Blockbusting:
Brokers and the Dynamics of Segregation

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Abstract

Legal and historical evidence suggest that real estate brokers played a substantial role in the white flight. This paper introduces real estate brokers in a tipping model of segregation. The model features voluntary disclosure of information by the broker in a game with private information and strategic complementarities. Real estate brokers can shift the equilibrium by disclosing information on black households’ valuation of housing, which are not perfectly known by households; brokers maximize profit on commission fees and disclose information accordingly. Strategic information disclosure is beneficial to black households and detrimental to white households.

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1 Introduction

This paper contributes to the literature on the dynamics of segregation and the determinants of the white flight by introducing real estate brokers in a tipping model of segregation.

The white flight has been widely studied in both the empirical and the theoretical literature. A basic ingredient of seminal papers of the dynamics of segregation (Benabou 1993, Benabou 1996, Schelling 1969, Schelling 1971, Card, Mas & Rothstein 2008a) is white households’ preference for white neighborhoods. These models predict the existence of multiple equilibria with high or low fractions of minority households. The neighborhood tips when the introduction of minorities in a neighborhood shifts the equilibrium from a low to a high fraction of minority households. Fundamentals such as black households’ income determines the tipping point, but evidence suggests that white households were not fully informed on the likelihood of tipping. Because white households were deciding when to leave and at what price without full knowledge of the likelihood of tipping, brokers could trigger “panic selling” through fear tactics called “blockbusting” (Orser 1994, Seligman 2005). Information disclosure by real estate agents can potentially determine when and where tipping happened.

Both Becker & Murphy (2001) and Schelling (1969) assume that information on the market is perfect and that transactions are costless. However, both anecdotal and empirical evidence suggest that the housing market has frictions, and that real estate brokers play an important role in matching buyers and sellers. The current paper introduces real estate brokers in a model of segregation inspired by Becker & Murphy (2001).

Anti-blockbusting provisions, which have been enacted by Congress in the Fair Housing Act of 1968 (Section 804 [c] 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.\footnote{A number of states have 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); Teaneck, N.J. Ordinance 1274, 1966.} Municipalities have also tried to prevent white flight by banning “For Sale” and “Sold” signs.\footnote{see for instance Linmark v. Willingboro. 431 U.S. 85 (1976)}

The paper first develops a model of “blockbusting”. The model is a model of neighborhood segregation inspired by Becker & Murphy (2001), where information is imperfect. Black households are heterogeneous in their valuations of housing and the mean valuation is not known by white
homeowners. The model shows that real estate brokers can influence white households by providing noisy signals on blacks’ mean valuation. Because the real estate agent get commission fees, and therefore have private incentives for turnover, and because real estate brokers have privileged information on the state of the market, their disclosure of information to homeowners can increase turnover and commission fees.

In other words, the model of “blockbusting” has four key building blocks: strategic complementarities, imperfect information, households’ private information (Morris & Shin 2002), and strategic information disclosure by the broker (Jovanovic 1982). Strategic complementarities stem from racial preferences: white households have a preference for white neighbors. Both subjectively stated preferences and structural estimations have shown that white households value the presence of white neighborhoods in an area (Krysan, Couper & Farley 2009, Bayer, Ferreira & McMillan 2007). Information is not perfect and private information (Morris & Shin 2002) is endogenized: White households do not know the true distribution of black households’ valuation of housing and infer the distribution of offer prices from their buyer’s valuation of housing. The uncertainty about the true distribution of offer prices generates a single equilibrium that depends on the fundamentals (Carlsson & van Damme 1993, Frankel, Morris & Pauzner 2003): The value of a house in the suburb, racial preferences, and black buyers’ valuation of their house. Imperfect information also creates an opportunity for real estate brokers to try to influence white households. Brokers will disclose information on black households’ valuation of housing to trigger sales and generate commission fees. Information is verifiable but noisy, and its revelation is costly. Brokers disclose information if these information can trigger enough turnover to cover the cost of entering the area.

Brokers’ information disclosure generates turnover, opens neighborhoods to black households, and thus generates gains from trade for black households. “Anti-blockbusting provisions” restrict the disclosure of information, and, in general, hurt the interests of black buyers and increases the welfare of white homeowners. Black households’ welfare losses increase with their bargaining power. White families’ welfare gains are stronger for white families with the strongest racial preferences. The anti-blockbusting provisions of the Fair Housing Act help white families with the strongest racial preferences. These are one of the few provisions of the Fair Housing Act that protect white homeowners at the expense of black households.

The paper also develops a model of “Sold” signs. In this model, the same ingredients are present,
but there are early and late movers. Early movers post “Sold” signs, therefore sending information about the equilibrium fraction of black households in the area. The “Sold” signs have an effect similar to information disclosure by the real estate broker.

In addition to the anti-blockbusting provisions of the Fair Housing Act, municipalities enacted statutes forbidding the posting of “Sold” signs (as in Willingboro, NJ). In this paper, I show that these statutes protected white households’ welfare, all the more when white households’ bargaining power is low.

Both the anti-blockbusting provisions and the municipal statutes forbidding “Sold” signs are meant to restrict the flow of information among white neighbors. However, my model suggests that these two dispositions have contradictory welfare implications. Whereas the Fair Housing Act restricts disclosure of information, the First Amendment protects “Sold” signs. Since disclosure has the same effect regardless of the nature of the information that is disclosed by the agent, it is hard to provide an economic rationale consistent with both legal dispositions, unless one believes that racial statements per se should be forbidden.

This paper models the role of real estate brokers as an informational role. Real estate brokers at no point buy a house. They make profit on commission fees only. However, a speculator with deep pockets can trigger the white flight by buying to 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. This strategy can happen under very particular circumstances only: 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.

Basic facts about the white flight have been extensively described in the literature. From 1940 to 1970, the black share in northern and western cities from 4 to 16 percent. In 1977, 62% of poor urban families lived in city centers (U.S. Bureau of the Census, 1978). In 1980, 72% of urban African-Americans lived in the center, whereas 67% of urban whites lived in the suburbs (Boustan 2007). The Great Migration increased demand for housing in city centers across Northern states: About 3.5 million African-Americans migrated from 1910 to 1940 (Collins 1997). Recent estimates suggest that each black arrival led to 2.7 white departures (Boustan 2007). Decreasing transportation costs have made this transition easier (Mieszkowski & Mills 1993) .
The rest of the paper is structured as follows. The next subsection shows that there were presents evidence of blockbusting in legal decisions and in legal dispositions and shows that there were above-the-average commission fees per census tract during the white flight. In section 3 I present the “blockbusting” model, its basic mechanisms and I show how tipping depends on the broker’s strategic information disclosure. Strategic information disclosure typically improves blacks’ welfare and lowers whites’ welfare. In section 5 I solve equilibria with perfect information, and present the model of “Sold” signs and its welfare implications. Section 6 concludes.

2 Real Estate Brokers’ Conflict of Interest

In this subsection, I use the Census and decisions of federal courts to shed light on the conflict interest of real estate brokers during the white flight. First, the white flight generated above-the-average profit, with substantially higher turnover and 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 the White Flight

Census tract files from 1950 to 1970 include variables that indicate when a household moved in their current dwellings, house prices by categories, and racial demographics. I considered only urban areas, and kept the same consistent set of counties over the time period. Finally, I compute aggregate profits 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 increases from 1940 to 1970. The third line of Table 1 suggests that turnover in urban areas was indeed at its highest point in 1950, at 18%, then 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 1000 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 1000 housing units were at their highest point at the height of the 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

Brokers who engage in blockbusting will typically approach a white household to let him know that “black families are entering the area” (Glassberg 1972). That is, they suggest that black households’ valuation of housing is actually higher than the price at which other white families are ready to leave.

Real estate brokers get this information from a variety of sources, the most important of which is Multiple Listing Services (Hendel, Nevo & Ortalo-Magné 2007), but also their previous activity on the market and their communication with other real estate brokers.

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 tip and reap profits.

A good example of real estate brokers’ tactics is the Zuch v. Hussey Michigan blockbusting case. “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 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.”

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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])

On this basis, 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.


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 detrimental to black households and 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 are playing a game of strategic interactions where the decision is “Willingboro, to sell or not to sell.” Ex-post statistical evidence does not suggest that the prohibition of “For Sale” and “Sold” signs had affected turnover in the area. Nevertheless, it is telling that the race of entrants was being seen as a major determinant of turnover and that both the Supreme Court and the Court of Appeals observed a growing “psychology of fear” related to panic selling.

The Supreme Court decided that the prohibition of “For Sale” and “Sold” signs was not compatible with the freedom of commercial speech, and thus it violates the First Amendment. Interestingly this decision is apparently contradictory with the anti-blockbusting provisions of title VIII of the Civil Rights Act of 1968, since the former increases the likelihood of tipping whereas the latter reduces the probability of tipping.

Observing “For Sale” and “Sold” signs is typically observing the decision of other households to move or to stay in the neighborhood. Section 5 designs a model of “For Sale” and “Sold” that suggests that the display of these signs is equivalent to the observation of information on black buyers’ willingness to pay for housing.

3 The Model

3.1 Basic Building Blocks

We model the strategic interaction of homeowners in a neighborhood that is initially all white. The model is an extension of Becker & Murphy (2001). The essential building blocks are (i) racial
preferences of white homeowners (ii) imperfect information about black buyers’ valuations of housing (iii) private information provided by the interaction with a specific black buyer (iv) disclosure of information by the real estate broker.

There are three 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.

• Individual offers by black buyers provide private information: when a black buyer makes an offer to a white seller, that offer gives information on his valuation of the house. There is a distribution of valuations of 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 valuation. 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 I present 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. I assume that information is verifiable (Jovanovic 1982). Thus brokers with information that sufficiently increases their profits will disclose information (unraveling property).

Overall this is a model of strategic complementarities with externalities, imperfect information, private and public information.

3.2 The Model

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

$$u(c, x) = c + \sigma(1 - b)$$
$c$ is consumption, $b \in [0,1]$ is the fraction of black households in the neighborhood, and $\sigma$ are racial preferences. Housing costs and income are sunk. They can buy a house in another neighborhood, the suburb, at exogenous price $p_s$. There is no black household in the suburb.

There is a density 1 of black households living in another area, the black neighborhood. Black households’ valuation of a house in the inner-city neighborhood is $v_b$. The distribution of valuations $v_b$ is normal with mean $\mu$ and standard deviation $\sigma_v$, $v_b = \mu + \varepsilon$.

There is a real estate broker who can match white and black households.

The timing of the model is as follows:

- **Period 1:** Nature selects a value of $\mu$. The broker obtains a signal $z = \mu + \eta$, where $\eta \sim N(0, \sigma_z^2)$. The broker can disclose the signal $z$ to each household at a cost $c$.

- **Period 2:** The broker matches each white household $i \in [0,1]$ to a black buyer with valuation $v_b \sim N(\mu, \sigma^2)$. $\sigma^2$ is common knowledge. White homeowners and black sellers bargain using the Nash axiomatic solution, white homeowners’ bargaining power is $\gamma \in (0,1]$. 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 $\alpha \in (0,1)$ of the transaction price to the real estate broker as a commission fee.

The real estate broker of the buyer’s side does not have an active role in the model.

### 4 Analysis of the model

#### 4.1 How the Broker Can Shift White Homeowners’ Beliefs

White homeowners do not know the mean of the distribution of valuations $\mu$. They have a flat prior for $\mu$ over $(-\infty, +\infty)$ and their information on $\mu$ comes from the signal sent by the broker $z$ and their matched black buyer.

$$
\mu | v_b, z \sim N(\delta v_b + (1 - \delta)z, \alpha)
$$

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In this version of the model, the broker sends the same signal to all households. Hence the signals sent to different households are perfectly correlated. I can also write a model where signals are not perfectly correlated across households. The implications are identical. Let $z_i = \mu + \eta_i$ the signal sent to household $i$, and assume that $\text{Corr}(z_i, z_j) = \rho$. Then $z_j | z_i \sim N(z, 2\sigma_z^2(1 - \rho))$. If $\rho = 1$ the model is equivalent to the model of the paper.
The real estate broker can then influence white households’ perception of black entry in the neighborhood by sending the signal $z$. How much the broker can influence white households’ perceptions depends on the standard deviation of the signal provided by the broker.

There is a threshold $\underline{z}$ such that if $z \leq \underline{z}$, the broker does not send a signal. However, white households are not naive. When no signal is sent by the broker, households know that $z < \underline{z}$.

$$\mu|v_b, \text{no signal} \sim \mu|v_b, z \leq \underline{z}$$

### 4.2 Bargaining between black buyers and white sellers

In period 2, the white homeowner is matched with a black buyer whose valuation, known to the white homeowner, is $v_b$ taken from the normal distribution with mean $\mu$ and standard deviation $\sigma_v$. $\sigma_v$ is common knowledge, and the household has a uniform improper prior for $\mu \in (-\infty, +\infty)$.

The white homeowner and the black buyer bargain considering (i) the valuation of the black buyer (ii) the price of housing in the outside option, i.e. the price of housing in the suburb (iii) the expected fraction of black households in the neighborhood in case the negotiation fails. The price is determined according to the generalized Nash bargaining outcome. Hence, the price of the transaction is:

$$p = \arg\max_p ((1 - \alpha)p - p_s + \sigma - \sigma(1 - E(b|v_b, z)))^\gamma (v_b - p)^{1 - \gamma}$$

where $\gamma \in (0, 1)$ is white households’ bargaining power, $p$ is the price of the transaction if accepted, $\alpha \in (0, 1)$ is the rate of commission fees, $p_s$ is the price of housing in the suburb, $\sigma$ are racial preferences, $b$ is the expected fraction of black households in the neighborhood, equal to the expected fraction of white households accepting the offer at equilibrium, $v_b$ is the black buyer’s valuation. Therefore the price of transaction, if carried out, satisfies

$$p = \gamma v_b + (1 - \gamma) \frac{1}{1 - \alpha} (p_s - \sigma E(b|v_b, z))$$

which shows that the price depends on the expected equilibrium fraction of black households in the neighborhood. This will be an increasing with the valuation of the buyer $v_b$. 

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Note that in what will follow, the equilibrium fraction of black households is independent of black households’ bargaining power. Bargaining power affects how the overall consumer surplus is shared between black and white households.

4.3 Equilibrium

I will be looking at monotone equilibria, that is, equilibria in which households sell only if their valuation is higher than a threshold (Van Zandt & Vives 2007).

As mentioned above the broker chooses whether or not to disclose information. Disclosure of the signal makes the entry of black households more or less likely, depending on the value of the signal. A higher signal $z$ tells white households that black households strongly value housing in the neighborhood. With a higher signal, blacks enter the area more easily, at lower prices, and they get higher gains from trade. Brokers disclose if the sales generated by disclosure exceed the cost of disclosure $c$. The model has an unraveling property, i.e. brokers disclose as long as the cost of disclosure is lower than the benefits of disclosure. Given the structure of the model detailed below, only brokers with a signal higher than a threshold $\bar{z}$ will disclose (Jovanovic 1982). The threshold $\bar{z}$ is increasing with the disclosure cost $c$.

A monotone equilibrium with disclosure of information by the broker incorporates the bargaining outcome between white owners and black buyers, the optimal action of white households (whether to sell or not), the optimal action of the real estate broker.

**Definition (Equilibrium with disclosure of information)** An equilibrium of the game with disclosure of information by the broker is a threshold signal $\bar{z}$, a threshold price $p^*(z)$, a threshold price $p^*$, a threshold valuation $v_b^*(z)$, a threshold valuation $v_w^*$ and an equilibrium fraction of black households $b^*(\mu, z)$ and $b^*(\mu)$ such that:

- **The broker discloses the signal if and only if $z \geq \bar{z}$.** In that case,
  - White households accept an offer $p$ if and only if $p \geq p^*(z)$, where $p^* = \frac{1}{1-\alpha} (p_s - \sigma E(b^*|z, v_b^*(z)))$.
  - Black buyers and white sellers bargain using the generalized Nash bargaining model, so that $p^*(z) = \gamma v_b^*(z) + (1 - \gamma) \frac{1}{1-\alpha} (p_s - \sigma E(b^*|z))$.
  - The fraction of black households in the neighborhood is the fraction of black households with valuation greater than $v_b^*(z)$, i.e. $b^*(\mu, z) = 1 - \Phi(\frac{v_b^*(z)-\mu}{\sigma_w})$. 

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The broker does not disclose the signal if \( z < \bar{z} \). In that case,

- White households accept an offer \( p \) if and only if \( p \geq p^* \), where \( p^* = \frac{1}{1-\alpha} (p_s - \sigma E(b^*|z < \bar{z}, v_b^*)) \).

- Black buyers and white sellers bargain using the generalized Nash bargaining model, so that \( p^* = \gamma v_b^* + (1 - \gamma) \frac{1}{1-\alpha} (p_s - \sigma E(b^*|z < \bar{z}, v_b^*)) \).

- The fraction of black households in the neighborhood is the fraction of black households with valuation greater than \( v_b^* \), i.e. \( f^*(\mu) = 1 - \Phi\left(\frac{v_b^* - \mu}{\sigma}\right) \).

The equilibrium number of black households depends on the information provided by the broker. The neighborhood changes dramatically for values of \( \mu \) around \( v_b^*(z) \). 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 (Equilibrium with disclosure of public information)** Assume that \( \sigma \leq \frac{1-\alpha}{1-\delta} \sqrt{\frac{2\pi}{\alpha}} \). Conditional on the signal, there is a unique equilibrium that survives the iterated elimination of dominated strategies. In this equilibrium, white households sell at price \( p \) if \( p \geq p^*(z) \), or equivalently if \( v_b \geq v_b^*(z) \).

\[ p^*(z) \text{ and } v_b^*(z) \text{ are the roots of} \]
\[
\begin{cases}
(1-\alpha)p^*(z) - p_s + \sigma = \sigma (1 - E(b|z, v_b^*(z))) \\
\frac{1}{1-\alpha} p^*(z) = \gamma v_b^*(z) + (1 - \gamma) \frac{1}{1-\alpha} (p_s - \sigma E(b|z, v_b^*(z)))
\end{cases}
\] (1)

And similarly for \( p_b^* \) and \( v_b^* \). The broker’s expected profit is an increasing function of the signal \( z \).

\[
E(\Pi|z) = \alpha E(p \geq p^*(z)|z) \cdot Pr(p \geq p^*(z)|z)
\]

The threshold signal \( \bar{z} \) is determined by

\[
E(\Pi|\bar{z}) - c = E(\Pi|z)
\]

where \( \Pi \) is the profit generated when no information is disclosed.

In any equilibrium of the game, bargaining power determines how the gains from trade are shared between the white homeowner and the black buyer but not the equilibrium number of black households in the neighborhood.

The higher the signal of black buyers’ valuation $z$, the higher the number of white households accepting the offer of their buyer. This is because a white household’s value of staying in the neighborhood decreases with the fraction of black households in the neighborhood. A higher $z$ suggests a higher fraction of black households in the neighborhood at equilibrium, thus weakening the bargaining position of white households.

Proposition (Signal and tipping) For a given distribution of valuations, the higher the signal $z$, the higher the number of white families accepting the offer, i.e. $v^*_b(z)$ is a decreasing function of $z$. Also, the higher the signal $z$, the higher the equilibrium fraction of black households in the neighborhood, i.e. $b^*(z)$ is an increasing function of $z$.

4.4 Equilibrium When the Broker Cannot Disclose Information

This section looks at the equilibrium effects of information disclosure. Does the disclosure of the signal $z$ actually increase the equilibrium fraction of black households in the neighborhood? In this section, I solve the equilibrium of the model with no signal $z$, and then compare it to the equilibrium of the full game.

4.4.1 White Homeowners’ Expectation Formation

White homeowners ignore the mean of the distribution of valuations $\mu$. They have a flat prior for $\mu$ over $(-\infty, +\infty)$ and their only source of information is the valuation of the buyer they are matched to.

$$\mu | v_b \sim N(v_b, \sigma^2)$$

Whites who are matched to a black household with a high valuation substantially overestimate buyers’ average valuation, and conversely, whites matched to a black household with a low valuation substantially underestimate buyers’ average valuation.
4.4.2 Monotone Equilibria

As in the previous equilibrium, I will be considering monotone equilibria. In these equilibria, households sell if and only if the price is higher than a given threshold. The equilibrium fraction of blacks entering the neighborhood is then an decreasing function of the threshold.

**Definition (Equilibrium with imperfect information)** An equilibrium of the game with imperfect information is a threshold price $p^*$, a threshold valuation $v_b^*$ and an equilibrium fraction of black households $b^*(\mu)$ such that:

- White households accept an offer $p$ if and only if $p \geq p^*$, where $p^* = \frac{1}{1-\alpha} (p_s - \sigma E(b^*|v_b^*))$.

- Black buyers and white sellers bargain using the generalized Nash bargaining model, so that $p^* = \gamma v_b^* + (1-\gamma) \frac{1}{1-\alpha} (p_s - \sigma E(b^*|v_b^*))$.

- The fraction of black households in the neighborhood is the fraction of black households with valuation greater than $v_b^*$, i.e. $b^*(\mu) = 1 - \Phi(\frac{v_b^* - \mu}{\sigma_v})$.

Only a single equilibrium survives the iterated elimination of dominated strategies. Uncertainty about black buyers’ valuation yields a single equilibrium depending on the true average valuation $\mu$ of black buyers.

**Proposition (Equilibrium with imperfect information)** There is a unique equilibrium that survives the iterated elimination of dominated strategies. In this equilibrium,

- White households sell to a black buyer if and only if the black buyer’s valuation is greater than $v_b^* = \frac{1}{1-\alpha} [p_s - \frac{\sigma}{2}]$.

- The fraction of white households selling to a black buyer is $b^* = 1 - \Phi(\frac{p_s - \frac{\sigma}{2} - \mu}{\sigma_v})$.

The broker’s profit $\Pi = \alpha E(p \geq p^*)P(p \geq p^*)$ is increasing with $\mu$.

**Proof** See appendix. The proof closely follows Morris & Shin (2002).

The threshold $v_b^*$ does not depend on the fundamental $\mu$ as white households do not observe the fundamental but only the valuation of their matched buyer. $v_b^* = p_s - \sigma/2$ so that white buyers with stronger racial preferences have a lower threshold and leave the area more easily.

The neighborhood changes dramatically around $\mu = p_s - \sigma/2$, and $b^* \to_{\mu \to \infty} 1$, $b^* \to_{\mu \to -\infty} 0$. Hence, small changes in black households’ income can trigger large changes in segregation in neighborhoods.
4.5 The Welfare Effects of the Broker’s Strategic Information Disclosure

Black households’ welfare depends on the number of trades carried out and the buying price of each house.

\[ W_b(\mu, z) = \int_{v_b^*(z)}^{\infty} (v_b - p(z, v_b)) f(v_b) dv_b \]

White households’ welfare is the sum of the welfare of families who stay in the neighborhood \((v_b \geq v_b^*(z))\) and of families who leave the neighborhood \((v_b \leq v_b^*(z))\).

\[ W_w(\mu, z, \sigma) = \int_{v_b^*(z)}^{\infty} ((1 - \alpha)p(z, v_b) - p_s + \sigma) f(v_b) dv_b + \int_{-\infty}^{v_b^*(z)} \sigma(1 - b^*(\mu, z)) f(v_b) dv_b \]

For a given distribution of black households’ valuation, when the signal \(z\) is higher, white homeowners estimate that more black families will enter the neighborhood. Since that lowers the value of staying in the neighborhood, this lowers the transaction price \(p(z, v_b)\) for all trades. Furthermore, white families are ready to accept lower prices for their houses, and more trades are carried out. Overall, more black families buy at cheaper prices, hence a higher value of the information \(z\) leads to a higher welfare for black households.

\[ \frac{dp(z, v_b)}{dz} < 0, \quad \frac{dv_b^*(z)}{dz} < 0, \quad \frac{db^*(z)}{dz} > 0 \]

**Proposition (Black and white households’ welfare conditional on the signal)** For a given distribution of valuations, black households’ welfare increases with the signal \(z\). White households’ welfare decreases with the signal \(z\).

When the signal \(z\) sent by the broker is higher, the price of transactions goes down, lowering the welfare of whites who leave and increasing the black households’ welfare. Also, when the signal is higher, the number of blacks entering the neighborhood goes up, \(db^*/dz > 0\) and the welfare of whites who stay decreases.

**Proposition (Disclosure vs Forbidden disclosure)** For small costs of disclosure, if racial preferences are sufficiently high, forbidding information disclosure lowers black welfare and increases white welfare.
Proof See appendix. The proof relies on the convexity of blacks’ welfare and the concavity of whites’ welfare.

The intuition behind the result is that blacks’ welfare is a convex function of \( z \) and whites’ welfare a concave function of the signal \( z \): the higher the signal, the more likely the neighborhood is to tip, i.e. be in the upper tail of the distribution of valuations.

5 Alternative Interpretations and Extensions

5.1 Equilibria with perfect information

In the model with perfect information, the distribution of valuations is common knowledge. Strategic complementarities, together with perfect information, 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.\(^5\)

I examine the equilibria of my model when the distribution of prices \( \mu \) is common knowledge. The game starts in period 3.

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

- White households accept an offer \( p \) if and only if \( p \geq p^* \), where \( p^* = \frac{1}{1-\alpha} (p_s - \sigma b^*) \).
- Black buyers and white sellers bargain using the generalized Nash bargaining model, so that \( p^* = \gamma v^*_b + (1 - \gamma) \frac{1}{1-\alpha} (p_s - \sigma b^*) \).
- The fraction of black buyers who buy a house in the neighborhood is \( b^* = 1 - \Phi(\frac{v^*_b - \mu}{\sigma v}) \).

The Nash equilibria of the game are at the intersection of the distribution of black households’ valuations and the curve of white households’ reservation prices. There are at most three equilibria, high, low, and mixed, consistent with prior literature.

\(^5\)This intermediate mixed equilibrium defines a tipping point, which is unstable when the neighborhood’s fraction of black households increases when the valuation of white households is lower than the valuation of the marginal black buyer (Benabou 1993, Becker & Murphy 2001, Card, Mas & Rothstein 2008b).
Proposition (Equilibria with perfect information) Equilibria of the game with perfect information are at the intersection of blacks’ distribution of valuations and whites’ valuation of their house, as illustrated in figure 5. There exist thresholds $\mu_\text{L}$ and $\mu_\text{U}$ such that,

- If $\mu < \mu_\text{L}$, there is a single equilibrium, with a low fraction of black households and a high price.
- If $\mu \in (\mu_\text{L}, \mu_\text{U})$, 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 $\mu > \mu_\text{U}$, there is a single equilibrium, with a high fraction of black households and a low price.

Overall, perfect information implies multiple equilibria. But the model with imperfect information shows that even a small degree of uncertainty on black buyers’ valuations leads to a unique equilibrium. This equilibrium depends on the fundamentals, i.e. the price of housing in the suburb, racial preferences, the average valuation of black buyers, and the variance of the valuations. “Animal spirits” are ruled out, and my full model with imperfect information suggests that fundamentals actually determine a single equilibrium outcome.

5.2 The Model of “For Sale” and “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 actions of the other players. 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? In this section, I show that observing for sale and sold signs is equivalent to observing noisy information disclosed by the real estate agent.

I model the neighborhood when there are two types of white homeowners, the early movers and the late movers. The fraction of early white homeowners is $e$. The density of early white homeowners leaving is $b_1$, and the density of late white homeowners leaving is $b_2$,

$$b = b_1 + b_2$$

is the total fraction of black households entering the neighborhood. The late movers observe the
selling decision of the early movers.

\[ \hat{b}_1 = b_1 + \varepsilon \]

where \( \varepsilon \) is distributed with a uniform distribution over \([-e, e]\) for the sake of simplicity.

In this version of the model, the real estate broker has no disclosure role, i.e. \( \alpha \equiv 0 \).

The timing of the model is adapted as follows:

- **Period 1:** Nature selects a value of \( \mu \).

- **Period 2:** The broker matches each “early” white household \( i \in [0, e] \) to a black buyer with valuation \( v_b \sim N(\mu, \sigma^2) \). \( \sigma^2 \) is common knowledge. White homeowners and black sellers bargain using the Nash axiomatic solution, white homeowners’ bargaining power is \( \gamma \in (0, 1] \).

  Each white homeowner accepts \( (a_i = 1) \) or rejects \( (a_i = 0) \) the offer. A noisy signal of the fraction selling \( \hat{b}_1 = b_1 + \varepsilon = \int_0^e a_i di + \varepsilon \) is observed by late homeowners.

- **Period 3:** The broker matches each “late” white household \( i \in [e, 1] \) to a black buyer with valuation \( v_b \sim N(\mu, \sigma^2) \). \( \sigma^2 \) is common knowledge. White homeowners and black sellers bargain using the Nash axiomatic solution, white homeowners’ bargaining power is \( \gamma \in (0, 1] \).

  Each white homeowner accepts \( (a_i = 1) \) or rejects \( (a_i = 0) \) the offer.

An equilibrium is defined by two thresholds. Early movers base their decision on one piece of information: their matched buyer’s valuation. Late movers observe a noisy signal of early movers’ choice and their matched buyer’s valuation.

**Definition (Equilibrium in the Early/Late mover sequential game)** An equilibrium is a threshold \( v_b^* \) and a threshold \( v_b^*(\hat{b}_1) \) such that:

- Early households sell if and only if the valuation of their buyer is greater than \( v_b^* \).

- Late households sell if and only if the valuation of their buyer is greater than \( v_b^*(\hat{b}_1) \).

Now, given this definition of the equilibrium, the observation of early movers’ choices is equivalent to the observation of a noisy signal of \( \mu \), the average black valuation. More precisely, any Nash equilibrium of the late movers’ strategic interaction corresponds to a Nash equilibrium when observation public noisy information on black households’ valuation.
Proposition (Equivalence of the observation of a signal and the observation of early movers’ choices) For \( e \) sufficiently large, there is a unique Nash equilibrium of the sequential game. Moreover, consider period 3; the observation of early households’ choices is equivalent to the observation of a normally distributed signal \( z \), such that:

\[
z = v_b^* - \sigma v \Phi^{-1}(1 - \hat{b}_1/e)
\]

This suggests that the observation of “For Sale” and “Sold” signs plays a similar role as information provided by the broker.

5.3 Blockbusting by Buying and Selling

In this paper, the story so far has been an informational story. Brokers match white and black households, and get commission fees. Brokers hold the property right on the house at no point during the model, their only role is to provide information and match two sides of the market.

However, blockbusting has also been described as a tactic in which a speculator or an agent would (i) buy from white households at high price and (ii) resell to black households at a loss, in order to introduce a sufficient number of black households, and get commission fees on the remaining transactions.

I consider the model with perfect information on black households’ valuations, and a value of \( \mu \) such that \( \mu \in (\mu, \bar{\mu}) \). In that case, consider the point \( \hat{b} \) as defined on figure 5.

The timing of the model is adapted as follows:

- **Period 1**: The broker buys the first \( \hat{b} \) houses at prices \( p \in [p_s; p_s - \sigma \hat{b}] \) and resells the houses to black households with valuations \( v_b \) such that \( v_b \in [F^{-1}(1 - \hat{b}), \infty] \).

- **Period 2**: The broker matches the remaining \( 1 - \hat{b} \) households to corresponding black sellers with valuations \( v_b \in [-\infty, F^{-1}(1 - \hat{b})] \).

Then I prove the following

Proposition (Profitability of blockbusting by buying and selling) The strategy is profitable for racial preferences superior to a given threshold \( \hat{\sigma} \). If white households have sufficiently high preferences for white neighbors, the strategy is profitable.
6 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’ valuation and (ii) gets commission fees on transaction prices. Because of this conflict of interest, real estate brokers disclose information on black buyers' willingness to pay for housing. The tactic of information disclosure is called “blockbusting.” Forbidding information disclosure through section 802 of the Fair Housing Act of 1968 protects white homeowners and reduces black homeowners' welfare for low disclosure costs. Thus the paper shows that the anti-blockbusting provisions of the Fair Housing Act of 1968 were likely to lower black households’ welfare.

Finally, “For Sale” and “Sold” signs are shown to convey similar information as a noisy public signal. The welfare consequences of the prohibition of “For Sale” and “Sold” signs are therefore likely to be similar to the welfare consequences of the anti-blockbusting provisions of the Fair Housing Act.

References


Tables and Figures
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<td>Annual turnover</td>
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<td>Annual commission fees per 1000 housing units</td>
<td>-</td>
<td>133,594</td>
<td>78,782</td>
<td>88,307</td>
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* 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).

Table 1: Estimates of Commission Fees
(i) Equilibrium fraction of white households selling

(ii) The broker’s profit

Figure 1: Equilibrium with private information
(i) Welfare analysis – $\gamma = 0.5$

(ii) Welfare analysis – $\gamma = 0.1$

Figure 2: Welfare analysis with private information but no public information
Figure 3: Private information and Real Estate Broker disclosure

(i) Fraction of black households entering the neighborhood.

(ii) Perceived black entry vs. Actual entry
Figure 4: Private information and Real Estate Broker disclosure

(i) White households' welfare

(ii) Black households' welfare
Figure 5: Equilibria with complete information
7 Appendix

7.1 Parameters of the simulation for figures

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Value</th>
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<tbody>
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<td>$p_s$</td>
<td>Price of housing in the outside option (the suburb)</td>
<td>20,000</td>
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<tr>
<td>$\mu$</td>
<td>Black households’ average valuation</td>
<td>15,000</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>White households’ racial preference</td>
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<tr>
<td>$\alpha$</td>
<td>Rate of commission fees</td>
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<tr>
<td>$\sigma_v$</td>
<td>Standard deviation of black households’ valuations</td>
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<td>$\sigma_z$</td>
<td>Standard deviation of the broker’s signal</td>
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<tr>
<td>$\gamma$</td>
<td>White households’ bargaining power</td>
<td>0.01</td>
</tr>
</tbody>
</table>

7.2 Tipping in the model with complete information

Proof of the proposition (Equilibria of the model with complete information)

The equilibria solve:

$$(1 + \alpha)(\gamma v^*_b + (1 - \gamma) \frac{1}{1 - \alpha}(p_s - \sigma b^*)) = p_s - \sigma b^*$$

with $b^* = 1 - \Phi(\frac{v^*_b - \mu}{\sigma_v})$. That is equivalent to:

$$v^*_b = \frac{1}{1 - \alpha} (p_s - \sigma(1 - \Phi(\frac{v^*_b - \mu}{\sigma_v})))$$

□

7.3 Imperfect Information – No disclosure of public information

Proof of the Proposition (Equilibrium with imperfect information)

Note that:
\[ E(b|v^*_b) = E(P(v_b \geq v^*_b|v^*_b)) = E(1 - \Phi(\frac{v^*_b - \mu}{\sigma_v})|v^*_b) = 1/2 \]

Hence the result that the equations have only one solution. In that case, the solution to the equations is the only equilibrium that survives the iterated elimination of dominated strategies. \[\square\]

### 7.4 Imperfect Information and Public Signal

**Proof of the proposition (Equilibrium with disclosure of public information)**

The proof closely follows Morris & Shin (2002). Note that the threshold valuation \( v^*_b(z) \) satisfies:

\[ v^*_b(z) = \frac{1}{1 - \alpha} \left[ p_s - \sigma (1 - \Phi(\sqrt{\alpha_v}(1 - \delta)(v^*_b(z) - z))) \right] \tag{2} \]

where \( \delta \) is the relative precision of the private signal. This equation has a unique solution whenever:

\[ \sigma \leq \frac{1 - \alpha}{1 - \delta} \sqrt{\frac{2\pi}{\alpha_s}} \tag{3} \]

**Lemma** If \( z = p_s - \sigma/2 \), the equilibrium is the same as the equilibrium with no public information. If \( z > p_s - \sigma/2 \), the equilibrium number of blacks is higher than the equilibrium number of blacks with no public information. If \( z < p_s - \sigma/2 \), the equilibrium number of blacks is lower than the equilibrium number of blacks with no public information.

From (2) \( z = p_s - \sigma/2 \) leads to \( v^*_b(z) = p_s - \sigma/2 \). Moreover

\[ b^*(\mu, z) = 1 - \Phi(\frac{v^*_b(z) - \mu}{\sigma_v}) \]

And \( \partial b^*/\partial z = -\phi(\cdot)\left[\frac{1}{\sigma_v} \frac{dv^*_b(z)}{dz}\right] \) is of the sign of \( -dv^*_b/dz \).

\( v^*_b(z) \) is an decreasing function of \( z \). Indeed, using the implicit function theorem,

\[ \frac{dv^*_b}{dz} = \frac{-A\phi(\cdot)}{1 - A\phi(\cdot)} \]

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where, because of condition 3, $A$ is such that $1 - A\phi \geq 0$ and $A\phi \geq 0$.

\[ \square \]

**Proposition (Disclosure vs Forbidden disclosure)** With costless disclosure, if racial preferences are sufficiently high, forbidding information disclosure lowers black welfare and increases white welfare.

**Proof** First, note that black welfare is a convex function of the signal $z$. Hence,

\[ \int W_b(\mu, z)f(z)dz \geq W_b(\mu, \mu) \]

Moreover, $W_b$ is an increasing function of the signal $z$. If $\mu \geq p_s - \sigma/2$,

\[ W_b(\mu, \mu) \geq W_b(\mu, p_s - \sigma/2) \]

Hence,

\[ \int W_b(\mu, z)f(z)dz \geq W_b(\mu, p_s - \sigma/2) \]

And information disclosure reduces black welfare.

Similarly, $W_w(\mu, z)$ is a concave function of $z$, and a decreasing function of the signal. Therefore if $\mu \geq p_s - \sigma/2$,

\[ W_w(\mu, p_s - \sigma/2) \geq \int W_w(\mu, z)f(z)dz \]

And forbidding information disclosure reduces white welfare.

\[ \square \]

7.5 Extensions: “For Sale” and “Sold” signs

**Proof of the uniqueness and existence of the Nash equilibrium**

At the Nash equilibrium, the early movers’ decision depends on their private information only, and the threshold price, threshold valuation and equilibrium number of early movers selling is defined by the following set of equations:
\[
\begin{align*}
\begin{cases}
p^* &= \gamma v^* + (1 - \gamma)(p_s - \sigma E(b_1^* | v^*_b) - \sigma E(b_2^* | \hat{b}_1 | b_1^*)) \\
p^* - p_s + \sigma &= \sigma(1 - E(b_1^* | v^*_b) - E(b_2^* | \hat{b}_1 | b_1^*)) \\
b_1^* &= e(1 - \Phi(\frac{v^* - \mu}{\sigma}))
\end{cases}
\end{align*}
\]

Late movers' choice depends on both their private information and the observation of the noisy signal \(\hat{b}_1\). Their threshold valuation, threshold price, and equilibrium fraction of late movers selling is defined by the following equations:

\[
\begin{align*}
\begin{cases}
p^*(\hat{b}_1) &= \gamma v^*_b(\hat{b}_1) + (1 - \gamma)(p_s - \sigma \hat{b}_1 - \sigma E(b_2^*(\hat{b}_1) | v^*_b(\hat{b}_1))) \\
p^*(\hat{b}_1) - p_s + \sigma &= \sigma(1 - \hat{b}_1 - E(b_2^*(\hat{b}_1) | v^*_b(\hat{b}_1), \hat{b}_1)) \\
b_2^*(\hat{b}_1) &= (1 - e)(1 - \Phi(\frac{v^*_b(\hat{b}_1) - \mu}{\sigma}))
\end{cases}
\end{align*}
\]

Solving for the threshold valuation of early and late movers,

\[
\begin{align*}
\begin{cases}
v^*_b &= p_s - \sigma e - \sigma E(b_2^*(\hat{b}_1) | b_1^*) \\
v^*_b(\hat{b}_1) &= p_s - \sigma \hat{b}_1 - \sigma(1 - e)\Phi(\sqrt{\alpha}(v^*_b(\hat{b}_1) - E(\mu | v^*_b(\hat{b}_1), \hat{b}_1)))
\end{cases}
\end{align*}
\]

And notice that:

\[
E(\mu | v^*_b(\hat{b}_1), \hat{b}_1) = \delta v^*_b(\hat{b}_1) + (1 - \delta)(v^*_b - \sigma v \Phi^{-1}(1 - \frac{\hat{b}_1}{e}))
\]

Hence:

\[
v^*_b(\hat{b}_1) - E(\mu | v^*_b(\hat{b}_1), \hat{b}_1) = (1 - \delta)(v^*_b(\hat{b}_1) - v^*_b + \sigma v \Phi^{-1}(1 - \frac{\hat{b}_1}{e}))
\]

This expression shows that there a unique Nash equilibrium. Moreover, observing early movers' choices is equivalent to observing a signal \(z\) such that:

\[
z = v^*_b - \sigma v \Phi^{-1}(1 - \frac{\hat{b}_1}{e})
\]

The signal \(\hat{b}_1\) is uniform, hence the signal \(z\) is normal. \(\square\)