Working Paper Series

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WP 25-05

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Two-sided platforms and the 6 percent real estate broker commission*

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June 23, 2025

Abstract

We build a model to explain the 6 percent real estate broker commission observed in the U.S. In our model, brokers operate a two-sided platform for trading homes. Using small-value handouts and exclusive buyer representation contracts, the platform captures the vast majority of buyers, thereby gaining a monopolist's position vis-á-vis the sellers. Home sellers' only outside option is to move while retaining ownership of their homes. Absentee homeownership, however, entails costs. As a monopolist, the platform sets its commission fee equal to the costs of absentee ownership. With these costs proportional to the home's value, the platform's optimal commission rate is the same for all homes, and remains insensitive to fluctuations in home valuations, while the platform's profit is pro-cyclical. The commission rate is also insensitive to reductions in underlying search costs because the seller's outside option does not involve selling the home. The model implies that commission rates should be higher where price-rent ratios are higher—a prediction we verify in the data. We also consider optimal regulation: a ban on exclusive buyer representation contracts implements a second-best optimal allocation, in which the platform charges lower commissions that are sensitive to both home valuations and search costs.

Keywords: real estate brokers, broker commission, two-sided platforms, monopolist pricing

JEL codes: D42, L12, L85

*The authors are grateful to Greg Buchak, Huberto Ennis, Kris Gerardi, Sonia Gilbukh, Lu Han, Hugo Hopenhayn, Chang-Tai Hsieh, Boyan Jovanovic, Todd Keister, Richard Lowery, Claudia Macaluso, Guillaume Plantin, Bruno Sultanum, Nicholas Trachter, and Russell Wong for their helpful comments, and to Brennan Merone and Vinh Phan for excellent research assistance. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Richmond or the Federal Reserve System.

1 Introduction

We study the pricing of brokerage services in the secondary market for residential housing in the United States. We build a model that replicates the following facts. First, within a local housing market, the same commission rate prevails for expensive and inexpensive homes. This is a puzzle if advertising and showing costs are less-than-proportional to the home's value. Second, broker commissions have remained largely unchanged over the last 30 years. This is a puzzle because improvements in communication and information technology have lowered search frictions significantly over this time period.

The relative uniformity of real estate commissions has been well documented; see, e.g., Hsieh and Moretti (2003), Barwick et al. (2017), Barry et al. (2025). Figure 1 plots Multiple Listing Service (MLS) commission data from the Houston, Texas, Regional Listing Service. For each year between 1997 and 2019, it shows the fraction of listings that offered the buyer's agent a commission of exactly 3 percent. The three lines show this fraction for homes in, respectively, the bottom quartile of the home price distribution, the middle 50 percent, and the top quartile.[1] The unconditional sample average is 0.965, meaning 96.5 percent of all homes listed for sale on the Houston MLS since 1997 offered exactly 3 percent in buyer-agent commission. The fraction of listings that offer the dominant buyer-agent commission rate is remarkably stable over time and across the home value distribution. On top of the buyer's agent commission, in a typical transaction, the seller also pays an equal amount in commission to her own agent. In effect, homeowners in Houston typically pay a 6 percent commission to sell their homes. Nationally, commission rates vary slightly across local housing markets, but show close to no variation within a given market, similar to the pattern we observe in Houston.[2]

In our model, broker commissions consistent with these facts emerge as a solution to a platform pricing problem with a two-sided market externality. A platform operated by an association of real estate brokers gains a monopolist position vis-à-vis the home sellers by capturing the gross of prospective home buyers. The platform captures the buyers by offering, on the one hand, an exclusive buyer representation contract, and, on the other hand, a few small-value benefits free of charge.[3] With close to all buyers tied to the platform, sellers face very low odds of finding a suitable buyer off the platform, which makes the platform a de facto monopolist for selling homes.

[1] The sample consists of 2,579,433 observations.

[2] We examine variation in average commission rates across U.S. metropolitan areas in Section 7. In Appendix A.10, we examine the dependence of commission rates on home prices within metropolitan areas.

[3] E.g., buyer agents can provide general market information, help with setting up home viewing appointments, help with hiring auxiliary service providers like home inspectors, etc. Conducting actual home showings can be thought of as the platform's service performed for sellers rather than buyers.

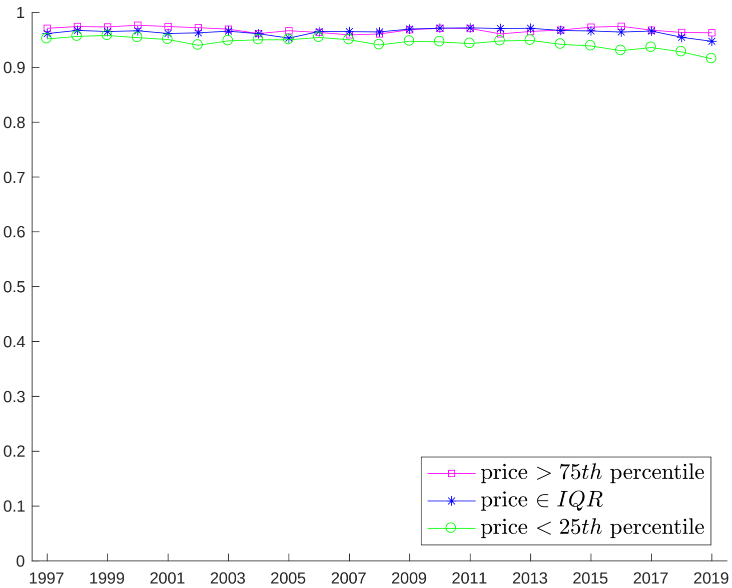

Figure 1: The fraction of MLS listings in Houston Regional Listing Service that offer a buyer agent compensation of exactly 3 percent, conditional on home price tier. Unconditional average: 0.965. Source: CoreLogic.

Homeowners face idiosyncratic shocks that create mismatch between their housing needs and the flow of housing services generated by the homes they own. Homeowners who are strongly mismatched sign exclusive listing contracts with the monopolist platform to sell their homes for a 6 percent commission. Homeowners who are mildly mismatched choose not to sell and stay in their homes despite the mismatch.

Signing an exclusive contract with a buyer's agent is also individually rational for the buyer. While buyers may be facing higher home prices due to capitalization of broker commissions, each individual buyer takes such a grossed-up price as given: by not signing with a broker, the buyer cannot obtain a lower price because sellers are already signed to pay 6 percent. For the same reason, searching off the platform is not a good strategy for buyers, as they anticipate sellers to be on the platform with an exclusive contract with a listing broker.

Exploiting this two-sided externality, the brokers' platform gains a monopolist's position for home sale transactions, and prices their services accordingly. We show that a solution to such a monopolist's pricing problem can generate a commission rate that is insensitive to changes in home values or the search costs.

In our model, the platform charges home sellers a total commission fee at a level determined by the sellers' outside option. Critically, a sellers' outside option does not represent the value of selling her home off the platform, as this option is rendered useless by the platform's capture of virtually all buyers. Rather, it represents the value of not selling the home at all. That value, in turn, is the larger of the following two options: keep the ownership of the home and move to another (i.e., become a so-called absentee owner) or keep the ownership of the home and stay put.

Which of these two options is chosen by a homeowner depends on two factors. One is the degree of mismatch between the homeowner's demand for housing services and the flow of housing services provided by the home she owns. The other is the level of costs associated with absentee ownership, i.e., the benefits of homeownership that are lost if the home is not owner-occupied. These costs include the cost of searching for renters, rent risk, taxes on rent income, property management fees, the cost of moral hazard in any upkeep duties delegated to renters, the loss of the option to customize the home to the occupant's taste, etc.[4] Let us define the absentee owner wedge as the sum of these costs relative to the ownership value realized by a suitable owner-occupant.[5] In our model, the homeowner's effective outside option is determined by the lower of the mismatch shock and the absentee owner wedge.

The homeowner's option to become an absentee owner puts an upper bound on the level of commission the brokers' platform can charge. With a commission rate higher than the absentee owner wedge, all owners, even those severely mismatched with their homes, would prefer to continue to own and move rather than pay the commission. The platform, thus, cannot charge a commission rate higher than the absentee owner wedge. Further, under a weak assumption on the distribution of the idiosyncratic mismatch shock, it is this upper bound that pins down the platform's optimal level of commission.

Charging this maximum rate is optimal for the platform because a cut in the commission produces only a small extensive-margin gain but a large intensive-margin loss. The extensive-margin gain comes from the additional sellers—those less mismatched with their homes—who choose to list. The intensive-margin loss occurs because the platform is unable to price discriminate based on the sellers' idiosyncratic mismatch shocks: any commission cut must be offered to all sellers in a given market segment, including those who are severely mismatched and willing to pay the maximum rate. We show that if the distribution of the homeowner mismatch shock is sufficiently thin at low values, the extensive-margin gain is dominated by the intensive-margin loss.

[4]See Goodman and Mayer (2018) for a survey of the literature on the economic benefits of homeownership.

[5]That is, the absentee owner wedge is the fraction of the home's value lost to absentee ownership.

Our model can deliver comparative statics consistent with the near-constant commission rates shown in Figure 1. In the cross-section, the platform's optimal commission rate will be the same for inexpensive, middle-value, and expensive homes as long as the absentee owner wedge is constant across the home-value distribution. This is consistent with Figure 1, which shows that the same commission rate dominates each of the three segments of the home-value distribution shown there.[6] Further, the level of search and matching costs does not impact the platform's optimal commission rate because the owner's outside option—the value of not selling—does not depend on these costs. As long as the platform's profit remains positive, changes in search costs impact the level of the platform's profit but not the commission rate the platform charges, consistent with the fee being virtually unchanged over the 22 years in the sample period in Figure 1. Decreasing search costs are consistent with increasing platform profits and the number of agents on the platform.[7]

We validate our model using cross-market variation in commission rates observed across 77 local housing markets in 2019. If the platform indeed charges a commission rate equal to the absentee owner wedge, then variation in this wedge across local housing markets should be reflected in cross-market variation in commission rates. Although the absentee owner wedge is not directly observable, we proxy for it using rental rates. Low rents, relative to home prices, worsen homeowners' outside options, and, hence, increase the absentee owner wedge, which should lead to higher observed commission rates. Higher rents, in turn, should force commission rates down. In Section 7, we validate this implication of the model by showing that, indeed, higher price-rent ratios are associated with higher average commission rates.

In addition to positive analysis, we conduct normative analysis of socially optimal commission rates under the following two assumptions. First, based on Hsieh and Moretti (2003), we assume platform profits are rents whose economic value is fully dissipated by excessive entry of agents.[8] In the planning problem, thus, the social welfare function does not count the platform's profit as welfare. Second, we assume that, perhaps due to past investments made by the brokers, their platform is a more efficient venue for matching sellers with buyers than the alternative, "open market" venue. By more efficient, we mean

[6]Our model can be consistent with different commission rates being charged for cheap and expensive homes, which would be the case if the absentee owner wedge were systematically related to the home's value. In Appendix A.10, however, we examine a national sample of commission rates and home prices and do not find evidence of a systematic relationship between a home's price and the commission rate charged to sell it.

[7]According to the NAR, there were approximately 0.7 million realtors in the the U.S. in 1995 and 1.5 million in 2019.

[8]As argued in Posner (1975), with free entry, the amount of resources wasted on competition for rents can be as high as the rents themselves.

the advertising and viewing costs are lower, and/or realized matching rates are higher.[9] In maximizing consumer welfare, the social planner trades off platform commissions against the efficiency gains from using the platform's superior matching technology.

We define a second-best planning problem, in which the platform can credibly threaten to withhold its superior matching technology from the planner's use, e.g., by exiting. As a solution to this problem, we obtain a socially optimal commission rate. We show that this rate is always lower than the rate charged by a monopolist platform. The level of the second-best fee is determined by equalizing the welfare of the consumers on the platform with the welfare they can achieve if all trade is moved off the platform, where competition is unfettered, but the matching technology is inferior. This socially optimal rate is not independent of the home's value or the level of search and matching costs. The platform still makes positive profit, but not as high as in the monopoly equilibrium.

Finally, we show that the socially optimal commission rate can be implemented with a simple ban on exclusive buyer representation contracts: if a buyer finds a home off the platform, the buyer's agent is not owed any commission. Such a ban prevents the platform from keeping buyers attached exclusively to its own listings, thus making it possible for sellers to find buyers off the platform, which improves the sellers' outside option. This gives rise to an equilibrium in which the platform chooses not to charge a monopolist's commission because it anticipates that sellers would respond by listing off the platform altogether. In the second-best efficient equilibrium, sellers are willing to accept a commission rate that still gives positive profit to the platform, but only because the platform's matching technology is superior, and not because the possibility of trade outside the platform is killed off by the buyers' exclusive attachment to it. The ban on exclusive buyer representation contracts is a light-touch regulation that preserves the platform's structure with its efficient matching while reducing the platform's rents to second-best efficient levels.

Our analysis is connected primarily to the literature on broker commissions in residential housing markets.[10] In a seminal paper, Hsieh and Moretti (2003) show that with a fixed commission rate and free entry, agent entry is excessive: low average productivity of an agent (few transactions executed per agent per year) dissipates the brokers' rents, resulting in normal profits for brokers and high transaction costs for consumers.[11] This finding raises two immediate questions: how is the fixed commission rate sustained in equilibrium, and what determines the level at which it is fixed? Why 6 percent and not 9 percent?

[9] This assumption is consistent with the findings of Hendel et al. (2009), who examine transaction data from Madison, WI, where a platform alternative to the MLS exists. They find evidence for higher search frictions on the smaller, alternative platform.

[10] Han and Strange (2015) and Barwick and Wong (2019) provide comprehensive reviews of this literature.

[11] Consistently, Han and Hong (2011) provide evidence of wasteful non-price competition among agents.

The first question has received considerable attention in the literature. The sellers' ability to negotiate with listing agents for lower rates is impeded by an implicit threat of "steering." Sellers compensate buyer agents, and if a seller lists her home with an offer of buyer agent commission below the "prevailing rate," buyer agents can steer their clients away from her listing toward listings that do offer the prevailing rate. Barwick et al. (2017), Barry et al. (2025), and Kim (2024) show evidence of such steering by buyer agents. Further, seller agents do not compete by reducing their portion of the commission paid by the seller. This lack of competition among seller agents is explained by Hatfield et al. (2025), who show that a fixed commission rate can be sustained despite free entry because a broker generally needs cooperation from other brokers to sell homes. The strategy of refusing to work with a broker who deviates from the "industry standard" pricing, complemented by an off-equilibrium temporary cut in commissions to decrease the value of the deviator's in-house matching, maintains collusive pricing despite free entry.

Our analysis is complementary to these studies. We take as given the lack of price competition among agents on the platform, and model the platform directly as a single, large player. Our focus is on the second question: what determines the level of commissions. Specifically, our model explains why the option to sell off the platform does not erode the platform's rents. We build on the two-sided market theory of Caillaud and Jullien (2003) and Rochet and Tirole (2003), and on the theory of labor coercion of Acemoglu and Wolitzky (2011), where a principal-agent problem is studied in which employers make ex ante investments that decrease the prospective workers' outside options. Similarly, in our model, the platform invests in capturing home buyers with low-value handouts and exclusive representation contracts, thus gaining monopoly power over home sellers.

To our knowledge, our paper is the first to propose an explanation for the level of commission set by the platform. Our explanation is based on the sellers' outside option of not selling, where sellers face the costs of absentee ownership. This explanation produces the right comparative statics, where the platform's monopoly rate does not vary with the home's price and does not decrease when search costs decline. At the same time—as we show empirically—the commission rate increases with the local market's price-rent ratio, consistent with our model.

In related quantitative work, Grochulski and Wang (2024) calibrate a housing search model and find excessive buyer agent commissions exceeding \$30 billion a year. They consider efficiency gains from implementing an á la carte pricing model for agent compensation, where buyers pay their agents directly and separately for each task performed. Similarly, Kim (2024) considers the policy of "decoupling," which requires buyers and sellers to each pay their respective brokers, and finds a 50 percent reduction in commission fees in an equilibrium with forced decoupling. In contrast to these studies, which consider regulating the pricing on the brokers' platform, our paper considers a light-touch regulation that does not interfere with the platform's business model but rather fosters cross-platform competition, with the open market serving as an alternative trading venue.

Buchak et al. (2024) investigate the impact of exogenous changes in agent commission rates on home sellers' and buyers' welfare and home prices in a calibrated dynamic equilibrium model of the housing market with repeated trade. They show that lower agent commissions increase sellers' and buyers' welfare while also increasing home prices, as housing becomes a more liquid, and therefore more valuable, asset in general equilibrium. In our static model with no repeat sales, we abstract from this general equilibrium effect: despite lower commissions, the buyer's maximum willingness to pay remains constant in our model. Including this effect, however, would not alter our explanation of the observed commission rates, as the platform's pricing is based on the seller's outside option, which does not involve selling the home.

Organization Section 2 introduces a model of homeowners' listing decision in response to a preference mismatch shock. Section 3 solves the problem of optimal pricing by the platform in a partial equilibrium setting, where the homeowners' listing decision is endogenous, but the expectations for the probabilities of finding a match on and off the platform are endogenously fixed. Section 4 outlines the buyers' search decision. Section 5 introduces matching functions on and off the platform and defines an equilibrium in which both sellers and buyers search decisions are endogenous, and the matching probability expectations are correct. Section 6 solves the platform's optimal pricing problem in this equilibrium setting. Section 7 conducts an empirical validation exercise for our model. Section 8 defines and solves for a constrained-optimal commission rate. Section 9 decentralizes the constrained-optimal allocation in an equilibrium with a ban on exclusive buyer representation. Section 10 concludes.

2 Model: a home-homeowner mismatch

We study the pricing of residential housing brokerage services. Demand for brokerage services arises from a mismatch between a homeowner's demand for housing and the housing service flow provided by the home she owns. In our model, we express this mismatch in present value terms, rather than flow terms.

2.1 Home values in hands of suitable owner-occupants

Let z be a vector of physical characteristics of a home: size, age, location, lot size, etc. Let $V(z)$ denote the market value of a home of type z. By market value, we understand the value a suitable owner-occupant is willing to pay. A suitable occupant is someone whose demand for housing services is well-matched with the service flow produced by the home.

In order to focus on the pricing of brokerage services, we assume away any discrepancies between transaction prices and market values. In our model, we assume that only suitable occupants buy residential housing at transaction prices $p(z)$ that match the homes' market values $V(z)$, i.e., $p(z) = V(z)$ for all home types z. In particular, this assumption does not allow homeowners to signal a high willingness to sell by posting an asking price lower than $V(z)$. This can be justified by adverse selection concerns. This assumption also does not allow homeowners to fish for desperate buyers by posting a price higher than $V(z)$. Also, sellers cannot gross up the price to include brokers commissions.[12] A distributional consequence of this assumption is that the broker commission fee decreases the seller's surplus and not the buyer's, as the buyer is paying his reservation price in all cases, regardless of the level of the commission fee.

In what follows, we identify the home type z with its market value $V(z)$ and focus exclusively on the latter. From now on, thus, a home's type will be synonymous with its market value V, which represents the maximum price a suitable owner-occupant is willing to pay for it.

If a home is not occupied by its owner, the owner incurs a proportional cost $0 < \kappa < 1$. That is, the net payoff to an owner who does not occupy her home is

$$(1 - \kappa)V.$$

The wedge κ captures the economies of homeownership that are lost if a home is not occupied by its owner. Narrowly, this wedge can be thought of as the present value of property management fees the owner has to pay if the home is rented out. More broadly, this wedge can represent costs related to moral hazard in the upkeep, where a non-owner resident does not have proper incentives to maintain and care for the property. It can also capture the value of the owner's ability to customize the home a renter does not have.

The assumption that the non-owner resident wedge is proportional to the home's value is consistent with the fact that property management fees are generally proportional to the managed property's value.

[12]This assumption also eliminates the possibility of a house being sold by one unsuitable owner-occupant to another unsuitable occupant, i.e., an absentee investor. Other phenomena we abstract from here include low-ball offers and price wars.

2.2 Homeowners' mismatch shocks and trade options

Consider a homeowner who occupies the home she owns. Initially, the homeowner's demand for housing services is well matched with the specific flow of housing services generated by her home, so the market value V matches the private valuation of the owner.

Our model has one period divided into three stages.

Stage 1 The homeowner receives an idiosyncratic preference shock, $\theta \in [0, 1]$, drawn from a cdf F.[13] This shock introduces a mismatch between the housing service flow the homeowner demands and the service flow her home provides. This shock can represent events such as a change in the family size, or a job change. We take θ as exogenous and private information of the homeowner. With a realized $\theta \in [0, 1]$, the owner's end-of-period payoff from continuing to live in the home is

$$(1 - \theta)V.$$

The multiplicative specification of the shock, with the loss of value due to mismatch being θV, is convenient but not essential.[14]

The homeowner has three options available to her at stage 1:

1. list the home for sale with the brokers' platform, denoted as P,
2. list the home for sale in open market, outside the brokers' platform, denoted as O,
3. hold onto the house despite the preference mismatch, denoted as H.

These options are mutually exclusive. In particular, the homeowner cannot list her house *both* on the brokers' platform, P, and on open market, O. The contract with a broker is exclusive, meaning if the homeowner simultaneously markets her home off the platform (in open market or to her own friends and family, etc.) and a buyer is found that way, the broker still has the right to commission.

If the homeowner lists, she lists at the price $p = V$.

Denote by c_1^m the (physical) cost to advertise or list a house on market m, where $m \in \{O, P\}$. This cost can depend on V or be the same for all homes.

Homeowner with a preference mismatch θ exits Stage 1 in one of the following three states: O, P, or H.

[13]The cdf F can be different for different V.

[14]The mismatch shock can have an additive component so long as an analog of Assumption 1 holds.

Stage 2 In state H, nothing happens in Stage 2. In states O and P, the homeowner-seller gets a showing with probability q_2^m, where $m \in \{O, P\}$, or does not get a showing with the complementary probability. Denote by c_2^m the physical cost of a showing of a home on market m, where $m \in \{O, P\}$. This cost can be thought of as the cost to hire a salesperson to physically show the home to a buyer.

Stage 3 If the homeowner chose H at stage 1, at stage 3 she gets the following payoff:

$$\max\{(1-\theta)V, (1-\kappa)V\}.$$

The first option represents the value of staying in the home despite the preference mismatch. The second option represents the value of moving and continuing to own the home as a non-resident, or absentee, owner. Since $\max\{(1-\theta)V, (1-\kappa)V\} = (1 - \min\{\theta, \kappa\})V$, staying in the home is better if the preference mismatch is lower than the absentee owner wedge, κ. Moving is better in the opposite case.

If the homeowner lists in stage 1 but does not get a showing in Stage 2, she gets the same payoff at Stage 3 as in state H.

If the seller gets a showing in Stage 2, she gets an offer in Stage 3 with probability q_3, and does not get an offer with the complementary probability. The showing is necessary for the potential buyer to determine if the home is suitable for them. This suitability can be determined only by visiting the home. Conditional on the buyer having done a pre-search to select homes with the right characteristics on paper (square footage, number of bedrooms and bathrooms, etc.), q_3 determines if the home is suitable for the buyer.

If there is an offer, the seller accepts it, and the house is sold for $p = V$. If there is no offer, the seller gets the same terminal payoff at Stage 3 as in state H.

To sum up, we now write a homeowner's values functions for the three options available to her at stage 1. First, the homeowner's value of choosing H in Stage 1 is

$$W^H(\theta) = (1 - \min\{\theta, \kappa\})V. \tag{1}$$

Second, the value of listing on O is

$$\begin{aligned} W^O(\theta) = &- c_1^O + q_2^O \left(-c_2^O + q_3 V + (1-q_3)(1-\min\{\theta,\kappa\})V\}\right) \\ &+ (1-q_2^O)(1-\min\{\theta,\kappa\})V. \end{aligned} \tag{2}$$

Thus, in O, the seller pays the costs to advertise and to show the property directly out of pocket. If an offer comes, the seller receives the full price $p = V$.

We will assume that the cost of showing the property to a matched buyer is not overwhelming. That is, at least for the most mismatched homeowner, $\theta = 1$, showing a home to a matched buyer is preferred to not showing it:

$$-c_2^O + q_3 V + (1 - q_3)(1 - \kappa)V > (1 - \kappa)V.$$

If this condition is violated, no homeowner would ever invest in organizing a showing. This condition simplifies to

$$q_3 \kappa V > c_2^O. \tag{3}$$

Third, the homeowner's value of listing with P in Stage 1 is

$$\begin{aligned} W^P(\theta) = q_2^P &\left(q_3(V - \phi(V)) + (1 - q_3)(1 - \min\{\theta, \kappa\})V\right) \\ &+ (1 - q_2^P)(1 - \min\{\theta, \kappa\})V. \end{aligned} \tag{4}$$

Following a standard broker contract, we assume that when listing with the brokers' platform P, the seller does not pay the costs to advertise or show the property directly out of pocket. Rather, she pays a fee $\phi(V)$ to the broker in the event the home sells. The cost to advertise and show the property are covered by the brokers' platform.[15]

We assume the platform sets its fee. The data show there is very little variation in this fee across home value segments V or over time. In this model, we do not explain how the platform manages to sustain cooperation between formally independent brokerage firms. We take that they cooperate as a single network/platform.[16]

Since the market is segmented by V, there is no loss of generality in expressing the fee $\phi(V)$ as $\phi(V) = a(V)V$, where $a(V)$ is the commission rate.

Since the value of not listing, H, is bounded below by the value of the option to move and rent the home out with a proportional property management fee κ, we have

$$W^H(\theta) \geq (1 - \kappa)V, \quad \forall \theta.$$

[15] In practice, the seller's broker advertises the property, and a buyer's broker bears the cost of showing the property to the buyer (i.e., the buyer's broker hires an agent to show up and unlock the lock box, open up, supervise the buyer while on the premises, etc.). How these costs, and the final commission fee, are split between the two brokers is not important in our model. In practice, the shift of the cost to show onto the buyer's broker makes it practically necessary for buyers to hire a buyer's agent: who will show the home to the buyer otherwise? Under the standard contract with the seller, the listing agent does not have an obligation to show the home to potential buyers. Specifically, under the standard contract, the listing agent does not ask for permission from the seller to show the home to buyers.

[16] In practice, as members of a single network, brokers remain in a repeated, long-term relationship where various ways to sustain collusion are possible.

A commission rate a higher than κ will thus attract no sellers. It is therefore without loss of generality to restrict our analysis to commission rates $a \in [0, \kappa]$ in the remainder of this paper.

We can now show a simple but important result: if the chance of finding a potential buyer on O is small enough, it is better for the homeowner to choose H rather than O.

Lemma 1 *If*

$$q_2^O < \frac{c_1^O}{-c_2^O + q_3 \kappa V}, \tag{5}$$

then $W^O(\theta) < W^H(\theta)$ *for all* $\theta \in [0, 1]$.

Proof See Appendix A.1. ■

Implication: if q_2^O is sufficiently small, the choice O will not be a part of any equilibrium. Note that this result is independent of the fee for broker services in the option P, as the comparison here only involves options O and H.

3 The platform's optimal commission

Consider now the platform's fee-setting problem taking the matching probabilities as given. We revisit this problem with endogenous matching probabilities in Section 5.

If a home of value V is listed on P at a contracted commission fee ϕ, then the platform's expected profit from this listing is

$$-c_1^P + q_2^P \left(-c_2^P + q_3 \phi\right). \tag{6}$$

Consider now the platform's problem of setting its fee, $\phi(V)$, so as to maximize the expected total profit from all transactions in the home value segment V.

Assumption 1 $\theta(1 - F(\theta))$ *is increasing on* $[0, \kappa]$.

This condition will be satisfied if F is relatively flat on $(0, \kappa)$, meaning the distribution of θ does not have a lot of mass in that region.

Proposition 1 *Suppose* F *and* κ *satisfy Assumption 1, and* q_2^O *satisfies* (5). *Suppose also* q_2^P *is independent of the commission fee* ϕ. *Then, the commission fee* $\phi(V) = \kappa V$ *maximizes the platform's profit in the value segment* V.

Proof See Appendix A.2. ■

Proposition 1 shows that platform optimally prices to the homeowner's outside option. The optimal fee is proportional to V because the outside option of the homeowner, W^H, is proportional to V.

Since nothing in Proposition 1 depends on the level of V, the proportional pricing $\phi(V) = \kappa V$ is optimal for all home types V, large and small. This can explain why in the data we see the same commission fee of 6 percent charged uniformly across the whole home value distribution.

Proposition 1 also shows that changes in the advertising and showing costs, c_1^P and c_2^P, leave the optimal fee unchanged because these costs do not affect the homeowner's outside option. These costs affect the profit of the platform but not the optimal fee. This explains why the fee remains approximately constant despite a decline in search frictions afforded by improvements in information technology.[17]

With this pricing, the homeowners with mismatch θ lower than κ choose H, and continue owning and occupying, despite the mismatch. The fee $\phi = \kappa V$ makes listing with P not optimal for them, and the absentee owner wedge κ makes moving and renting their home out not optimal. The platform chooses to price these types out of the market, as lowering the commission fee, necessary to attract some of these types, would also lower the fee for all more mismatched types, who are willing to pay the maximum commission fee κV.

3.1 Discussion of the sufficient condition

Assumption 1 requires that the distribution of the mismatch shock θ should not have much mass above 0 and below κ. Indeed, if the cdf F is relatively flat on $(0, \kappa)$, lowering the fee below κV produces small extensive-margin gains, i.e., attracts few additional listings, while simultaneously producing large intensive-margin losses, as the fee discount applies to all homeowners whose mismatch is larger than κ, who choose to list already at the maximum fee κV.

The condition in Assumption 1 is quite intuitive in the context of a homeowner's decision whether or not to sell their home. A shock to one's housing needs that makes one consider selling their home is likely to be a big shock (a change in work or family situation) rather than something marginal (a minor shift in "the taste for the number of bedrooms"). Our condition requires that most shocks to one's housing needs be "larger than 6 percent,"

[17] Similarly, as long as the profit earned by the platform is positive, the solution to the platform's pricing problem is invariant to any dependence of the showing costs, or the matching probabilities, on the home size/value V. Our model thus allows for these costs and matching rates to depend on V.

which is consistent with this idea. If a couple have a child, for example, that is a 50 percent increase in the family size. It therefore seems reasonable to assume that shocks that lead homeowners to seek to sell their homes are large relative to the absentee owner wedge, κ, which is on the order of magnitude of 6 percent. The brokers' platform can charge up to this wedge, and chooses to do so, as few additional listings are attracted by lowering this commission fee.

One stark example in which our sufficient condition is met is a two-point distribution, where F has some mass at 0 and the remaining mass at some level $\bar{\theta}$, where $\bar{\theta} > \kappa$. Homeowners with $\theta = 0$ will not list even if the commission fee is zero, as they stand to gain nothing from the sale at the buyer's reservation price, while all homeowners with $\theta = \bar{\theta}$ will list at the maximum fee $\phi = \kappa V$. Another example could be the uniform distribution. For a uniform distribution on $[0, 1]$, Assumption 1 holds with any $\kappa \leq 0.5$.

4 Buyers

We model homebuyers in simple terms. We assume a seller's market, meaning sellers capture all gains from trade, after commissions, while buyers are reduced to their reservation value. For simplicity, buyers are not also homeowners. The market is segmented. Each buyer has demand for housing services that is met by a home of a specific market value, V, provided the home is idiosyncratically suitable for the buyer. Thus, each buyer searches in a unique value segment V. To find out if a home is suitable for the buyer, a showing must take place. Since in a seller's market buyers have no bargaining power, the buyer pays $p = V$ if a suitable home is found.

Similar to sellers, buyers can search on the platform, P, off the platform, O, or not search at all, H. Since they pay $p = V$, their final payoff is the same, normalized to zero, in all cases.

In our model, as in practice, the platform offers an exclusive contract under which it provides buyers with access to the homes listed on P. This means the buyer is forced to choose between searching on P and searching on O. Since buyers are indifferent, as their share of the gains from trade is nil in a seller's market, they accept such an exclusive contract. Further, the platform may also offer some low-value handouts or free services to encourage buyers to choose P over O.[18] We do not model such handouts explicitly, but

[18] In practice, buyers receive some services from agents at no direct charge. Agents help buyers schedule showings, provide some free advice and market research. Such services buyers can get on P but not on O. Buyers do get showings on O, and the cost to show is explicitly modeled as c_2^O and c_2^P. The low-value benefits we have in mind here are additional to the home showings themselves.

instead we assume that buyers go with P if indifferent.

In sum, buyers face three mutually exclusive options: H, O, and P. Their payoffs are identical in all cases, normalized to 0. Being indifferent, and perhaps encouraged by small-value handouts from the platform, all buyers choose P.

4.1 Discussion

Do exclusive buyer representation contracts really force buyers to choose between searching on and off the platform? Are buyers not free to search everywhere?

In practice, if a buyer wants to search on O while being under contract to search on P, he faces two obstacles. First, his agent is owed commission, even if the home is found on O, but sellers on O are not under contract to cover it. The buyer would then need to pay this commission out of pocket. In our model, this is enough to deter the buyer from searching on O, as sellers capture all gains from trade in a seller's market. In practice, buyers do capture a part of the gains from trade in many cases. In these cases, however, the buyer's situation is similar to Lemma 1: there may be few actual sellers active on O because sellers, anticipating buyers being on P, sign exclusive contracts with the platform to put their homes on P.[19] The low odds of success on O and the out-of-pocket commission due to the buyer's agent make searching on O while also searching on P impractical, even if gains from trade can be captured by the buyer.

Second, if a buyer does not sign with P but still wants to search on P, he faces the technical obstacle in that the seller's listing agent is not under contract with the seller to actually show the home. The listing agent's role is to list with the platform. With a buyer's agent missing, the potential buyer has no one who would show the home to him. In our model, this alone makes the strategy of searching on P without a buyer's agent ineffective. In practice, under the platform's rules, the listing agent should only show the home to an interested buyer if the buyer signs a representation contract with them, which leads to the so-called dual agency situation and means the buyer abandons his strategy of searching on P without a contract.[20] In face of possible competition from other buyers,

[19] This argument becomes stronger if a subset of buyers exists that almost always hire an agent. Sellers then are more likely to list on P in order to not exclude this group from their demand pool, which in turn makes it more likely that other buyers search on P as well. An example of such a group could be the first-time home buyers. According to the NAR, 38 percent of buyers were first-time home buyers in 2023.

[20] Alternatively, the listing agent may show without signing to verify the buyer likes the home, which makes it more likely the buyer signs the representation contract ex post.In the same vein, the so-called open house showings organized by seller agents are, in part, recruiting events for seller agents to also become buyers' agents.

being unrepresented is a disadvantage, as the listing agent and the agents representing other buyers interact repeatedly on the platform. Only in a strong buyer's market can being unrepresented possibly help the buyer obtain concessions from the seller, as the buyer's agent does not need to be compensated. In most situations, however, searching on P without a buyer's agent is not an optimal strategy for buyers.

To sum up, in practice, buyers who wish to search both on and off the platform face significant obstacles that make such a strategy impractical, with exclusive representation contracts playing a central role. Accordingly, in our model, buyers face a binary choice between P and O.

5 Matching functions and equilibrium

In Proposition 1, we treat the matching probabilities as exogenous. In this section, we define a market equilibrium in which the matching probabilities are endogenous. We show that the maximal fee $\phi = \kappa V$ remains optimal for the platform in this equilibrium.

5.1 Matching functions

Denote the measure of home sellers and buyers in market $m \in \{O, P\}$ by , respectively, $\mu^{S,m}$ and $\mu^{B,m}$. On each market $m \in \{O, P\}$, there is a matching function: $\mathcal{M}^m(\mu^{S,m}, \mu^{B,m}) \geq 0$. The arguments of each matching function are measures of buyers and sellers active on each market. The value $\mathcal{M}^m$ represents the number of matches between buyers and sellers created on m. The matching functions are also segmented by V.

Assumption 2 *For* $m \in \{O, P\}$,

$$\mathcal{M}^m(x, y) = \eta^m \min\{x, y\},$$

where $\eta^m \in (0, 1]$.

Under Assumption 2, the matching function $\mathcal{M}^m$ simply produces the fraction η^m of all matches that are possible on m, which means η^m captures the efficiency of matching on market m. Specifically, we have the following two properties of $\mathcal{M}^m$:

$$\mathcal{M}^m(2x, 2y) = 2\eta^m \min\{x, y\} = 2\mathcal{M}^m(x, y),$$
$$x < y \;\Rightarrow\; \frac{\mathcal{M}^m(x, y)}{x} = \frac{\eta^m \min\{x, y\}}{x} = \frac{\eta^m x}{x} = \eta^m.$$

These properties imply that there are no congestion effects on the short side of the market. If sellers are on the short side of the market, then adding new sellers does not decrease an individual seller's chance of finding a match so long as sellers remain the short side.[21]

5.2 Equilibrium definition

We can now define equilibrium in the home value segment V. The set of players consists of a continuum of homeowners, a continuum of homebuyers, with their masses normalized to one, and the broker's platform, a large player. The platform moves first, setting a commission rate $a \in [0, \kappa]$.

The sellers' beliefs about the matching probabilities on P and on O are a key equilibrium object. Let the mapping from the platform's fee to the sellers' expected matching probabilities be denoted by

$$Q_2^m(a) \quad \text{for} \quad m \in \{P, O\}. \tag{7}$$

Given the expectations of matching probabilities (7), a strategy for owners/seller, denoted by l, maps (a, θ) into $\{P, O, H\}$. For buyers, a strategy, denoted by b, is simply a choice from $\{P, O, H\}$.

Definition 1 *An equilibrium in the home value segment V consists of the matching expectations mappings $Q_2^m(\cdot)$, $m \in \{P, O\}$, a commission rate $a \in [0, \kappa]$, a sellers' strategy $l(\cdot, \theta)$, and a buyers' strategy b, such that:*

1. *Given the expected matching rate mappings $Q_2^m(\cdot)$, $m \in \{P, O\}$, for every seller type θ, the strategy $l(\cdot, \theta)$ is optimal, i.e., $l(a, \theta)$ is type θ's best response to a.*

2. *The strategy b is optimal for buyers.*

3. *Given the expected matching rate mappings $Q_2^m(\cdot)$, $m \in \{P, O\}$, the commission fee aV maximizes the platform's profit.*

4. *The matching probability expectation functions are correct: for all $a \in [0, \kappa]$, $m \in \{P, O\}$,*

$$Q_2^m(a) = \frac{\mathcal{M}^m\left(\int \mathbf{1}_{\{l(a,\theta)=m\}} dF(\theta), \mathbf{1}_{\{b=m\}}\right)}{\int \mathbf{1}_{\{l(a,\theta)=m\}} dF(\theta)} \text{ if } \int \mathbf{1}_{\{l(a,\theta)=m\}} dF(\theta) > 0, \text{ otherwise } 0. \tag{8}$$

[21] On the long side, there is competition. If buyers are the long side of the market, adding new buyers does decrease an individual buyer's chance of finding a match.

Note that the off-equilibrium believes, summarized by the matching expectation mappings $Q_2^m(a)$, are defined for all $a \in [0, \kappa]$, i.e., not just for the equilibrium commission rate. Note also that if the mass of sellers in a market is zero, then if one seller decides to enter, she will not find a match. There must be a mass of sellers for there to be a market. With a slight abuse of notation, we will denote the equilibrium commission rate by $a(V)$.

6 Platform equilibrium

In this section, we show the existence of an equilibrium in which all trade takes place on the platform, and the platform is able to charge the maximum commission rate $a = \kappa$ in each value segment V.

Theorem 1 *Under Assumptions 1 and 2, the following is an equilibrium in the value segment V:*

$$b = P, \tag{9}$$
$$\forall a \in [0, \kappa],\ Q_2^P(a) = \eta^P, \tag{10}$$
$$Q_2^O(a) = 0, \tag{11}$$
$$l(a, \theta) = P \text{ for } \theta \geq a,\ \ l(a, \theta) = H \text{ for } \theta < a, \tag{12}$$
$$\forall V,\ a(V) = \kappa. \tag{13}$$

Proof See Appendix A.3. ■

Theorem 1 is an equilibrium version of Proposition 1. Since this equilibrium meets the assumptions of Lemma 1, the odds of finding a buyer on O are sufficiently low to make sellers unwilling to invest in advertising their properties on O. Sellers whose mismatch θ exceeds κ are willing to list on P. With this cutoff, sellers remain the short side of the market on P and, hence, their matching rate on P is the same for all commission rates $a \leq \kappa$, as shown in (10). As in Proposition 1, then, the intensive-margin loss of profit from cutting the fee below κV is larger than the corresponding extensive-margin gain from attracting new sellers. The commission rate $a = \kappa$, thus, maximizes the platform's profit, and so, it is chosen by the platform in every market segment V in this equilibrium.

Note that if the matching function were not completely congestion-free on the short side of the market and q_2^P were to decrease when new sellers list on the platform, this congestion effect would additionally discourage the platform from cutting the fee below the maximum level κ, because the platform gets paid only when a seller sells. In other words, the platform's concern for market congestion on the seller side would reinforce the optimality of charging the maximum fee.[22]

Proposition 2 *The platform's optimal commission rate is the same for all V. The sensitivity of the platform's optimal commission rate to the search costs c_1^P and c_2^P and to the matching efficiency parameter η^P is nil.*

Proof Immediate from $a(V) = \kappa$ for all V. ∎

Proposition 2 considers comparative statics with respect to the search costs, c_1^P and c_2^P, and the matching efficiency parameter, η^P. The search costs may depend on V as well as change over time.[23] The level of these costs, however, does not change the platform's optimal commission rate. The reason for this is that the platform charges to the sellers' outside option, H, and the value of this option is independent of the search costs or of the efficiency of matching, because the option H does not involve selling the home.

The level of search costs does not impact the platform's optimal fee but has direct impact on the level of the platform's profit. This prediction of our model is consistent with near-constant commission pricing, shown in Figure 1, concurrent with employment in the residential brokerage industry increasing over the same period, as predicted by the excessive entry model of Hsieh and Moretti (2003). That is, declining search costs increase the platform's rents, which amplifies excessive entry of agents seeking these rents. With free entry, the social waste from rent-seeking offsets exactly the efficiency gains from declining search costs.

7 Cross-market validation

In our model, it is optimal for the platform to set its commission rate equal to the absentee owner wedge, κ. Our model, therefore, implies that variation in κ should be reflected in variation in commissions. The wedge κ is not observable directly, but we can proxy for it. One factor that should influence κ is the price-rent ratio. Low rents, relative to home prices, decrease the value of absentee ownership, which makes the wedge κ higher. Higher rents, in turn, should make the absentee owner wedge smaller. If commissions are indeed determined by the wedge κ, then variation in price-rent ratios across metropolitan areas

[22] Similarly, if we explicitly included in the expression for the platform's profit the cost of low-value services the platform uses to attract buyers, the optimality of κ would be reinforced so long as this cost increases in the number of matches formed on the platform.

[23] Likely, the search costs are lower at the end of the sample in Figure 1 than at the beginning.

should be reflected in variation in commission rates. In this section, as a validation exercise, we test this implication of our model using cross-market variation in commission rates and price-rent ratios.

7.1 Data on average commission rates across MSAs

We extract buyer agent commission information from MLS data provided by CoreLogic. Our sample consists of 1,501,440 home sale transactions from 2019. We observe buyer agent commission and the transaction's close price. The observations come from 77 Metropolitan Statistical Areas (MSAs) out of the 100 largest MSAs in the U.S. by the 2019 population.[24] For each MSA, we have computed the average buyer agent commission rate, `avgBAC`, and the median home price, `Med_price`. MSA-level price-rent ratios for December 2019 and 2015 come from Florida Atlantic University (variables `PR_19` and `PR_15`).[25] Table 1 provides summary statistics.

Table 1: Summary statistics for 77 MSAs.

Variable	Unit	Mean	Std. Dev.	Min	Max
`avgBAC`	%pts	2.740	0.226	2.044	3.069
`Med_price`	$1000s	300.706	162.213	151.250	1,252.500
`PR_19`	$/$	16.558	3.961	10.850	32.380
`PR_15`	$/$	15.518	3.619	10.520	28.630

Consistent with earlier studies, e.g., Hsieh and Moretti (2003), and with our Figure 1, Table 1 shows very little variation in average commission rates relative to the cross-MSA variation in home prices.

7.2 PR ratios and average commission rates

Across MSAs, our model suggests that correlation between the average BAC rate and the local price-rent ratio should be positive:

$$\texttt{avgBAC}_j = \kappa\big(\underbrace{\texttt{PR}_j}_{(+)}\,;\,X_j\big),$$

[24] Appendix A.9 provides more details on the construction of our sample.

[25] Source: https://business.fau.edu/executive-education/price-to-rent-ratios/national-data/index.php Data accessed on April 30, 2025. The price-rent ratios are constructed using the approach of Davis et al. (2008), see Beracha and Johnson (2012).

conditional on some observable local housing market characteristics, X_j. Specifically, to account for the cross-MSA variation in the average BAC, we control for the median level of home prices in the MSA. That is, we estimate the following regression:

$$\texttt{avgBAC}_j = \beta_0 + \beta_{PR}\texttt{PR}_j + \beta_{MP}\texttt{Med\_price}_j + \epsilon_j, \tag{14}$$

where we expect the coefficient β_{PR} to be strictly positive. We estimate three separate specifications for (14), in which we use, respectively, the contemporaneous MSA price-rent ratio, PR_19, the four-year lagged price-rent ratio, PR_15, and their average. We also estimate a baseline univariate regression in which the price-rent ratio is dropped. We estimate (14) by Weighted Least Squares using MSA observation counts as weights.[26]

Table 2 provides the results. The average commission rate is negatively associated with the median price and positively associated with the local price-rent ratio. This result is robust to the lagging of the price-rent ratio variable, i.e., it holds in all three specifications (2)-(4). The price-rent ratio helps account for the cross-MSA variation in average commission rates: relative to the baseline with just the metro median price, the adjusted R^2 goes up significantly upon the inclusion of the price-rent ratio. Specification (2), with contemporaneous price-rent ratios, fits the data slightly better than specifications (3) and (4). The marginal effect of the price-rent ratio is also quantitatively significant. An increase in PR_19 from the sample min to the sample max value (i.e., from 10.85 to 32.38) implies an increase in the average buyer agent commission of 0.74 percentage points, which accounts for 72% of the min-max spread in the average BAC in the sample.

The positive correlation between the price-rent ratio and the average level of BAC in the MSA supports our model's predictions: lower rents indeed are associated with higher commission rates, consistent with the latter being determined by the absentee owner wedge κ. The fact that this correlation is observed for both contemporaneous and lagged PR variables suggests that the price-rent ratio captures highly persistent differences in the absentee owner wedge κ across metro areas.

Our model does not provide a prediction about the sign of the cross-MSA correlation between the median home price and the average BAC. The fact that median price plays a significant role in accounting for cross-MSA variation in average BAC suggests that the wedge κ is not determined by the price-rent ratio alone but is also influenced by other factors that are correlated with the MSA's median home price.

In sum, the evidence presented in this section supports our theory: the price-rent ratio, a

[26] When the dependent variable is an average, using Weighted Least Squares with weights equal to the number of observations underlying each average is a standard approach to correcting heteroskedasticity in the error terms.

Table 2: Weighted Least Squares regressions of avgBAC in 77 MSAs (p-values in parentheses).

	(1)	(2)	(3)	(4)
constant	3.128	2.824	2.899	2.854
	(0.000)	(0.000)	(0.000)	(0.000)
Med_price	-1.205×10^{-3}	-2.028×10^{-3}	-1.790×10^{-3}	-1.927×10^{-3}
	(0.000)	(0.000)	(0.000)	(0.000)
PR_19		3.428×10^{-2}		
		(0.001)		
PR_15			2.712×10^{-2}	
			(0.011)	
PR_avg				3.166×10^{-2}
				(0.002)
Adj R^2	0.368	0.456	0.414	0.436

proxy for the absentee owner wedge, is positively associated with the level of commissions paid by home sellers across major metropolitan areas in the U.S.

8 Social welfare and optimal allocations

In this section, we characterize socially optimal commission fees. We discuss the first-best optimal allocation, in which the planner can dictate the rate the platform should charge, and a second-best allocation, in which the platform has some bargaining power vis à vis the planner because the platform's search and matching technology may be more efficient than the off-platform alternative.

Under our "seller's market" assumption, buyers are always reduced to their outside option. Their welfare, thus, is the same in all cases, and so we do not explicitly include their utility in the social welfare function. Further, as explained in Hsieh and Moretti (2003), brokers' profits are dissipated through excessive entry and inefficient use of agents' labor, which means platform profits do not enhance social welfare. Social welfare, thus, equals the sellers' surplus.

We define a social welfare function, $\boldsymbol{W}(a)$, as follows

$$\boldsymbol{W}(a) := \int_0^1 W(\theta) dF(\theta),$$

where, for a listing/participating seller, as in (4):

$$W(\theta) = q_2 q_3 (V - \phi(V)) + (1 - q_2 q_3)(1 - \min\{\theta, \kappa\})V,$$

where, so long as the matching technology P is used, $q_2 = \eta^P$. If a seller does not list/participate, then, as in (1):

$$W(\theta) = (1 - \min\{\theta, \kappa\})V.$$

8.1 Matching efficiency and profit

Proposition 1 and Theorem 1 describe the fee charged by the platform in equilibrium, but they do not pin down the level of the platform's profit. We will now make an assumption sufficient for the platform's profit to be positive in equilibrium.

Assumption 3 *Assume*

$$-c_1^O + \eta^O \left(-c_2^O + q_3 \kappa V\right) > 0. \tag{15}$$

Also,

$$c_1^P \leq c_1^O, \quad c_2^P \leq c_2^O, \quad \eta^P \geq \eta^O, \tag{16}$$

with at least one of these inequalities strict.

Inequality (15) says the matching technology O is viable in every property value segment V. In particular, it implies that if a monopolist platform were to operate in segment V with a matching technology only as efficient as O, then that monopolist would be able to make positive profit.

The inequalities in (16) further assume that, perhaps due to past investments made by the platform, the platform's technology P is more efficient than the open-market matching technology O. Clearly, combined with (15), this implies that the platform, operating the more efficient technology P, makes positive profit in equilibrium, i.e.,

$$\Pi(\kappa) = \left(-c_1^P + \eta^P \left(-c_2^P + q_3 \kappa V\right)\right)(1 - F(\kappa)) > 0. \tag{17}$$

In this expression, profit is given by the product of the expected profit per listing and the number of listings under the platform's optimal fee $\phi(V) = \kappa V$.[27]

[27] Note that Assumption 3 implies that inequality (3) holds.

The positive platform profit assumption is consistent with the evidence in Han and Hong (2011), which shows that commissions exceed broker service costs. In practice, there may be houses with such a low value V that, even with small transaction costs, the positive platform profit condition is not met. For simplicity, we exclude such low-value properties from this analysis.[28]

8.2 First best

We now define first-best optimal allocations. In this section, we assume the planner uses the superior matching technology, P, which is also used in the platform equilibrium of Theorem 1. Then, in Section 8.3, we consider the alternative assumption.

With technology P operated by the platform, a first-best mechanism is as follows. Without loss of generality, all buyers join the platform. The planner chooses a fee $\phi(V) = aV$ the sellers are to pay to the platform.[29] The sellers' participation constraint implies no seller joins if $a > \kappa$. If $a \leq \kappa$, then types $\theta \geq a$ join and types $a < \kappa$ do not. The planner thus chooses a from $[0, \kappa]$.

The platform's participation constraint is $\Pi(a) \geq 0$. Under Assumption 2, with sellers remaining less numerous than buyers, the number of matches formed is $\eta^P(1 - F(a))$, and each seller finds a buyer with probability $q_2^P = \eta^P$. Thus,

$$\Pi(a) = \left(-c_1^P + \eta^P\left(-c_2^P + q_3 aV\right)\right)(1 - F(a)). \tag{18}$$

Under this mechanism, we have

$$\begin{aligned}\boldsymbol{W}(a) = &\int_0^a (1 - \min\{\theta, \kappa\})V dF(\theta) \\ &+ \int_a^1 \eta^P q_3(V - aV) + (1 - \eta^P q_3)(1 - \min\{\theta, \kappa\})V dF(\theta),\end{aligned}$$

or, simplifying,

$$\boldsymbol{W}(a) = V - \int_0^a \theta V dF(\theta) - (1 - \eta^P q_3)\int_a^1 \min\{\theta, \kappa\} V dF(\theta) - \eta^P q_3 aV(1 - F(a)). \tag{19}$$

Here, V is the value of the sellers' welfare if all homes were to sell. The first loss term represents the mismatch from homes that are never listed for sale, as their owners choose

[28] In Grochulski and Wang (2024), we calibrate the minimum profitable house price segment at approximately \$90k in 2019.

[29] We allow a to depend on V, so writing the fee as aV is without loss of generality.

to not list/participate. The second loss term is the mismatch from the homes that get listed but do not sell. The last term captures the fees that sellers pay to the platform.

It is easy to check that

$$\boldsymbol{W}(\kappa) = \int_0^1 W^H(\theta)dF(\theta), \tag{20}$$

where, as in (1), $W^H(\theta)$ is the value of not listing for an owner whose mismatch is θ. This means social welfare attained with $a = \kappa$ is the same as what obtains if no homeowner lists, i.e., if all homeowners choose H. Clearly, since no homes are listed in this scenario, $\boldsymbol{W}(\kappa)$ is independent of the parameters of the matching technology. If $a = \kappa$, as is the case in the equilibrium of Theorem 1, it does not matter for social welfare how good or bad the matching technology is because commission fees collected by the platform capture all gains from trade: the fee is exactly the same as the absentee owner wedge κ homeowners with mismatch larger than κ incur when they choose H.

Let us denote the first-best optimal fee rate by a^*.

Proposition 3 *The first-best optimal fee is unique and given by*

$$a^* = \frac{c_1^P + \eta^P c_2^P}{\eta^P q_3 V}. \tag{21}$$

The platform's first-best profit is $\Pi(a^*) = 0$. *Under Assumption 3,* $a^* < \kappa$.

Proof See Appendix A.4. ■

Social welfare is decreasing in a, and the platform's profit is increasing. The first best optimum, a^*, is therefore pinned down by the platform's zero-profit condition $\Pi(a^*) = 0$.

Note that the first-best commission rate a^* declines if advertising and showing costs, c_1^P and c_2^P decline, and it increases if the matching efficiency parameter η^P declines. Also, a^* depends on V both directly and indirectly, through a potential dependence of the cost and matching parameters on V. If these parameters are independent of V, then a^* is decreasing in V.

8.3 First best on O

Suppose technology P is not available and, hence, the inferior technology O must be used for trading. What is optimal?

In a direct mechanism, all buyers, as indifferent to the outcome, join. The planner sets a threshold a such that homeowners with mismatch $\theta > a$ market their homes on O, and those with $\theta \leq a$ stay in their homes. For this mechanism to satisfy the homeowners' participation constraints, it must be the case that $W^O(\theta) - W^H(\theta) \geq 0$ for all $\theta \geq a$, where W^O and W^H are given in (2) and (1), respectively. From (2) and (1), we have

$$W^O(\theta) - W^H(\theta) = -\, c_1^O + \eta^O \left(-c_2^O + q_3 \min\{\theta, \kappa\} V\}\right).$$

If a homeowner markets her home on O, she directly pays the advertising cost c_1^O. If she does not get a match, her continuation value is the same as in the option H. If she obtains a match, she pays the showing cost c_2^O. If the match turns out suitable, the home is sold for V, which yields an excess payoff, relative to the option H, of $\min\{\theta, \kappa\}V$.[30]

The strict inequality (15) in Assumption 3 implies now that the homeowners with $\theta \geq \tilde{a}^*$ join, and the homeowners with $\theta < \tilde{a}^*$ do not join, where

$$\tilde{a}^* = \frac{c_1^O + \eta^O c_2^O}{\eta^O q_3 V}. \tag{22}$$

Given the matching rate η^O, the homeowners whose mismatch θ is low are deterred by the advertising and showing costs, c_1^O and c_2^O. They do not put their homes on the market. However, inequality (15) implies

$$\tilde{a}^* < \kappa, \tag{23}$$

which means more owners list here, in the first best restricted to the inferior technology O, than in the equilibrium of Theorem 1, where the matching technology is superior but the commission fee is set by a monopolist.[31]

Let us denote by $\tilde{\boldsymbol{W}}(\tilde{a}^*)$ the level of social welfare attained in the first best with the inferior matching technology O. Analogously to (19), we have

$$\tilde{\boldsymbol{W}}(\tilde{a}^*) = V - \int_0^{\tilde{a}^*} \theta V dF(\theta) - (1 - \eta^O q_3) \int_{\tilde{a}^*}^1 \min\{\theta, \kappa\} V dF(\theta) - (c_1^O + \eta^O c_2^O)(1 - F(\tilde{a}^*)), \tag{24}$$

where the last term is the sum of the advertising and showing costs paid by the sellers.

The following lemma compares first-best outcomes attained with technology P and O.

[30] Note that the most mismatched owners gain κV in case of sale, as for them H means becoming an absentee owner and incurring the proportional cost κ.

[31] Equivalently, we could treat the planning problem here as if the planner was choosing a commission rate a to be charged by a monopolist operator of the technology O subject to a non-negative profit constraint. In this "as if" problem, reasoning analogous to Proposition 3 implies that the planner chooses $a = \tilde{a}^*$, and the allocation is the same as in the direct mechanism described here.

Lemma 2 $\tilde{a}^* > a^*$ *and* $\tilde{\boldsymbol{W}}(\tilde{a}^*) < \boldsymbol{W}(a^*)$.

Proof See Appendix A.5. ■

With higher listing and showing costs and with less efficient matching, fewer homeowners list and a lower value of social welfare is attained in the first best on O than in the first best on P.[32]

Remark Grochulski and Wang (2024) and Kim (2024) study the implications of á la carte pricing of agent services, and, equivalently, decoupling of commissions, for the efficiency of search on the brokers' platform.[33] Under that pricing model, there is no compensation from the seller side to the buyer's agent, so buyers must compensate their agents directly. That pricing model is shown to induce efficient search behavior among buyers, and to foster competition between brokers on the platform. These studies, however, assume the platform's structure itself does not respond to a forced change to its pricing model. In practice, decoupling could lead to fragmentation of the platform potentially foregoing the matching efficiency gains highlighted in our Assumption 3.[34] Decoupling, thus, could be equivalent to what in our model is the first best on O rather than the first best on P.

8.4 Second best

The first-best allocation on P may be too idealized, as it assumes the planner can reduce to zero the level of profit attained by a large player who owns a superior technology. In this section, we modify the social planning problem recognizing that the platform may have some "bargaining power vis à vis the planner" because of its superior matching technology P.

Formally, we consider a mechanism in which the platform proposes a commission rate a to the planner. If the planner rejects, the platform is committed to exiting. If the

[32]Equivalently, if we treat the first-best planning problem as if the planner was choosing a commission rate a to be charged by a monopolist operator of the technology O subject to a non-negative profit constraint, the planner chooses a higher commission fee here than on P to allow the monopolist to cover the higher costs on O. However, $\tilde{a}^* < \kappa$ implies $\tilde{\boldsymbol{W}}(\tilde{a}^*) > \tilde{\boldsymbol{W}}(\kappa)$, i.e., in the first best on O, the planner delivers higher social welfare than what an unregulated monopolist operating the O technology would deliver in equilibrium.

[33]See also U.S. Department of Justice (2024) for additional arguments for decoupling of commissions.

[34]Recently, a more modest change to the platform's rules has allowed brokers, with sellers' consent, to withhold listings from the platform and instead market them internally to their own buyers. This change alone appears to have lead to partial fragmentation of the platform. See, e.g., the reporting by Riquier (2025).

platform exits, the planner can implement the first-best allocation but only with the inferior technology O.

The second-best planning problem, thus, can be expressed as follows:

$$\max_{a \leq \kappa} \left\{ \Pi(a) \ s.t. \ \boldsymbol{W}(a) \geq \tilde{\boldsymbol{W}}(\tilde{a}^*) \right\}, \tag{25}$$

where the mechanism is also subject to the sellers' participation constraint, i.e., only sellers with $\theta > a$ participate. The seller's outside option, $W^H(\theta)$, implies a must satisfy $a \leq \kappa$.

Let us denote the second-best optimal commission rate, i.e., a solution to (25), by a^{**}.

Proposition 4 *$a^* < a^{**} < \kappa$, $\Pi(a^{**}) > 0$, and $\boldsymbol{W}(\kappa) < \boldsymbol{W}(a^{**}) < \boldsymbol{W}(a^*)$.*

Proof See Appendix A.6 ■

In the second best, the planner accepts the platform's positive profit in exchange for the use of its superior technology, P. The platform, however, does not propose $a = \kappa$ in the second best. We have

$$\boldsymbol{W}(\kappa) = \tilde{\boldsymbol{W}}(\kappa) < \tilde{\boldsymbol{W}}(\tilde{a}^*) = \boldsymbol{W}(a^{**}), \tag{26}$$

where the left equality follows from (20): if $a = \kappa$, social welfare is the same under the good and bad technology, as sellers obtain no surplus from trade. The strict inequality in (26) means the planner would reject an offer $a = \kappa$ because the inferior technology O can deliver some gains from trade to the sellers. The right equality (26) means the planner's outside option binds in the second-best planning problem (25): the platform proposes the highest commission rate a that will be accepted by the planner. This rate is lower than κ but higher than a^*.

We now turn to comparative statics for a^{**}. In contrast to the monopoly commission rate $a(V) = \kappa$, the second-best optimal commission rate a^{**} is sensitive to the cost parameters and to V.

Proposition 5 *Assume the search cost and matching efficiency parameters are independent of V. Then $\frac{da^{**}}{d\eta^P} > 0$ and $\frac{da^{**}}{dc_1^P} = \frac{da^{**}}{dc_2^P} = 0$, $\frac{da^{**}}{d\eta^O} < 0$, $\frac{da^{**}}{dc_1^O} > 0$, $\frac{da^{**}}{dc_1^O} > 0$, and $\frac{da^{**}}{dV} < 0$.*

Proof See Appendix A.7. ■

In the second best, the constraint $\boldsymbol{W}(a) \geq \tilde{\boldsymbol{W}}(\tilde{a}^*)$ binds, i.e., the second-best commission rate a^{**} is determined as a solution to

$$\boldsymbol{W}(a^{**}) = \tilde{\boldsymbol{W}}(\tilde{a}^*). \tag{27}$$

Improvements in the inferior matching technology O decrease the optimal rate a^{**}, and the platform profit $\Pi(a^{**})$, as they improve the planner's outside option, $\tilde{\boldsymbol{W}}(\tilde{a}^{*})$, and make the binding constant (27) tighter. Improvements in the superior platform matching technology P increase the platform's profit $\Pi(a^{**})$. A higher matching rate η^{P} relaxes (27), as higher social welfare can be delivered on the platform with more matches formed, which allows the platform to obtain a higher commission rate a^{**}. A decrease in listing or showing costs on the platform, c_1^P or c_2^P, has no direct impact on (27), so the second-best commission rate is a^{**} unaffected. But the platform's profit $\Pi(a^{**})$ increases directly due to lower platform costs. Also, with search costs and matching rates the same in all value segments V, higher-valued homes pay a lower percentage commission rate in the second best than lower-valued ones.[35]

Next, we discuss implementation of the second-best optimum.

9 Second-best efficient equilibrium

In this section, we study a policy intervention aimed at implementing the second-best optimum in a market equilibrium. This policy consists simply of a ban on exclusive buyer representation contracts.

The model remains the same as in Section 2. A homeowner/seller's problem is the same as in Section 2.2. She has three actions available to her at stage 1: P, O and H. Her contract with a broker remains exclusive, and she is a price taker vis à vis the platform. We continue to make the seller's market assumption, i.e., the buyers' value remains equal to the value of not searching, in all cases.

The difference now is that exclusive buyer representation contracts are banned. Therefore, buyers have only two options: H and $\{P, O\}$, i.e., to not search or to search. If a buyer searches, he searches everywhere. In particular, with exclusive contracts banned, the platform can no longer use a low-value handout to capture an otherwise indifferent buyer and keep him off O.

Equilibrium definition remains the same as in Definition 1 in Section 5.2.

[35]These comparative statics results are straightforward to extend to cases in which search costs and matching rates vary across the home value segments V.

9.1 Equilibrium with nonexclusive contracts

Theorem 2 *With a ban of exclusive buyer representation contracts, maintaining Assumptions 1 and 2, the following is an equilibrium in the home value segment V:*

$$b = \{P, O\}, \tag{28}$$

$$Q_2^P(a) = \begin{cases} \eta^P & \text{if} \quad a \leq a^{**}, \\ 0 & \text{if} \quad a > a^{**}, \end{cases} \tag{29}$$

$$Q_2^O(a) = \begin{cases} 0 & \text{if} \quad a \leq a^{**}, \\ \eta^O & \text{if} \quad a > a^{**}, \end{cases} \tag{30}$$

$$\forall a \in [0, a^{**}], \quad l(a, \theta) = \begin{cases} P & \text{for} \quad \theta \geq a, \\ H & \text{for} \quad \theta < a, \end{cases} \tag{31}$$

$$\forall a \in (a^{**}, \kappa], \quad l(a, \theta) = \begin{cases} O & \text{for} \quad \theta \geq \tilde{a}^*, \\ H & \text{for} \quad \theta < \tilde{a}^*, \end{cases} \tag{32}$$

$$\forall V, \quad a(V) = a^{**}. \tag{33}$$

Proof See Appendix A.8. ■

In this equilibrium, sellers expect other sellers to move to O if the platform charges a commission rate higher than a^{**}. Buyers are present on both P and O, which makes moving to O a viable option for sellers. Anticipating this, the platform will not charge more than a^{**}. Since the platform's profit increases in the commission rate, a^{**} maximizes the platform's profit among all rates that do not cause sellers to move to O. This equilibrium is second-best efficient.

Comparative statics of Proposition 5 apply to this equilibrium outcome. In particular, higher-valued homes get a lower commission rate. Decreasing search costs on O reduce the equilibrium commission rate a^{**}. Decreasing search costs on P increase the platform's profit without affecting a^{**}.

A ban on exclusive buyer representation is necessary for the existence of the second-best optimal equilibrium of Theorem 2. Indeed, as long as the platform is able to use exclusive contracts and low-value handouts to keep buyers off of O, the matching expectation functions of Theorem 2, (29) and (30), are inconsistent with the buyers' and sellers' optimal actions. In particular, absent a ban on exclusivity, if the platform posts a commission rate $a > a^{**}$ and sellers respond by listing on O instead of P, they will find no matches because there are no buyers searching on O.

Note also that a policy not banning exclusive contracts, but only mandating that a nonexclusive option be also offered to buyers, is insufficient. In our model, as well as in practice, buyers can be easily persuaded to choose exclusive representation, for example, through a minor differentiation in the low-value benefits offered to them by the agents. Concerned with this possibility, sellers view the off-platform venue as inferior, even if only some buyers are tied exclusively to the platform. For this reason, in the equilibrium of Theorem 2, a clear ban is needed on any impediments to the buyers' ability to search simultaneously on and off the platform.

9.2 Coordination among sellers

By allowing for full coordination among the sellers, the equilibrium concept of Definition 1 side-steps the question of potential coordination failure among them. In this paper, we do not address this question. Our focus is on the two-sided structure of the residential brokerage market that allows a platform of real estate agents to gain market power vis à vis the sellers. In future research, our analysis can be extended to address potential coordination failures directly. In practice, public introduction of a ban on exclusive buyer representation contracts could by itself coordinate the home sellers' expectations to be consistent with (29), as the ban is clearly intended to make sure buyers can be found on O, that is, off the platform.

With equilibrium built around the matching expectation functions, our model admits multiple equilibria. In particular, a ban on exclusive buyer representation does not eliminate the monopoly equilibrium of Theorem 1. Indeed, even if buyers are present on both P and O, if the matching expectation functions q_2^P and q_2^O are the same as in (10) and (11) in Theorem 1, then the platform can still charge $a = \kappa$ because no seller will choose to move to O while expecting $q_2^O = 0$. With the ban, however, this monopoly equilibrium is fragile: if a positive-measure subset of sellers move to O regardless of the expectation function q_2^O, they will find matches there. With the ban, thus, the monopoly equilibrium can be eliminated in an appropriate equilibrium refinement. Without a ban, by contrast, the monopoly equilibrium is not fragile. Indeed, under the assumptions of Theorem 1, if a positive-measure subset of sellers move to O, they will not find any matches there because all buyers choose to search exclusively on P.

10 Conclusion

We build a model to explain the level of real estate commissions. Our model connects commissions to the costs of absentee homeownership, since becoming an absentee owner is the only practical alternative to selling one's home on the real estate brokers' platform, a de facto monopoly. The model is consistent with the same commission rate being charged in a local housing market for selling inexpensive and expensive homes, with commission rates showing no response to housing valuation changes over time, and with no response to a secular decline in search costs. The fact that, across local housing markets, commissions are positively correlated with price-rent ratios—which we show empirically—additionally validates the model.

Limiting sellers' outside options through buyer capture is key for the platform in securing its monopolist position. We show that a different equilibrium exists if exclusive buyer representation contracts are banned: with buyers searching freely on and off the platform, the platform becomes concerned about the possibility of trade moving off-platform. This concern leads the platform to lower its fee to a constrained-efficient level. In this equilibrium, commission rates are lower for higher-valued homes, and are no longer insensitive to changes in housing valuations or to reductions in underlying search costs.

Our analysis abstracts from several dimensions of the real estate market that may be important in evaluating the implications of potential reforms of the market and its commission structure. These include fostering competition among agents on the platform while preserving efficient buyer-seller matching, understanding how free-of-charge services provided by the platform shape buyers' incentives for efficient search, assessing the distribution between buyers and sellers of the consumer welfare gains resulting from lower commissions, and controlling for changes to the relative bargaining power between buyers and sellers over the housing cycle.

These issues, however, concern the internal organization of the platform and the behavior of buyers, sellers, and brokers operating on it. Our normative analysis, in contrast, concerns the external conditions under which the platform operates rather than the platform's internal organization. The policy implication we obtain—the optimality of banning exclusive buyer representation contracts—is a light-touch regulatory intervention that, by making off-platform trade viable, fosters external competition faced by the platform while leaving the platform's internal organization unregulated. It is therefore intuitive that our policy implication does not depend on the details of the platform's internal organization. Although strengthened external competition may induce the platform to reform itself beyond the commission rate cuts described in the second-best equilibrium of our model, this would not negate the optimality of banning exclusive buyer representation contracts in the first place.

Similarly, recent lawsuits brought against the National Association of Realtors may force significant changes in how business is conducted on the platform.[36] By not intervening in the platform's internal organization and fostering external competition instead, our approach is complementary. We show that a simple ban on exclusive buyer representation contracts should, by itself, have a positive effect on equilibrium commission pricing. At the same time, our light-touch approach leaves room for more direct regulation of the platform's operations and pricing in the future, should it prove necessary.

Appendix

A.1 Proof of Lemma 1

From (1) and (2), we have

$$W^O(\theta) - W^H(\theta) = -c_1^O - q_2^O c_2^O + q_2^O q_3 (V - W^H(\theta)). \tag{34}$$

Since $1 - \min\{\theta, \kappa\} \geq 1 - \kappa$ for any θ, we have $V - W^H(\theta) \leq \kappa V$ for any θ, which implies

$$\begin{aligned} W^O(\theta) - W^H(\theta) &\leq -c_1^O + q_2^O \left(-c_2^O + q_3 \kappa V\right) \\ &< 0, \end{aligned}$$

where the last inequality follows from (5). Note that, by (3), the term in the bracket is strictly positive. QED

A.2 Proof of Proposition 1

By Lemma 1, homeowners of all types θ prefer H to O. A homeowner with shock θ will thus list with P if and only if

$$W^P(\theta) \geq W^H(\theta).$$

From (1) and (4), we have

$$\begin{aligned} W^P(\theta) - W^H(\theta) &= q_2^P q_3 \Big(V - \phi(V) - (1 - \min\{\theta, \kappa\}) V \Big) &\quad (35) \\ &= q_2^P q_3 \Big(\min\{\theta, \kappa\} V - \phi(V) \Big). &\quad (36) \end{aligned}$$

[36] E.g., the settlement reached in the *Burnett* and *Moehrl* cases in Missouri bans publishing any sellers' offers of buyer agent compensation on the MLS, and requires that the buyer agent's compensation be explicitly described in a written contract between the buyer and the buyer agent before the buyer tours any homes listed on the MLS. See Burch (2024) for further details.

Thus, the homeowner will list with P if the commission fee is not more than the loss from owning the home despite mismatch θ:

$$\phi(V) \leq \min\{\theta, \kappa\}V. \tag{37}$$

Since the loss from continuing to own the home is increasing in the preference mismatch θ, the homeowner's listing decision takes a cutoff form. Indeed, if $\phi(V) \leq \min\{\theta_1, \kappa\}V$ for some θ_1, then (37) holds for all $\theta \geq \theta_1$. Let $\hat{\theta}(\phi)$ denote the listing cutoff for a given fee ϕ.

With the listing cutoff $\hat{\theta}(\phi)$, using (6), the platform's expected profit in the home value segment V is given by

$$\left(-c_1^P + q_2^P\left(-c_2^P + q_3\phi(V)\right)\right)\left(1 - F(\hat{\theta}(\phi))\right). \tag{38}$$

Since $\min\{\theta, \kappa\}V \leq \kappa V$ for all θ, $\phi > \kappa V$ implies homeowners of all types θ prefer H over P. For P to be preferred by some types θ, we thus must have

$$\phi(V) \leq \kappa V.$$

Under the maximum fee $\phi(V) = \kappa V$, the listing cutoff is $\hat{\theta} = \kappa$, and the platform's profit is

$$\left(-c_1^P + q_2^P\left(-c_2^P + q_3\kappa V\right)\right)\left(1 - F(\kappa)\right). \tag{39}$$

Consider a cut in the fee below the maximum level: $\phi(V) = (\kappa - \delta)V$ for some $\delta \in [0, \kappa]$. Using (37), the listing cutoff goes down to $\tilde{\theta} := \kappa - \delta$, and the platform's profit becomes

$$\left(-c_1^P + q_2^P\big(-c_2^P + q_3\tilde{\theta}V\big)\right)\left(1 - F(\tilde{\theta})\right). \tag{40}$$

Denoting the difference between (40) and (39) by $\Delta(\tilde{\theta})$, we have

$$\Delta(\tilde{\theta}) = \left(-c_1^P - q_2^P c_2^P + q_2^P q_3\kappa V\right)\left(F(\kappa) - F(\tilde{\theta})\right) - q_2^P q_3(\kappa - \tilde{\theta})V\big(1 - F(\tilde{\theta})\big).$$

The first term represents the gain from attracting additional listings. The second term represents the loss from lowering the fee for all listings. To finish the proof, it is sufficient to show that $\Delta(\tilde{\theta}) \leq 0$ for all $\tilde{\theta} \in [0, \kappa]$. Since c_1^P, c_2^P are non-negative, it is sufficient to show that

$$q_2^P q_3\kappa V\big(F(\kappa) - F(\tilde{\theta})\big) \leq q_2^P q_3(\kappa - \tilde{\theta})V\big(1 - F(\tilde{\theta})\big)$$

for all $\tilde{\theta} \in [0, \kappa]$, which, after dividing by $q_2^P q_3 V$, is implied by Assumption 1. QED

A.3 Proof of Theorem 1

P is (weakly) optimal for buyers, and the exclusivity clause means P precludes O, i.e., $\mathbf{1}_{\{b=P\}} = 1$ and $\mathbf{1}_{\{b=O\}} = 0$.

Since condition (5) is met, Lemma 1 implies that O is strictly dominated by H for all homeowner types θ, meaning $\int \mathbf{1}_{\{l(a,\theta)=O\}} dF(\theta) = 0$ for all $a \in [0, \kappa]$. Using $\phi(V) = aV$ in (35), with $a \leq \kappa$, we have

$$\begin{aligned} W^P(\theta) - W^H(\theta) = &\ Q_2^P(a) q_3 \Big((1-a)V - (1 - \min\{\theta, \kappa\})V \Big), \\ = &\ \eta^P q_3 (\min\{\theta, \kappa\} - a)V, \end{aligned}$$

which implies $W^P(\theta) \geq W^H(\theta)$ for all $\theta \geq a$, and $W^P(\theta) < W^H(\theta)$ for $\theta < a$. This means, for each $a \in [0, \kappa]$, $\int \mathbf{1}_{\{l(a,\theta)=P\}} dF(\theta) = 1 - F(a)$.

With $q_2^P(a) = \eta^P$ for all $a \leq \kappa$, the assumptions of Proposition 1 are met. Hence, $a = \kappa$ maximizes the platform's profit.

We have thus verified that the proposed equilibrium strategies are indeed optimal for buyers, sellers, and the platform. Finally, we check that the implied matching probabilities satisfy the equilibrium consistency condition (8):

$$Q_2^P(a) = \frac{\mathcal{M}^P(1 - F(a), 1)}{1 - F(a)} = \eta^P,$$

and $Q_2^O(a) = 0$ because $\mathbf{1}_{\{b=O\}} = 0$ and $\int \mathbf{1}_{\{l(a,\theta)=O\}} dF(\theta) = 0$ for each $a \in [0, \kappa]$. QED

A.4 Proof of Proposition 3

Assumption 1 implies that $1 - F(a) - af(a) \geq 0$ for all $a \leq \kappa$. Differentiating (18), we have

$$\begin{aligned} \Pi'(a) &= -\left(-c_1^P + \eta^P\left(-c_2^P + q_3 aV\right)\right) f(a) + \eta^P q_3 V\left(1 - F(a)\right) \\ &= \left(c_1^P + \eta^P c_2^P\right) f(a) + \eta^P q_3 V \big(1 - F(a) - af(a)\big) \\ &> 0 \end{aligned} \tag{41}$$

for all $a \leq \kappa$. Differentiating (19), we have

$$\begin{aligned} \boldsymbol{W}'(a) &= -aVf(a) + (1 - \eta^P q_3)\min\{a, \kappa\} V f(a) - \eta^P q_3 V (1 - F(a)) + \eta^P q_3 a V f(a) \\ &= -aVf(a) + (1 - \eta^P q_3) a V f(a) - \eta^P q_3 V (1 - F(a) - af(a)) \\ &= -\eta^P q_3 a V f(a) - \eta^P q_3 V (1 - F(a) - af(a)) \\ &< 0 \end{aligned} \tag{42}$$

for all $a \leq \kappa$. The optimal a, thus, is pinned down by the platform's zero profit condition:

$$\eta^P q_3 a V (1 - F(a)) = \left(c_1^P + \eta^P c_2^P\right)(1 - F(a)),$$

which we solve for a to obtain (21). Under Assumption 3, $\Pi(\kappa) > 0$, which, with $\Pi(\cdot)$ strictly increasing, implies $a^* < \kappa$. QED

A.5 Proof of Lemma 2

We have

$$\tilde{a}^* = \left(\frac{c_1^O}{\eta^O} + c_2^O\right)(q_3 V)^{-1} > \left(\frac{c_1^P}{\eta^P} + c_2^P\right)(q_3 V)^{-1} = a^*,$$

where the strict inequality follows from (16). Next, to show $\boldsymbol{W}(a^*) > \tilde{\boldsymbol{W}}(\tilde{a}^*)$, we note that, for any $a \leq \kappa$,

$$\int_a^1 \min\{\theta, \kappa\} dF(a) = \int_a^\kappa \theta dF(\theta) + \int_\kappa^1 \kappa dF(\theta) = \int_a^\kappa \theta dF(\theta) + \kappa(1 - F(\kappa)).$$

Using this in (19), we obtain

$$\begin{aligned} \boldsymbol{W}(a) = V &- \int_0^\kappa \theta V dF(\theta) - \kappa(1 - F(\kappa))V \\ &+ \eta^P q_3 V \left(\int_a^\kappa \theta dF(\theta) + \kappa(1 - F(\kappa)) - a(1 - F(a))\right). \end{aligned} \tag{43}$$

Also, using (22) in (24), we have

$$\tilde{\boldsymbol{W}}(\tilde{a}^*) = V - \int_0^{\tilde{a}^*} \theta V dF(\theta) - (1 - \eta^O q_3) \int_{\tilde{a}^*}^1 \min\{\theta, \kappa\} V dF(\theta) - \eta^O q_3 \tilde{a}^* V (1 - F(\tilde{a}^*)),$$

which we can rewrite as

$$\begin{aligned} \tilde{\boldsymbol{W}}(\tilde{a}^*) = V &- \int_0^\kappa \theta V dF(\theta) - \kappa(1 - F(\kappa))V \\ &+ \eta^O q_3 V \left(\int_{\tilde{a}^*}^\kappa \theta dF(\theta) + \kappa(1 - F(\kappa)) - \tilde{a}^*(1 - F(\tilde{a}^*))\right), \end{aligned} \tag{44}$$

By Assumption 1, $\kappa(1 - F(\kappa)) - a(1 - F(a))$ is positive and decreasing in a for any $a \leq \kappa$. Comparing (43) evaluated at a^* with (44), the conclusion now follows from $\tilde{a}^* > a^*$ and $\eta^P \geq \eta^O$. QED

A.6 Proof of Proposition 4

First, it follows directly from Lemma 2 that the constraint in the second-best planning problem (25) is slack at $a = a^*$:

$$\boldsymbol{W}(a^*) > \tilde{\boldsymbol{W}}(\tilde{a}^*). \tag{45}$$

Next, we show that the constraint in this planning problem is violated at $a = \kappa$:

$$\boldsymbol{W}(\kappa) < \tilde{\boldsymbol{W}}(\tilde{a}^*). \tag{46}$$

From (43), we have

$$\boldsymbol{W}(\kappa) = V - \int_0^\kappa \theta V dF(\theta) - \kappa(1 - F(\kappa))V,$$

and from (44) we then have

$$\tilde{\boldsymbol{W}}(\tilde{a}^*) = \boldsymbol{W}(\kappa) + \eta^O q_3 V \left(\int_{\tilde{a}^*}^\kappa \theta dF(\theta) + \kappa(1 - F(\kappa)) - \tilde{a}^*(1 - F(\tilde{a}^*)) \right).$$

Thus, $\boldsymbol{W}(\kappa) < \tilde{\boldsymbol{W}}(\tilde{a}^*)$ is equivalent to

$$0 < \eta^O q_3 V \left(\int_{\tilde{a}^*}^\kappa \theta dF(\theta) + \kappa(1 - F(\kappa)) - \tilde{a}^*(1 - F(\tilde{a}^*)) \right),$$

which holds because $\eta^O > 0$ and $\tilde{a}^* < \kappa$.

By (41), the platform's profit function $\Pi(a)$ strictly increasing. The slack constraint, (45), thus implies $a^{**} > a^*$. But (46) implies $a^{**} < \kappa$. With Π strictly increasing, we thus have $0 = \Pi(a^*) < \Pi(a^{**}) < \Pi(\kappa)$.

Finally, by (42), the social welfare function $\boldsymbol{W}(a)$ is strictly decreasing. Thus, $\kappa > a^{**} > a^*$ implies $\boldsymbol{W}(\kappa) < \boldsymbol{W}(a^{**}) < \boldsymbol{W}(a^*)$. QED

A.7 Proof of Proposition 5

At a^{**}, the constraint in the second-best planning problem (25) binds: $\boldsymbol{W}(a^{**}) = \tilde{\boldsymbol{W}}(\tilde{a}^*)$. Using (43) and (44), we can express this equality as

$$\eta^P G(a^{**}) = \eta^O G(\tilde{a}^*), \tag{47}$$

where

$$G(a) := \int_a^\kappa \theta dF(\theta) + \kappa(1 - F(\kappa)) - a(1 - F(a)).$$

By Assumption 1, $G(a) \geq 0$ and $G'(a) < 0$ for $a \in [0, \kappa]$.

Directly from (22), we have

$$\frac{\partial \tilde{a}^*}{\partial c_1^O} > 0, \quad \frac{\partial \tilde{a}^*}{\partial c_2^O} > 0, \quad \frac{\partial \tilde{a}^*}{\partial \eta^O} < 0, \quad \frac{\partial \tilde{a}^*}{\partial V} < 0. \tag{48}$$

Let x stand for c_1^O, c_2^O, c_1^P, c_2^P or V. Differentiating (47) totally with respect to x, we obtain

$$\eta^P G'(a^{**}) \frac{da^{**}}{dx} = \eta^O G'(\tilde{a}^*) \frac{\partial \tilde{a}^*}{\partial x}, \tag{49}$$

where we have assumed c_1^O, c_2^O, c_1^P, c_2^P are independent of V. Using $G' < 0$ and (48) in (49), we obtain $\frac{da^{**}}{dc_1^O} > 0$, $\frac{da^{**}}{dc_2^O} > 0$, and $\frac{da^{**}}{dV} < 0$. Since $\frac{\partial \tilde{a}^*}{\partial c_1^P} = \frac{\partial \tilde{a}^*}{\partial c_2^P} = 0$, (49) also implies $\frac{da^{**}}{dc_1^P} = \frac{da^{**}}{dc_2^P} = 0$.

Differentiating (47) totally with respect to η^O, we have

$$\eta^P G'(a^{**}) \frac{da^{**}}{d\eta^O} = G(\tilde{a}^*) + \eta^O G'(\tilde{a}^*) \frac{\partial \tilde{a}^*}{\partial \eta^O} > 0,$$

where the inequality follows from $G \geq 0$, $G' < 0$, and $\frac{\partial \tilde{a}^*}{\partial \eta^O} < 0$. This implies $\frac{da^{**}}{d\eta^O} < 0$.

Differentiating (47) totally with respect to η^P, we get

$$G(a^{**}) + \eta^P G'(a^{**}) \frac{da^{**}}{d\eta^P} = 0,$$

which implies $\frac{da^{**}}{d\eta^P} > 0$. QED

A.8 Proof of Theorem 2

The search option $\{P, O\}$ is (weakly) optimal for buyers, thus $\mathbf{1}_{\{b=\{P,O\}\}} = 1$.

If $a \leq a^{**}$, then $Q_2^O(a) = 0$ implies condition (5) is met, so Lemma 1 implies that O is strictly dominated by H for all homeowner types θ, meaning $\int \mathbf{1}_{\{l(a,\theta)=O\}} dF(\theta) = 0$. Further, we have

$$\begin{aligned} W^P(\theta) - W^H(\theta) &= Q_2^P(a) q_3 \Big((1-a)V - (1 - \min\{\theta, \kappa\})V \Big), \\ &= \eta^P q_3 (\min\{\theta, \kappa\} - a) V, \end{aligned}$$

which implies $W^P(\theta) \geq W^H(\theta)$ for all $\theta \geq a$, and $W^P(\theta) < W^H(\theta)$ for $\theta < a$. This confirms (31) and implies $\int \mathbf{1}_{\{l(a,\theta)=P\}} dF(\theta) = 1 - F(a)$, for each $a \leq a^{**}$.

If $a > a^{**}$, then $q_2^P(a) = 0$ implies

$$W^P(\theta) - W^H(\theta) = 0$$

for all θ, and $Q_2^O(a) = \eta^O$ implies

$$\begin{aligned} W^O(\theta) - W^H(\theta) = &- c_1^O + \eta^O \left(-c_2^O + q_3 V + (1-q_3)(1-\min\{\theta,\kappa\})V\right) \\ &+ (1-\eta^O)(1-\min\{\theta,\kappa\})V \\ &- (1-\min\{\theta,\kappa\})V \\ = &- c_1^O + \eta^O \left(-c_2^O + q_3 V \min\{\theta,\kappa\}\right). \end{aligned}$$

For $\theta \geq \kappa$, we thus have

$$W^O(\theta) - W^H(\theta) = - c_1^O + \eta^O \left(-c_2^O + q_3 V \kappa\right) > 0,$$

where the inequality follows from Assumption 3.

For $\theta < \kappa$, in turn, we have

$$W^O(\theta) - W^H(\theta) = - c_1^O + \eta^O \left(-c_2^O + q_3 V \theta\right),$$

which is positive for $\theta \geq \tilde{a}^*$ and negative for $\theta < \tilde{a}^*$, where $\tilde{a}^*$ is given in (22). This confirms (32) and implies $\int \mathbf{1}_{\{l(a,\theta)=O\}} dF(\theta) = 1 - F(\tilde{a}^*)$, for each $a > a^{**}$.

Now consider the platform's profit maximization. Since $\int \mathbf{1}_{\{l(a,\theta)=P\}} dF(\theta) = 0$ for any $a > a^{**}$, $\Pi(a) = 0$ for all a in this range. For $a \leq a^{**}$, we have $\int \mathbf{1}_{\{l(a,\theta)=P\}} dF(\theta) = 1 - F(a)$ and hence

$$\Pi(a) = \left(-c_1^P + \eta^P(-c_2^P + q_3 a V)\right)(1 - F(a)).$$

That this profit is maximized by a^{**} follows from an argument identical to that of Proposition 1 except with the domain of a restricted to $[0, a^{**}]$. Thus, $a = a^{**}$ is the platform's optimal commission rate.

We have verified that the proposed equilibrium strategies are indeed optimal for buyers, sellers, and the platform. Finally, it is straightforward to verify that the matching probabilities implied by the equilibrium strategies of the buyers and sellers satisfy the equilibrium consistency conditions (29) and (30). QED

A.9 Description of the sample

The MLS data from CoreLogic contain 4,105,538 records with a closing date in 2019 after we drop: duplicate records; records with missing original listing price, closing price, or commission total; records for properties that are rentals, foreclosures, short sales, bank REO, new construction, and corporate owned.

In these data, buyer agent commission (BAC) is recorded as a string. We extract BAC by parsing out the written information from string to numerical values. We censor any records with the resulting BAC rate larger than 10 percent or if our parsing returns a missing BAC. We then drop the records with a closing price smaller than \$100,000. This gives us an N=1,962,032.

We proceed to use a HUD crosswalk file to map property ZIP codes to CBSA codes. We subsequently drop all observations that do not come from a top-100 Metropolitan Statistical Area by 2019 population. We then merge by CBSA code with Florida Atlantic University data, which provide MSA-level price-rent ratios for 98 large MSAs for 2019 and 2015. This results in 85 matched MSAs and an N=1,501,454. We then drop all MSAs that hold 3 or fewer records. This results with an N=1,501,440 coming from 77 MSAs. In the final sample, there are 19,499.22 observations per MSA on average, with a standard deviation of 28,526.23, a minimum observation count of 13, and a maximum of 102,847. The MSA names are listed along the horizontal axes in the two panels of Figure 2 in Appendix A.10.

A.10 Commission rates and individual home prices

In this section, we look for evidence of a systematic relationship between a home's price and the buyer-agent commission rate offered to sell it. We use our national sample covering 77 of the 100 largest Metropolitan Statistical Areas, as described in Appendix A.9. In each of these MSAs, we regress the transaction-level buyer agent-commission rate, `BAC`, on the home's price, `home_price`.

In these regressions, we obtain an insignificant coefficient (p-value above 0.05) in 24 cases, with an average R^2 of 0.0199, and a significant coefficient in 53 cases, with an average R^2 of 0.0327. Among the statistically significant cases, the estimated slope coefficient is negative for 41 MSAs and positive for 12 MSAs.

The magnitude of the estimated slope coefficients is very small. The average coefficient in the 77 regressions is -9.57×10^{-5}, which means the buyer-agent commission rate drops by less than one basis point, i.e., 0.01 of a percentage point, for every \$100,000 increase in the home's price, on average. The median estimated slope coefficient is even closer to zero: -5.93×10^{-5}. Figure 2 plots the estimated slope coefficients with their 95 percent confidence intervals for the 77 MSAs in our sample.

This evidence is consistent with the observation we made in Section1 about the BAC rates from Houston, shown in Figure 1: within a local housing market, commission rates vary

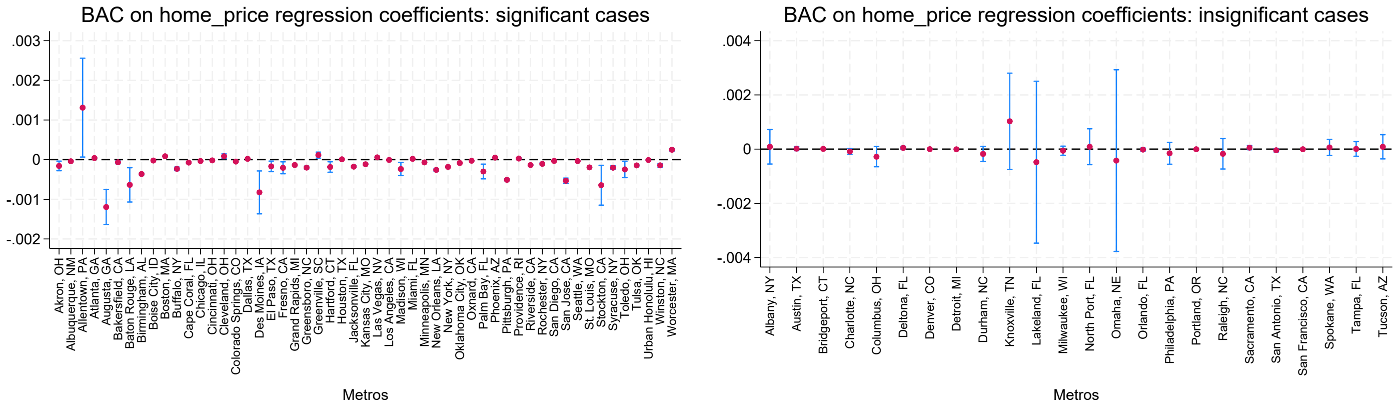

Figure 2: Coefficients from regressing `BAC` on `home_price` separately within each MSA. Left panel: the MSAs with a significant regression coefficient (41 negative, 12 positive); average $R^2 = 0.0327$. Right panel: the 24 MSAs with an insignificant coefficient; average $R^2 = 0.0199$. The average slope coefficient in all 77 regressions is -9.57×10^{-5}.

little and are not systematically related to individual home prices.

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