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Real Estate Commissions and Homebuying

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Real Estate Commissions and Homebuying*

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Abstract

We study home search and buying in the U.S. housing market, focusing on the level and structure of buyer agent commissions. In our model, as in practice, homebuyers receive free house showings while buyer agents earn a 3% commission from the seller. We show that the prevailing commission level and structure deviate from cost basis, generating excessive agent profits and inefficient searches. Adopting a cost-based commission system could raise social welfare by nearly $40 billion annually by improving home search efficiency and reducing rent-seeking by agents. We discuss policy implications of our findings, including for the recent NAR settlement.

Keywords: Real estate commissions, Real estate agents, Housing market, Search and matching

JEL Classification: D4, L1, L8, R3

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1 Introduction

High and distinctively structured commissions are a salient feature of the U.S. residential housing market. Despite substantial technological advances that have lowered the costs of home search and matching over the past three decades, real estate agents continue to charge high percentage-based commissions, and sellers—rather than buyers—pay the commissions of buyer agents. In a typical housing transaction, the seller pays her agent a 6% commission, half of which is passed to the buyer's agent. Until very recently, sellers were required to post the commission offered to buyer agents when listing their homes on the Multiple Listing Service (MLS). Using MLS data, Figure 1 plots the distributions of listed house prices and buyer-agent commissions (BAC) in the Houston metropolitan area from 1997 to 2019.[1] In the full sample of 2.58 million homes listed for sale, 96.5% offered to pay exactly 3% of the home's sale price to the buyer's agent. The buyer agent commission rate is strikingly uniform across time as well as across the home-price distribution.[2]

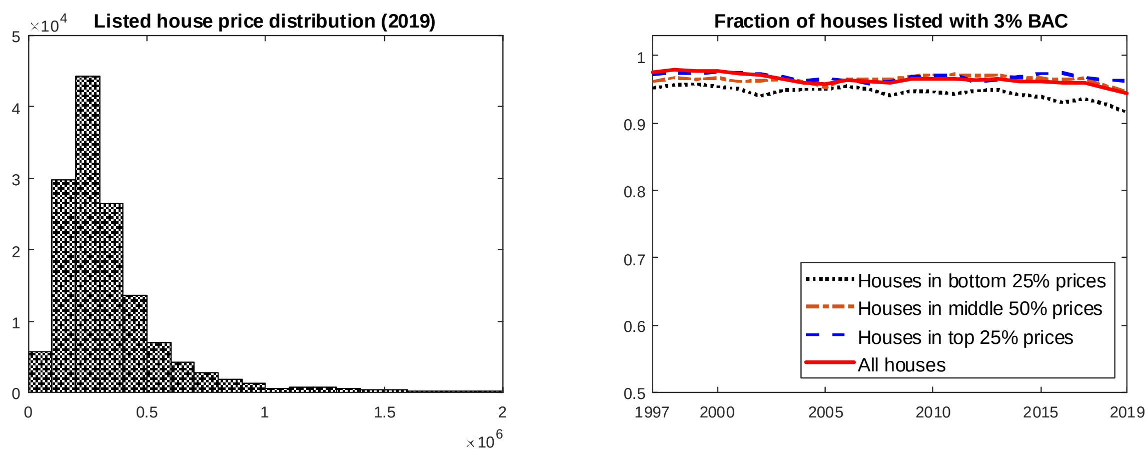

FIG. 1. HOUSE PRICES AND BUYER AGENT COMMISSIONS IN HOUSTON

This level and structure of commissions make the United States an anomaly compared with many other developed countries, where sellers typically pay much lower commission

[1] Data source: CoreLogic.

[2] The uniformity of commission rates in U.S. residential housing market has been a well established fact. See, e.g., Hsieh and Moretti (2003) and Barry et al. (2024). In reality, some buyers may negotiate with their agents to receive a portion of the agent's compensation as a rebate. If so, buyer agent commissions could be less uniform than they appear. However, such rebates are uncommon. Fewer than 6% of agents surveyed reported that they offer cash rebates, and a number of states ban such rebates entirely (Barry et al., 2024).

rates and buyers more commonly compensate their agents directly.[3] Comparing across industries, the persistently high real estate commission rate is also puzzling. Over the past few decades, the internet has compressed margins and reduced employment in many sales and advisory professions.[4] In housing, however, according to a recent survey by the National Association of Realtors (NAR), more than half of buyers now find their homes independently online, yet 89% still retain an agent and commission rates have barely changed.[5] Meanwhile, NAR membership has exceeded 1.5 million in the 2020s—nearly double its size in the 1990s.

Policymakers and industry observers have been concerned that real estate commissions deviate from underlying costs.[6] With commissions based solely on the price of the home purchased, the buyer agent's compensation is not determined by the quantity or quality of the service rendered by the agent. There is no evidence that buyer agents incur higher service costs assisting buyers shopping for higher-priced homes. Also, with buyer agents paid by sellers, some buyers may be misled into believing and acting as if they receive free services. In October 2023, a Missouri court found the NAR and two brokerage firms liable for $1.8 billion in damages for conspiring to keep commissions artificially high. Subsequently, the NAR agreed to a historical settlement that amended the rules on buyer agent commissions.[7]

In this paper, we study—both theoretically and quantitatively—the distortions that the prevailing commission level and structure impose on the home search and buying process. In our model, as in practice, homebuyers receive free house showings and do not pay their agents directly; instead, buyer agents earn a commission equal to 3% of the home's price, paid by the seller once a transaction is completed. We show that this

[3] According to cross-country surveys from 2002 and 2015, the typical commission rate paid by a seller is less than 2% in the United Kingdom, Ireland, Netherlands, Singapore, Sweden, and Norway, much lower than the 6% rate in the United States. In many countries, such as Australia, Canada, and Denmark, buyers commonly purchase properties without agent representation. Even if a buying agent is involved, the buyer typically pays his agent's service directly, as in the United Kingdom, China, Japan, and Italy (Barwick and Wong, 2019).

[4] E.g., travel agent employment has shrunk from 100,000 in 2000 to 52,000 in 2019, while financial advisors, who used to charge *ad valorem* fees, have been shifting to fee-for-service models.

[5] *2024 Home Buyers and Sellers Generational Trends Report*, National Association of Realtors.

[6] E.g., see *Competition in the Real Estate Brokerage Industry*, the Federal Trade Commission and the U.S. Department of Justice, April 2007.

[7] As the result of the settlement, the NAR has banned posting commissions offered to buyers' agents on the MLS, effective August 2024. See Section 6 for more discussions on the NAR settlement.

compensation system departs from cost basis and affects home search efficiency in two distinct ways. First, buyer agents earn excess profits, which raise the overall cost of purchasing a home and make buyers more selective in their search. Second, free house showings reduce the marginal cost of searching, leading buyers to visit more homes than is socially optimal. Together, these two distortions prolong the search process, overuse agent services, and contribute to higher home prices.

We use our model to quantify the magnitude of these distortions. The results show that switching to a cost-based commission system, in which buyer agents do not earn excess profits and buyers face the marginal cost of house showings, can increase consumer welfare by $38.52 billion a year. Most of this gain reflects a redistribution of buyer agent profits back to consumers. Net of redistribution, social surplus increases by $479.84 million annually due to improved home search efficiency. In addition, transferring agent profits to consumers enhances social surplus by reducing industry rents and mitigating the excessive agent entry documented by Hsieh and Moretti (2003) and Barwick and Pathak (2015). Taken together, the annual $38.52 billion increase in consumer welfare represents a broad social surplus gain that incorporates both effects.

Using the model framework, we examine policy options for improving the efficiency of the U.S. housing market. We argue that banning seller payments to buyer agents can effectively foster competition among buyer agents and pave the way for a cost-based à la carte commission system. Under such a system, both sellers and buyers would pay their agents directly, and buyers could compensate their agents separately for each service provided, independent of the home's purchase price. By removing price distortions, the à la carte system promotes efficiency in both buyers' search decisions and agents' entry into the market. Our policy analysis also sheds light on the limitations of the recent NAR settlement.

In our analysis, we assume a permanent "buyer's market," in which buyers have all the bargaining power over sellers. As a result, any cut in agent commissions is fully captured by the buyers through lower home prices. Because sellers retain no welfare gains, lowering agent commissions does not increase resale values of houses, so home prices fall in our model regardless of the buyers' future possibility of reselling. We should note, however, that the level of home prices is not a direct measure of consumer welfare. Buchak et al. (2024) study the impact of lowering agent commissions under the assumption of a permanent "seller's market." They find that reducing agent commissions can lead to higher home prices, as lower future transaction costs increase the resale value of houses, which benefits the sellers. While each model captures a different market scenario, both predict that lowering agent commissions enhances consumer welfare. The differing home price responses reflect how welfare gains are distributed between buyers and sellers.

Our paper contributes to the growing literature on real estate brokerage, such as Genesove and Mayer (1997, 2001), Hsieh and Moretti (2003), Levitt and Syverson (2008), Hendel et al. (2009), Han and Hong (2011, 2016), Genesove and Han (2012), Merlo et al. (2015), Barwick and Pathak (2015), Barwick et al. (2017), Cunningham et al. (2022), Aiello et al. (2024), Buchak et al. (2024), Gilbukh and Goldsmith-Pinkham (2024), Barry et al. (2025), Hatfield et al. (2025), and Kim (2025). We complement this literature by being the first to quantify pricing distortions in the buyer agent commission system using a structural model.

More broadly, our work is related to research on the incentives of brokers and expert advisors. Relevant studies include Mehran and Stulz (2007), Christoffersen et al. (2013), Foerster et al. (2017), Hoechle et al. (2018), Egan (2019), Chalmers and Reuter (2020), and Egan et al. (2022) in financial services, as well as Clemens and Gottlieb (2014), Ho and Pakes (2014), Einav et al. (2017), Lavetti and Simon (2018), and Grennan et al. (2024) in healthcare.

Our study also connects to the literature on many other network markets that feature two-sidedness (e.g., Rochet and Tirole, 2003, 2006). For example, in the payment card markets, the interchange fee, paid by merchant acquirers to card issuers, is comparable to the buyer agent commission in our analysis. In both cases, percentage fees are not based on costs but rather on users' willingness to pay, which is a form of price discrimination (Wang and Wright, 2017, 2018). These fees allow the networks to profit and grow, which is arguably necessary for a network at its nascent stage. But as a network reaches maturity, the extra profits have become increasingly less justifiable.

The rest of the paper is organized as follows. Section 2 lays out the model, and Section 3 solves the market outcome under the existing commission regime. Section 4 provides welfare analysis, comparing the market outcome with counterfactual regimes where pricing distortions are removed. Section 5 calibrates the model to quantify the welfare findings. Section 6 discusses policy implications, and Section 7 concludes. The Appendix contains model proofs, robustness checks of the quantitative analysis, and a model extension for evaluating a uniform commission cap regulation.

2 Model setup

To study how real estate commissions affect home search and buying, we adapt a standard sequential search model to the housing market context.[8]

In a given local housing market, we define a home type by its seller's reservation value, z, based on the characteristics of the home (e.g., size and quality).[9] We assume that buyers are segmented by z, i.e., each buyer has a unique home-type segment in which he searches. We denote the range of home type segments in a given local housing market by $[\underline{z}, \bar{z}]$.

To complete a sale, a seller needs to pay a commission proportional to the final sale price to both the seller agent and the buyer agent. We denote these commission rates by S and B, respectively.

We assume the so-called "buyer's market," meaning that when a buyer and a seller meet, the buyer makes a take-it-or-leave-it offer to the seller. The buyer offers the seller's reservation value and the seller accepts. The house is sold at a final price, inclusive of commissions, p_z, such that $p_z = z + Sp_z + Bp_z$, which means

$$p_z = \frac{z}{1 - S - B}. \tag{1}$$

A buyer who looks for a type-z house searches sequentially with no recall. Each period, the buyer has an exogenous probability θ of viewing a type-z home for sale.[10] The buyer incurs a cost $c_b z$ to view the house, capturing the opportunity cost of the buyer's time,

[8] See e.g., Rogerson et al. (2005) for a review of the standard sequential search model.

[9] The value z can be interpreted as the present value of the rental income that a seller would earn from renting out the house.

[10] In a buyer's market, there are many more sellers than buyers, so θ mainly depends on the buyer's own schedule constraints rather than the housing market tightness. This simplifying assumption allows us to abstract from congestion externalities among buyers in their home searches.

which is proportional to the home's value.[11]

In a viewing, the buyer learns a buyer-home match quality, u, specific to the home visited. Given a match quality realization u, the buyer's total lifetime expected utility from the housing services generated by the home is $(1+u)z$.[12] We assume that u is an i.i.d. draw from a cumulative distribution function $F(u)$ over the domain $[0, \bar{u}]$. We assume

$$(i) \quad E[u] > c_b, \quad \text{and} \quad (ii) \quad p_z < (1+\bar{u})z, \tag{2}$$

meaning the search cost is not prohibitive and the match quality is potentially high enough to make the buyer's search worthwhile.

Once matched to a home with match quality u, the buyer either buys it or rejects it and stays in the market.[13] The buyer, thus, solves the following problem

$$V_z(u) = \max\left\{(1+u)z - p_z, \beta W_z\right\}, \tag{3}$$

where

$$W_z = \theta\left(\int_0^{\bar{u}} V_z(u')dF(u') - c_b z\right) + (1-\theta)\beta W_z. \tag{4}$$

Here, $V_z(u)$ is the buyer's value with the realized match quality u, W_z is the value of search prior to finding a match, and β is the time discount factor.

A large number of real estate agents work in the market, serving either as sellers' agents or as buyers' agents. To focus our analysis on the buyer agent commission, we take the seller agent commission S as given and assume it is cost-based. Buyer agents incur a cost c_a per house showing and a cost k_a at closing of the home purchase transaction. Buyer agents do not charge commissions equal to their costs. Rather, they are paid a percentage commission rate B by the sellers. We take $B = 3\%$, as it is in the data.[14]

[11] The associated time cost reflects the buyer's forgone income and rises with the value of the property under consideration. As personal finance advisors typically recommend purchasing homes valued at roughly two to three times annual household income, we model the house-viewing cost as proportional to the value of the home being visited.

[12] Under the permanent buyer's market assumption, any future sales of the home by the buyer do not add value because the gains from trade will be captured by prospective buyers.

[13] In the model, we do not formally include the option to stop searching and leave the market altogether. In the quantitative analysis, we verify $W_z > 0$ so that this option is never "in the money" for the buyer.

[14] While we do not explain why the 3% rate prevails, it may reflect a historically established focal point or the constrained profit-maximizing rate beyond which buyers and sellers would switch to alternative home search venues. Our analysis is consistent with either interpretation.

3 Buyer's search decision and agent's profit

In this model environment, we now solve for a buyer's optimal search rule and the corresponding profit of the buyer's agent.

—**Buyer's decision.** In the buyer's decision in Eq. (3), the first option (i.e., the value of purchasing the home matched with in the current period) is strictly increasing in u, while the second option (i.e., the value of continuing to search) is independent of u. Thus, the buyer's optimal decision rule is a threshold rule: for some u^*, all $u > u^*$ are accepted, and all $u < u^*$ are rejected. At u^*, the buyer is indifferent:

$$(1 + u^*)z - p_z = \beta W_z. \tag{5}$$

The following proposition pins down the buyer's optimal acceptance threshold, u^*.

Proposition 1 *Assuming (2), the buyer's acceptance threshold u^* is interior and uniquely determined as the solution to*

$$(1 + u^*)z - p_z = \frac{\beta\theta}{1-\beta}\left(\int_{u^*}^{\bar{u}} (u' - u^*) z dF(u') - c_b z\right). \tag{6}$$

Everything else being equal, u^* increases with the buyer agent commission rate B, decreases with the buyer's own per-visit cost c_b, but does not vary with the house type z. The buyer's expected welfare W_z decreases in both B and c_b.

Proof. See Appendix A1. ■

Condition (6) states that the buyer is indifferent between purchasing the house and continuing the search at the cutoff value u^*, consistent with the standard logic of sequential search. Because both the home price p_z and the buyer's own search cost $c_b z$ enter this condition, the comparative statics of (6) provide useful insights into how buyers adjust their search behavior.

Note that the left-hand side of (6) increases in u^*, while the right-hand side decreases in u^*, guaranteeing a unique interior solution for the threshold u^*. A rise in the buyer agent commission rate B increases the home price p_z, which shifts the left-hand side of (6) downward and leaves the right-hand side unchanged, leading to a higher cutoff

u^*. In contrast, an increase in the buyer's search cost c_b shifts the right-hand side of (6) downward without affecting the left-hand side, resulting in a lower u^*. Finally, any change in the house type z affects both sides of (6) proportionally and therefore cancels out, leaving the cutoff u^* unchanged.

Furthermore, the indifference condition (5) implies comparative statics for the buyer's ex ante value of search, W_z. For example, a cut in B increases W_z because the direct impact of B on p_z is always stronger than the indirect impact of B on u^*. Appendix A1 provides formal proofs for these results.

—**Buyer's search time.** The buyer's search problem implies that in each period a buyer has the probability $\theta\lambda$ of buying a house, where $\lambda = 1 - F(u^*)$.

Let T be the random variable that corresponds to the length of time until a buyer successfully purchases a home. We have $\Pr\{T = j\} = \theta\lambda(1-\theta\lambda)^{j-1}$, and, thus, the average search time for a buyer in the market is given by

$$E[T] = \sum_{j=1}^{\infty} j \Pr\{T = j\} = \sum_{j=1}^{\infty} j\theta\lambda(1-\theta\lambda)^{j-1} = \frac{1}{\theta\lambda},$$

which means $E[T]$ increases with u^*. Using Proposition 1, it is straightforward to show that a homebuyer's average search time $E[T]$ increases with the buyer agent commission rate B, decreases with the buyer's per-visit cost c_b, but, because $\lambda = 1 - F(u^*)$ is independent of z, it does not vary with house type z.

—**Buyer agent profit.** In the model, we assume seller agents do not earn extra profits, and we focus on buyer agents. In each period, with probability θ, a buyer agent incurs a cost c_a to show a house. Following a house showing, the buyer purchases the home with probability λ at price p_z, in which case the buyer agent incurs a cost of k_a to assist with the transaction and earns a commission $p_z B = \frac{zB}{1-S-B}$. With probability $1-\theta\lambda$, however, the buyer does not purchase a home. Accordingly, the buyer agent's expected profit, denoted as π_z, is determined by

$$\pi_z = \theta\left(\frac{\lambda z B}{1-S-B} - \lambda k_a - c_a\right) + (1-\theta\lambda)\beta\pi_z,$$

which yields

$$\pi_z = \frac{\theta\lambda}{1-(1-\theta\lambda)\beta}\left(\frac{zB}{1-S-B} - k_a - \frac{c_a}{\lambda}\right). \tag{7}$$

Recall from Proposition 1 that λ is independent of z. The agent's expected profit, thus, increases in z and decreases in the agent's cost to show, c_a, and in the cost to close, k_a. Proposition 1 also implies that λ increases in the buyers search cost c_b, which means π_z increases in c_b.

As above, the agent's total expected service cost, denoted by Ω, can be derived as

$$\Omega = \frac{\theta\lambda}{1-(1-\theta\lambda)\beta}\left(k_a + \frac{c_a}{\lambda}\right). \tag{8}$$

Thus, the buyer agent's expected service cost does not vary with z.

For a given value of commission rate B, nonnegative buyer agent profit, $\pi_z \geq 0$, is implied by

$$\frac{zB}{1-S-B} - k_a - \frac{c_a}{\lambda} \geq 0,$$

or, equivalently, by

$$z \geq \left(k_a + \frac{c_a}{1-F(u^*)}\right)\frac{1-S-B}{B}. \tag{9}$$

Define $\underline{z} = \left(k_a + \frac{c_a}{1-F(u^*)}\right)\frac{1-S-B}{B}$. In our analysis, we assume that $z \geq \underline{z}$ always holds, i.e., we focus on the housing segments where buyer agents earn nonnegative profits at the prevailing commission rate of $B = 3\%$.[15]

4 Welfare analysis

In our baseline model, as in reality, the buyer agent's commission deviates from cost basis in two ways: the above-cost charge at closing and the below-cost (namely, zero) charge per showing. To evaluate the effects of these deviations, we remove them one at a time. Specifically, we compare the market baseline with two counterfactual pricing regimes. In Regime I, we assume that buyer agents continue to offer free house showings, but charge a reduced commission at closing that just allows them to break even. In Regime II, buyer

[15] We take $B = 3\%$ as exogenously given, which does not have to be the maximizer of π_z given by Eq. (7). In reality, agents may face additional pricing constraints not specified in our model that caps $B = 3\%$ (see, e.g., Grochulski and Wang, 2025 for related discussions).

agents simply pass their costs to the buyers, charging c_a per house showing and k_a per home purchase. The seller agent commissions in both counterfactuals are at the same dollar amount, $\frac{zS}{1-S-B}$, as in the market baseline, which covers seller agents' service costs.

Our analysis shows that the two departures from cost basis embedded in the existing commission system distort buyers' decisions, leading to prolonged home searches, overused agent services, and elevated home prices. Due to these deviations, consumer welfare and social surplus (i.e., the sum of consumer welfare and agent profits) are both lower.

4.1 Counterfactual Regime I: a zero-profit cap

In Regime I, buyer agents continue to offer free house showings and collect a commission, in the amount Φ_z, from sellers, when a home is purchased. The commission Φ_z is set by a planner at a level lower than the market baseline:

$$\Phi_z < \frac{zB}{1-S-B}, \tag{10}$$

for any house type $z \geq \underline{z}$. The planner sets Φ_z just high enough for the buyer's agent to break even, essentially a zero-profit cap. The seller agent receives the same dollar amount of commission as in the market baseline, $\frac{zS}{1-S-B}$. The transaction price for a house of type z, therefore, is

$$p_z^{\mathbf{I}} = z + \frac{zS}{1-S-B} + \Phi_z. \tag{11}$$

Buyers maximize their expected value of search by solving (3)-(4), but with the transaction price $p_z^{\mathbf{I}}$ given in (11). As before, a buyer's optimal purchase decision takes a threshold form with an acceptance threshold, $u_z^{\mathbf{I}}$, determined by[16]

$$(1+u_z^{\mathbf{I}})z - p_z^{\mathbf{I}} = \frac{\beta\theta}{1-\beta}\left(\int_{u_z^{\mathbf{I}}}^{\bar{u}} \left[(u' - u_z^{\mathbf{I}})z\right] \, dF(u') - c_b z\right). \tag{12}$$

Comparing (12) against (6), we obtain that the buyer's acceptance threshold is lower in Regime I than in the baseline: $u_z^{\mathbf{I}} < u^*$.[17]

Taking into account the buyers' optimal search behavior, the planner's problem is

[16] See Appendix A1 for a general proof.

[17] Indeed, with $p_z^{\mathbf{I}} < p_z$, the left-hand side of (12) is an upward shift of the left-hand side of (6), while their right-hand sides are the same.

choosing Φ_z ex ante to reduce the level of commission relative to the market baseline, as in (10), and to ensure buyer-agent zero profit, $\pi_z = 0$, in each home type segment z.

Proposition 2 *In Regime I, a unique solution to the planner's problem exists for each $z \geq \underline{z}$:*

$$\Phi_z = k_a + \frac{c_a}{1 - F(u_z^{\mathbf{I}})}. \tag{13}$$

Compared with the market baseline, Regime I yields (i) shorter buyer search time, (ii) lower agent service costs if time discounting is sufficiently small, (iii) lower home prices, and (iv) higher consumer welfare and social surplus.

Proof. See Appendix A2. ■

Using Regime I as a theoretical paradigm, we isolate the distortion caused by agents' extra profits. Compared with the market baseline, Regime I increases consumer welfare by lowering agent commissions. Moreover, it improves social surplus defined as the sum of consumer welfare and agent profits. In the market baseline, homebuyers respond to high commissions by prolonging their search process, thereby creating deadweight loss. Lower commissions in Regime I reduce this deadweight loss by reducing the delay in buyers' acceptance decision.

While Regime I improves market performance, it does not achieve full efficiency. In this regime, homebuyers' agents are paid by sellers, so homebuyers do not directly face the marginal cost of house showings even though their agents make zero profit. This leaves another pricing distortion, as we discuss in the following counterfactual Regime II.

4.2 Counterfactual Regime II: cost-based pricing

We now consider a counterfactual Regime II, in which buyer agents directly pass their costs (i.e., c_a per showing and k_a at closing) to the buyers.[18] The seller agent commission remains at the same dollar amount as in the baseline, $\frac{zS}{1-S-B}$. We show that Regime II not only improves the market outcome over Regime I but also achieves social optimum.

[18] Alternatively, we could assume in Regime II, buyer agents charge c_a per showing to the buyer and charge k_a to the seller. In this case, home price $p_z^{\mathbf{II}} = z + \frac{zS}{1-S-B} + k_a$ and the rest of the analysis remains intact.

In Regime II, the transaction price for a house of type z is

$$p_z^{\mathbf{II}} = z + \frac{zS}{1 - S - B}. \tag{14}$$

The buyer's acceptance threshold, denoted by $u^{\mathbf{II}}$, is determined by[19]

$$(1 + u_z^{\mathbf{II}})z - p_z^{\mathbf{II}} - k_a = \frac{\beta\theta}{1-\beta}\left(\int_{u_z^{\mathbf{II}}}^{\bar{u}} \left[(u' - u_z^{\mathbf{II}})z\right] \, dF(u') - c_b z - c_a\right). \tag{15}$$

At closing of the transaction, in addition to the transaction price inclusive of the seller agent commission, the buyer covers his own agent's cost, k_a, which enters the left-hand side of (15). During the search process, the buyer also pays his agent c_a for each house showing, which enters the right-hand side of (15).

Comparing condition (15) against (12), we obtain that the buyer's acceptance threshold in Regime II is lower than in Regime I: $u_z^{\mathbf{II}} < u_z^{\mathbf{I}}$.[20]

Proposition 3 *Compared with Regime I, Regime II yields (i) shorter buyer search time, (ii) smaller agent service costs if time discounting is sufficiently small, (iii) lower home prices, and (iv) higher consumer welfare and social surplus.*

Proof. See Appendix A3. ∎

Relative to Regime I, Regime II does not affect buyer agents' profits, as these are already zero in Regime I. Regime II does, however, further improve the efficiency of the buyer's search process by eliminating the incentive to overuse agent services—an incentive that arises in both the market baseline and Regime I because house showings are free. Once fees are set equal to agents' service costs, the buyer's optimal search behavior becomes fully efficient.[21]

Proposition 4 *Regime II maximizes consumer welfare and social surplus.*

Proof. See Appendix A4. ∎

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[19] See Appendix A1 for a general proof.

[20] Indeed, relative to (12), the right-hand side of (15) shifts down while the left-hand side shifts up.

[21] Note that cost-based pricing of Regime II is not a unique fee structure that induces efficient buyer search behavior. Specifically, if the closing fee, in dollar terms, is B_z and the showing fee is b_z, then search remains efficient if $(1-\beta)(B_z - k_a) = \theta\beta(b_z - c_a)$. This condition is never met if the agent does not charge a showing fee, as is the case in the baseline regime and in Regime I.

5 Quantitative analysis

In this section, we use our model to quantify the magnitude of the distortions embedded in the current commission system. We first calibrate the baseline model and then compare it with counterfactual Regimes I and II. Our findings show that switching to a cost-based commission system, in which buyer agents do not earn extra profits and do not provide free house showings, could increase consumer welfare by $38.52 billion a year. Because agents' extra profits are economic rents that attract excessive agent entry and misallocate labor, removing them improves social efficiency. We show that the annual increase in consumer welfare provides a reasonable approximation of the broader social surplus gains.

5.1 Model calibration

We calibrate the model to U.S. homebuying data before the COVID pandemic. The unit of time is one week, and five model parameter values are chosen based on a priori information, as shown in Table 1.

Table 1. Model parameters based on a priori information

Discount factor	Home search probability	Buyer search cost	Seller agent commission	Buyer agent commission
β	θ	c_b	S	B
0.999	0.9	$\frac{0.5}{260\times2.75\times0.94}$	3%	3%

We take agent commission rates $S = B = 3\%$, as they are in practice.[22] We set a weekly discount rate $\beta = 0.999$, which corresponds to an annual discount rate of 0.95. According to a 2019 survey conducted by the NAR, homebuyers spent a median of 10 weeks searching and viewed 9 homes before purchasing—a pattern that has remained remarkably consistent across years and regions.[23] Based on this information, we set

[22] A 3% buyer-agent commission is the most commonly applied rate in our sample across both the Houston and national U.S. markets (see Section 5.3 for more discussions).

[23] Source: *2020 Home Buyers and Sellers Generational Trends Report.* The NAR has conducted annual surveys documenting how long buyers search for homes and how many properties they view before purchasing. The findings are remarkably consistent. Between 2009 and 2013, the median search duration was 12 weeks, declining to 10 weeks from 2014 to 2024, with a temporary dip to 8 weeks during the 2020–2021 pandemic period. In most years, homebuyers viewed a median of 9 to 10 homes before making a purchase. These search patterns have also remained similarly stable across geographic regions and age groups.

$\theta = 0.9$, i.e., a buyer gets a viewing with 90% probability each week. The NAR survey also shows that the ratio of median home price to median homebuyer household income was 2.75 in 2019. Denoting household income by i, we have $p_z = \frac{z}{1-S-B} = 2.75i$, so $z = 0.94 \times 2.75i$. We use this ratio to calibrate the buyer's search cost, c_b. We assume the buyer's opportunity cost of visiting a home for sale and deliberating the purchase decision is a half workday. With 260 workdays in a year, we thus have $c_b z = 0.5i/260$. Solving these two equations for c_b, we obtain $c_b = \frac{0.5}{260 \times 2.75 \times 0.94}$.

For the buyer-home match quality u, we assume a uniform distribution over $[0, \bar{u}]$. With the five parameter values chosen above, we calibrate $\bar{u}$ so that the model solution matches the data moment $E[T] = 10$ from the NAR survey. From $E[T] = 1/(\theta\lambda) = 1/(0.9\lambda) = 10$, we obtain $\lambda = 1 - F(u^*) = 1 - u^*/\bar{u} = 1/9$. Using this restriction in Eq. (6), we solve for $\bar{u} = 0.1298$ and the acceptance threshold of $u^* = 0.1154$.

To calibrate buyer-agent service costs, we use agent salary data from Redfin.[24] According to Ziprecruiter.com, the nationwide average wage for a Redfin real estate agent is \$41 per hour. We assume a buyer agent spends on average 2.5 hours to prepare, show, and follow up with a client per home showing, and 40 hours assisting a successful home purchase transaction (writing an offer, facilitating home inspection, a mortgage, and closing services). This gives us $c_a = \$41 \times 2.5$ and $k_a = \$41 \times 40$.

With the calibrated parameters, using Eq. (8), we compute the buyer agent's expected cost to serve a customer: $\Omega = \$2,540$. Using condition (9), we then compute the lower bound above which buyer agents make positive profit: $\underline{z} = \$80,291$. Finally, using Eqs. (5) and (7), we confirm that for each $z \geq \underline{z}$ our calibrated model yields $W_z > 0$, meaning homebuyers prefer searching to dropping out of the market, and $\partial W_z/\partial B < 0$ and $\partial \pi_z/\partial B > 0$ for any $B \leq 3\%$, meaning a commission cut would benefit buyers and lower buyer agents' profits.

It is worth noting that our quantitative results are not sensitive to specific parameter choices. In Appendix B, we conduct a series of robustness checks using alternative parameter values, all of which produce broadly similar qualitative and quantitative results.

[24] Redfin is a large broker that, as an exception from the industry standard, compensates agents with a salary rather than commission. See https://www.redfin.com/guides/agent-resources/working-at-redfin.

5.2 Comparing market baseline with Regimes I and II

Figure 2 presents quantitative results of our model, comparing the market baseline with Regimes I and II.

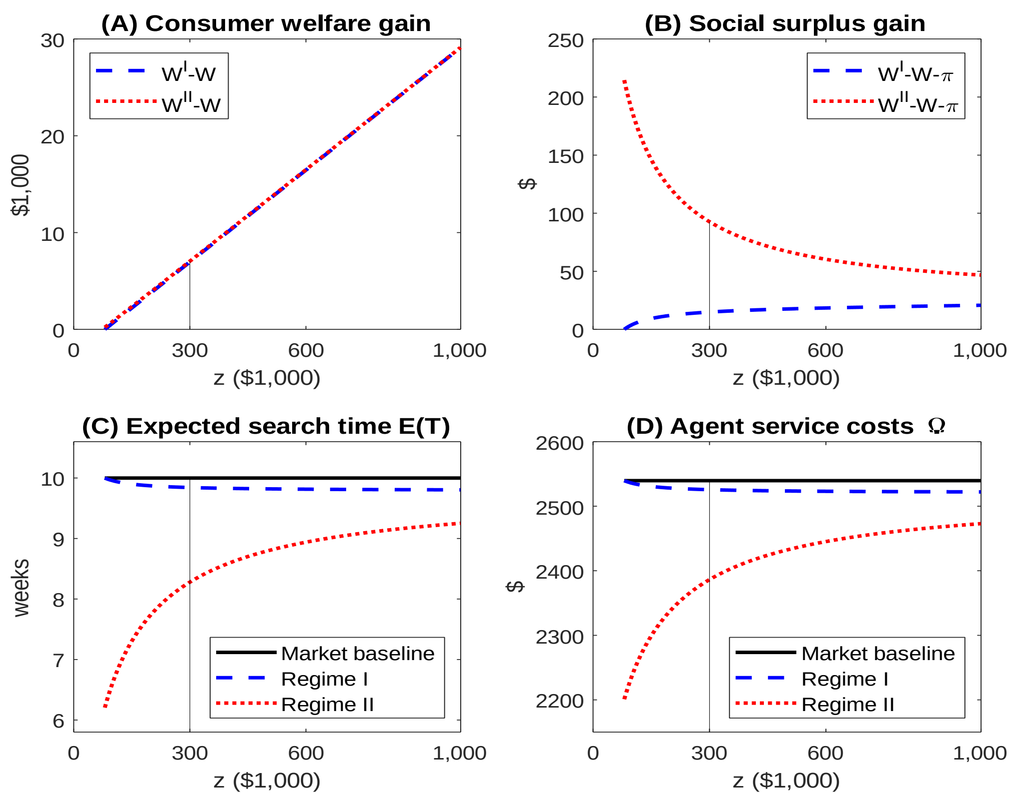

FIG. 2. COMPARING MARKET OUTCOME WITH REGIMES I AND II

Figure 2(A) shows that shifting from the baseline system to the cost-based Regime II significantly increases consumer welfare, with larger gains for buyers of higher-valued houses. For a middle-tier home ($z = \$300,000$), the welfare gain is \$7,042, or 2.21% of the home's price.[25] For a high-end home ($z = \$1,000,000$), the welfare gain is \$29,137, or 2.74% of the home's price. Most of these consumer welfare gains come from the redistribution of buyer agent profits, as Regime I provides the bulk of the welfare improvements generated under Regime II.[26]

[25]For context, the median U.S. home sale price was $\$257,500$ and the mean price was $\$350,915$ in 2019 (see Section 5.3 for the U.S. home sale price distribution).

[26]The consumer welfare gains under Regime I and II appear nearly overlapping in Figure 2(A).

Figure 2(B) shows social surplus gains—that is, the increase in the sum of buyer welfare and buyer agent's profit. For most home types, switching to the cost-based Regime II generates social surplus gains of roughly \$50 to \$200 per transaction. The figure also highlights that it is not simply the level of commissions, but rather the adjusted commission structure, that delivers substantial improvements in social surplus, particularly for lower-valued homes. For example, the social surplus gain from Regime II over and above Regime I is \$77.73 for a middle-tier home with $z = \$300,000$, and \$214.58 for a low-end home with $\underline{z} = \$80,291$.

Figures 2(C)-2(D) plot the impact on home search behavior. As shown in Section 4, a reduction in commissions by shifting to Regime I speeds up the search process. Quantitatively, however, this effect is modest at the weekly search frequency, as it operates only through the discounting channel: the lower the commission, the smaller the benefit from prolonging the search in order to postpone paying the commission. Figure 2(C) shows that for a middle-tier home ($z = \$300,000$), Regime I reduces the expected search time from 10 weeks to 9.84 weeks, a 1.6% reduction. This saves the buyer's search cost and the agent's service cost. Correspondingly, Figure 2(D) shows that the agent service cost declines by \$13.98.

Switching to Regime II, however, has a much stronger impact on search behavior. Because house showings are no longer free, homebuyers visit fewer houses, with the effect especially pronounced for lower-valued houses. Figure 2(C) shows that the expected search time for a middle-tier home ($z = \$300,000$) falls to 8.28 weeks, a 17.2% reduction relative to the market baseline. For a low-end home ($\underline{z} = \$80,291$), search time drops to 6.21 weeks, a 37.9% reduction. Correspondingly, Figure 2(D) shows that agent service costs decline by \$153.27 and \$338.65, respectively.

5.3 Aggregate welfare gains

With the calibrated model, we can compute aggregate consumer welfare and social surplus gains from the buyer agent commission (BAC) reform for local housing markets and for the nation as a whole. In this section, we first conduct a quantitative assessment for the Houston metro market and then expand the analysis to the national market. To do so, we compile comprehensive home sales data from CoreLogic.[27] Figure 3 shows the histograms of home sale prices in Houston and in the U.S. in 2019.

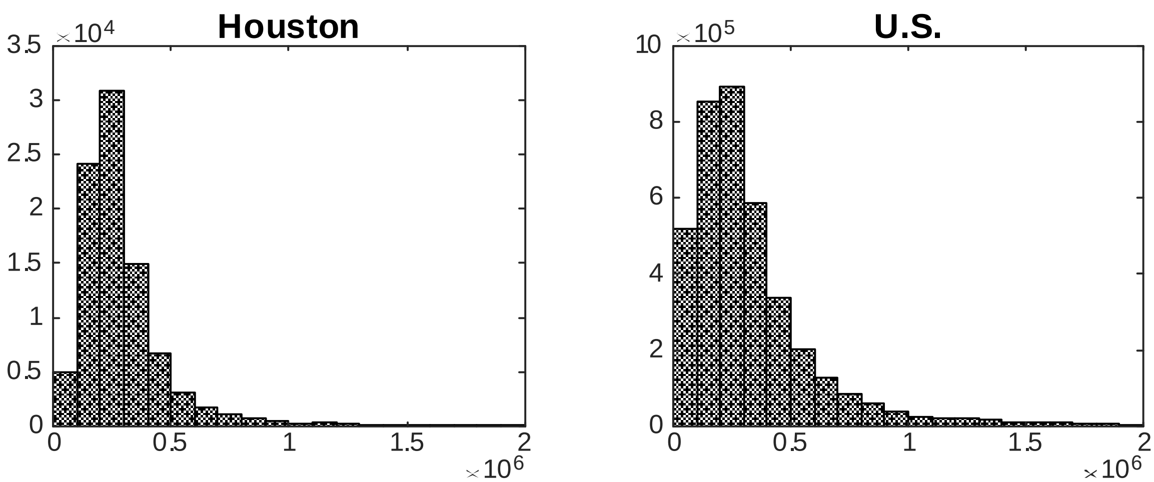

Fig. 3. Histogram of Home Sale Prices in 2019: Houston vs. U.S.

Houston. According to CoreLogic data, 90,458 houses were sold in the Houston metro market in 2019, with a median price of \$243,000 and a mean price of \$303,124. Among all the sales, 88,720 (or 98%) homes were sold for no more than \$1 million, and 1,721 (or 1.9%) homes were sold between \$1-5 million. We ignore 17 (or 0.02%) homes sold above \$5 million to avoid overly expensive outliers, and we also remove 3,971 (or 4.39%) homes below $p_{\underline{z}} = \$85,416$ (i.e., $\underline{z} = p_{\underline{z}} \times (1 - B - S) = \$80,291$). We then use our model to compute the welfare gains for each \$1,000 price bin and aggregate over all transactions in the sample.[28] We find that switching from the existing buyer agent commission system to the cost-based Regime II would increase consumer welfare by \$595.32 million in Houston in 2019. Net of the redistribution, social surplus would increase \$9.50 million.

U.S. The U.S. home sales in 2019 totaled 5.344 million,[29] approximately 59 times the number of sales in Houston. A direct projection based on our Houston result would suggest that the BAC reform could increase consumer welfare by \$35.17 billion and social

[27] The CoreLogic Real Estate Database contains property-level data and sale listings for properties across the U.S. It obtains Multiple Listing Service (MLS) data directly from regional boards of realtors. In our analysis, we focus on homes sold in 2019, and we exclude bank REO, foreclosures, short sales as well as homes under construction and corporate owned.

[28] Our result is robust to the choice of the price bin size.

[29] Data source: NAR.

surplus by \$561.39 million across the U.S. in 2019. However, a more accurate estimate can account for the differences between Houston and the national market—particularly in terms of home price distribution and buyer agent commission rates.

To address these differences, we compile all U.S. housing transactions in 2019 covered by CoreLogic. Our sample includes 3.86 million transactions, representing 72.2% of all home sales nationwide. As shown in Figure 3, the national home price distribution is more right-skewed than Houston's, with a higher median sale price of \$257,500 and a higher mean price of \$350,915. Without adjusting for this difference, a simple projection from Houston to the national market would underestimate consumer welfare gains and overestimate social efficiency gains from the BAC reform. After accounting for the national home price distribution and applying our calibrated model with a 3% buyer agent commission rate, we find that shifting to the cost-based Regime II would raise consumer welfare by \$42.31 billion and increase social surplus by \$494.82 million in the U.S. in 2019.[30]

Furthermore, national data show variation in buyer agent commission rates that is absent in Houston. Most U.S. home sales offered buyer agent commissions between 2.5% and 3%, with 3% being the most common (used in 50.7% of sales), followed by 2.5% (30.7%). The prevalence of these rates also varies with home prices. Among homes sold for no more than \$1 million, 51.8% used a 3% rate and 29.5% used a 2.5% rate. For homes sold above \$1 million, however, only 25.8% used a 3% rate, while 55.9% used a 2.5% rate. Incorporating this commission heterogeneity—together with the distribution of U.S. home prices—into our quantitative model moderates the estimated impact of the BAC reform relative to the assumption of a uniform 3% commission rate nationwide. Under this refined calibration, switching to the cost-based Regime II would raise consumer welfare by \$38.52 billion and increase social surplus by \$479.84 million in 2019.

Although our quantitative analysis abstracts from some potentially important factors such as housing cycles and local market specifics, it offers a national-data-based estimate of consumer welfare and social surplus losses due to the inefficient agent commission system, and shows that the scale of these losses is enormous. In fact, with 5.344 million home sales and \$350,915 average sale price in 2019, the total U.S. home purchase value

[30] Our calculation takes into account that our sample covers 72.2% of the entire home sales in the U.S. in 2019.

reached \$1.88 trillion. Under a 3% commission rate, buyer agents would have earned \$56.26 billion in revenue. Our analysis shows that the vast majority of that could be returned to consumers under a cost-based commission system, plus additional gains from improved home search efficiency. We conduct a series of robustness checks with alternative model assumptions and the results are quantitatively similar (see Appendix B).

5.4 Agent rent seeking, excessive entry, and misallocation

In our social welfare analysis, we treat agents' profit on par with buyers' welfare. This approach, however, ignores the problem of agent rent seeking, excessive entry, and the resulting resource misallocation. As shown in Hsieh and Moretti (2003) and Barwick and Pathak (2015), fixed agent commissions and the associated excess agent profits, together with relatively unobstructed entry into the industry, have led to an oversupply of agents and, consequently, very low agent utilization rates. On average, agents devote substantial time to searching for clients rather than serving them, which represents a socially wasteful allocation of labor.[31]

Indeed, despite significant technological advances, labor productivity in the U.S. housing brokerage industry has declined over the past 30 years. While the number of real estate transactions in the 2010s was only moderately higher than in the 1990s, the number of agents and firms nearly doubled. Compared with the United Kingdom, where real estate commissions are much lower, the United States has roughly six times more housing transactions annually but employs twenty-six times more agents.

Once this misallocation is taken into account, redistributing agent profits to consumers is not social-welfare neutral, as it has been treated in our model so far. Rather, it enhances social welfare by reducing the misallocation of agent labor and resource use. As shown in Posner (1975), with free entry, the amount of resources wasted on competition for rents can be as high as the rents themselves. In our calibration, switching to cost-based commission implies a transfer of about \$38.04 billion per year (\$38.52 billion less \$479.84 million) from agents' profits to consumers. This amount can therefore be regarded as an upper-bound estimate on annual social surplus gains from removing rent seeking.

[31] Gilbukh and Goldsmith-Pinkham (2024) discuss how excessive entry can also lead to suboptimal experience distribution of agents, hurting their average service quality.

In fact, the results in Barwick and Wong (2019) suggest that our estimate may be a tight upper bound on the social welfare gains from removing rent seeking. Barwick and Wong (2019) report that if real estate agent productivity had remained at its 1990s level, the number of agents working in real estate today would be nearly one million fewer than it is now. These one million workers would instead be available to work in other, more productive sectors. Assuming that half of these individuals currently work as buyer agents, our estimate of buyer agent excess profits, \$38.04 billion a year, implies that each such agent foregoes $\$76,080$ annually that they could earn in alternative industries, an amount closely aligned with current salary levels for salespeople in other sectors.

In sum, once we account for the reduction in rent-seeking behavior, the consumer welfare gain estimated by our model—\$38.52 billion per year—can be viewed as a reasonable estimate of the social surplus gain generated by both improved home search efficiency and the reduction in rent-seeking-induced resource misallocation.

6 Policy discussion

In this section, we discuss policy interventions through which an efficient, cost-based commission system could be implemented in practice. We first consider interventions that regulate the *level* of buyer agent commissions without fundamentally changing their *structure*. We then discuss structural reforms that implement an efficient commission system. We conclude with remarks on the recent NAR settlement.

In the current commission system, homebuyers do not directly compensate their agents. Instead, sellers attach an offer of buyer agent compensation to their home's listing and raise the home's price to recover this amount. Buyers ultimately pay for their agent through a circular system in which money flows from the buyer to the seller and then to the buyer's agent.

This circular compensation system stifles competition and preserves the pricing distortions identified in our analysis (i.e., excess agent profits and unpriced buyer services) via the following mechanism. First, buyer agents offer free services to capture potential buyers so that sellers are willing to work with them in order to reach buyers. Second, sellers are forced to offer excessive commissions in their listings as they are concerned that buyer agents may steer clients away from their properties unless they offer the prevailing commission rate.[32] Finally, buyers pay these excessive commissions through higher house prices and cannot easily negotiate lower commissions because the commission is determined ex ante by the seller.

Without reforming this circular compensation structure, policy options to remedy the pricing distortions are limited and less effective. Our Regime I characterizes a theoretical paradigm where zero-profit caps are used to eliminate excess agent profits in all home value segments z. However, these caps depend on agent service costs and on buyers' search behavior and thus are not uniform across z, making their implementation impractical. In Appendix C, we discuss introducing a uniform percentage cap in the existing commission system. A uniform cap is practically implementable, but it does not fully remove excess agent profits in high-z house segments, and like Regime I, it does not address the problem of free house showings.

We are therefore led to believe that a fundamental change to the circular compensation structure is necessary to achieve market efficiency. In theory, policymakers could cap seller payments to buyer agents at the agent's cost of closing k_a or below. This amount would be insufficient for buyer agents to break even, forcing them to negotiate fees directly with buyers and to charge for house showings. However, this approach remains difficult to implement because it would require ongoing assessment of agent costs across the industry.

In contrast, an outright ban on all payments from sellers to buyer agents can be a practical and effective solution. This simple policy does not require price controls but rather it forces buyer agents to bargain directly with buyers and to compete with one another for fees. It eliminates buyer-agent steering and enables buyers to negotiate for both the price and the scope of services they purchase from the agents.

With sufficient competition among buyer agents, this policy would align the buyer agents' commissions with their service costs. Further, because buyers' welfare is higher in Regime II than in Regime I, our model implies that strong competition among buyer agents would also lead to unbundling of services: a contract with a per-showing fee and a separate closing-assistance fee would dominate a bundled contract that only charges

[32] Empirical studies (e.g., Barwick et al., 2017 and Barry et al., 2024) provide strong evidence that steering helps substain high commission fees.

a single fee at the closing. As the result, the buyer agent compensation system would naturally evolve into an à la carte pricing system, in which buyers face separate fees for each service and competition aligns the level of these fees with agents' costs.

The ban on seller payments, however, can be insufficient in the cases where competition among buyer agents is limited. In those cases, additional policy interventions, such as banning anti-competitive bundling, can be implemented to further agent competition to help achieve the à la carte pricing system.

A potential concern with a cost-based commission system is whether liquidity-constrained buyers would be disadvantaged by having to pay buyer agent fees out of pocket, since the current system allows these commissions to be embedded in the home price and partially financed through a mortgage. In practice, however, this concern can be readily addressed. Buyers can request that the seller cover their agent's commission as part of the purchase offer. When drafting an offer, both the buyer and the buyer's agent know the commission amount and can incorporate it into the offer price. In this way, the commission can still be rolled into the mortgage, just as under the current system. The key difference is that buyers now internalize the marginal cost of home showings in their search process, even though they do not have to pay the fees out of pocket.

The recent NAR settlement helps increases consumer awareness of excessive commission rates and prohibits the posting of buyer agent commissions on the MLS. However, the settlement does not go as far as our analysis suggests is needed. Because the settlement does not ban seller payments to buyer agents outright, buyer agents may still receive commission offers from sellers through off-MLS channels. As a result, the settlement could still preserve the circular structure of buyer agent compensation. Moreover, by moving these offers off-MLS, the settlement may reintroduce the information asymmetry between buyers and buyer agents that the Department of Justice sought to eliminate in the 2020 settlement.[33] While the full impact remains to be seen, these limitations may significantly hinder the settlement's effectiveness.[34]

[33] In 2020, the Department of Justice settled with the NAR for anticompetitive violations including the NAR's Commission Concealment Rules that prohibit an MLS from disclosing to prospective buyers the amount of commission that the buyer broker will earn if the buyer purchases a home listed on the MLS.

[34] A recent New York Times article reports that "One year after the National Association of Realtors agreed, as part of a legal settlement, to change a key rule on real estate commissions, little has changed...Though average commissions appear to be slipping, industry watchdogs say that realtors and their brokerages have used workarounds and pressure on sellers to subvert the settlement...Average com-

7 Conclusion

This paper develops a model of home search and buying to evaluate the commission level and structure that prevail in the U.S. residential real estate market. In our benchmark environment, mirroring current practice, homebuyers receive free house showings and face no direct charges for buyer agent services. Instead, buyer agents earn a 3% commission paid by the seller upon closing. We show that this circular compensation system systematically departs from cost-based pricing: it generates excess buyer agent profits, induces buyers to search longer than is socially optimal, and distorts the allocation of labor and resources in the real estate brokerage sector.

Our quantitative analysis suggests that these distortions are large. Transitioning to a cost-based commission system could increase consumer welfare by nearly $40 billion per year. This gain reflects both a reduction in rents earned by buyer agents and improvements in the efficiency of home search. More broadly, the welfare gain can be interpreted as a measure of the social surplus lost under the current regime due to prolonged search, misallocation of agent effort, and excessive entry driven by commission-based rents.

Building on these findings, we examine a range of policy interventions. Measures that regulate only the level of commissions, such as caps, reduce some distortions but do not address the fundamental problem: buyers do not directly face the marginal cost of buyer agent services. In contrast, policies that eliminate payments from sellers to buyer agents naturally induce a more competitive, cost-based pricing environment. When buyer agents must negotiate fees directly with buyers, competition encourages the unbundling of services and promotes an à la carte structure in which buyers pay separately for house showings and closing services. Such a system better aligns fees with underlying costs and encourages efficient search behavior.

Our analysis also sheds light on the recent National Association of Realtors (NAR) settlement. While the settlement prohibits posting buyer agent commissions on the MLS, it does not eliminate the seller-to-buyer-agent payment channel. As a result, key dis-

missions dropped from 5.64 percent to 4.96 percent in the months that followed, according to a survey of 1,300 agents conducted by RISMedia, a real estate media company...Two other studies, conducted by the online brokerage Redfin and the cloud-based real estate accounting firm AccountTech, found commissions have not changed." — See "Home Sellers and Buyers Accuse Realtors of Blocking Lower Fees," *New York Times*, March 15, 2025.

tortions, particularly agent steering and buyer inattention to the cost of showings, may persist. Fully realizing the potential efficiency gains identified in our model likely requires a more fundamental restructuring of the commission system.

Although our framework captures key features of the homebuying process, several extensions offer promising avenues for future research. Incorporating heterogeneity in buyer sophistication, modeling strategic interactions among agents, or introducing supply-side responses by sellers could sharpen the policy implications. Evaluating how alternative commission structures affect market access for first-time or liquidity-constrained buyers is another important direction. Finally, studying general-equilibrium responses (such as changes in agent entry, service quality, and technological adoption) would further deepen our understanding of how commission reforms propagate through the housing market.

Overall, our findings highlight that aligning buyer agent compensation with service costs is central to improving efficiency in the U.S. housing market. A transition toward a competitive, cost-based, and à la carte commission system has the potential to generate substantial welfare gains for homebuyers and contribute to a more transparent and efficient marketplace.

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Appendix A. Proofs

A1. A general proof for Proposition 1 and other cases

We provide a general proof for uniquely solving for the threshold value of u in the baseline model, as well as in Regimes I, II, and under a uniform commission cap regulation.

We start with a generalized model environment that incorporates our baseline model and all other cases studied in this paper. Buyers who are interested in type z houses search sequentially, and there is no recall. Each period, a buyer has an exogenous probability θ to search. The buyer then incurs a cost x_z to visit a house. During the visit, the buyer learns a buyer-home match quality u specific to the home visited. Given a match quality realization u, the buyer's total lifetime expected utility from the housing services generated by the home is $(1+u)z$. We assume that u is an i.i.d. random variable draw from the cumulative distribution function $F(u)$ over the domain $[0, \bar{u}]$. We assume the search cost is not prohibitive:

$$E[u]z > x_z. \tag{16}$$

Let X_z denote buyer's cost-to-close, i.e., the home purchase price inclusive of any commissions the buyer pays to purchase a property of type z. We assume

$$0 \leq X_z - z < \bar{u}z. \tag{17}$$

The first inequality follows from assuming that the seller's reservation price is z, which means the buyer must pay at least that amount even in the absence of any agent commissions. The second inequality says that the match quality can potentially be high enough to make the buyer's search worthwhile, given the total purchase cost of X_z.

Once matched with a home of type z and with match quality u, the buyer either buys it or rejects it and stays in the market. He thus solves the following problem:

$$V_z(u) = \max\left\{(1+u)z - X_z, \beta W_z\right\}, \tag{18}$$

where

$$W_z = \theta\left(\int_0^{\bar{u}} V_z(u')dF(u') - x_z\right) + (1-\theta)\beta W_z. \tag{19}$$

Here, $V_z(u)$ is the value with the realized match quality u, W_z is the value of searching prior to finding a match, and β is the buyer's time discount factor.

—**Buyer's decision.** In the buyer's decision in Eq. (18), the first option, i.e., the value of purchasing the home matched with in the current period, is strictly increasing in u, while the second option, i.e., the value of continuing to search, is independent of u. The buyer's optimal decision rule, thus, is a threshold rule: for some u^*, all $u > u^*$ are accepted, and all $u < u^*$ are rejected. At u^*, the buyer is indifferent:

$$(1+u^*)z - X_z = \beta W_z. \tag{20}$$

The following theorem summarizes the solution of the buyer's sequential search problem.

Theorem 1 *Under conditions (16) and (17), the buyer's acceptance threshold u^* is interior and uniquely determined as a solution to*

$$(1+u^*)z - X_z = \frac{\beta\theta}{1-\beta}\left(\int_{u^*}^{\bar{u}} (u' - u^*)z dF(u') - x_z\right). \tag{21}$$

Everything else being equal, u^* increases in the purchase cost X_z and decreases in the buyer's per-visit cost x_z, and the buyer's expected welfare W_z decreases in both X_z and x_z.

Proof. First, we show that u^* satisfies (21). Using the threshold rule, we have

$$V_z(u) = \begin{cases} \beta W_z = (1+u^*)z - X_z & \text{if} \quad u \leq u^*, \\ (1+u)z - X_z & \text{if} \quad u > u^*. \end{cases} \tag{22}$$

Solving (19) for W_z, we obtain

$$\begin{aligned} W_z &= \frac{\theta}{1-(1-\theta)\beta}\left(\int_0^{\bar{u}} V_z(u')dF(u') - x_z\right) \\ &= \frac{\theta}{1-(1-\theta)\beta}\left(\begin{array}{c} \int_0^{u^*} \left[(1+u^*)z - X_z\right] dF(u') \\ + \int_{u^*}^{\bar{u}} \left[(1+u')z - X_z\right] \; dF(u') - x_z \end{array}\right), \end{aligned} \tag{23}$$

where the second line uses (22).

The indifference condition (20) can therefore be written as

$$(1+u^*)z - X_z = \frac{\beta\theta}{1-(1-\theta)\beta}\left(\begin{array}{c} \int_0^{u^*}[(1+u^*)z - X_z]\,dF(u') \\ +\int_{u^*}^{\bar{u}}[(1+u')z - X_z]\ \ dF(u') - x_z \end{array}\right)$$

and simplified as follows:

$$\begin{aligned} & \int_0^{u^*}[(1+u^*)z - X_z]\,dF(u') + \int_{u^*}^{\bar{u}}[(1+u^*)z - X_z]\,dF(u') \\ = \ & \frac{\beta\theta}{1-(1-\theta)\beta}\left(\begin{array}{c} \int_0^{u^*}[(1+u^*)z - X_z]\,dF(u') \\ +\int_{u^*}^{\bar{u}}[(1+u')z - X_z]\ \ dF(u') - x_z \end{array}\right) \end{aligned}$$

$\Longrightarrow$

$$\begin{aligned} & \left(1-\frac{\beta\theta}{1-(1-\theta)\beta}\right)\int_0^{u^*}[(1+u^*)z - X_z]\,dF(u') \\ = \ & \frac{\beta\theta}{1-(1-\theta)\beta}\int_{u^*}^{\bar{u}}[(1+u')z - X_z]\,dF(u') - \int_{u^*}^{\bar{u}}[(1+u^*)z - X_z]\,dF(u') - \frac{\beta\theta}{1-(1-\theta)\beta}x_z \end{aligned}$$

$\Longrightarrow$

$$\begin{aligned} & (1-\beta)\int_0^{u^*}[(1+u^*)z - X_z]\,dF(u') \\ = \ & \beta\theta\int_{u^*}^{\bar{u}}[(1+u')z - X_z]\,dF(u') - (1-\beta+\theta\beta)\int_{u^*}^{\bar{u}}[(1+u^*)z - X_z]\,dF(u') - \beta\theta x_z, \end{aligned}$$

which simplifies to (21).

Second, we show that u^* exists as a unique interior solution to (21). Denote the left-hand side (LHS) of (21) by $L(u^*)$ and its right-hand side (RHS) by $R(u^*)$. We have $L(0) = -(X_z - z) \leq 0$, where the inequality follows from (17), and $R(0) = \frac{\beta\theta}{1-\beta}\left(E[u']z - x_z\right) > 0$, where the inequality follows from (16), which means $L(0) < R(0)$. Also, $L(\bar{u}) = \bar{u}z - (X_z - z) > 0$, where the inequality follows from (17), and $R(\bar{u}) = -\frac{\beta\theta}{1-\beta}x_z < 0$, which means $L(\bar{u}) > R(\bar{u})$. Continuity now implies the existence of u^* that satisfies (21).

To show uniqueness, it is enough to verify that L is strictly increasing and R strictly decreasing. Indeed, L is linear with slope $z > 0$, and $R'(u^*) = -\frac{\beta\theta}{1-\beta}z(1-F(u^*)) < 0$. Thus, u^* is interior and unique. Figure A1 helps visualize how u^* is determined.

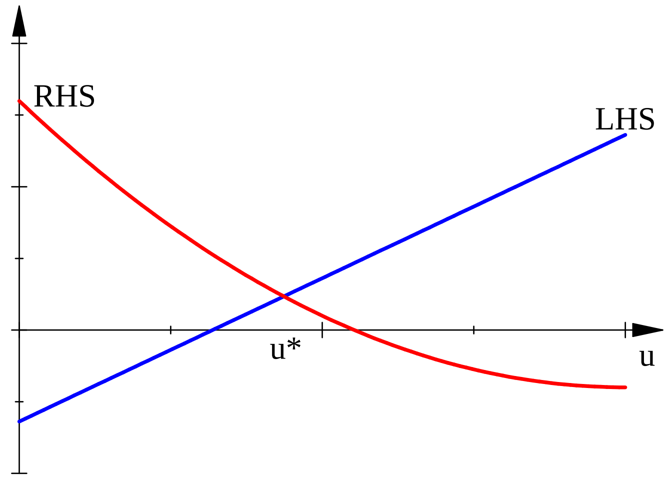

FIG. A1. DETERMINING THE THRESHOLD VALUE u^*

To show how u^* depends on X_z and x_z, we differentiate (21) and obtain

$$\frac{du^*}{dX_z} = \frac{1}{z\left[1 + \frac{\beta\theta}{1-\beta}(1 - F(u^*))\right]} > 0 \quad \text{and} \quad \frac{du^*}{dx_z} = \frac{-\frac{\beta\theta}{1-\beta}}{z\left[1 + \frac{\beta\theta}{1-\beta}(1 - F(u^*))\right]} < 0. \quad (24)$$

Figure A1 illustrates the findings of (24) intuitively: An increase in X_z shifts down the LHS, resulting in a higher value of u^*, while an increase in x_z shifts down the RHS, resulting in a lower value of u^*. From (24) we also obtain

$$\frac{d\left[(1+u^*)z - X_z\right]}{dX_z} = \frac{1}{1 + \frac{\beta\theta}{1-\beta}(1 - F(u^*))} - 1 = \frac{-\frac{\beta\theta}{1-\beta}(1 - F(u^*))}{1 + \frac{\beta\theta}{1-\beta}(1 - F(u^*))} < 0,$$

and

$$\frac{d\left[(1+u^*)z - X_z\right]}{dx_z} = \frac{-\frac{\beta\theta}{1-\beta}}{1 + \frac{\beta\theta}{1-\beta}(1 - F(u^*))} < 0,$$

which, with W_z given in (20), implies

$$\frac{dW_z}{dX_z} < 0 \quad \text{and} \quad \frac{dW_z}{dx_z} < 0.$$

Therefore, the buyer's expected welfare W_z decreases in both X_z and x_z. ■

—**Application to each case in the paper.** The above Theorem 1 can be applied to each of the cases we study in the paper:

Baseline model:

$$X_z = \frac{z}{1-S-B}, \quad x_z = c_b z.$$

Regime I:

$$X_z = z + \frac{zS}{1-S-B} + \Phi_z, \quad x_z = c_b z.$$

Regime II:

$$X_z = z + \frac{zS}{1-S-B} + k_a, \quad x_z = c_b z + c_a.$$

A uniform commission cap regulation in Appendix C:

$$X_z = \frac{z(1-B)}{(1-S-B)\,(1-B^{\mathbf{cap}})}, \quad x_z = c_b z.$$

A2. Proof of Proposition 2

In Regime I, with commission Φ_z, the buyer's agent profit is

$$\pi_z^{\mathbf{I}} = \frac{\theta\lambda_z^{\mathbf{I}}}{1-(1-\theta\lambda_z^{\mathbf{I}})\beta}\left[\Phi_z - k_a - \frac{c_a}{\lambda_z^{\mathbf{I}}}\right],$$

where $\lambda_z^{\mathbf{I}} = 1 - F(u_z^{\mathbf{I}})$. Setting $\pi_z^{\mathbf{I}} = 0$ and solving for Φ_z gives us $\Phi_z = k_a + \frac{c_a}{1-F(u_z^{\mathbf{I}})}$. To show that this commission is a solution of the planner's problem, we need to verify $\Phi_z < \frac{zB}{1-S-B}$ for each $z \geq \underline{z}$. Indeed, using the definition of $\underline{z}$ and $u_z^{\mathbf{I}} < u^*$, we obtain

$$z \geq \underline{z} = \left(k_a + \frac{c_a}{1-F(u^*)}\right)\frac{1-S-B}{B} > \left(k_a + \frac{c_a}{1-F(u_z^{\mathbf{I}})}\right)\frac{1-S-B}{B} = \Phi_z \frac{1-S-B}{B}.$$

(i) The buyer's average search time is shorter in Regime I because

$$E(T_z^{\mathbf{I}}) = \frac{1}{\theta\,(1-F(u_z^{\mathbf{I}}))} < E(T) = \frac{1}{\theta\,(1-F(u^*))}.$$

(ii) In both the baseline and Regime I, the buyer agent's expected service cost is given by

$$\Omega = \frac{\theta\lambda}{1-(1-\theta\lambda)\beta}\left[k_a + \frac{c_a}{\lambda}\right].$$

Differentiation yields

$$\frac{\partial\Omega}{\partial\lambda} < 0 \quad \text{iff} \quad \beta > \frac{1}{1+(c_a/k_a)\theta}, \tag{25}$$

i.e., the expected service cost decreases in λ for β high enough. With $\lambda_z^{\mathbf{I}} = 1 - F(u_z^{\mathbf{I}}) > 1 - F(u^*) = \lambda$ for any $z \geq \underline{z}$, the service cost is smaller in Regime I for β high enough.

(iii) Home prices are lower in Regime I because

$$p_z^{\mathbf{I}} = \frac{z(1-B)}{1-S-B} + \Phi_z < p_z = \frac{z}{1-S-B}.$$

(iv) Given that $u_z^{\mathbf{I}} < u^*$, we prove that, relative to the baseline model, Regime I yields higher consumer welfare, $W_z^{\mathbf{I}} > W_z$, and higher social surplus, $W_z^{\mathbf{I}} + \pi_z^{\mathbf{I}} > W_z + \pi_z$.

— *Consumer welfare comparison.* We first prove consumer welfare, which is equal to the buyers' surplus in our model, is higher in Regime I than in the baseline. By Theorem 1, $\frac{dW_z}{dX_z} < 0$, where X_z is the total cost to the buyer at close. $W_z^{\mathbf{I}} > W_z$ now follows from $p_z^{\mathbf{I}} < p_z$ shown in part (iii).

— *Social surplus comparison.* We now prove social surplus is higher in Regime I: $W_z^{\mathbf{I}} + \pi_z^{\mathbf{I}} > W_z + \pi_z$ or, equivalently, $W_z^{\mathbf{I}} - W_z > \pi_z - \pi_z^{\mathbf{I}}$.

Recall that in the baseline model we have

$$(1+u^*)z - p_z = \beta W_z,$$

and in Regime I we have

$$(1+u_z^{\mathbf{I}})z - p_z^{\mathbf{I}} = \beta W_z^{\mathbf{I}}.$$

Subtracting these two, we obtain

$$p_z - p_z^{\mathbf{I}} = \beta(W_z^{\mathbf{I}} - W_z) + (u^* - u_z^{\mathbf{I}})z. \tag{26}$$

Writing out W_z and $W_z^{\mathbf{I}}$, we have

$$W_z = \frac{\theta}{1-(1-\theta)\beta}\begin{pmatrix} -c_b z - p_z \\ +\int_0^{u^*}(1+u^*)zdF(u') + \int_{u^*}^{\bar{u}}(1+u')zdF(u') \end{pmatrix}$$

and

$$W_z^{\mathbf{I}} = \frac{\theta}{1-(1-\theta)\beta}\begin{pmatrix} -c_b z - p_z^{\mathbf{I}} \\ +\int_0^{u_z^{\mathbf{I}}}(1+u_z^{\mathbf{I}})zdF(u') + \int_{u_z^{\mathbf{I}}}^{\bar{u}}(1+u')zdF(u') \end{pmatrix}.$$

Subtracting these two, we obtain

$$W_z^{\mathbf{I}} - W_z = \frac{\theta}{1-(1-\theta)\beta}\begin{pmatrix} p_z - p_z^{\mathbf{I}} \\ +\int_0^{u_z^{\mathbf{I}}}(u_z^{\mathbf{I}} - u^*)zdF(u') + \int_{u_z^{\mathbf{I}}}^{u^*}(u' - u^*)zdF(u') \end{pmatrix}. \tag{27}$$

The last two terms in (27) imply that

$$\begin{aligned}
\int_0^{u_z^{\mathbf{I}}}(u_z^{\mathbf{I}} - u^*)zdF(u') + \int_{u_z^{\mathbf{I}}}^{u^*}(u' - u^*)zdF(u') &> -\left(\int_0^{u_z^{\mathbf{I}}}(u^* - u_z^{\mathbf{I}})zdF(u') + \int_{u_z^{\mathbf{I}}}^{u^*}(u^* - u_z^{\mathbf{I}})zdF(u')\right) \\
&= -\left(\int_0^{u^*}(u^* - u_z^{\mathbf{I}})zdF(u')\right) \\
&= -(u^* - u_z^{\mathbf{I}})zF(u^*).
\end{aligned}$$

Using this inequality in (27), we obtain

$$\begin{aligned}
W_z^{\mathbf{I}} - W_z &> \frac{\theta}{1-(1-\theta)\beta}\left(p_z - p_z^{\mathbf{I}} - (u^* - u_z^{\mathbf{I}})zF(u^*)\right) \\
&= \frac{\theta}{1-(1-\theta)\beta}\left(\beta(W^{\mathbf{I}} - W) + (u^* - u_z^{\mathbf{I}})z - (u^* - u_z^{\mathbf{I}})zF(u^*)\right) \\
&= \frac{\beta\theta}{1-(1-\theta)\beta}(W^{\mathbf{I}} - W) + \frac{\theta}{1-(1-\theta)\beta}(u^* - u_z^{\mathbf{I}})z\left(1 - F(u^*)\right),
\end{aligned}$$

where the second line uses (26). Simplifying, we get

$$(1-\beta)(W_z^{\mathbf{I}} - W_z) > \theta(u^* - u_z^{\mathbf{I}})z\left(1 - F(u^*)\right) > 0. \tag{28}$$

Denote by B_z^* the dollar amount of buyer agent commission in the baseline model, i.e.,

$B_z^* = \frac{zB}{1-S-B}$. We have $p_z - p_z^{\mathbf{I}} = B_z^* - \Phi_z$. It then follows from (26) that

$$B_z^* - \Phi_z = \beta(W_z^{\mathbf{I}} - W_z) + (u^* - u_z^{\mathbf{I}})z. \tag{29}$$

Recall that the buyer agent profit in the baseline is

$$\pi_z = \frac{\theta\lambda}{1-(1-\theta\lambda)\beta}\left[B_z^* - k_a - \frac{c_a}{\lambda}\right].$$

Similarly, the buyer agent profit in Regime I is

$$\pi_z^{\mathbf{I}} = \frac{\theta\lambda_z^{\mathbf{I}}}{1-(1-\theta\lambda_z^{\mathbf{I}})\beta}\left[\Phi_z - k_a - \frac{c_a}{\lambda_z^{\mathbf{I}}}\right]. \tag{30}$$

In (30), given that $\Phi_z > k_a$, we can verify that $\partial\pi_z^{\mathbf{I}}/\partial\lambda_z^{\mathbf{I}} > 0$. Therefore, with $\lambda_z^{\mathbf{I}} > \lambda$, we have

$$\begin{aligned}
\pi_z - \pi_z^{\mathbf{I}} &= \frac{\theta\lambda}{1-(1-\theta\lambda)\beta}\left[B_z^* - k_a - \frac{c_a}{\lambda}\right] - \frac{\theta\lambda_z^{\mathbf{I}}}{1-(1-\theta\lambda_z^{\mathbf{I}})\beta}\left[\Phi_z - k_a - \frac{c_a}{\lambda_z^{\mathbf{I}}}\right] \\
&< \frac{\theta\lambda}{1-(1-\theta\lambda)\beta}\left[B_z^* - k_a - \frac{c_a}{\lambda}\right] - \frac{\theta\lambda}{1-(1-\theta\lambda)\beta}\left[\Phi_z - k_a - \frac{c_a}{\lambda}\right] \\
&= \frac{\theta\lambda}{1-(1-\theta\lambda)\beta}\left(B_z^* - \Phi_z\right) \\
&= \frac{\theta\lambda}{1-(1-\theta\lambda)\beta}\left(\beta(W_z^{\mathbf{I}} - W_z) + (u^* - u_z^{\mathbf{I}})z\right) \\
&< W_z^{\mathbf{I}} - W_z,
\end{aligned}$$

where the fourth line uses (29) and the final inequality follows from (28).

A3. Proof of Proposition 3

(i) The buyer's expected search time is shorter in Regime II because

$$E(T_z^{\mathbf{II}}) = \frac{1}{\theta\left(1 - F(u_z^{\mathbf{II}})\right)} < \frac{1}{\theta\left(1 - F(u_z^{\mathbf{I}})\right)} = E(T_z^{\mathbf{I}}).$$

(ii) Using (25), $\Omega_z^{\mathbf{II}} < \Omega_z^{\mathbf{I}}$ for all $z \geq \underline{z}$ follows from $\lambda_z^{\mathbf{II}} = 1 - F(u_z^{\mathbf{II}}) > 1 - F(u_z^{\mathbf{I}}) = \lambda_z^{\mathbf{I}}$

as long as $\beta > \frac{1}{1+(c_a/k_a)\theta}$ holds.

(iii) Home prices are lower in Regime II because

$$p_z^{\mathbf{II}} = \frac{z(1-B)}{1-S-B} < \frac{z(1-B)}{1-S-B} + \Phi_z = p_z^{\mathbf{I}}.$$

(iv) With $u_z^{\mathbf{II}} < u_z^{\mathbf{I}}$, we now prove consumer welfare is higher in Regime II than in Regime I, i.e., $W_z^{\mathbf{II}} > W_z^{\mathbf{I}}$. Note that because buyer agents earn zero profit in both regimes, the comparison of consumer welfare is equivalent to the comparison of social surplus. Recall that in Regime I we have

$$(1+u_z^{\mathbf{I}})z - p_z^{\mathbf{I}} = \beta W_z^{\mathbf{I}}.$$

Similarly, in Regime II we have

$$(1+u_z^{\mathbf{II}})z - p_z^{\mathbf{II}} = \beta W_z^{\mathbf{II}}.$$

Subtracting these two, we obtain

$$\beta(W_z^{\mathbf{II}} - W_z^{\mathbf{I}}) = (u_z^{\mathbf{II}} - u_z^{\mathbf{I}})z + p_z^{\mathbf{I}} - p_z^{\mathbf{II}}. \tag{31}$$

Writing out $W_z^{\mathbf{I}}$ and $W_z^{\mathbf{II}}$, we have

$$W_z^{\mathbf{I}} = \frac{\theta}{1-(1-\theta)\beta}\left(\begin{array}{c} -c_b z - p_z^{\mathbf{I}} \\ +\int_0^{u_z^{\mathbf{I}}}(1+u_z^{\mathbf{I}})z dF(u') + \int_{u_z^{\mathbf{I}}}^{\bar{u}}(1+u')z dF(u') \end{array}\right),$$

and

$$W_z^{\mathbf{II}} = \frac{\theta}{1-(1-\theta)\beta}\left(\begin{array}{c} -c_b z - p_z^{\mathbf{II}} - c_a \\ +\int_0^{u_z^{\mathbf{II}}}(1+u_z^{\mathbf{II}})z dF(u') + \int_{u_z^{\mathbf{II}}}^{\bar{u}}(1+u')z dF(u') \end{array}\right).$$

Subtracting these two yields

$$W_z^{\mathbf{II}} - W_z^{\mathbf{I}} = \frac{\theta}{1-(1-\theta)\beta}\left(\begin{array}{c} -c_a + p_z^{\mathbf{I}} - p_z^{\mathbf{II}} \\ +\int_0^{u_z^{\mathbf{II}}}(u_z^{\mathbf{II}} - u_z^{\mathbf{I}})z dF(u') + \int_{u_z^{\mathbf{II}}}^{u_z^{\mathbf{I}}}(u' - u_z^{\mathbf{I}})z dF(u') \end{array}\right). \tag{32}$$

Note that the last two terms in (32) imply that

$$\begin{aligned}
\int_0^{u_z^{\mathbf{II}}}(u_z^{\mathbf{II}}-u_z^{\mathbf{I}})zdF(u')+\int_{u_z^{\mathbf{II}}}^{u_z^{\mathbf{I}}}(u'-u_z^{\mathbf{I}})zdF(u') &> -\left(\int_0^{u_z^{\mathbf{II}}}(u_z^{\mathbf{I}}-u_z^{\mathbf{II}})zdF(u')+\int_{u_z^{\mathbf{II}}}^{u_z^{\mathbf{I}}}(u_z^{\mathbf{I}}-u_z^{\mathbf{II}})zdF(u')\right)\\
&= -\left(\int_0^{u_z^{\mathbf{I}}}(u_z^{\mathbf{I}}-u_z^{\mathbf{II}})zdF(u')\right)\\
&= -(u_z^{\mathbf{I}}-u_z^{\mathbf{II}})zF(u_z^{\mathbf{I}}).
\end{aligned}$$

Applying this inequality to (32), we have

$$\begin{aligned}
W_z^{\mathbf{II}}-W_z^{\mathbf{I}} &> \frac{\theta}{1-(1-\theta)\beta}\left(-c_a+p_z^{\mathbf{I}}-p_z^{\mathbf{II}}-(u_z^{\mathbf{I}}-u_z^{\mathbf{II}})zF(u_z^{\mathbf{I}})\right)\\
&= \frac{\theta}{1-(1-\theta)\beta}\left(-c_a+p_z^{\mathbf{I}}-p_z^{\mathbf{II}}+F(u_z^{\mathbf{I}})(\beta(W_z^{\mathbf{II}}-W_z^{\mathbf{I}})-(p_z^{\mathbf{I}}-p_z^{\mathbf{II}}))\right)\\
&= \frac{\theta}{1-(1-\theta)\beta}\left(-c_a+\frac{c_a}{1-F(u_z^{\mathbf{I}})}+F(u_z^{\mathbf{I}})\left(\beta(W_z^{\mathbf{II}}-W_z^{\mathbf{I}})-\frac{c_a}{1-F(u_z^{\mathbf{I}})}\right)\right)\\
&= \frac{\theta}{1-(1-\theta)\beta}F(u_z^{\mathbf{I}})\beta(W_z^{\mathbf{II}}-W_z^{\mathbf{I}}),
\end{aligned}$$

where the second line uses (31). Factoring this inequality, we obtain

$$\left(W_z^{\mathbf{II}}-W_z^{\mathbf{I}}\right)\left(1-\frac{\theta F(u_z^{\mathbf{I}})\beta}{1-(1-\theta)\beta}\right)>0, \tag{33}$$

which implies $W_z^{\mathbf{II}}-W_z^{\mathbf{I}}>0$ because

$$1-\frac{\theta F(u_z^{\mathbf{I}})\beta}{1-(1-\theta)\beta}=\frac{1-\beta+\theta\beta(1-F(u_z^{\mathbf{I}}))}{1-(1-\theta)\beta}>0.$$

A4. Proof of Proposition 4

Consider the problem of maximizing total social surplus $\Delta_z = W_z + \pi_z$, where the sum of the buyer's welfare and the agent's profit matters but not their distribution. Suppose a social planner chooses the agent fees, with the buyer paying his agent q_z per showing and Q_z at closing, and the buyer's acceptance threshold, which we denote by $u_z^{\mathbf{soc}}$ subject to buyer incentive compatibility. We prove that a solution to this problem coincides with Regime II.

In the planner's problem, with fees q_z, Q_z and the acceptance threshold $u_z^{\mathbf{soc}}$, the buyer's welfare is given by

$$\begin{aligned} W_z &= \theta\left(\int_{u_z^{\mathbf{soc}}}^{\bar{u}}\left((1+u')z-\left(z+\frac{zS}{1-S-B}+Q_z\right)\right)dF(u')-(c_bz+q_z)\right) \\ &\quad +\beta\left(1-\theta\int_{u_z^{\mathbf{soc}}}^{\bar{u}}dF(u')\right)W_z, \end{aligned} \tag{34}$$

and the buyer agent profit is

$$\pi_z=\theta\left(\int_{u_z^{\mathbf{soc}}}^{\bar{u}}(Q_z-k_a)\,dF(u')+(q_z-c_a)\right)+\beta\left(1-\theta\int_{u_z^{\mathbf{soc}}}^{\bar{u}}dF(u')\right)\pi_z. \tag{35}$$

Adding Eqs. (34) and (35), we obtain

$$\begin{aligned} \Delta_z &= \theta\left(\int_{u_z^{\mathbf{soc}}}^{\bar{u}}\left((1+u')z-\left(z+\frac{zS}{1-S-B}+k_a\right)\right)dF(u')-(c_bz+c_a)\right) \\ &\quad +\beta\left(1-\theta\int_{u_z^{\mathbf{soc}}}^{\bar{u}}dF(u')\right)\Delta_z. \end{aligned} \tag{36}$$

As we see, Q_z and q_z drop out, i.e., total social surplus depends only on the acceptance threshold $u_z^{\mathbf{soc}}$, and not on the fees Q_z, q_z.

Rearranging terms in (36), we have

$$\begin{aligned} \Delta_z &= \frac{\theta}{1-\beta\left(1-\theta\int_{u_z^{\mathbf{soc}}}^{\bar{u}}dF(u')\right)} \\ &\quad \left(\int_{u_z^{\mathbf{soc}}}^{\bar{u}}\left[(1+u')z-\left(z+\frac{zS}{1-S-B}+k_a\right)\right]dF(u')-(c_bz+c_a)\right). \end{aligned} \tag{37}$$

To maximize Δ_z, we take the first-order condition $d\Delta_z/du_z^{\mathbf{soc}}=0$, which with some algebra can be reduced to

$$(1+u_z^{\mathbf{soc}})z-\left(z+\frac{zS}{1-S-B}+k_a\right)=\frac{\beta\theta}{1-\beta}\left(\int_{u_z^{\mathbf{soc}}}^{\bar{u}}\left[(u'-u_z^{\mathbf{soc}})\,z\right]dF(u')-(c_bz+c_a)\right).$$

This is the same condition as that determines the threshold $u_z^{\mathbf{II}}$ in Regime II. We also verify that the second-order condition $d^2\Delta_z/(du_z^{\mathbf{soc}})^2 < 0$ holds at this $u_z^{\mathbf{soc}}$. Hence, $u_z^{\mathbf{II}} = u_z^{\mathbf{soc}}$, which means that the pricing of buyer agent services in Regime II induces homebuyers to use an efficient, i.e., surplus-maximizing, acceptance threshold. This confirms search is efficient under Regime II. Because buyer agents earn zero profit in Regime II, this also implies that Regime II maximizes consumer welfare.

Appendix B. Quantitative analysis: Robustness checks

Our quantitative findings are robust under alternative model assumptions. In the baseline exercise, we assume $\theta = 0.9$ so homebuyers take house tours almost every week. Alternatively, we could consider a slower market with $\theta = 0.45$, so homebuyers visit houses about every other week. Everything else equal, this yields that buyers' expected home search time $E(T) = 19.33$ weeks, almost doubling that in the baseline. Nevertheless, the welfare comparison results for each housing segment z, shown in Appendix B1, are very similar to the baseline. The aggregate effects are also similar. Assuming $\theta = 0.45$ for the entire national housing market and incorporating the heterogeneity of B in the data, we find that shifting to Regime II would increase U.S. annual consumer welfare by \$38.19 billion and annual social surplus by \$482.16 million.

In the baseline analysis, we assume seller agent commission rate $S = 3\%$. In recent years, discount brokers such as Redfin have expanded into many housing markets. Sellers who use Redfin often pay 1% for seller agent commission, but they still have to pay the prevailing commission rate to buyer agents. For robustness checks, we reran the quantitative analysis by assuming $S = 1\%$ while $B = 3\%$. The welfare comparison results are very similar to our baseline case for each housing segment z, as shown in Appendix B2. The aggregate effects are also similar. Assuming $S = 1\%$ for the entire national housing market and incorporating the heterogeneity of B in the data, we find that switching to Regime II would increase U.S. annual consumer welfare by \$38.40 billion and annual social surplus by \$464.97 million.

We assume that in the baseline analysis, buyers search for homes 2.75 times their annual household income. In some scenarios, consumers could bear a higher home price to income ratio. Our model predicts that the higher the home price to income ratio, the longer the home search (cf. $\partial u^*/\partial c_b < 0$ in Proposition 1), and therefore, the higher social surplus gains from shifting to a cost-based commission system. To see that, we reran the quantitative analysis by adjusting $c_b = \frac{0.5}{260 \times 5.5 \times 0.94}$, which means a buyer searches for a home worth 5.5 times his annual household income. The welfare results for each housing segment z, shown in Appendix B3, confirm the theoretical prediction and show substantially higher social surplus gains by shifting to Regimes I and II. In terms of the aggregate effect, we find that shifting to Regime II would increase U.S. annual consumer welfare by \$37.25 billion and annual social surplus by \$981.75 million.

In the baseline calibration, we assume that $k_a = \$41 \times 40$ and $c_a = \$41 \times 2.5$. What if agents incur higher costs? In Appendix B4 and B5, we continue to assume $B = S = 3\%$ and we adjust the cost parameters by doubling the values of k_a and c_a, respectively. The results show that a higher k_a makes the shift from the existing commission system to Regime II less socially beneficial compared with the baseline, but a higher c_a makes it more beneficial. This is because with a higher k_a, the distortion due to agents' extra profits is smaller in the existing commission system, but with a higher c_a, the distortion due to free house showings is larger. Therefore, the changes of k_a and c_a have opposite effects. In terms of aggregate effects, we find that if the value of k_a is doubled (i.e., $k_a = \$41 \times 80$), switching from the existing commission system to Regime II (taking into account the heterogeneity of B in the data) would increase annual consumer welfare by \$31.11 billion and annual social surplus by \$367.62 million. In comparison, if the value of c_a is doubled (i.e., $c_a = \$41 \times 5$), switching to Regime II would increase annual consumer welfare by \$35.11 billion and annual social surplus by \$1.35 billion.

B1. Alternative value of θ

To check robustness, we adjust the value $\theta = 0.45$ (instead of $\theta = 0.9$) so that buyers' expected search time $E(T) = 19.33$ weeks, almost doubling what in the baseline model. This captures a slower housing market. The welfare comparison results are similar to our baseline case.

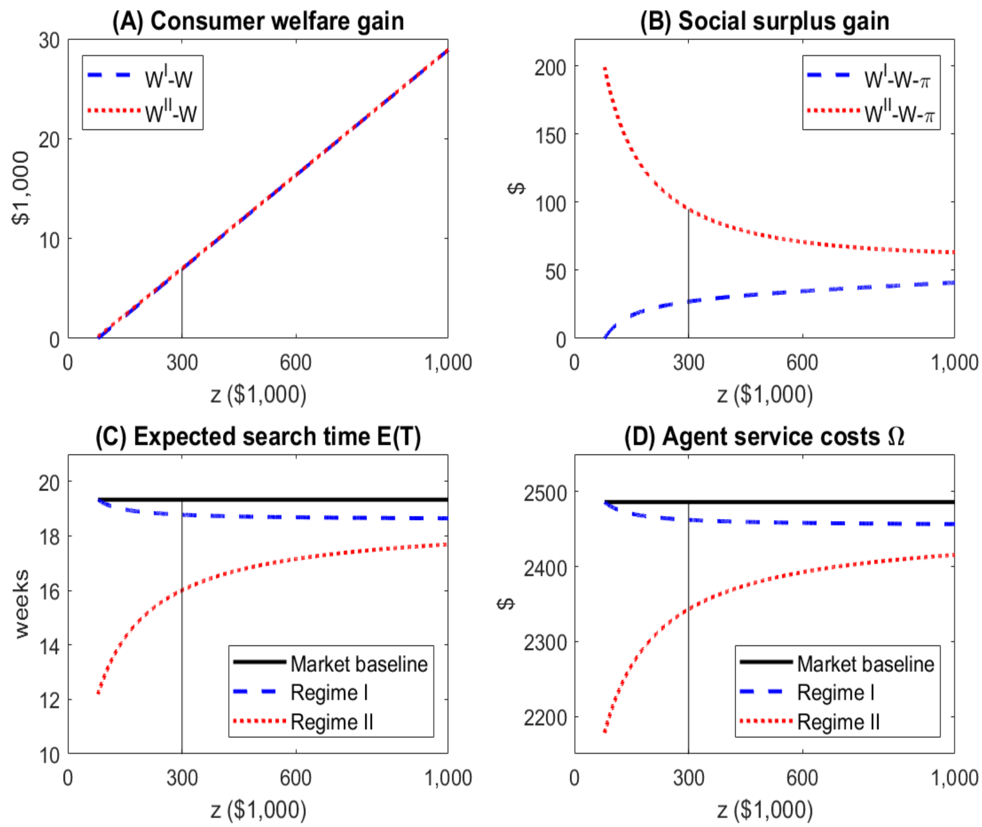

FIG. B1. COMPARING MARKET BASELINE WITH REGIMES I AND II ($\theta = 0.45$)

B2. Alternative value of S

To check robustness, we adjust sellers' commission rate $S = 1\%$ (instead of $S = 3\%$) while $B = 3\%$. This covers the cases in which home sellers use discounted brokers. The welfare comparison results are similar to our baseline case.

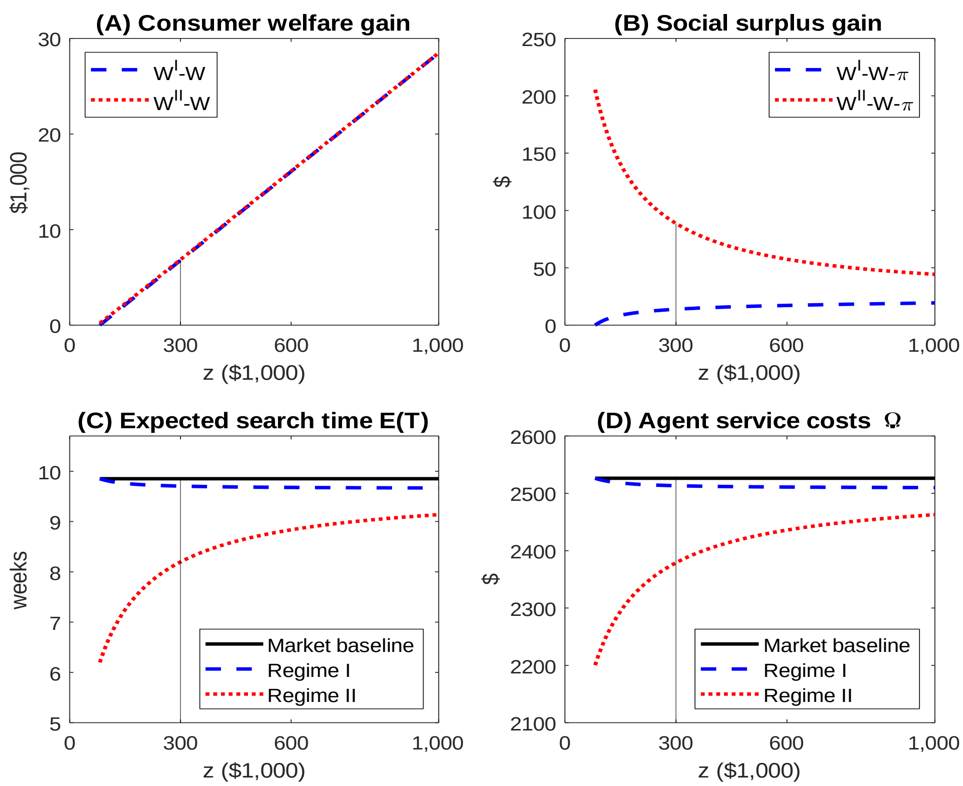

FIG. B2. COMPARING MARKET BASELINE WITH REGIMES I AND II ($S = 1\%$)

B3. Alternative value of c_b

To check robustness, we adjust $c_b = \frac{0.5}{260 \times 5.5 \times 0.94}$, which means a buyer searches for a home worth 5.5 times his annual household income. The results show longer buyer search time compared with the baseline, and higher social surplus gains by shifting to Regimes I and II.

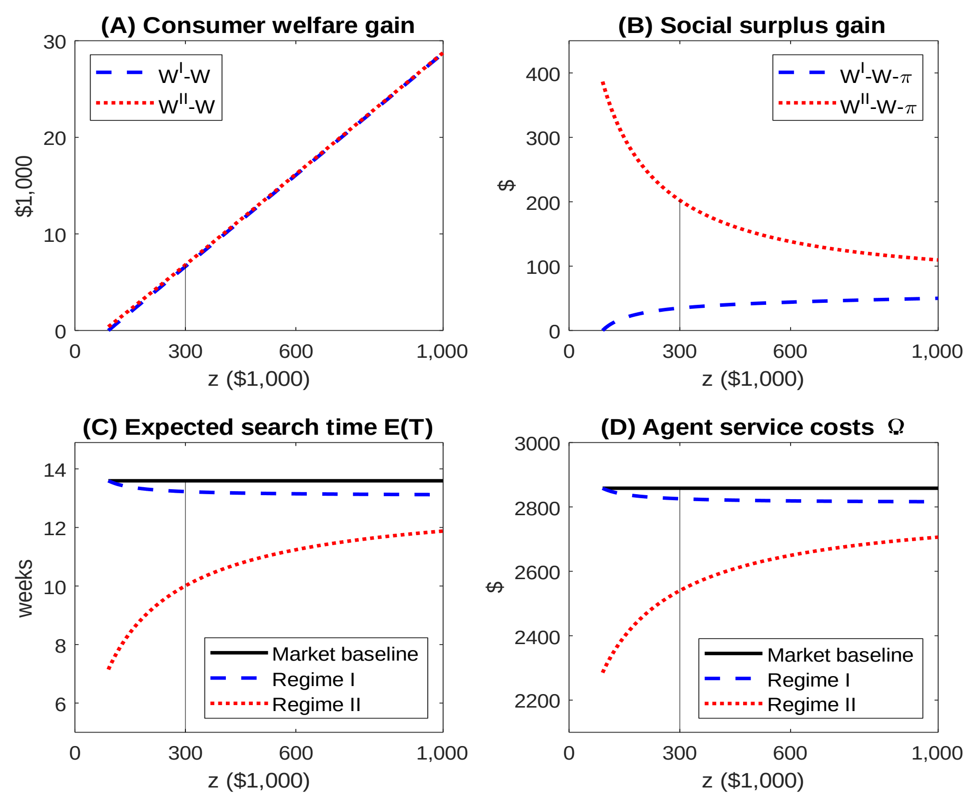

FIG. B3. COMPARING MARKET BASELINE WITH REGIMES I AND II

$(c_b = \frac{0.5}{260 \times 5.5 \times 0.94})$

B4. Alternative value of k_a

To check robustness, we reran the quantitative exercise by assuming $k_a = \$41 \times 80$, doubling buyer agents' cost at closing in the baseline. This raises the lower bound of z so that $\underline{z} = \$131,678$. The results show lower gains of consumer welfare and social surplus by shifting to Regimes I and II compared with the baseline, and more so for low-value house transactions.

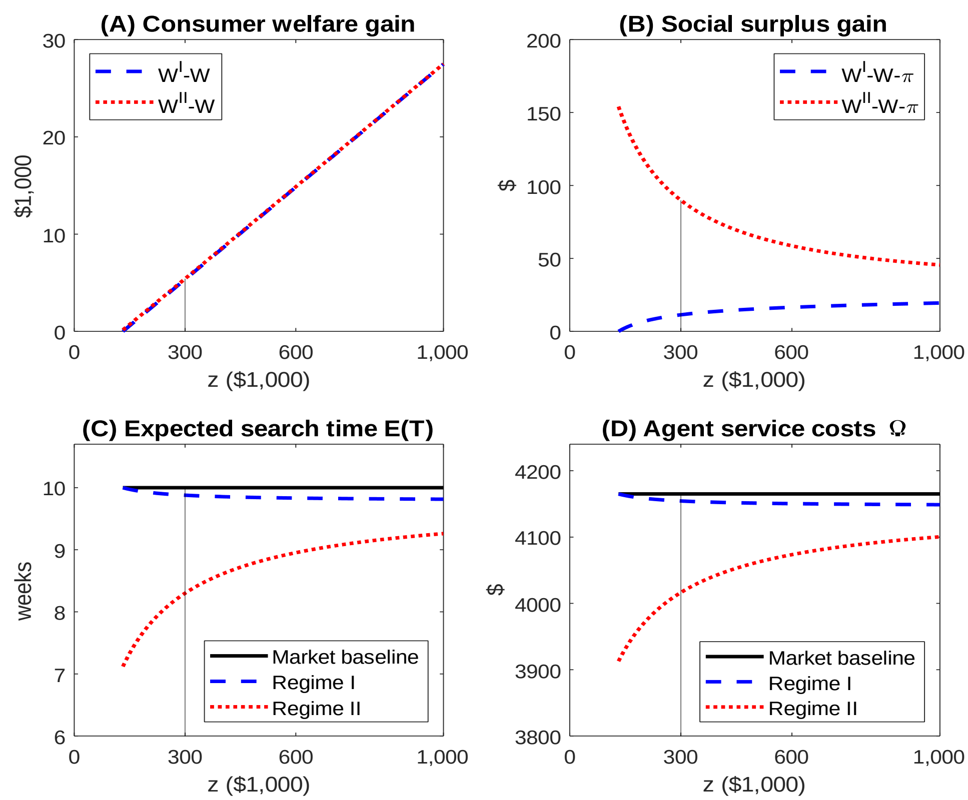

FIG. B4. COMPARING MARKET BASELINE WITH REGIMES I AND II ($k_a = \$41 \times 80$)

B5. Alternative value of c_a

To check robustness, we reran the quantitative exercise by assuming $c_a = \$41 \times 5$, doubling buyer agents' cost of per house showing in the baseline calibration. This raises the lower bound of z so that $\underline{z} = \$109,195$. The results show smaller consumer welfare gains but higher social surplus gains by shifting to Regimes I and II compared with the baseline case, and more so for low-value house transactions.

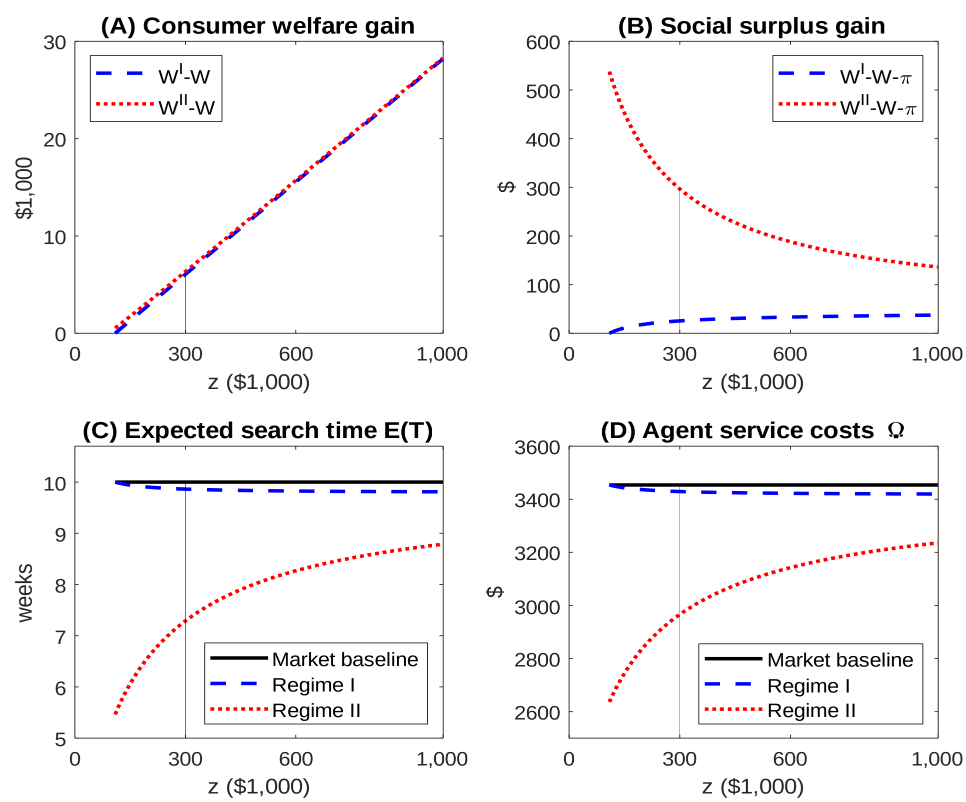

FIG. B5. COMPARING MARKET BASELINE WITH REGIMES I AND II ($c_a = \$41 \times 5$)

Appendix C. A uniform commission cap regulation

In the paper, we show that Regime II achieves the socially efficient outcome and we discuss its implementation via an à la carte system. For comparison, we extend the model to evaluate a regulation that imposes a simple uniform percentage cap on the buyer agent commission $B^{\mathbf{cap}}(< B = 3\%)$ in the existing system.

We again assume seller agents maintain the same commission compensation in fixed dollar amount as in the baseline model, (i.e., $\frac{zS}{1-S-B}$, where $S = B = 3\%$). Accordingly, house price $p_z^{\mathbf{cap}}$ is given by

$$p_z^{\mathbf{cap}} = z + \frac{zS}{1-S-B} + B^{\mathbf{cap}} p_z^{\mathbf{cap}},$$

which yields

$$p_z^{\mathbf{cap}} = \frac{z(1-B)}{(1-S-B)\,(1-B^{\mathbf{cap}})}. \tag{38}$$

Homebuyers choose the threshold value $u^{\mathbf{cap}}$ that satisfies the following equation (see Appendix A1 for a general proof):

$$(1+u^{\mathbf{cap}})z - \frac{z(1-B)}{(1-S-B)\,(1-B^{\mathbf{cap}})} = \frac{\beta\theta}{1-\beta}\left(\int_{u^{\mathbf{cap}}}^{\bar{u}} [(u' - u^{\mathbf{cap}})z]\, dF(u') - c_b z\right). \tag{39}$$

Accordingly, buyers' probability of purchasing a house they visited is given by $\lambda^{\mathbf{cap}} = 1 - F(u^{\mathbf{cap}})$, and buyers' expected search time is $E(T^{\mathbf{cap}}) = \frac{1}{\theta\lambda^{\mathbf{cap}}}$.

Recall that in the baseline commission regime, the house price p_z is given by

$$p_z = \frac{z}{1-S-B}, \tag{40}$$

and the buyer's threshold value u^* is determined by

$$(1+u^*)z - \frac{z}{1-S-B} = \frac{\beta\theta}{1-\beta}\left(\int_{u^*}^{\bar{u}} (u' - u^*)z dF(u') - c_b z\right). \tag{41}$$

Comparing Eqs. (38) and (40) yields $p_z^{\mathbf{cap}} < p_z$ given $B^{\mathbf{cap}} < B$. As a result, the left-hand side of Eq. (39) is an upward shift compared with that of Eq. (41), so we have $u^{\mathbf{cap}} < u^*$, $\lambda^{\mathbf{cap}} > \lambda$, and $E(T^{\mathbf{cap}}) < E(T)$.

Also, for buyer agents not to incur a loss, it is required that

$$B^{\mathbf{cap}} p_z^{\mathbf{cap}} - k_a - \frac{c_a}{\lambda^{\mathbf{cap}}} \geq 0,$$

which implies

$$z \geq \left(k_a + \frac{c_a}{\lambda^{\mathbf{cap}}}\right) \frac{(1-S-B)\,(1-B^{\mathbf{cap}})}{B^{\mathbf{cap}}(1-B)}. \tag{42}$$

For any z satisfying condition (42), the buyer agent profit is given by

$$\pi_z^{\mathbf{cap}} = \frac{\theta\lambda^{\mathbf{cap}}}{1-(1-\theta\lambda^{\mathbf{cap}})\beta} \left[\frac{z(1-B)B^{\mathbf{cap}}}{(1-S-B)\,(1-B^{\mathbf{cap}})} - k_a - \frac{c_a}{\lambda^{\mathbf{cap}}}\right], \tag{43}$$

and homebuyers' expected welfare $W^{\mathbf{Cap}}$ is given by

$$\beta W^{\mathbf{Cap}} = (1+u^{\mathbf{cap}})z - \frac{z(1-B)}{(1-S-B)\,(1-B^{\mathbf{cap}})}. \tag{44}$$

Figure C1 plots the model simulations for $B^{\mathbf{cap}} = 1\%$ and $B^{\mathbf{cap}} = 2\%$, respectively.

Fig. C1. Uniform Commission Cap Regulation

Comparing with the market baseline where $B = 3\%$, the cap regulation reduces buyers' search time and agent profits, and increases consumer welfare and social surplus, especially for buying high-value houses. However, comparing with Regime II, the uniform cap does not fully address the excessive agent profits in high-z house segments as well as the issue of free house showings.

Keeping the existing commission structure unchanged, Figure C1 shows a side effect of the cap regulation on buyers of low-value houses. When the commission cap is set at 2%, the lower-bound home price that allows buyer agents to earn a nonnegative profit is $p_{\underline{z}} = \$129,101$. When the cap is set at 1%, $p_{\underline{z}} = \$260,171$. This implies that under the existing commission structure, the cap regulation would force buyer agents to stop serving the low-value housing segments. However, it is possible that the cap may change the commission structure endogenously for buying low-value houses and force buyer agents to turn to buyers to negotiate for compensation, which may improve the market outcome.