-blockbusting provisions of the 1968 Civil Rights Act (section 804[e]) forbade making representations regarding the entry or prospective entry of persons of a particular race, color. It is interesting to note that the intent of the law was to protect both white homeowners and prospective black buyers. In the model of blockbusting, forbidding information disclosure lowers the fraction of black neighbors at equilibrium and increases the welfare of white buyers, in neighborhoods inhabited by white households with strong racial preferences. Forbidding information disclosure will increase the fraction of black neighbors at equilibrium and lower the welfare of white homeowners, in neighborhoods inhabited by white households with low racial preferences.

Proposition 13. ***(The broker's strategic disclosure increases the fraction of black households)*** *For small costs of disclosure $c < \tilde{c}$, the equilibrium fraction of black households in the neighborhood at equilibrium is higher with strategic disclosure than with forbidden disclosure, as long as racial preferences ρ are above $2(p_s - (1-\kappa)\mu)$, or, alternatively, if the average offer price μ is above $\frac{1}{1-\kappa}[p_s - \frac{\rho}{2}]$.*

Proof See appendix for the proof and the characterization of $\tilde{c}$. □

White households' welfare is the sum of the welfare of families who stay in the neighborhood, i.e. those who are matched to a black buyer with offer price $p \leq p^*(m)$, and of the welfare of families who leave the neighborhood, i.e those who are matched to a black buyer with offer price $p \geq p^*(m)$.

$$W(p^*) \quad = \quad ((1-\kappa)E(p|p \geq p^*) - p_s + \rho) \cdot P(p \geq p^*) + \rho(1-b^*) \cdot P(p \leq p^*)$$

As m increases, higher values of m indicate higher values of the average black buyers' offer price, A higher message m makes black buyers more likely to enter the neighborhood than with lower values of m. The gains of white homeowners who leave, when selling to black buyers, do not increase sufficiently to offset the aggregate welfare loss of white homeowners who stay.

Proposition 14. (White households' welfare and the message) *When the message m increases, white households' welfare decreases.*

Proof See appendix. □

A key implication of the model is whether forbidding information disclosure by brokers highers or lowers the welfare of white households. When racial preferences are sufficiently strong, forbidding information disclosure by real estate brokers indeed benefits white households.

Proposition 15. (Forbidding the broker's strategic disclosure increases white welfare) *Under the conditions of proposition 13, forbidding the disclosure of the message increases the aggregate welfare of white households.*

Proof See appendix. The aggregate welfare is concave with respect to the equilibrium fraction of blacks b^* and hence the fact that forbidding disclosure lowers the equilibrium fraction of black households. □

The model gives conditions under which forbidding information disclosure actually helps white households with strong racial preferences. When racial preferences are strong or when the average offer price is large, forbidding information disclosure

increases the welfare of white households. The intuition for the result is that forbidding information disclosure avoids the occurence of very high messages m – messages which may lead to significantly lower welfare for white households – and welfare is concave and decreasing in the fraction of black neighbors (see appendix).

This is the main conclusion of this analysis; the model suggests that the anti-blockbusting provisions of the Civil Rights act have increased the welfare of white households when prospective black buyers strongly valued housing in the neighborhood, or when white households' racial preferences were sufficiently strong.

6 The Model of "Sold" Signs

As mentioned in section 2, municipalities tried to prevent some perceived white flight by banning the use of "For Sale" and "Sold" signs. These signs are signals of the decision of other households. Does a noisy signal of the choices of other households provide information as good as the information provided by the real estate broker? Is the entry of black households into the neighborhood easier or harder?

This section models the neighborhood when households observe "Sold" signs. "Sold" signs give households a noisy contemporaneous signal of the number of white households leaving for the suburbs.[15]

$$s = s(b, \nu)$$

where the number of sold signs is an increasing function of the number of black households who buy in the neighborhood. The noise is normally distributed $\nu \sim$

[15]This equilibrium concept is discussed in Angeletos & Werning (2006). Interestingly, a model where 'late' movers observe a noisy signal of the 'early' movers gives similar predictions as the model presented here.

$\mathcal{N}(0, \sigma_\nu^2)$, independently of the offer prices p. Interestingly, the number of sold signs has to be consistent with the number of houses actually sold.

For tractability, the signal function is specified as $s(b, \nu) = -\Phi^{-1}(1-b) + \nu$ as in Angeletos & Werning (2006), so that s is distributed normally.

Definition 16. (Equilibrium of the neighborhood with "Sold" signs) An equilibrium is a threshold price $p^*(s)$, an equilibrium fraction of black neighbors $b^*(\mu, \nu)$, and a signal $s(b^*, \nu)$ such that:

- white homeowners sell if and only if $p \geq p^*(s)$.
- the equilibrium fraction of black neighbors is $b^*(\mu, \nu) = 1 - \Phi(\frac{p^*(s(b,\nu))-\mu}{\sigma})$,
- the signal s is such that $s(b^*, \nu) = -\Phi^{-1}(1-b^*) + \nu$.

Proposition 17. *There is a unique equilibrium of the neighborhood given μ and ν if* $\sqrt{2\pi}(1-\kappa) \geq \rho\sqrt{\alpha}(1-\delta)$.

Proof The equilibrium is characterized by:

$$\begin{cases} p^*(s) &= \frac{1}{1-\kappa}[p_s - \rho E(b^*|p^*(s), s)] \\ b^*(\mu, \nu) &= 1 - \Phi(\frac{p^*(s(b^*,\nu))-\mu}{\sigma}) \\ s(\mu, \nu) &= -\Phi^{-1}(1 - b^*(\mu, \nu)) + \nu \end{cases}$$

Define $z \equiv Z(s) = p^*(s) + \sigma s$. Then $z = \mu + \sigma\nu$ is a noisy signal of μ, such that $z \sim \mathcal{N}(\mu, \sigma^2\sigma_\nu^2)$. Hence, in any symmetric equilibrium,

$$\begin{aligned} p^*(s) &= \frac{1}{1-\kappa}[p_s - \rho(1 - \Phi(\sqrt{\alpha}(1-\delta)(p^*(s) - Z(s))] \\ &= \frac{1}{1-\kappa}[p_s - \rho\Phi(\sqrt{\alpha}(1-\delta)\sigma s)] \end{aligned}$$

Where δ is the relative precision of the private signal. The existence and uniqueness of the equilibrium relies on the existence and uniqueness of roots of this equation:

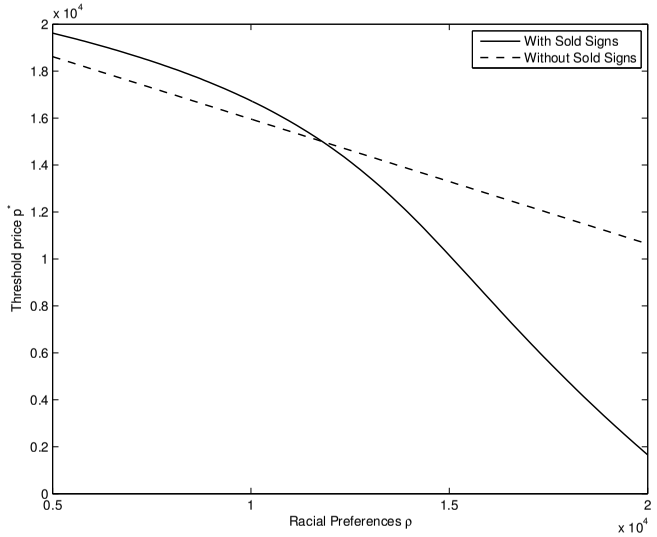
$$p^*(s) + \sigma s = z$$

It is easy to show that an equilibrium always exists. Indeed, $p^*(s) + \sigma s \to +\infty$ if $y \to +\infty$ and $p^*(s) + \sigma s \to -\infty$ if $s \to -\infty$, and $\frac{dp^*(s)}{ds} + \sigma > 0$ under the condition $\sqrt{2\pi}(1-\kappa) \geq \rho\sqrt{\alpha}(1-\delta)$. Hence the existence and uniqueness of s given μ and ν. p^* and b^* are obtained using the characterization of the equilibrium. □

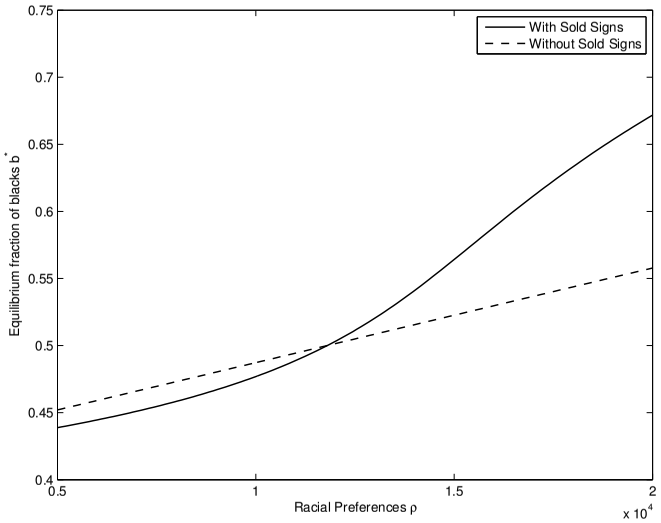
The equilibrium is pictured in figure 3. Each figure presents the equilibrium as a function of racial preferences ρ. When racial preferences are stronger, whites sell at lower prices, and they sell at *much* lower prices when they observe "Sold" signs (graph (i)). "Sold" signs typically amplify the white flight. With "Sold" signs, the fraction of blacks increases much more than without "Sold" signs when racial preferences are higher (graph (ii)). As racial preferences increase, the profit of the broker increases, and it increases much more when "Sold" signs are observed. Welfare increases mechanically when racial preferences increases, but they increase by less when "Sold" signs are observed.

On the other hand, for low racial preferences, the observation of "Sold" signs typically leads to less black neighbors at equilibrium (left side of figure (ii)), and to lower profits (left side of figure (iii)).

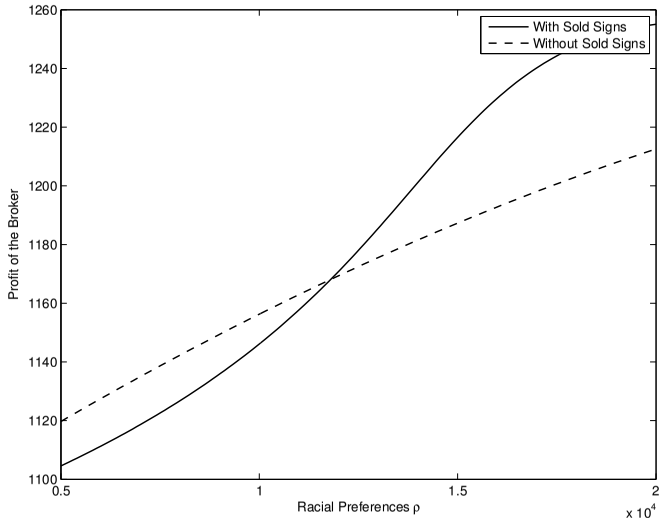
Proposition 18. *If racial preferences are higher than $2(p_s - (1-\kappa)\mu)$, there is more black entry with "Sold" signs than without. Welfare is lower, profit is higher with "Sold" signs than without. If racial preferences are lower than $2(p_s - (1-\kappa)\mu)$, there is less black entry with "Sold" signs than without. Similarly, welfare is higher, profit is lower with "Sold" signs than without.*



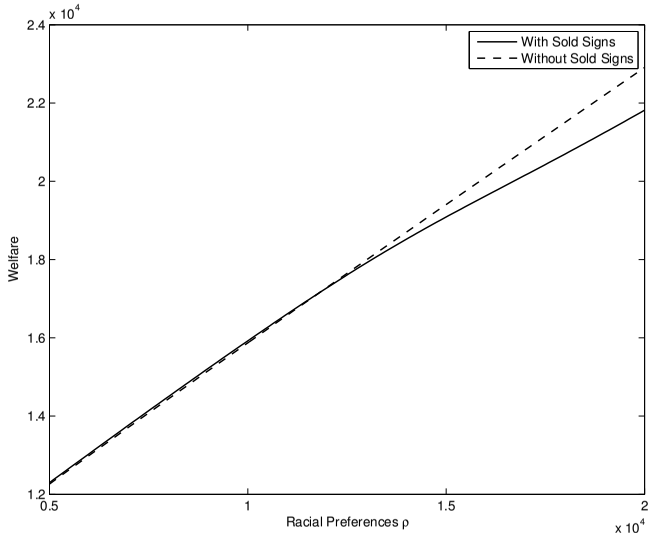
(i) Threshold offer price p^*



(ii) Equilibrium fraction of blacks b^*



(iii) The broker's profit



(v) Welfare

Parameters of the model. Commission fees $\kappa = 6\%$ of house prices. Price of housing in the suburbs $p_s = \$20,000$. Average offer price from black buyers, $\mu = \$15,000$, Racial preferences $\rho = \$15,000$. Standard deviation of offer prices $\sigma_p = 30,000$. Standard deviation of the noise of the aggregate signal (i.e. sold signs) $\sigma_s = 9,000$.

Figure 3: The Model of "Sold" Signs - Equilibrium Outcomes

Proof See Appendix. □

A direct corollary is that forbidding "Sold" signs benefits white households with strong racial preferences, i.e. above $2(p_s - (1-\kappa)\mu)$. Moreover, the higher the racial preferences, the higher the welfare gains of forbidding "Sold" signs.

In terms of policy implications, these results relate directly to the analysis of forbidding "Sold" signs in municipalities. Forbidding "Sold" signs benefits white households with the strongest racial preferences. "Sold" signs imply more black entry in areas where racial preferences are strong.

7 Conclusion

This paper designed a model of the dynamics of segregation that features a real estate agent who (i) has privileged information on black buyers' offer prices and (ii) gets commission fees on transaction prices. Because of this conflict of interest, real estate brokers disclose information strategically to maximize their profit. This tactic is called "blockbusting." The model shows that strategic information disclosure increases the fraction of black households in the neighborhood and lowers white welfare in areas where racial preferences are strong or where the average offer price of prospective black buyers is high. Hence, forbidding information disclosure through section 802 of the Fair Housing Act of 1968 is likely to protect white homeowners.

Finally, the paper develops a model of "Sold" signs. "Sold" signs act as a signal of the decisions of the other households. "Sold" signs magnify the effect of racial preferences. The model shows that white flight is stronger with "Sold" signs in a neighborhood where white homeowners have strong racial preferences. The model suggests that municipalities' decision to prohibit the use of "Sold" signs protects the welfare of white homeowners who have strong racial preferences.

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Appendix: The perfect information benchmark

The technical appendix with proofs is presented in a separate file.

In the model with perfect information, the distribution of offer prices is common knowledge. Strategic complementaries typically generate at least three equilibria (Benabou 1993, Benabou 1996, Schelling 1971, Schelling 1969): an equilibrium with a low fraction of black households, an equilibrium with a high fraction of black households, and an intermediate mixed equilibrium.[16]

This section presents the equilibria of the model when the distribution of prices μ is common knowledge. The model starts in period 3.

Definition 19. (Equilibrium with perfect information) An equilibrium of the game with perfect information is a threshold price p^* and an equilibrium fraction of black households b^* such that:

- White households accept an offer p if and only if $p \geq p^*$, where $p^* = \frac{1}{1-\kappa}(p_s - \rho b^*)$.
- The fraction of black buyers who buy a house in the neighborhood is $b^* = 1 - \Phi(\frac{p^* - \mu}{\sigma_p})$.

The Nash equilibria of the game are at the intersection of the distribution of black households' offer prices and the curve of white households' demand curve. There are at most three equilibria, high, low, and mixed. That result is consistent with prior literature.

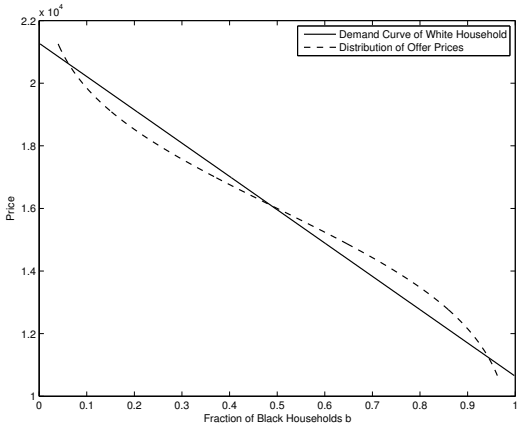
Proposition 20. ***(Equilibria with perfect information)*** *Equilibria of the game with perfect information are at the intersection of blacks' distribution of offer prices*

[16] This intermediate mixed equilibrium has been called a tipping point in the literature(Benabou 1993, Becker & Murphy 2001, Card et al. 2008).

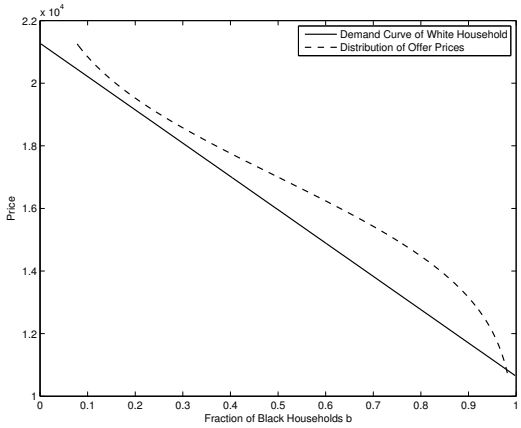
and whites' demand curve, as illustrated in figure 4. There exist thresholds $\underline{\mu}$ *and* $\overline{\mu}$ *such that,*

- *If* $\mu < \underline{\mu}$*, there is a single equilibrium, with a low fraction of black households and a high price.*
- *If* $\mu \in (\underline{\mu}, \overline{\mu})$*, there are three equilibria, an equilibrium with a low fraction of black households and a high price, an intermediate equilibrium, and an equilibrium with a high fraction of black households and a low price.*
- *If* $\mu > \overline{\mu}$*, there is a single equilibrium, with a high fraction of black households and a low price.*

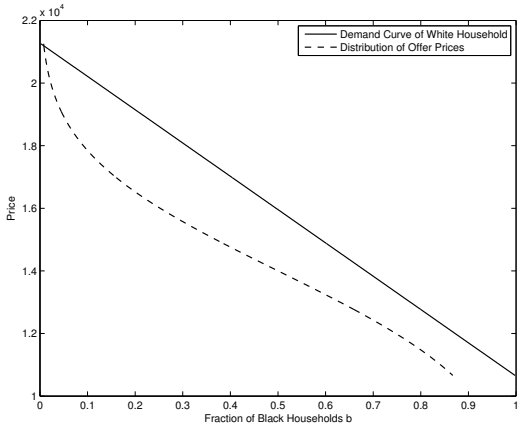
Overall, perfect information implies multiple equilibria. In the paper, the models with imperfect information suggest that fundamentals, i.e. the price of housing in the suburb, racial preferences, the average and the variance of offer prices, actually determine a single equilibrium outcome. Hence, without the message of the broker, even a small degree of uncertainty on black buyers' offer prices or on neighbors' racial preferences lead to a unique equilibrium, as in Morris & Shin (2002).



(i) Three Equilibria
Average Offer Price $\mu \in (\underline{\mu}, \overline{\mu})$



(ii) One Equilibrium, High Fraction of Black Households
Average Offer Price $\mu > \underline{\mu}$



(iii) One Equilibrium, Low Fraction of Black Households
Average Offer Price $\mu < \overline{\mu}$

Figure 4: Appendix - Equilibria with perfect information

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