Flipping Houses in a Decentralized Market

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Abstract

How does intermediation in the housing market affect an economy's house price distribution, trade volume, and welfare? I study *flipping houses* - fast buying and reselling houses by intermediaries, which has become more prevalent in recent years. While more flipping increases market thickness, it also involves intermediaries holding housing assets instead of households. Which effect dominates for welfare? To answer these questions, I develop a decentralized trade model with intermediaries with two-sided heterogeneity in inventory and housing asset valuation, where households trade houses with each other or with flippers. Search is random, information is asymmetric, and household valuations evolve stochastically. Using a universe of administrative transaction data from Ireland, I document a steady increase in house prices, trade volume, and flipped transactions between 2012 and 2022. In particular, I find that the number of flipped transactions doubled. Through a calibrated model, I use an increase in the mass of flippers to cause an increase in flipping. This increase in flipping led to a 1.5% decrease in average house prices, implying the increase in house prices seen in the data was not caused by flippers but instead by the decrease in mortgage rates. The increase in flipping in the model caused a modest increase in trade volume as compared to the data. Finally, I find the increase in flipping caused an average decrease in household welfare of 0.2%, chiefly by decreasing the steady state fraction of households owning a home. On the positive side, misallocation of housing due to search frictions decreased.

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1 Introduction

This paper studies flippers, who are agents that buy and resell houses within a short period. Flippers facilitate trade between households by playing the role of a middleman. Flipping has become increasingly popular in recent years [1]. Despite that, the role of flippers remains incompletely understood, especially regarding their impact as intermediaries within the larger housing market.

On the one hand, flippers thicken the market. On the other hand, at least for some time, flippers hold onto houses that households would otherwise own, which comes at a welfare cost. Considering this trade-off, the welfare implications of flipping become theoretically ambiguous and must be assessed using a quantitative model. Further, what are the magnitudes of such welfare effects, and what are the effects of flipping on prices and trade volume? To answer these questions, I develop a decentralized search model of households and flippers, disciplining its parameter choices using a universe of transaction data from Ireland.

The economy consists of a unit mass of households and a mass f of flippers. There is a fixed supply of houses. Every house is either owned by a flipper or a household, and every party at all times must own either zero or one house. Over time, households randomly meet flippers or other households, providing an opportunity for trade if one party currently owns a house and the other does not. Households derive utility from owning a house based on their individual type, denoted by δ, which represents their flow payoff of housing. These payoffs evolve stochastically over time due to preference shocks, arriving at a Poisson rate γ. This dynamic captures the empirical reality that households' housing needs change due to factors like job relocations, changes in family size, or shifts in financial circumstances. A household with a high δ values owning a house more and is willing to pay a higher price to purchase one, whereas a household with a low δ is more inclined to sell.

Flippers, in contrast, do not derive direct utility from holding houses. Their objective is purely to profit from the price spread between buying and selling properties. This assumption reflects their role as market participants who prioritize short-term gains over the intrinsic value of living in a home. Flippers act as middlemen, stepping in to buy houses when a suitable household buyer has not yet been found and reselling these

[1] As evidenced by the nearly doubled proportion of flipped transactions in my sample, rising in Ireland from 4.55% in 2012 to 8.05% in 2021. A similar trend is seen in the United States, where the share of flipped transactions grew from 5.1% in 2008 to 9.6% in 2021. Data source: ATOM, real estate data provider.

houses when a household with a higher valuation appears. This role is crucial in a market characterized by search frictions, as flippers help to smooth transactions and reduce the time it takes for houses to change hands. Without flippers, households may face longer waits to find suitable trading partners, leading to greater inefficiency in the market.

A flipper, lacking knowledge of the exact δ of the household, sets take-it-or-leave-it prices P_0 and P_1 for buying and selling, respectively. This pricing mechanism reflects the asymmetric information in real estate transactions, where intermediaries like flippers must set prices without knowing the precise valuation of their counterparties. In equilibrium, households and flippers follow cutoff strategies. Households without houses accept offers to buy based on whether their current flow payoff δ exceeds a threshold $\delta_0(P_1)$. Similarly, households with houses accept offers to sell based on whether their current flow payoff δ falls below a threshold $\delta_1(P_0)$. When two households meet, they negotiate the price through a Nash bargaining process, splitting equally the surplus generated from the trade. Unlike transactions with flippers, this negotiation considers the valuations of both parties, allowing households to directly capture a portion of the trade surplus. This simplification of inter-household interaction captures the complex dynamics often seen in housing markets, where various intermediaries, such as real estate agents or platforms like Zillow, can reduce information frictions and influence pricing and trade outcomes.

The core mechanism of the model revolves around how flippers impact the distribution of trades and the resulting price distribution. An increase in the number of intermediaries (f) deepens both the market for sellers and buyers by increasing the likelihood of a household encountering a counterpart. It allows houses to change hands more frequently, which, in a dynamic context, reduces average prices as future values of houses decrease. This outcome is particularly relevant in markets with high transaction costs or time delays, where a thicker market can smooth price adjustments and facilitate faster adjustment between willing-to-trade agents. However, for welfare, the presence of flippers also means that a portion of the housing stock is held by non-households at any given time, which could otherwise be owned by households, introducing a tension between liquidity provision and ownership displacement.

The model reveals that the price spread [2], between buying and selling prices is independent of search parameters like meeting rates (λ), as flippers extract all surplus from the marginal household. Instead, the spread is directly related to the underlying distribution of household valuations, $G(\cdot)$, and the stochastic evolution of δ. This independence from search rates highlights a fundamental property of the housing market: price differen-

[2] one of measures of liquidity in the market

tials are shaped more by the heterogeneity in valuations and the dynamics of preference changes than by the frequency of meetings. It comes from a price-setting design in which the flipper targets a marginal type of household. Comparative statics show that while an increase in f generally leads to lower prices due to increased speed of transaction for both buyers and sellers, the effect of changes in the meeting rate (λ)- a standard exercise in the literature of decentralized trade- is more nuanced and is misleading. A higher λ implies that in equilibrium, it is more even to meet flippers without a house, but the distribution of surplus between them can shift depending on the prevailing market conditions. For the relevant part of parameter space, it means an increase in prices whenever trade happens with a flipper.

I use comprehensive administrative transaction data from Ireland, covering the entire universe of residential property sales. This dataset includes detailed information on transaction dates, addresses, and sale prices. I document key moments of the house price distribution and returns in that market for the whole country. I also analyze the composition of trade, distinguishing between transactions involving flippers and those involving only households, which sheds light on the market's evolution over the decade.

A crucial part of my empirical work is the identification of flipped transactions. Following the standard definition in the housing literature, I classify a house as flipped if it is resold within two years of purchase. The proportion of flipped transactions nearly doubled, rising from 4.55% in 2012 to 8.05% in 2021, while real house prices increased by 76% over the same period. This trend mirrors developments in other markets, such as the United States, where the proportion of flipped transactions increased from 5.1% in 2008 to 9.6% in 2021[3]. This period also saw a 135% increase in trade volume.

These empirical observations motivate the development of a quantitative model to assess the role of flippers as intermediaries. Through a calibrated model, I use an increase in the mass of flippers to cause an increase in flipping. The model is estimated using data from 2012 and from 2021. This increase in flipping led to a 1.5% decrease in average house prices, implying the increase in house prices seen in the data was not caused by flippers but instead by the decrease in mortgage rates. The findings challenge the conventional view that flippers necessarily drive up prices. The increase in flipping in the model caused a modest increase in trade volume and turnover as compared to the data. Trade volume increased by 5%, where inter-household trade is crowded out by trade with flippers. Household welfare decreases by 0.2%, implying that ease of facilitating trade is dominated by the reduction in homeownership among households. The change in owner

[3] Data source: ATOM, real estate data provider.

distribution combined with a high level of value function for owners will generate most of this overall negative effect since, with more flippers, there are fewer household owners. Even though more houses are in the hands of flippers, due to general equilibrium effects, house allocation is less inefficient. Misallocation is measured in the mass of agents in the wrong asset position versus an efficient allocation. On the positive side, misallocation of housing due to search frictions decreased.

To explore policy implications, I conduct counterfactual exercises of regulating fast-house trading through sales taxes on flipping activity. I assess the consequences of introducing a 9% sales tax on flippers, similar to the policy in place in Ireland before 2011. The results show that such a tax significantly curtails the number of flipped transactions, leading to a reduction in total trade volume. While this policy mitigates the crowding out of household trades, it comes with a downside: the welfare gains for non-owners are reversed, and misallocation increases.

1.1 Literature review

Measurement of Flipping. The literature on speculative activity in housing markets is well-established, with studies such as Bayer et al. (2020), Depken et al. (2009), and Lee and Choi (2011) providing definitions and frameworks for analyzing flipping behavior. These studies typically define flipping as buying and reselling houses within a short period—usually two years. The role of flippers, however, is often not fully appreciated within the broader context of market intermediation. While many studies focus on local price effects and short-term returns, this is the first one to study the impact of flippers on the whole housing market and welfare. My paper extends this literature by examining flipping through the lens of search frictions and intermediation, building on the broader housing market literature that includes studies like Gavazza (2016), which looks at intermediation and its impact on liquidity, and Hugonnier et al. (2020), which explores liquidity provision in broader asset markets. By extending the time horizon and geographic scope, I analyze the welfare implications of flippers in a dynamic context. Some studies have investigated whether house improvements occur during short-term ownership in flipping. For instance, Depken et al. (2009) finds that a subset of flipped houses underwent improvements, though this is not necessary for flipping to occur. Literature focuses on various roles of flippers and differentiates between quality improvements, pure arbitrage, and the role of middleman, often conflated in other studies. In my analysis, I focus on the role of a middleman.

Intermediation and Search Frictions. This paper contributes to the literature on Over-the-Counter (OTC) search and decentralized markets. Intermediation in markets with search frictions has been widely studied by Duffie et al. (2005), Hugonnier et al. (2020), Weill (2020), and Lagos and Rocheteau (2009), Albrecht et al. (2007), Üslü (2019) who focus on how the presence of middlemen influences price formation and liquidity. My model draws on this literature by incorporating intermediaries into a decentralized market, with two-sided heterogeneity in asset valuation as a basis for trade.

My contribution builds upon the OTC literature by extending the analysis to a new asset category - housing asset. Unlike traditional OTC markets like corporate bonds or money market assets, the housing market involves less frequent transactions, which introduces unique search frictions and welfare considerations. In such a setup, flippers serve as liquidity providers but also generate inefficiencies due to their holding of housing assets. In this sense, my model aligns more closely with housing-specific studies such as Krainer and LeRoy (2002) and Allen et al. (2019), Albrecht et al. (2016) who have examined the role of search frictions in determining house prices and liquidity. In particular, I extend the insights from these papers by modeling the endogenous asset position of an intermediary, who not only facilitates trade but does it by holding onto assets (similar to car dealers).

Intermediation in the Housing Market. Unlike financial markets with brokers acting as pure intermediaries, intermediaries in housing play a more complex role. Gavazza (2016) (similar Ngai and Tenreyro (2014), Wheaton (1990)) shows that real estate brokers help reduce transaction costs and increase liquidity, though their fees can affect the net costs for buyers and sellers. Andrew Haughwout, et al. (n.d.) examines how investors, including flippers, influenced housing supply during the market crisis, stabilizing prices but also amplifying cycles when they acted collectively. My work builds on this by modeling flippers' decision-making as intermediaries who balance holding assets with facilitating transactions, providing insights into their impact on market liquidity, prices, and welfare.

Price Distribution and Welfare Effects. The distribution of housing prices, especially in the context of search frictions, has been explored by authors such as Piazzesi et al. (2020), Rekkas et al. (2020), and Diamond and Diamond (2024),Iacoviello (2005). These studies investigate how search frictions affect price dispersion and affordability, but they typically do not incorporate the role of intermediaries in their models. My paper fills this gap by analyzing how flippers influence price distribution by participating in both market sides, thereby affecting liquidity and welfare outcomes. Furthermore, the welfare implications of flipping are ambiguous due to the opposing forces of increased market thickness and the costs of delayed allocation. Similar to Head et al. (2014), I model these welfare effects and quantify their magnitude through counterfactual policy experiments, such as imposing taxes on flippers. These taxes have been studied in housing literature, as in Kopczuk and Munroe (2015), which focuses on capital gains taxation. Still, few studies have explored the differential effects of taxing short-term ownership, as I do here. The taxation of housing transactions, particularly in the context of speculative behavior, has been analyzed by authors such as Sommer and Sullivan (2018), Davis and Van Nieuwerburgh (2015) and İmrohoroğlu et al. (2018). However, these studies primarily focus on broader property tax implications rather than specific taxes targeting short-term ownership by intermediaries. My paper adds to this literature by evaluating the impact of a 9% sales tax on flippers, a policy analogous to the pre-2011 tax regime in Ireland. Through a calibrated model, I show how such a tax influences prices, trade volumes, and welfare outcomes, specifically highlighting its negative impact on non-owner households.

Outline. Section 2 introduces a toy model of the housing market, where households trade exclusively with flippers. The model highlights the role of flippers as intermediaries and the trade-off between liquidity and hold-up. Section 3 presents empirical findings related to prices, returns, and patterns of trade and flipping in Ireland, using the universe of transaction data and cross-sectional household surveys. Section 4 extends the model to include household-to-household and household-to-flipper trades and calibrates the model. That section explains the main mechanism of the model. Section 5 discusses the counterfactual exercises, tax policy experiment, and simulation of the model. The section first analyzes the effects of the increased mass of intermediaries, examining price, quantity, and welfare changes. Additionally, it explores the implications of a change in search rate equivalent to increasing flipping activity, an exercise prevalent in OTC search literature, comparing these scenarios. The policy analysis involves quantifying the impact of a 9% sales tax on flippers, a policy similar to the pre-2011 tax regime in Ireland, and evaluating its effects on market outcomes and welfare. Section 6 provides robustness checks, sensitivity analyses for the model. Finally, Section 7 concludes by summarizing the key results. All proofs, derivations, additional empirical results and data validation are included in the Appendix.

2 Simplified Model

In the following section, I consider a simplified environment where all transactions between households are mediated through flippers, and direct household-to-household trades are excluded. Houses are traded in a decentralized market based on differences in their valuations, and the flipper lacks knowledge of household type. The model analyzes how flippers facilitate trade between households, acting as intermediaries in a market where the timing of trade opportunities is random. The reason for this simplified model is that it captures the core mechanism of intermediation as detailed in the quantitative model (see Section 4). However, it does not reflect the empirical reality that most transactions in the market occur directly between households without involving flippers. Key results here show that the price spread between buying and selling prices is independent of search parameters like meeting rates (λ), and the comparative statics highlight that increasing the number of flippers (f) reduces prices while changes in the meeting rate (λ) can have varied effects depending on the parameter values.

Environment. Economy is populated by measure 1 of households and mass f of flippers. Time is continuous, and agents are infinitely lived. There are two goods: nonstorable consumption good c and indivisible housing asset q. Houses are homogenous, and their supply is fixed at s. There is neither production of houses nor deterioration of the housing supply. Households and flippers trade houses for consumption goods. Trade in houses is decentralized, and meeting opportunities arrive at random. For now trade is restricted to flipper and household; and household and flipper only. Trade between households is prohibited. One-on-one meetings between interested parties arrive with Poisson intensity λ. If a meeting happens, the flipper (acting as buyer or seller) proposes a price. The household accepts or rejects the offer. If the offer is accepted, the price is paid, the asset changes owners, and the subperiod ends. Meetings between one specific household and individual flipper have a.s. zero chances to repeat in the future. Both households and flippers discount future with a common rate of r. All agents have risk-neutral preferences. This implies that agents will have $q \in \{0, 1\}$ of houses. The exact timing of the discrete version of this dynamic continuous time game can be found in Appendix A.

Households. Households have heterogeneous types δ. Delta captures how much an agent values owning a house. Those δ dividends from owning a house are non-tradable and evolve stochastically.

A household without a house and all flippers has zero flow utility. Household with a house enjoys flow δ. Types are drawn from a fixed distribution with cumulative distribution function $G(\cdot)$. Assume that $G(\cdot)$ is uniform on $[0, \bar{\delta}]$. Distribution $G(\cdot)$ is public knowledge. Valuations are private to households; in particular, flippers don't know individual household's valuations. With Poisson intensity, γ type changes, and it is redrawn from the distribution $G(\cdot)$.

Flippers. Flippers do not derive any flow utility from owning or not owning an asset. Their sole purpose is to facilitate trade. They act as intermediaries, ensuring that households can buy or sell houses. Their only role involves proposing a price during bilateral meetings. By private information assumption about types, the flipper can not condition terms of trade on specific δ type of household they trade with.

Strategies. I focus on history-independent strategies (with no dependence on the history of past realizations of λ, γ). A flipper without a house $q = 0$ proposes a ***bid*** price P_0, while a flipper with a house $q = 1$ proposes an ***ask*** price P_1. A household in state (q, δ) upon meeting a flipper in state with opposite asset position $1 - q$ decides to accept or reject relevant price offer P_{1-q}. Across all households, this decision is characterized by cutoff $\delta_q(P_{1-q})$. This reservation value characterizes households with q houses, who are indifferent between accepting and rejecting the flipper's offer P_{1-q}. In equilibrium, with prices P_0^* and P_1^*, the household buys an asset if he does not have one and his $\delta \geq \delta_0^*(P_1^*)$ and sells the asset if she has one and $\delta \leq \delta_1^*(P_0^*)$. Assume that trade follows at cutoffs. Payments follow, and the house changes hands.

Objects of interest are : the cumulative distribution of households $H(q, \delta)$, fraction of flippers $F(q)$ for each $q \in \{0, 1\}$, two prices: P_0 proposed by flipper-buyer and P_1 proposed by flipper with a house; cutoffs $\delta_0(\cdot)$ for households buying a house and $\delta_1(\cdot)$ for households without a house, value functions for flippers $W(q)$ and for households $V(q, \delta)$. First, I will describe household problems and then the flipper's problem - the only agent making the decision (price offer), stationary distribution conditions and equilibrium definition.

Household's problem. Each household derives value potentially from flow utility, shocks to preferences, and trade surplus.
Buyer. Household without a house with type δ has 0 flow utility. Preference shock arrives at rate γ. Conditional on arrival, δ' is redrawn from the distribution G. That household meets with *a* flipper with intensity λ. The household will meet a flipper with a house with rate $\lambda F(1)$. Trade will follow whenever there is a double coincidence of wants. If there

are gains from trade, the household pays the price P_1 and becomes an owner.

$$rV(0,\delta) = \underbrace{\gamma \int_0^{\bar{\delta}} [V(0,\delta') - V(0,\delta)]dG(\delta')}_{\textbf{change of type}} + \underbrace{\lambda F(1) \cdot \max\{-P_1 + V(1,\delta) - V(0,\delta), 0\}}_{\textbf{HH vs F trade surplus}} \quad (1)$$

Seller. Homeowner household with type δ gets: flow utility δ, shock to type arrives at rate γ and trade opportunity arrives with one-on-one rate λ. If trade benefits the seller, he gets paid P_0 and becomes the nonowner.

$$rV(1,\delta) = \underbrace{\delta}_{\textbf{flow}} + \underbrace{\gamma \int_0^{\bar{\delta}} [V(1,\delta') - V(1,\delta)]dG(\delta')}_{\textbf{change of type}} + \underbrace{\lambda F(0) \cdot \max\{P_0 + V(0,\delta) - V(1,\delta), 0\}}_{\textbf{HH vs F trade surplus}} \quad (2)$$

Each household value function problem can be seen as no arbitrage condition with instantaneous return from investing $V(q,\delta)$ at rate r on the left-hand side and with three sources of dividend: flow utility, state change, and benefit from trade. Note that there is no capital gain due to stationarity of the problem.

Flipper's problem. Flipper does not inhabit a house and has 0 flow utility. **Buyer.** Flipper without a house decides to pick a price P_0, taking into account the cutoff $\delta_1(\cdot)$ and its effect on which fraction of households she trades with. Household buyers come from probability distribution $dH(1,\delta)$, and trade opportunities arrive randomly at rate λ. Thus overall meeting rate is equal to $\lambda \int_0^{\delta_1(P_0)} dH(1,\delta)$. If a meeting happens and trade follows, she pays P_0 and becomes an owner. This problem looks in the following way:

$$rW(0) = \max_{P_0} \lambda \int_0^{\delta_1(P_0)} [-P_0 + W(1) - W(0)]dH(1,\delta) \quad (3)$$

Seller. Flipper with a house has no flow, proposes a price P_1 and meets randomly at rate λ households without a house from distribution $dH(0,\delta)$ taking $\delta_1(\cdot)$ into account. When the meeting succeeds, and the offer is accepted, she gets paid P_1 and becomes a nonowner:

$$rW(1) = \max_{P_1} \lambda \int_{\delta_0(P_1)}^{\bar{\delta}} [P_1 + W(0) - W(1)]dH(0,\delta) \quad (4)$$

Accountings. Households and flippers who own a house hold all of s houses, which means that:

$$\int_0^{\bar{\delta}} dH(1,\delta) + F(1) = s \quad (5)$$

For any δ sum of all households without a house and below δ and households with a house and below δ has to be equal corresponding level of cdf of type $G(\delta)$,thus:

$$\int_0^\delta dH(0,\delta) + \int_0^\delta dH(1,\delta) = G(\delta) \quad \forall \delta \in [0,\bar{\delta}] \tag{6}$$

Sum of fraction of flippers without a house $F(0)$ and wit $F(1)$ is equal f, so:

$$F(0) + F(1) = f \tag{7}$$

Law of Motion. In stationary equilibrium, inflow and outflows to homeownership and non-ownership, both for households and flippers, must be balanced. Trade and change in the evolution of types generate those flows. Let's focus on inflows and outflows to $[0,\delta]$ taking into account position of δ vs cutoffs $\delta_0^*(P_1^*), \delta_1^*(P_0^*)$.

Homeownership (inflow and outflow to $[0,\delta], q = 1$). Inflows to homeownership come from households buying houses and changes in valuations. If the first term is positive (trade happens), if δ is high enough such that households who don't own a house are willing to trade (their valuation is between $\delta_0^*(P_1^*)$ and δ), and trade will happen with intensity $\lambda F(1)$. The second inflow to $[0,\delta]$ is proportional to the mass of households who are owners and are above δ and with intensity γ are hit with taste shock and redraw valuation to be below δ which happens with probability $G(\delta)$.

$$\begin{aligned}
&\underbrace{\lambda F(1) \int_{\delta_0^*(P_1^*)}^{\max\{\delta,\delta_0^*(P_1^*)\}} dH(0,\delta')}_{\text{inflow from trade}} + \underbrace{\gamma G(\delta) \int_\delta^{\bar{\delta}} dH(1,\delta')}_{\text{inflow from change of type from}[\delta,\bar{\delta}]} = \\
&= \underbrace{\lambda F(0) \int_0^{\min\{\delta,\delta_1^*(P_0^*)\}} dH(1,\delta')}_{\text{outflow from trade}} + \underbrace{\gamma (1 - G(\delta)) \int_0^\delta dH(1,\delta')}_{\text{outflow from change of type to}[\delta,\bar{\delta}]}
\end{aligned} \tag{8}$$

Not owning (inflow and outflow to $[0,\delta], q = 0$). Outflows from homeownership come from selling houses by households and changes in valuation. Trade happens for low enough valuations (below or at $\delta_1^*(P_0^*)$), the mass of interested households is equal to integral, and the rate at which trade happens is equal to $\lambda F(0)$. The second outflow from $[0,\delta]$ is proportional to the mass of households who are non-owners and are below δ and with intensity γ are hit with taste shock and redraw valuation to be above δ which happens with probability $1 - G(\delta)$. In a similar way, we can derive flows to and from nonownership by households.

$$\underbrace{\lambda F(0)\int_0^{\min\{\delta,\delta_1^*(P_0^*)\}} dH(1,\delta')}_{\text{inflow from trade}} + \underbrace{\gamma G(\delta)\int_\delta^{\bar{\delta}} dH(0,\delta')}_{\text{inflow from change of type from}[\delta,\bar{\delta}]} =$$

$$= \underbrace{\lambda F(1)\int_{\delta_0^*(P_1^*)}^{\max\{\delta,\delta_0^*(P_1^*)\}} dH(0,\delta')}_{\text{outflow from trade}} + \underbrace{\gamma(1-G(\delta))\int_0^{\delta} dH(0,\delta')}_{\text{outflow from change of type to}[\delta,\bar{\delta}]} \tag{9}$$

Using the equations above for $\delta = \bar{\delta}$, we can derive the equilibrium trade balance for flippers. It equates a rate of trade of flippers buying and selling:

$$\lambda F(1)\int_{\delta_0^*(P_1^*)}^{\bar{\delta}} dH(0,\delta) = \lambda F(0)\int_0^{\delta_1^*(P_0^*)} dH(1,\delta) \tag{*}$$

Prices are such that the agent at the cutoff is indifferent between trading and not trading, i.e., in equilibrium:

$$P_0^* = V(1,\delta_1^*(P_0^*)) - V(0,\delta_1^*(P_0^*)) \tag{10}$$

$$P_1^* = V(1,\delta_0^*(P_1^*)) - V(0,\delta_0^*(P_1^*)) \tag{11}$$

2.1 Equilibrium

Stationary, symmetric Markov Perfect Equilibrium with cutoffs consists of the cumulative distribution of households $H(q,\delta)$, fraction of flippers $F(q)$ for each $q \in \{0,1\}$, two prices: P_0^* proposed by flipper-buyer and P_1^* proposed by flipper with a house; cutoffs $\delta_0^*(\cdot)$ for households buying a house and $\delta_1^*(\cdot)$ for households without a house, value functions for flippers $W(q)$ and for households $V(q,\delta)$. Formally:

Definition 1 (Stationary, Symmetric Markov Perfect Equilibrium with Cutoffs)**.** *is:*

1. *distributions :* $H : (q,\delta) \to \mathbb{R}$, $F : (q) \to \mathbb{R}$
2. *value functions* $V : (q,\delta) \to \mathbb{R}$, $W : (q) \to \mathbb{R}$
3. *decision rules: cutoffs* $\delta_q^*(\cdot) : (\cdot) \to \mathbb{R}, q \in \{0,1\}$*, prices* $P_q^* \in \mathbb{R}_+, q \in \{0,1\}$

- *Given prices* $P_\cdot^*$*: value functions* V *and cutoffs* $\delta_\cdot^*$ *solve household problem (given by HJB equations 1, 2 and conditions 10, 11)*

- *Given cutoffs $\delta^*_\cdot(\cdot)$: value functions W and prices $P^*_\cdot$ solve flipper problem (given by HJB equations 3, 4)*

- *Accounting holds (given by equations 8, 9)*

- *Law of motions hold (given by equations 5, 6, 7)*

In short, I will call this equilibrium the stationary equilibrium.

2.2 Characterization

In this section, we show the existence of stationary equilibrium with cutoffs. We characterize distributions, value functions, inaction region, and bid-ask spread. Proposition 1 establishes the existence and uniqueness of symmetric stationary equilibrium. Because the model has many ingredients and proofs for each of these ingredients are different, I relegated the formal discussion to the Appendix B.

Proposition 1 (Existence). *If $f < s < 1$ and $G \sim U[0, \bar{\delta}]$, there exists a unique stationary equilibrium with cutoffs: with value functions V, W, pdf dH, masses F and prices $P_\cdot$ satisfying 1-11.*

Proposition 2 (Characterization). *In equilibrium*

1. *$V(q, \cdot)$ are increasing, piecewise linear and differentiable everywhere except at cutoffs*
2. $\delta^*_1(P^*_0) < \delta^*_0(P^*_1)$
3. *$dH(q, \cdot)$ are piecewise constant*
4. $$P^*_1 - P^*_0 = \frac{\delta^*_0(P^*_1) - \delta^*_1(P^*_0)}{r + \gamma} = \frac{\bar{\delta}}{2(r + \gamma)}$$

Linear and monotonous value functions ensure the existence of cutoffs. The final part of a proposition 2 establishes inaction region-agents between $\delta^*_1(P^*_0)$ and $\delta^*_0(P^*_1)$. For such types, households are not interested in trade, no matter their asset position. Linearity of value functions and of cumulative distribution function allows us to characterize spread and note that the inaction region will consist of half of all households (search parameter invariant).

This result relies on the assumption that the exogenous distribution of types G is uniform. Let's notice that spread (return) is not a function of market structure: search friction parameter λ or mass of flipper f. That means that spread is unaffected by intermediation or speed at which trade opportunities are realized. This result is in line with monopolistic dealer results from Duffie et al. (2005).

Price setting The Flipper, by price choice, affects the marginal agent with whom he trades, which influences how fast he trades. The problem of flippers resembles the problem of monopolists who, by choosing price, affect quantity. Suppose that equilibrium price P_0^* has been perturbated and increased by an infinitesimal amount- there is a net gain to the flipper without a house- a higher rate of meeting interested seller, but there is an additional cost-namely that he has to pay a bit more. In equilibrium, marginal changes in costs and benefits equalize, which allows us to derive it as a first-order condition using this perturbation:

$$\underbrace{\int_0^{\delta_1^*(P_0^*)} dH(1,\delta)}_{\text{MB to } F(1) \text{from charging less}} = \underbrace{[-P_0^* + W(1) - W(0)] \cdot \delta_1'^*(P_0^*) \cdot dH(1, \delta_1^*(P_0^*))}_{\text{MC to } F(1) \text{from decreasing prices}}$$

Likewise, for a flipper who is selling a house, perturbation of form decreasing a price around equilibrium price P_1 allows us to get:

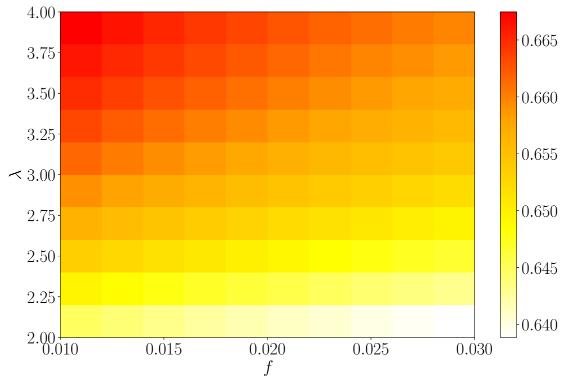
$$\underbrace{\int_{\delta_0^*(P_1^*)}^{\bar{\delta}} dH(0,\delta)}_{\text{MB to } F(1) \text{from charging more}} = \underbrace{[P_1^* + W(0) - W(1)] \cdot \delta_0'^*(P_1^*) \cdot dH(0, \delta_0^*(P_1^*))}_{\text{MC to } F(1) \text{from increasing prices}}$$

Comparative statics There are two ways in which more intermediation can happen in this model. It can be faster to meet a trading partner (increase in λ), or there are more trading partners (increase in f). A numerical example from Figure 1 captures the difference between those two. This plot presents cuttoff of non owners $\delta_0^*(P_1^*)$, sufficient statistic due to Propostion 2. An increase in the number of trading partners decreases a cutoff $\delta_0^*(P_1^*)$ and, in effect, decreases price P_1^* as well P_0^*. Both masses $F(0)$ and $F(1)$ increase, making meeting a flipper more likely. This way, both buyers' and sellers' chances of meeting their counterparts both in the current period and in the future improve. It also reduces $dH(1,\delta)$ mass of agents interested in trade with flippers [4]. Taking this into account, the price offer of the flipper seller at the time of meeting with the household decreases since it has to internalize an option value of a flipper once he becomes a buyer and wants to buy. It will be easier for households in the future to sell a house to a flipper, and price offers

[4] as shown in appendix B

proposed by flippers take this into account. Effects of λ depend on bargaining protocol

Figure 1: Sufficient statistic : cutoff of non owners $\delta_0^*(P_1^*)$



Notes: Panel $\delta_0(P_1)$ as function of f and λ Model solved for $r = 0.036, s = 0.69, \gamma = 0.07, \bar{\delta} = 1$. $\delta_0^*(P_1^*)$ is decreasing function of f and increasing in λ. The price offer of the flipper seller at the time of meeting with the household decreases since it has to internalize an option value of a flipper once he becomes a buyer and wants to buy. It will be easier for households in the future to sell a house to a flipper, and price offers proposed by flippers take this into account. With individual meetings λ becoming more instant, masses of flippers with and without a house will equalize, making the meetings of one type faster and another slower versus the status quo, creating a potential increase in price via a reduction in $F(1)$.

and are, in principle, ambiguous. Both types of flippers extract all the surplus from cutoff agents, but which type's outside option improves more depends on the parameters of the model. With individual meetings λ becoming more instant, masses of flippers with and without a house will equalize, making the meetings of one type faster and another slower versus the status quo, creating a potential increase in price via a reduction in $F(1)$. In case presented on Figure 1, $\delta_0^*(P_1^*)$ and thus P_1^* is increasing in λ. For studying intermediation, I will choose varying mass of flippers f, keeping deep meeting parameter λ unchanged.

3 Data

In this section, I use transaction data and household survey data related to the Irish housing market. This section offers insights into price trends, flipping activity, and the evolving composition of trade between 2012 and 2021. Though the calibrated quantitative model in the next section uses data only from the years 2012 and 2021, this section documents secular trends of the whole housing market in a country using full tax data. The analysis highlights several key findings: a substantial increase in the proportion of flipped transactions, a notable rise in house prices, and shifts in mortgage rates and trade volume. Specifically, the share of flipped transactions nearly doubled, and real house prices grew significantly. Additionally, I explore the residual price variation using regression analysis to isolate the contribution of unexplained factors, which connects the empirical patterns to the theoretical model. This connection is particularly important for capturing heterogeneity in households' valuations in the quantitative analysis.

3.1 Data sets

We utilize three data sets to study the effects of flipping: *transaction data*, *cross-section data on households* and *data on quality of houses* for Ireland. The first data set is administrative data[5] from the Residential Property Registry of Ireland, covering all residential property transactions between 2010 and early 2024. The dataset contains detailed information on 638,751 transactions of over 513,506 unique homes, including: transaction dates (exact day of transaction), prices, exact addresses, and whether the property is a new house or an old dwelling. Due to the definition of a 2-year time leg between trades in defining flipping, I will present evidence for data between 2012 and 2021, highlighting that in quantitative changes, the focus is on the years 2012 and 2021 only. Approximately 20% of these transactions are trades of houses multiple times in the sample. The housing stock in Ireland between 2010 and 2024 is roughly constant at 2 mln houses[6]. That data is used to identify flipping transactions, trade volume, and prices. Cross-section data from the Household Finance and Consumption Survey (HFCS) provides detailed information on households' financial conditions. Collected for Eurozone countries and, in particular, contains information about homeownership, consumption, mortgages, and income [7]. We use

[5]Data source: tax data from collecting stamp duty - sales tax on houses

[6]Data source: Irish census

[7]Data set similar to Survey of Consumer Finances (SCF)

second and fourth wave[8] of HFCS. The house in this survey is defined as a household's main residence.

3.2 Descriptive Evidence

First, use a data set of all residential property transactions (houses, apartments, condos, and construction sites). We identify a house by its exact address. Using information about data of transactions allows us to identify houses that have been:(a) never retraded in our sample, (b) flipped (traded between 30 days and 2 years either leg), or (c) traded multiple times but not flipped. We drop suspicious observations of properties retraded in multiples within 30 days [9] and of abnormal gross returns [10]. This eliminates housing units sold in bulk (often apartment buildings saved in our dataset without separate apartment unit numbers) and those houses that underwent extreme change. In effect, that reduces our sample by less than 1%. Our procedure, if anything, underestimates a fraction of fast trades.

Margin of flipping. Figure 2 is a central figure of this paper. The red line shows the fraction of house transactions where either the purchase or sale occurred within less than 2 years - applying the literature definition of flipping absent of conditioning on improving the quality of housing. It nearly doubled, from 4.55% in 2012 to 8.05% in 2021. The dotted (dashed) red line shows the fraction of transactions where the flip was on the buyer (seller) side. Overall, buyers and seller flips don't suggest imbalance and holding by either type of flipper[11].

Table 1 contains statistics on mean prices for flippers, non-flipped multiply traded, and average prices for all houses. All house prices are in 2012 euros. Average prices for each type of trade are increasing. Figure 3 shows the behavior of prices across time (left panel) and quantities (right). The increase between the years 2012 and 2021 in average traded price was 76%. The data reveals that flipped houses are generally cheaper and exhibit lower price variance than non-flipped houses. The latter fact can be found in the appendix. The right panel presents a volume of traded houses between 2012 and 2021,

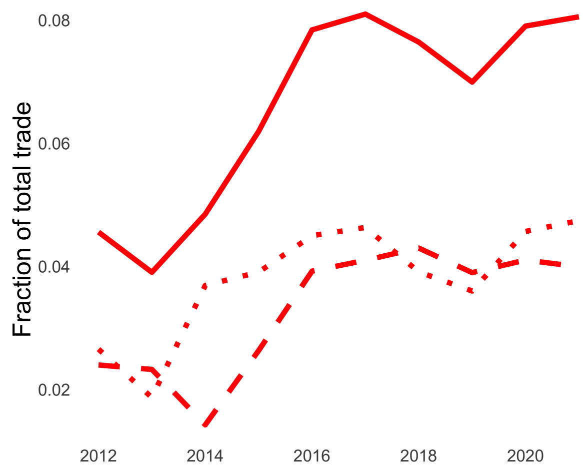
[8]For most countries, the fieldwork was carried out in 2010 and 2011 for the first wave (2010), between 2013 and the first half of 2015 for the second wave (2014) - with Irish cross section collected in 2013- and in 2017 for the third wave (2017). The fourth wave (2021) was carried out between the first half of 2020 and the first half of 2022

[9]Quite often apartments registered as single address and sold within a short period of time

[10]Within $(-\infty, 10000\%]$ annual return excluding less than 500 observations out of 25k flipped addresses- most likely mistakes in data collection.

[11]That matters for the quantitative model in which the abovementioned trade balance in stationary equilibrium is one of the equilibrium conditions

Figure 2: Flipping in Ireland 2012-2021



Notes: Red solid line shows the fraction of house transactions where either the purchase or sale occurred within less than 2 years - applying the literature definition of flipping absent of conditioning on improving housing quality. It doubled, from 4% in 2012 to 8% in 2021. The dotted (dashed) red line shows the fraction of transactions where the flip was on the buyer (seller) side. Overall, buyers and seller flips don't suggest imbalance and holding by either type of flipper.

Table 1: Mean house prices

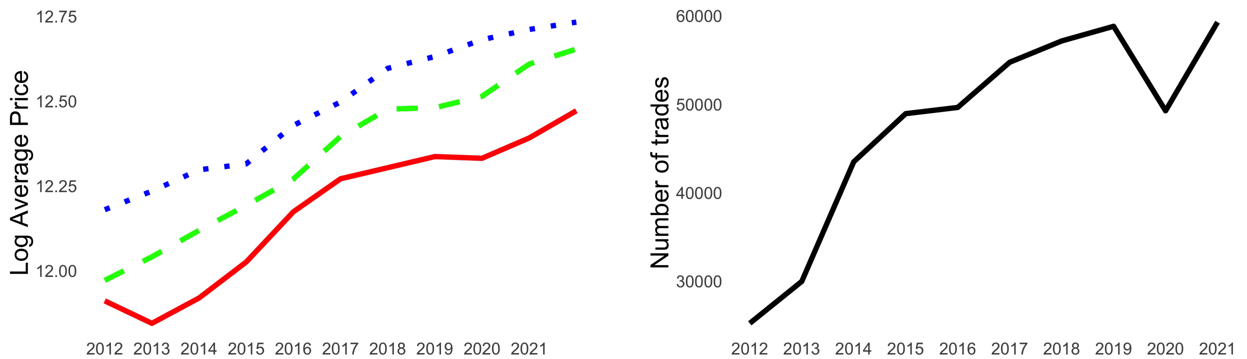
Year	No retrade	Retraded < 2y	Retraded ≥ 2y	Overall
2012	194,900	148,900	158,200	190,700
2013	205,900	139,400	169,600	200,800
2014	219,200	150,200	183,300	209,400
2015	223,100	167,000	197,400	215,800
2016	249,900	193,700	213,400	240,100
2017	267,800	213,500	241,800	259,700
2018	295,700	220,600	262,200	285,600
2019	306,200	227,900	263,300	295,100
2020	321,800	226,800	272,300	307,700
2021	331,600	240,800	299,400	319,800

Note: Table shows mean prices of residential properties in Ireland (2012 euros) across different types of transactions from 2012 to 2021. The average prices are broken down into properties that were not retraded, those retraded within two years (flipped), and those retraded after two years. Overall, prices have shown a consistent increase across all categories.

which increased by 135%. Freeze in trade due to the COVID-19 pandemic seems to be isolated only to the 2020 year. This and the fact that HFCS was conducted every 3 years allowed the conduct of the 2012-2021 analysis instead of restricting the sample to pre-2020, making further analysis of stationary economies: one in 2012 and one in 2021.

Figure 3: Prices and Quantities

(a) Prices (b) Trade Volume



Note: The left panel displays the average prices for all transactions, with a distinction between flipped houses (red solid line), multiply traded houses (green dashed line), and overall average prices (blue dotted line). Flipped houses tend to be priced lower, with less variation compared to non-flipped properties. The right panel illustrates the growth in the volume of house transactions.

Table 2 shows annualized gross returns on multiply traded houses - flipped, traded over more than 2 years, overall. Those returns are annualized averages for that year of the second trade. What is notable is that returns on flipped houses are uniformly higher. Lower values of non-flipped trades early in the sample come from the composition of the sample - the limit of observed transactions in the past. For that reason, only returns on flipped houses would be used in later Section 4.

Table 2: Gross returns

Year	Retraded $<$ 2y	Retraded $\geq$ 2y	Overall
2012	1.29	0.93	1.22
2013	1.28	0.97	1.18
2014	1.47	1.00	1.29
2015	1.55	1.11	1.42
2016	1.45	1.16	1.36
2017	1.45	1.14	1.30
2018	1.38	1.15	1.25
2019	1.33	1.12	1.19
2020	1.27	1.10	1.15
2021	1.32	1.10	1.15

Note: Annualized gross returns for multiply traded houses in Ireland, categorized by flips (re-traded within 2 years), trades that took over 2 years, and the overall sample. The returns are averaged based on the year of the second trade. Flipped properties consistently show higher annualized returns compared to houses re-traded after longer periods. The lower returns observed for longer-held properties in the earlier years are likely influenced by the limited transaction data available from past periods.

Results from HFCS, a household survey data, are summarized in Table 3. Those moments capture characteristics of the Irish housing market in 2012 and 2021. One can find: homeownership rate, average: house value, other property value, price of house at acquisition; time owner lives in a house, consumption and information related to mortgages.
Irish households use more than one mortgage to finance their housing asset purchase. This motivates using the average mortgage rate on all mortgages for later calculates of discount rate in Section 4.

Table 3: Housing Market in Survey Data

Variable	**Moment**	**2012 Value**	**2021 Value**
Homeownership	Fraction	68.84	69.05
Mortgage Rate	Net Rate	3.62	2.47
Consumption	Mean	17,000	19,000
Live in House	Mean years	17.88	17.28
Home Value	Mean	190,000	316,000
Other Property	Mean	391,000	448,000
Wealth	Mean	216,000	370,000
Size of House	Mean sqm	111	129
Home Price at Acquisition	Mean	157,000	176,000
Current Home Value	Mean	192,000	316,000
Nr of Mortgages on hmr	Mean	1.52	1.56
Nr of Properties	Mean	1.77	1.80
Income	Mean	55,000	71,000

Note: Summary of key statistics from the Household Finance and Consumption Survey (HFCS) for the Irish housing market in 2012 and 2021. The table presents data on homeownership rates, mortgage rates, and average values for consumption, home value, and other property values, as well as the number of years households live in their homes. It also includes information on the size of houses, home prices at acquisition, and the number of mortgages and properties owned. The decline in mortgage rates and increase in property values between 2012 and 2021 reflect significant changes in the Irish housing market over the decade. These data moments are critical for parameter calibration in the quantitative model discussed in Section 4.

Average house prices. For the sake of the model, the average house in our sample is an object of interest. To find the average house price distribution, I exploited observable variations in data by running hedonic regression[12]. First, calculate residual prices by regressing log prices on observables.
I took residuals of such regression, add estimated average fixed effects, and take exponent. This way of working can address the issue of fat tails and does not require reducing

[12]building on Rosen (1974)

the sample for extreme observations. In baseline case we will use city and quarter-year fixed effects.

Alternative set ups are presented in Table 4 with details of regressions in appendix

Table 4: Variation Explained by Observables

Fixed Effects	R^2
County	0.27
City	0.36
District	0.50
City, Quarter-Year	0.42
District, Quarter-Year	0.57

Note: The table presents the R^2 values from hedonic regressions of log prices on various spatial and time-fixed effects. The city and quarter-year fixed effects specification captures 42% of the price variation, highlighting significant unobserved heterogeneity in household valuations beyond geographic and time-specific factors.

E. In particular, $R^2 = 42\%$ for city, quarter-year fixed effects set up shows a non-trivial dispersion in residual prices, which we will connect to unexplained heterogeneity due to household types distribution. Literature on house prices (Rekkas et al. (2020),Diamond and Diamond (2024)) supports this observation, finding similar levels of observable variation. Table 5 presents prices of average houses for different years. The increase between the years 2012 and 2021 in average house price was 68%.

Table 5: Mean prices of average houses

Year	No retrade	Retraded < 2y	Retraded ≥ 2y	Overall
2012	161,400	175,300	160,800	162,000
2013	163,900	162,500	159,400	163,600
2014	183,200	164,800	165,200	179,100
2015	192,100	176,200	181,300	189,500
2016	214,700	203,700	199,500	211,600
2017	229,500	217,600	220,500	227,300
2018	249,800	233,700	240,200	247,400
2019	255,300	243,000	246,600	253,300
2020	269,200	247,100	253,100	265,300
2021	287,700	269,900	282,100	285,500

Note: Table shows the average prices of houses in Ireland for different transaction categories from 2012 to 2021, expressed in 2012 euros. Categories include houses that were not retraded, houses retraded within 2 years, and those retraded after 2 or more years. Across all categories, average house prices increased significantly, with an overall rise of 68% from 2012 to 2021.

4 Quantitative Model

In this section, we extend the model of trading in the housing market by allowing households to buy and sell directly with each other, in addition to trading with flippers. This enriched framework captures the more complex interactions in the market, where households with varying valuations meet randomly and negotiate the terms of trade. Inter-household trade is quantitatively important and accounts for over 90% of trade.

The computational strategy used to solve this model is outlined in Appendix D. The model is estimated using minimum distance estimation, targeting key empirical moments of the Irish housing market in 2012. Then, I explain the main mechanism, with a concentration of trade with flippers happening with extreme household types and inter-household with moderate types. I explain equilibrium distribution, reservation value, prices, and meeting rates across types. I simulate the model to analyze the behavior of households around trade events, where I find mean reversion of types to pre-trade levels.

Key exercises include a counterfactual analysis with the proportion of flippers increased to match the observed rise in flipped transactions between 2012 and 2021 in Ireland. Another exercise compares the impact of increasing the mass of flippers (f) against changes in the meeting rate (λ), which is commonly studied in the literature on intermediation. A notable finding is that increasing λ results in disproportionately high welfare gains for flippers, which is less realistic compared to adjustments in f. Finally, I conduct a policy experiment in which a sales tax of 9% is imposed on flippers, similar to what Ireland had until 2011.

4.1 Allowing Household - Household trade

Building on Section 2, we add another way for trade between agents. In addition to household vs. flipper trade- which happens at a one-on-one rate λ- we allow another type of meeting.

Now, households can also trade with each other in housing assets, and such a one-on-one meeting rate is ρ. Households are heterogeneous in δ and in meeting rates as well. Meetings are random, and masses of traders meet. Conditional on meeting if trade surplus is positive, it is split via Nash bargaining 50-50 between buyer and seller. This way of modeling inter-household trade follows closely Hugonnier et al. (2020) and captures complicated games between households, which is not modeled here explicitly. What is important is that this interaction results in an equal share of surplus between trading households. Shocks to current type δ happen with rate γ. The supply of housing assets is s, and the discount rate is r. The central object of interest is *reservation value* defined as:

$$\Delta V(\delta) = V(1,\delta) - V(0,\delta)$$

Which relates the value of having an asset to lack thereof.

Household's problem.
Seller. Homeowner household with valuation δ gets: flow utility δ, can change its type, which happens with γ rate, and it's drawn from the distribution G and trade opportunity with flipper without a house arrive at rate λ while trade opportunities with other households arrive at rate ρ. Conditional on specific meeting and positive surplus, the household sells a house to a flipper without a house (for P_0) or to another household (with type δ' for $P(\delta,\delta')$) and becomes nonowner. Using the Bellman optimality principle, the value function is characterized by the following:

$$rV(1,\delta) = \underbrace{\delta}_{\textbf{flow}} + \underbrace{\gamma\int_0^{\bar{\delta}}[V(1,\delta') - V(1,\delta)]dG(\delta')}_{\textbf{change of type}} + \underbrace{\lambda F(0)\cdot\max\{P_0 - \Delta V(\delta), 0\}}_{\textbf{HH vs F trade surplus}} +$$

$$+\underbrace{\rho\int_0^{\bar{\delta}}\max\{P(\delta,\delta') + V(0,\delta) - V(1,\delta), 0\}dH(0,\delta')}_{\textbf{HH vs HH trade surplus}}$$

Buyer. On the other hand, a household without a house with type δ has: 0 flow utility and can experience a shock to its current type δ with rate γ. With intensity λ meets with flipper with a house and with rate ρ meets with another household with a house with type δ'. If a household buys from a flipper (pays for it P_1) or from another household (with type δ' for $P(\delta,\delta')$ and becomes owner.

$$rV(0,\delta) = \underbrace{\gamma\int_0^{\bar{\delta}}[V(0,\delta') - V(0,\delta)]dG(\delta')}_{\textbf{change of type}} + \underbrace{\lambda F(1)\max\{-P_1 + \Delta V(\delta), 0\}}_{\textbf{HH vs F trade surplus}}$$

$$+\underbrace{\rho\int_0^{\bar{\delta}}\max\{-P(\delta,\delta') + V(1,\delta) - V(0,\delta), 0\}dH(1,\delta')}_{\textbf{HH vs HH trade surplus}}$$

Prices are proposed by flippers such that marginal household with the opposite asset position has all the surplus extracted. Therefore, in equilibrium price offered by flipper-seller (buyer) P_1^* (P_0^*) extracts from household-buyer (seller) $\delta_0^*(P_1^*)$ ($\delta_1^*(P_0^*)$), so:

$$P_1^* = \Delta V(\delta_0^*(P_1^*)) \qquad P_0^* = \Delta V(\delta_1^*(P_0^*))$$

When trade between buyer δ and seller δ' households happens they split the surpluses in half:

$$P(\delta,\delta') = \frac{1}{2}\Delta V(\delta) + \frac{1}{2}\Delta V(\delta')$$

A necessary condition for trades to follow in equilibrium is that the buyer's type is higher than the seller's,i.e., $\delta' \geq \delta$. We break ties by allowing flippers to trade if they have identical deltas. Note that only trade between *low* delta owner and *high* delta nonowner can happen.

Reservation value representation. In equilibrium, only sellers with lower type will trade with buyers with higher type. This, combined with expression for prices between households, yields for owners:

$$rV(1,\delta) = \delta + \gamma\int_0^{\bar{\delta}}[V(1,\delta') - V(1,\delta)]dG(\delta') + \lambda F(0)\mathbb{1}[\delta < \delta_1^*(P_0^*)][\Delta V(\delta_1) - \Delta V(\delta))] +$$

$$+\rho\int_{\delta}^{\bar{\delta}}\frac{1}{2}[\Delta V(\delta') - \Delta V(\delta)]dH(0,\delta')$$

With the last integral summing over nonowner types higher than δ.
For nonowners, the problem becomes:

$$rV(0,\delta) = \gamma\int_0^{\bar{\delta}}[V(0,\delta') - V(0,\delta)]dG(\delta') + \lambda F(1)\mathbb{1}[\delta > \delta_0^*(P_1^*)][-\Delta V(\delta_0) + \Delta V(\delta)] +$$

$$+\rho\int_0^{\delta}\frac{1}{2}[\Delta V(\delta) - \Delta V(\delta')]dH(1,\delta')$$

With the last expression integrating over lower deltas of owners. This problem can be represented using an object characterizing agent-specific discount rate, which considers the additional opportunity cost r, a shock to types, and random trade opportunities, call it *endogenous discount rate*. Formally:

Definition 2. *Endogenous discount rate:*

$$\sigma(\delta) = r + \gamma + \lambda F(0)\mathbb{1}[\delta < \delta_1^*(P_0^*)] + \lambda F(1)\mathbb{1}[\delta > \delta_0^*(P_1^*)] + \frac{\rho}{2}\int_{\delta}^{\bar{\delta}} dH(0,\delta') + \frac{\rho}{2}\int_0^{\delta} dH(1,\delta')$$

At this point we can see also endogenous rates of meeting a flipper $\lambda F(0)$, $\lambda F(1)$ and with other households $\frac{\rho}{2}\int_{\delta}^{1} dH(0,\delta')$, $\frac{\rho}{2}\int_{0}^{\delta} dH(1,\delta')$.
Using an effective discount rate allows us to rewrite the value function as follows:

$$\begin{aligned}
\sigma(\delta)\Delta V(\delta) = \delta + \gamma \int_0^{\bar{\delta}} \Delta V(\delta')\, dG(\delta') \\
&+ \lambda F(0)\mathbb{1}[\delta < \delta_1^*(P_0^*)]\Delta V(\delta_1^*(P_0^*)) \\
&+ \lambda F(1)\mathbb{1}[\delta > \delta_0^*(P_1)]\Delta V(\delta_0^*(P_1^*)) \\
&+ \frac{\rho}{2}\int_{\delta}^{\bar{\delta}} \Delta V(\delta')\, dH(0,\delta') + \frac{\rho}{2}\int_0^{\delta} \Delta V(\delta')\, dH(1,\delta')
\end{aligned}$$

This representation separates type-specific δ discount -$\sigma(\delta)$ and δ reservation value-$\Delta V(\delta)$ from the total flow on the right-hand side. The total flow comes from agent-specific flow utility, continuation value, and expected payment in trade with flippers and households.

Flippers problem. Flippers behavior remains like in Section 2 so we skip it here. To determine equilibrium, the value function of flippers with a house is equal in equilibrium to:

$$W(1) = \frac{\lambda}{r}\frac{[\int_{\delta_0^*(P_1^*)}^{\bar{\delta}} dH(0,\delta')]^2}{\sigma(\delta_0^*(P_1^*))dH(0,\delta_0^*(P_1^*))}$$

where

$$\sigma(\delta_0^*(P_1^*))^{-1} = r + \gamma + \frac{\rho}{2}\int_{\delta_0^*(P_1^*)}^{\bar{\delta}} dH(0,\delta') + \frac{\rho}{2}\int_0^{\delta_0^*(P_1^*)} dH(1,\delta')$$

The difference here with Section 2 is only in the discount rate, instead of r with a part coming from inter-household trade against relevant parts of the distribution. At cutoff, there is no effect on the discount rate.
Similarly, the value of a flipper without a house is expressed as:

$$W(0) = \frac{\lambda}{r}\frac{[\int_0^{\delta_1^*(P_0^*)} dH(1,\delta')]^2}{\sigma(\delta_1^*(P_1^*))dH(1,\delta_1)}$$

where

$$\sigma(\delta_1)^{-1} = r + \gamma + \frac{\rho}{2}\int_{\delta_1^*(P_0^*)}^{\bar{\delta}} dH(0,\delta') + \frac{\rho}{2}\int_0^{\delta_0^*(P_1^*)} dH(1,\delta')$$

Problems of flipper and agent can be linked together, and one can express reservation values of agents at cutoffs as:

$$\Delta V(\delta_0^*(P_1^*)) = (1+\frac{r}{\lambda})W(1) - W(0)$$

$$\Delta V(\delta_1^*(P_0^*)) = W(1) - (1+\frac{r}{\lambda})W(0)$$

In other words, the marginal household's value is the flipper's reservation value, and trade delays cause the correction.

Envelope condition. In equilibrium, the endogenous discount rate is equal to the inverse of the marginal reservation value:

$$\sigma(\delta) = \frac{1}{\Delta V'(\delta)}$$

Stationary distribution. Following close notation from Section 2, we focus on the flow equation using cumulative distributions.

Homeownership (inflow and outflow to $[0,\delta], q = 1)$ is characterized by:

$$\underbrace{\lambda F(1)\int_{\delta_0^*(P_1^*)}^{\max\{\delta,\delta_0^*(P_1^*)\}} dH(0,\delta') +}_{\text{F \textbf{sells} to HH}} \quad \underbrace{\gamma G(\delta)\int_{\delta}^{\bar{\delta}} dH(1,\delta')}_{\text{inflow from change of type from}[\delta,\bar{\delta}]} \quad = \tag{12}$$

$$= \underbrace{\lambda F(0)\int_{0}^{\min\{\delta,\delta_1^*(P_0^*)\}} dH(1,\delta') +}_{\text{F \textbf{buys} from HH}} \underbrace{\gamma(1-G(\delta))\int_{0}^{\delta} dH(1,\delta')}_{\text{outflow from change of type to}[\delta,\bar{\delta}]} + \underbrace{\rho\int_{0}^{\delta} dH(1,\delta')\int_{\delta}^{\bar{\delta}} dH(0,\delta')}_{\text{HH trades with HH}} \tag{13}$$

To characterize trade volumes (overall and each type) as a rate per period, we use the following definition in the spirit of OTC literature:

Definition 3 (Trade Volumes)**.** *Denote by κ, κ_1, and κ_2 overall, household vs. household and flipper vs. household trade volumes, respectively. Then:*

$$\kappa = \underbrace{\rho\int_0^{\bar{\delta}}\int_0^{\bar{\delta}} \mathbb{1}[\delta' \geq \delta] dH(1,\delta) dH(0,\delta')}_{\kappa_1-\textbf{\textit{HH vs HH}}\ \textit{trade}} + \underbrace{\lambda F(0)\int_0^{\delta_1^*(P_0^*)} dH(1,\delta') + \lambda F(1)\int_{\delta_0^*(P_1^*)}^{\bar{\delta}} dH(0,\delta')}_{\kappa_2-\textbf{\textit{F and HH}}\ \textit{trade}}$$

The distinction between trade between household κ_1 and κ_2 would be central in calibrating the model. Note that we count successful trades above, which happen between households only if the seller has lower δ than the buyer's δ'. Also, the last two integrals would equal the volume of houses sold and bought in total by flippers.

Definition 4 (Price distribution). *F is cdf of prices:*

$$F(p) := \frac{\rho}{\kappa}\int_0^{\bar{\bar{\delta}}}\int_0^{\delta'} \mathbb{1}[P(\delta,\delta') \leq p]dH(1,\delta)dH(0,\delta') + \frac{\kappa_2}{2\kappa}\mathbb{1}[P_0^* \leq p] + \frac{\kappa_2}{2\kappa}\mathbb{1}[P_1^* \leq p]$$

The last two elements are prices from Flipper's trade.

Now, I characterize an economy where there are no search frictions. That would be a reference for trade via a centralized market with a unique price.

4.2 Frictionless Economy

Consider an economy with mass f of flippers in which trade happens immediately, in Walrasian fashion. There is no search friction, and interested parties can exchange housing assets in an anonymous exchange at any time.

In that case, in the equilibrium, top s agents who value the asset the most will hold it[13]. Given that in such an economy, flippers don't value housing assets, households with δ equal and above $1-s$ have all assets in equilibrium. Let's denote the lowest house owner δ^*. Note that this allocation is efficient. The price P^* for which market clears is equal to present value of δ^* agent holding asset forever, thus: $P^* = \frac{\delta^*}{r} = \frac{1-s}{r}$.

At any point in time, due to shock, the γ mass of agents ends up in the wrong asset position and trades immediately. The rate at which owners will end up in the wrong asset position is γ per owner (mass of $G(\delta^*)$ and they would trade with nonowners like to trade which mass is $1-G(\delta^*)$. Volume of trade as a rate is then $\kappa_F = \gamma(1-G(\delta^*))G(\delta^*) = \gamma s(1-s)$ while turnover is equal to $\gamma(1-s)$.

4.3 Computation

Numerical algorithm. Computation of equilibrium requires solving for two cutoffs, two value functions, endogenous distributions for households, and masses for flippers. The hard part of the problem is to find cutoffs. It relies on the generalization of the proof of existence from Section 2, which shows the fixed point on recursion for cutoffs. The general idea follows from combining recursion on cutoffs and solving value function iter-

[13] Consider trade in equilibrium from section 2 - their flippers have to keep some of the housing stock if non-zero trade happens in equilibrium. Or there would be autarky.

ation for reservation values using continuous time methods. For fixed cutoffs, I use equations related to stationary distributions (law of motion, balance of trade for flippers, and accounting) to find relevant masses and distributions. Value functions of flippers are explicit functions of distribution, masses, and cutoffs. Next, I use them to solve households' reservation value function problem by discretizing the grid on δ types and using integration as a linear operator to represent it in matrix form. Solving this essentially means inverting a numerically well-conditioned matrix. Reservation values of households at cutoffs allow introducing recursion on cutoffs. Since the flow utility enters linearly, recursion has an additive form, which makes it converge. Once convergence is achieved, we solve for individual value functions of household-given reservation values, solving two standard discrete value function iterations. The numerical solution and algorithm details are described in the appendix D.

Matching data with model. We define flipping in the data by separating flippers from households using the time between double trades: flippers are those who conduct both transactions under the 2-year limit, and households when retrade takes over 2 years. The model uses exponential random variables, which implies that multiple trades are exponential. Technical details are discussed in appendix G.
This allows us also, in a clear way without simulating the model, to match the returns of flippers in model $\frac{P_1}{P_0}$ to the ones in the data. The data counterpart is calculated as the mean return of flipped houses, which is average across those trades, with the first leg between 2010 and 2012 and the second leg of the transaction in 2012.

Parametrization. The unit of time is one year. Discount rate r is set to 3.62%, average mortgage rate in 2012 (calculated using HFCS survey data)[14]. It is standard for housing literature to take mortgage rate for discount rate as opposite to T-bills rates (Favilukis et al. (2017),Daljord et al. (2019)). Household consumption and homeownership rate s were calculated from HFCS survey data. Set $\bar{\delta}$ to 1, effectively bounding flow from ownership by one year of consumption. The rest of the parameters -f, λ, ρ, γ were jointly estimated.

Estimation strategy. To estimate the parameters f, λ, ρ, and γ of the model, we use a minimum distance estimator (MDE). The following moments are used: the share of flipped transactions, the average price of houses, the return on flipping, and the average time since moving into a house. Parameter f guides share of flipped houses, λ return on flip-

[14] 37% of households own a mortgage, and those who own a property quite often have more than one (via Table 3. I used the average for all mortgages, including on the second and next house.

ping, ρ mean price, and γ time since moving in. The minimum distance estimator seeks to find the parameter values that minimize the distance between the model-generated moments and the corresponding empirical moments relative to target values. Formally, the estimator is defined as:

$$\hat{\theta} = \arg\min_{\theta} \left[\left(\frac{m(\theta) - \bar{m}}{\bar{m}}\right)' W \left(\frac{m(\theta) - \bar{m}}{\bar{m}}\right) \right]$$

where $\theta = (f, \lambda, \rho, \gamma)$ represents the parameters to be estimated, $m(\theta)$ denotes the vector of moments predicted by the model, $\bar{m}$ is the vector of empirical moments, and W is the weighting matrix, in this case identity matrix weighting deviations.

The calibration results are summarized in Table 6, which shows the estimated parame-

Table 6: Estimation

Parameter	**Description**	**Value**			
		Externally	**Source**		
r	Mortgage rate	3.62%	HFCS		
s	Homeownership rate	68.84%	HFCS		
		Matched moments	**Target**	**Model**	**Data**
f	mass of Flippers	2.1%	Fraction of flipped	4.81%	4.56%
ρ	Search HH vs HH	0.3	Average price	11.62	11.42
λ	Search F vs HH	3	Return on flipping	1.27	1.29
γ	Taste shock	7%	Tenure time	2.54%	5.59%

Note: All parameters are estimated to 2012 data. Mortgage rate r and homeownership rate s are externally calibrated to HFCS household data. The other four parameters f, λ, ρ, γ are estimated using a minimum distance estimator. Parameter f guides share of flipped houses, λ return on flipping, ρ mean price, and γ time since moving in.

ters and their fit with the empirical data. The advantage of the model is that to calculate model implied moments, I didn't have to simulate the model. In particular, distributions $dH(q, \cdot)$ don't require iterating on market clearing conditions once cutoffs are determined.

4.4 Model Fit

Simulating the model, I run a regression of prices on a dummy flipper variable for transactions in which trade happened with a flipper:

$$P_i = \alpha + \beta F_i$$

β was calculated in simulation for $T = 100$ periods, discretized with $dt = 0.1$ for $N = 10,000$ households and $f * (1 + N)$ flippers. In the data counterpart, I regressed 2012 prices (divided by 2012 consumption) on a dummy indicating trade with flippers, with city, and quarter-year fixed effects for 25,238 observations. Negative correlation from Table 7 suggests that trade with flippers has lower prices. Such correlation corresponds to price lower by around 5% on average.

Table 7: Untargeted moment: regression coefficient

	Data	**Model**
β	-0.21	-0.29
Fixed effects	✓	
Consumption adjusted	✓	

Note: β was calculated in simulation for $T = 100$ periods with a time step $dt = 0.1$, involving $N = 10,000$ households and $f \times (1 + N)$ flippers. The empirical counterpart uses data from 2012 prices adjusted for consumption, with city and year-quarter fixed effects, across 25,238 observations.

Table 8 reports results regarding the composition of trade in percentage of housing stock, overall and with flippers, for 2012 and 2021.

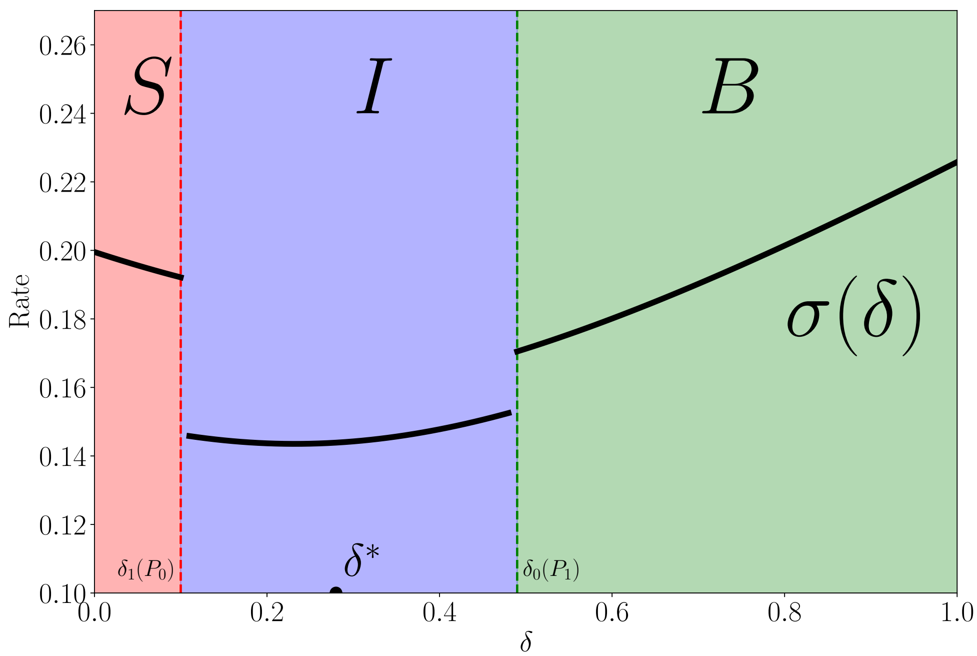
Table 8: Untargeted moment: Trade volume as fraction of housing stock

	Data	**Model**
	2012	
Total trade	1.274	1.298
Flipper trade	0.058	0.062
	2021	
Total trade	2.410	1.243
Flipper trade	0.183	0.103

Note: In second part of table f comes from counterfactual (with r at 2012 level) and r was adjusted to 2021 level, no reestimation of model otherwise

4.5 Main mechanism

Figure 4: Effective discount rate



Notes: The figure illustrates three key aspects of the model: (1) Trade concentration by type—sellers (red area S) trade with flippers when $\delta \leq \delta_1^*(P_0^*)$, while buyers (green area B) purchase from flippers when $\delta \geq \delta_0^*(P_1^*)$; households with $\delta \in (\delta_1^*(P_0^*), \delta_0^*(P_1^*))$ remain inactive (blue area I). (2) Price determination—reservation values at $\delta_1^*(P_0^*)$ and $\delta_0^*(P_1^*)$ represent the bid and ask prices in trades with flippers, while $\Delta V(\delta^*)$ approximates the price of household-to-household trades. (3) The curvature of the reservation value is driven by $\sigma(\delta)$, which is decreasing for lower δ (convex value function) and increasing for higher δ (concave value function), with δ^* as an inflection point and a zone of minimal trade partner availability.

Properties of value functions, distribution of households, and price distribution are presented in appendix F. The main mechanism of the model is presented in Figure 4. It allows us to infer three crucial things: trade concentration for each type of trade, prices for each type of trade, and the curvature of the reservation value.

First are the areas where trade is concentrated with flippers and inter-household trade. Households with a house with $\delta \leq \delta_1^*(P_0^*)$ (sellers in red area S) sell a house when meeting with a flipper without a house happens. Homeowners above this $\delta_1^*(P_0^*)$ cut-off won't have a surplus from trade and won't trade. This in equilibrium keeps $dH(1,\delta)$ for $\delta \leq \delta_1^*(P_0^*)$ low. Non-owners with $\delta \geq \delta_0^*(P_1^*)$ (buyers in the green area B) buy a house when they meet the flipper with a house. In equilibrium, $dH(0,\delta)$ for $\delta \geq \delta_0^*(P_1^*)$ will be low since trade with the flipper reduces the mass of nonowner in that part of the type's space. Non-owners below $\delta_0^*(P_1^*)$ won't trade with flippers since there are no gains from trade. Overall all households with $\delta \in (\delta_1^*(P_0^*), \delta_0^*(P_1^*))$ (blue area of inaction I) won't trade with flipper. Inter-household trade can be inferred from $\sigma(\delta)$. On the one hand, a surplus of the owner in selling to other households decreases in δ when such an opportunity arrives. On the other hand, the overall rate of meeting nonowners is decreasing in δ. This makes the distribution of owners $dH(1, \delta)$ increasing function of δ. A similar effect for non-owner makes high δ have a high surplus from buying a house from another household. At the same time, the overall rate at which such trade arrives is relatively low. Since high types buyers will meet at easy sellers in equilibrium $dH(0, \delta)$ for high types will be low. $\sigma(\delta)$ considers both buyer and seller opportunities for each type δ. $\sigma(\cdot)$ has the minimum at δ^*, a point at which overall meetings of both sellers and buyers are the lowest. Around that point, mass buyers and sellers in the wrong asset position (wrong versus frictionless allocation) are the highest, the rates at which they can find households are the lowest, and the trade volume is the highest. The reason why meetings of trade partners are the hardest around δ^* is that the mass of counterparty interested in trade and wrong asset position is relatively low. Suppose you are the seller just below δ^*. Inefficient allocation means you are interested in selling. The mass of household sellers with higher δ is low because they have high chances of meeting a buyer with a lower delta but more likely below δ^*.

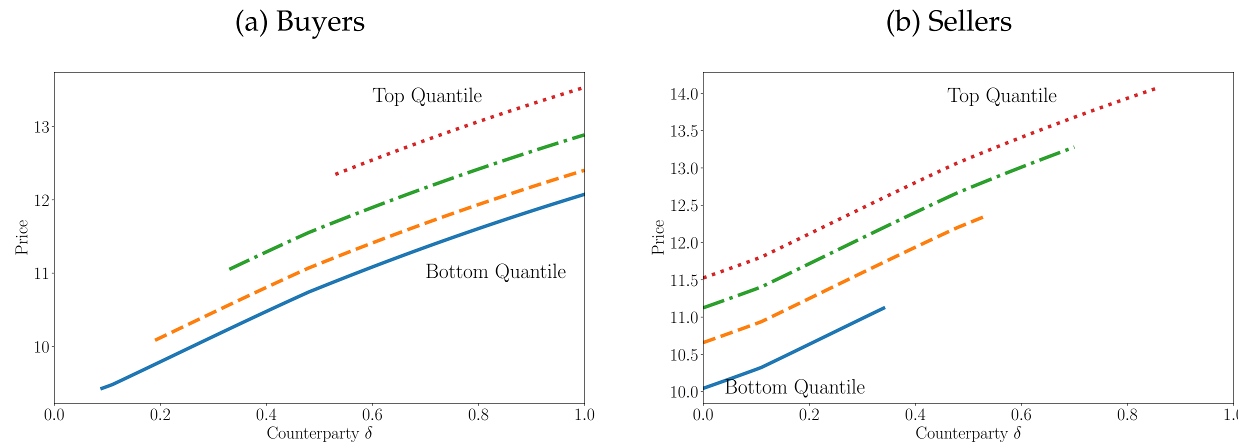
Secondly, one can read prices in this model from Figure 4. Reservation value at cutoffs $\delta_1^*(P_0^*)$,$\delta_0^*(P_1^*)$ are bid and ask price from flipping. Since most inter-household trade is around δ^*, $\Delta V(\delta^*)$ approximates the mean household-household price. Note that in frictionless case δ^* was important to determine price as well.

Finally, the endogenous discount rate informs about the curvature of the value function. Envelope condition relates $\sigma(\cdot)$ inversely with marginal reservation value. Since $\sigma(\cdot)$ is first decreasing for lower δ, reservation value is convex, and for higher δ, reservation value is a concave function. δ^* is an inflection point, representing a marginal change in how households value having a house relative to lack of it. Also, non differentiability occurs only at cutoff values, and that's where trade decisions with flipper affect $\sigma(\cdot)$.

Price schedules. Figure 5 presents price schedules for each quantile of household buyers (left panel) and sellers (right) as a function of the counterparty's type. The highest quantile of buyers can pay more than other quantiles since they have bought the house the most. The higher the type of seller they will meet, the higher the price they will pay. Note that the lower the quantile, the closer the price schedule is. This comes from the fact that the top quantile of sellers is below δ^* and the convexity of the reservation value.

Similarly, the top quantile of sellers has the highest price schedule since it accepts only high-type buyers compared to the other quantiles.

Figure 5: Price schedule with Household vs Household trade



Note: The price schedules for each quantile of household buyers and sellers illustrate how transaction prices adjust based on the counterparties' types. For sellers, the schedule starts at their own delta and increases with the buyer's delta, reflecting their preference for higher offers from high-type buyers. Similarly, for buyers, the schedule begins at their delta and rises as the seller's delta increases, indicating a willingness to pay a premium for houses held by high-type sellers.

Misallocation. The model allows us to characterize distributional misallocation by defining for each interval $[0, \delta]$ mass of households allocated different quantity of housing assets than in a frictionless economy:

$$M(\delta) = \int_0^\delta \mathbb{1}\{\delta' < \delta^*\} dH(1, \delta') + \int_0^\delta \mathbb{1}\{\delta' \geq \delta^*\} dH(0, \delta')$$

This measure captures how many households own a house in an economy with friction to those who don't own it in a frictionless economy (first term) and how many households don't own a house in an economy with search friction to those who would in a frictionless economy (second term).

The left panel of Figure 6a shows misallocation density defined as a derivative of misallocation with respect to deltas. We note that misallocation is concentrated right below δ^* and we mostly contribute it to homeowners.

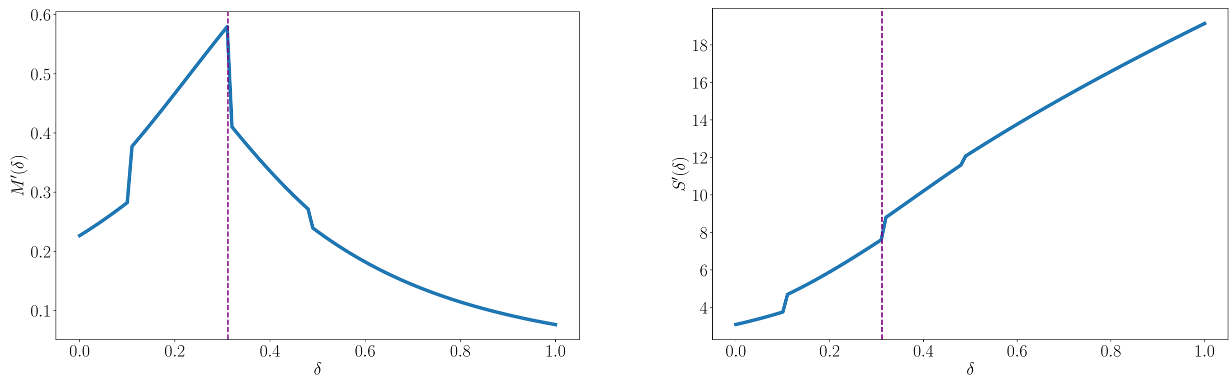
But across the whole distribution of private types, it is nonnegligible.

Welfare cost of search friction. To assess the severity of search friction, I use the difference between the welfare of households up to delta and its frictionless counterpart. Moreover, I can express deviation from frictionless value for each type. Welfare cost of

Figure 6

(a) Misallocation density

(b) Density of welfare cost of search friction



Note: The left panel illustrates the density of misallocation, defined as the derivative of the misallocation measure $M(\delta)$ with respect to private types, δ. Misallocation is concentrated around δ^*, indicating that a significant portion of homeowners is in the wrong asset position versus a frictionless economy. The right panel shows the density of welfare costs due to search frictions, highlighting how frictions impact households across the distribution of private types, with higher types incurring most of the search friction.

search of household up to δ, $S(\delta)$ is equal to:

$$S(\delta) = \sum_q \int_0^\delta V(q, \delta') dH(q, \delta') - \sum_q \int_0^\delta V^F(q, \delta') dH^F(q, \delta')$$

The right panel of Figure 6a shows its density, which turns out to be increasing in types. It is homeowners who are the most distorted versus frictionless economy and contribute the most on margin to this welfare cost.

5 Experiments

This section explores a series of simulation-based exercises, providing insights into how different factors influence agent behavior, price dynamics, and market outcomes. The first result establishes that average levels of agent types (δ) among owners and non-owners remain stable over time in the stationary equilibrium, clustering around higher values for owners and lower values for non-owners. Even though houses are sold from lower to higher types, moving houses up between households, they do until the flipper becomes the owner and resets the ladder. Secondly, I investigate agents' behavior around transaction times. Event study reveals that sellers experience a drop in their δ (valuation for holding a house) around the time of a sale, and agent types mean-revert after. This suggests that trades are often triggered by temporary changes in agents' valuations, aligning with the intuition that agents trade when their valuations deviate significantly from the market average.

5.1 Behavior of types

The average type level of the owner and nonowner is constant across time as shown in panel (a) of Figure 7. In stationary equilibrium, most owners have a high delta, while non-owners are at a lower level. Indeed, cross-section averages cluster around two levels of deltas—lower for non-owners (red) and higher for owners (blue). Simulating the decentralized model allows tracking the type of owner of each house over time. Delta of the owner of exemplum house nr 5 at the moment of transaction is presented on panel (b) of Figure 7. The model does not admit the property of houses owned by higher deltas over time [15]. It is true that as long as houses pass between households, a chain of bilateral transactions puts them in the hands of higher-delta households. However, the owner's delta evolves on its own and may deteriorate over time. Secondly, once the house is transacted with a flipper, the chain of deltas breaks and starts at extreme delta values where trade with the flipper is only active—effectively resetting the whole ladder.

5.2 Types around the date of transaction

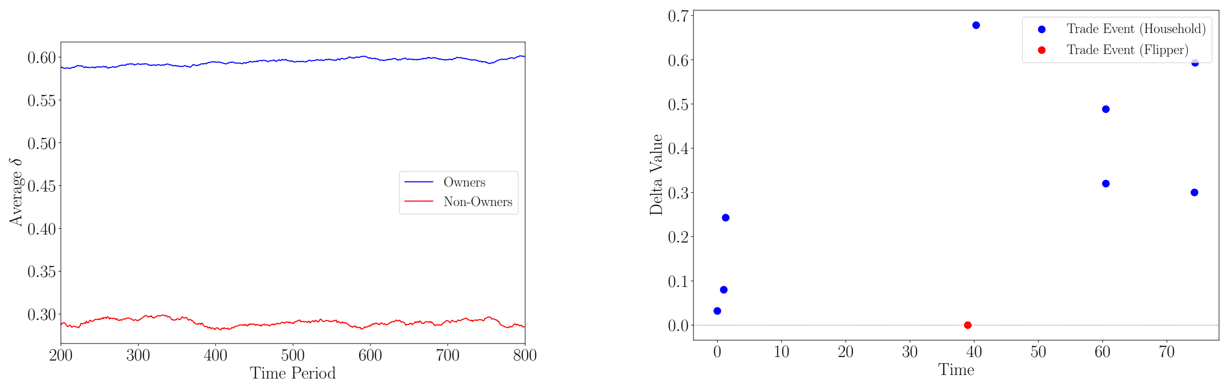
Another property of the model is that δ falls (increases) upon trade time for sellers (buyers) and means revert. In Figure 8, I conduct an event study of the average change in δ around transaction in houses for various types of households- buyers and sellers (panel

[15] Property of job ladder exploited search models in labor literature like from Cahuc et al. (2006)

Figure 7

(a) Average δ of Owners and Nonowners over time

(b) δ of the buyer of the house nr 5 at time of transaction

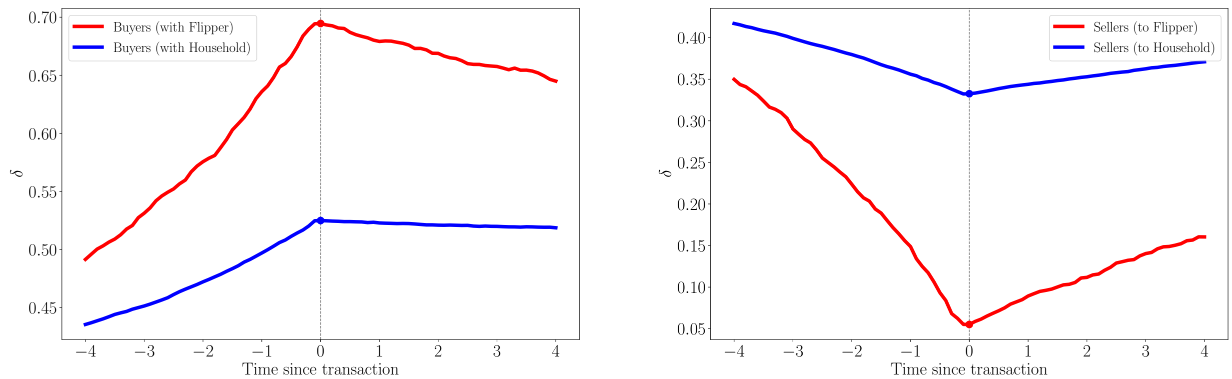


Panel (a) shows the average δ level of owners (blue) and non-owners (red) remains constant over time, clustering around higher values for owners and lower for non-owners in stationary equilibrium. Panel (b) shows δ of the buyer of house nr 5 at the time of transaction shows that while bilateral trades tend to place houses with higher-δ households, the owner's δ can, in principle, deteriorate over time. Transactions with flippers reset the chain of deltas to extreme values, breaking the progression.

(a) and (b) respectively)- with different types of counterparty- households or flippers (red and blue line respectively). Using a simulation of the model, I identify households that traded at time t and center that event. Following households engaged in trade at time t, I trace the type of that agent backward and forward, and I calculate the average type level δ. It is important to distinguish three events that can happen at any point in time but can't happen at once: change of δ, meeting household, or meeting flipper. On the right (left) panel, the seller's (buyer's) valuation is the lowest (highest) at the time of the trade t, decreasing (increasing) the most for the household that ends up trading with the flipper at that time. Low delta shock increases the chances of selling to households. A very low delta makes the trade to Flipper possible. Since trade happens at t, no change in δ occurred then. An agent who just sold t at the time would have changed his type to $t - dt$ or before. Similarly, after selling at t, the agent becomes a potential buyer $t + dt$, with some fraction of the agents experiencing shocks to their delta, some meeting seller households or flippers. Overall, making time $t + dt$ group at a higher level of δ on average than at transaction time. Also, the non-owner at $t + dt$ with a low δ level carried from t has a relatively high chance of meeting a trading partner - this time, the seller. In a similar fashion, changes in delta follow for $dt, 2dt, \ldots$. This exercise suggests that trade is triggered temporarily and that the type experiences a faster change of type before the trade than after. Overall, moving from the average buyer (seller) type to the average seller (buyer) type takes nontrivial time and depends on the counterparty.

Figure 8: Average Types around Transaction Dates

(a) Buyer (b) Seller



Panel (a) shows average δ for buyers before and after trade, differentiated by counterparty—households (red line) or flippers (blue). (b) Similar analysis for sellers. δ decreases for sellers and increases for buyers at the time of trade, with faster changes occurring before the transaction than after. Transactions with flippers are associated with more significant changes in δ, while trades between households involve more gradual adjustments. Following a sale at time $t = 0$, a seller's δ increases for later periods, whereas buyers with low δ after trade at t have a higher chance of finding a seller.

5.3 Main Counterfactual Exercises

In this exercise, I analyze the impact of increasing the fraction of flippers, f, to align with the observed changes in the fraction of flipped transactions in 2012 and 2021. The changes of moments of price distribution, quantities, return, and time are in Table 9. By increasing f we increase both masses $F(0), F(1)$, change distribution H, affect prices P_0^*, P_1^*, P, cutoffs and corresponding value functions. On theoretic grounds, it is hard to disentangle the forces, something we were able to do in the case of the simplified model. As the fraction of flippers rises, we observe that mean price and variance have decreased. The almost doubling of the mass of intermediaries implies negative price spillovers of 1.5%. The mean price of the average house increased by 68% between 2012 and 2021. That suggests that such an increase wasn't caused by flipping activity; the effect of flippers on house prices was quite the opposite. Those agents are infinitesimal, don't coordinate their price decisions, and compete against each other and households. Due to more available intermediation household-household trade decreased by almost 8%. Accounting for the surge of flipper-household trade, total trade increased by 5%. While inter-household trade was crowded out by more intense intermediation, overall trade increased. Turnover increased by 5% and returns increased by almost 1%. Motivated households had to wait a shorter time to trade in housing assets, flippers were less selective. Cutoffs moved more to extreme sides of types distribution, and inaction region expanded, making ex-post returns on flipping higher.

Table 9: Results of counterfactual increase of f - Prices and Quantites

Variable	% **Change**
Mean Price	-1.51
Var Price	-0.31
HH Trade	-7.95
Total Trade	5.16
Return	0.99
Turnover	5.16

Note: This table displays the effects of increasing the fraction of flippers, f, on key moments of the housing market. As f rises, both mean and variance in prices decline, with a negative price spillover effect of -1.5%. The shift in market dynamics also leads to a crowding-out effect on household-to-household trade while increasing total trade and turnover by over 5%, along with a modest rise in returns on flipping.

Table 10 decomposes changes in welfare from more intermediation, measured in consumption certainty equivalent between different groups of agents. Flippers experienced a significant drop in welfare due to more competition between them. Non-homeowners' current welfare increased by a substantial 3% while homeowners' current welfare increased by 0.34%. More intermediation will improve the trade options of non-owners by easing search frictions. Even though those groups' welfare improves due to more, overall welfare decreases by 0.2%. This is because the composition of homeowners and non-owners changes between scenarios. The change in owner distribution combined with a high level of value function for owners will generate most of this overall negative effect since, with more flippers, there are fewer household owners.

Even though more houses are in the hands of flippers, due to general equilibrium effects, house allocation is less inefficient. Misallocation is measured in the mass of agents in the wrong asset position vis a frictionless economy. Table 10 reports on total change decomposes it between current owners and non-owners. Changes in misallocation are in line with changes in welfare. Though welfare considers all distribution of agents of each asset position integrated over δ's misallocation, it looks at part of this endogenous mass. More intermediation relaxes misallocation along the whole distribution of households by 5% and for non-owners by 7% and for owners by 3%. This means that there are more nonowners with type above δ^* and fewer homeowners with type below δ^*.

Table 10: Results of counterfactual increase of f - Welfare and Misallocation

Variable	% Change
Welfare pc	
Total	-2.44
Households	-0.20
Homeowners	0.34
Non-Homeowners	3.02
Flipper	-23.43
Misallocation	
Total	-5.22
Owners	-3.03
Non-Owners	-7.36

Note: This table presents the welfare and misallocation effects of increasing the fraction of flippers, f, measured in consumption certainty equivalents. Increased competition leads to a welfare drop for flippers, while non-homeowners see a 3% rise and homeowners a 0.34% rise, highlighting the benefits of reduced search frictions. Despite improvements for these groups, overall welfare declines by -0.2% due to a change in the composition of homeowners and non-owners. Misallocation is reduced by 5% overall, with reductions of 7% for non-owners and 3% for owners, indicating better asset allocation across the household distribution.

5.4 Effects of change in λ

In this section, we explore the impact of varying the meeting rate λ as an alternative to changing the fraction of flippers f. This comparative statics exercise is grounded in the OTC literature, where the meeting rate λ is adjusted to study its effects on intermediation. Keeping meeting rates of flippers $\lambda F(0)$ and $\lambda F(1)$ with the previous exercise, so such intermediation has fixed contact rates between flipper and household.

Table 11 highlights the contrasting effects of increasing the meeting rate λ versus raising the fraction of flippers f. An increase in λ reduces mean price variation more significantly than an increase in f, indicating that a higher meeting rate improves price stability by facilitating faster trades. While both parameters boost total trade, λ does so more effectively, emphasizing the flippers' role as intermediaries and slightly reducing household-only trades. Welfare effects are also divergent: a higher λ yields a substantial welfare increase for flippers (147%), unlike f, which reduces their welfare due to heightened competition. This suggests that increasing λ enhances liquidity without over-saturating the flipper market, while a higher f introduces competition that limits flipper welfare. Households benefit modestly from a higher λ, but non-homeowners experience a welfare reduction,

Table 11: Comparison to equivalent change in λ

Variable	% Change	
	Change in f	**Change in λ**
Mean Price	-1.51	-1.47
Var Price	-0.31	-3.54
HH Trade	-7.95	-13.56
Total Trade	5.16	6.67
Return	0.99	1.39
Turnover	5.16	6.67
Welfare pc		
Total	-2.44	1.34
Households	-0.20	0.17
Homeowners	0.34	0.43
Non-Homeowners	3.02	2.49
Flipper	-23.43	147.15
Misallocation		
Total	-5.22	-8.42
Owners	-3.03	-7.28
Non-Owners	-7.36	-9.54

Note: The table compares outcomes from changes in the flipper fraction f and meeting rate λ, showing that increasing λ yields substantial welfare gains for flippers and sharp price adjustments, contrasting with the effects of increasing f alone.

potentially facing entry barriers. Finally, both changes reduce misallocation, with λ being more efficient in aligning housing transfers to demand, underscoring its role in improving market dynamics beyond competition alone.

5.4.1 Price Growth

While the primary focus of the counterfactual exercises is on understanding the role of intermediaries like flippers, it is also crucial to examine whether the model can capture the substantial increase in house prices observed between 2012 and 2021. Table 12 presents the results of this analysis by comparing changes in key parameters—specifically, r (the discount rate) and f (flippers' activity)—to assess their impact on price growth and the composition of trade over time. The table is structured into three sets of columns: the first two columns show the baseline estimation results for 2012, which serve as a reference point. The following two columns report the moments implied by the 2021 discount rate r while keeping the 2012 value of f unchanged. This scenario isolates the effect of changes

Table 12: Results of change in both f and r

s, γ, λ, ρ **at 2012**						
	r, f **2012**		f **2012,** r **2021**		r, f **2021**	
	Data 2012	**Model**	**Data 2021**	**Model**	**Data 2021**	**Model**
Fraction of Flipped	4.56%	4.81%	8.05%	4.97%	8.05%	8.28%
Average Price	11.42	11.62	16.78	16.83	16.78	16.66
Return on Flipping	1.29	1.27	1.32	1.19	1.32	1.20
Turnover	5.59%	2.54%	5.79%	2.54%	5.79%	2.69%

Note: This table aims at explaining price growth observed in data explained by the change in both f and r. The first two columns display the baseline estimation results for 2012. The next two columns show the moments implied by r, derived solely from the 2021 data while keeping the other parameters unchanged. In the final two columns, we used f from the main counterfactual and r obtained exclusively from the 2021 data. This last part is based on changes in r indicated by the data and does not involve re-estimating f.

in the discount rate on market outcomes. The final two columns incorporate both the updated r from 2021 and the adjusted f parameter derived from the main counterfactual scenario, which reflects the increased flipper activity in 2021. The primary driver of price changes is the adjustment in r. As the cost of consumption decreases, the price of an asset in terms of consumption goods increases. Changes in f have a more nuanced impact and was discussed above. The rise in the discount rate r from 2012 to 2021 aligns closely with the observed increase in average house prices, as evidenced by the match between the model and data values in the columns focusing on 2021. Adjusting r alone does little to explain the increase in the fraction of flipped transactions; a higher f value in the final two columns captures the rise in flipping activity seen in the data. The share of flipped transactions increases from 4.81% in the baseline model to 8.28% when the 2021 values of both r and f are applied, mirroring the observed increase in flipped transaction share to 8.05%.

5.5 Policy - sales tax on flippers

The policy of interest is a sales tax on houses, taxing the sale of properties not used as the primary residence and returning tax revenue to households via uniform transfers. Before 2011, Ireland imposed a 9% sales tax on such properties, which had a notable impact on flipped transactions [16]. Using our model, we analyze the effects of tax on flipping activity, house prices, trade volumes, and welfare outcomes. Best to my knowledge, this is the first analysis of this type of tax policy in the context of the search model.

As shown in Table 13, the introduction of a 9% sales tax leads to a substantial decrease in flipping activity—nearly 2/3 of trades facilitated by flippers disappear, accounting for over halving in welfare per flipper. The mean price increased by a substantial 9%. The results show that such a tax significantly curtails the number of flipped transactions, leading to a decrease in total trade volume. While this policy mitigates the crowding out of household trades, it comes with a downside: the welfare gains for non-owners are reversed, and average transaction times increase, which can stifle the overall market recovery. The tax reduces the competition between households and flippers, partially alleviating the crowding out effect, where households were previously outcompeted by faster-moving flippers. However, the impact of taxes is mixed. While the crowding-out of

Table 13: Effects of Sales Tax on Flipping $\tau = 0.09$

Variable	**% Change**
Mean Price	8.89
Var Price	4.16
Flipper Share	-65.37
HH Trade	4.57
Total Trade	-4.20
Return	2.40
Turnover	-4.20
Welfare pc	
Total	-0.49
Households	0.03
Homeowners	-0.27
Non-Homeowners	-2.17
Flipper	-64.76
Misallocation	
Total	3.50
Owners	2.23
Non-Owners	4.74

Note: Results reflect the impact of a 9% sales tax on flipping activity, showing reductions in flipping transactions and welfare changes across groups.

[16] examples of other countries imposing taxes on fast trade: Germany: traded up to 10 years, 14-45% rate, Canada: 1 year, 15-33%, Singapour: 3 years, 12%, Hong Kong : 3 years 20%

households diminishes, the welfare gains previously observed among non-homeowners reverse, as increased transaction times make it harder for them to enter the housing market. Even though the tax rate is substantial, the overall effect on the welfare of all households is diminutive. Homeowners experience a slight decrease in welfare, while non-homeowners face a more significant loss of 2%.

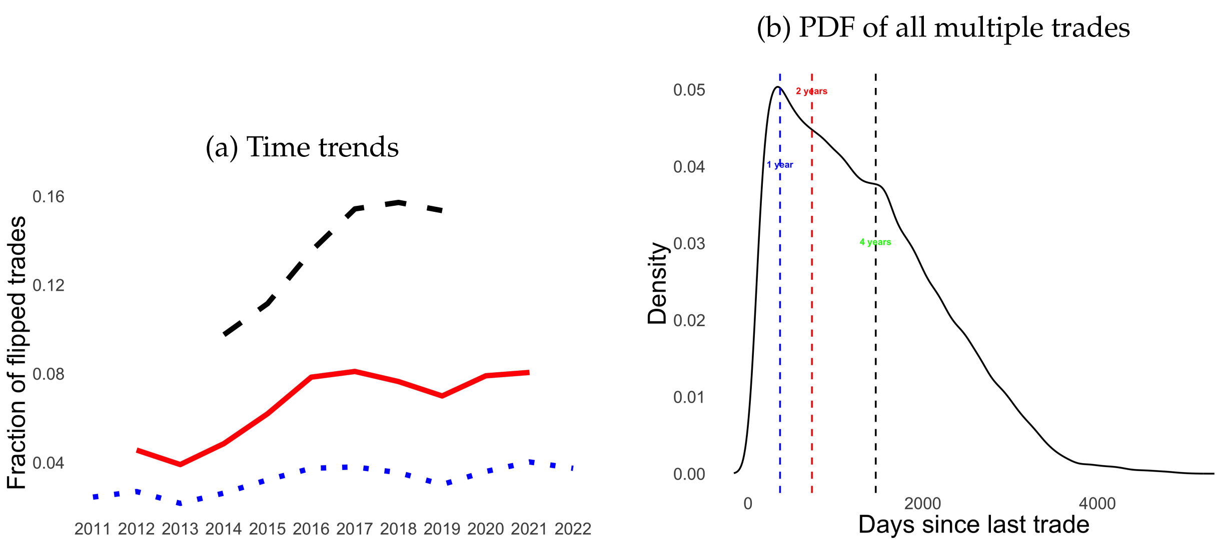
Results in this section should be interpreted with caution, as the policy experiment is intentionally simplified. It does not account for broader government interventions or potential market adjustments that could occur in response to the tax. For example, the model does not allow for flippers' decisions to enter or exit the market as a reaction to the policy change, potentially underestimating the total effect on trade volume and market dynamics.

6 Robustness and Validation

6.1 Alternative definitions of flipping

Figure 9 considers different definitions of the time window between two leg transactions to identify flipped transactions. The left panel shows levels of flipping across time for different time differences between transactions - 1 year (blue), 2 years (red), and 4 years (black). For either of those definitions, we observe an increase in the fraction of flipped trades across the sample. The right panel presents a pdf of time differences between multiple trades (as a function of time on the x-axis). The red dotted line marks the time definition of flipping between trades used in the main body of this paper. That distribution spikes at 1 year (blue) and has bunches at 4 years (green).

Figure 9: Different time definitions of flipping



Note: Left panel shows levels of flipping across time for different time differences between transactions - 1 year (blue), 2 years (red), and 4 years (black). For either of those definitions, we observe an increase in the fraction of flipped trades across the span of the sample. The right panel presents a pdf of time differences between multiple trades (as a function of time on the x-axis). The red dotted line marks the time definition of flipping between trades used in the main body of this paper. That distribution spikes at 1 year (blue) and has bunches at 4 years(green).

Table 14 explores the outcomes of defining flipping with different time windows between transactions (1, 2, and 4 years). Under a 1-year definition, the model estimates a lower flipping share but a high return on flipping, reflecting the fast turnover characteristic of short-term trades. The baseline 2-year definition aligns closely with observed data in terms of flipping share and return, indicating it captures typical market dynamics. Extending the window to 4 years increases the flipping share, as more transactions are clas-

Table 14: Alternative definitions of flipping

	1 year		2 years (baseline)		4 years	
f	0.009		0.0021		0.013	
γ	0.09		0.07		0.09	
ρ	0.3		0.3		0.3	
λ	3.0		3.0		5.0	
	Model	Data	Model	Data	Model	Data
Fraction of flipped	2.53%	2.44%	4.81%	4.56%	9.27%	9.75%
Mean price	11.98	12.88	11.62	11.42	11.85	12.54
Return on flipping	122.73%	111.29%	126.96%	129.33%	123.35%	151.41%
Tenure time	2.72%	5.59%	2.54%	5.59%	2.86%	5.59%
Loss function	0.28		0.30		0.28	
	Main Counterfactual % Change					
Mean Price	-2.34		-1.51		-2.53	
Var Price	0.70		-0.31		-0.07	
Flipper Share	240.90		67.42		104.13	
HH Trade	-10.28		-7.95		-16.50	
Total Trade	10.62		5.16		12.50	
Return	0.90		0.99		1.45	
Turnover	10.62		5.16		12.50	
Welfare pc						
Total	-3.38		-2.44		-2.58	
Household	-0.41		-0.20		-0.52	
Homeowners	0.38		0.34		0.54	
Non-Homeowners	5.49		3.02		5.53	
Flipper	-29.41		-23.43		-32.67	
Misallocation						
Total	-7.16		-5.22		-10.51	
Owners	-4.18		-3.03		-6.59	
Non-Owners	-10.02		-7.36		-14.34	

Note: Table contains alternative time windows for defining flipped transactions. For 1 year (2 years; 4 years) definition between trades, model was estimated to target 2011 (2012; 2014) moments from data. Counterfactual was done for 1 year (2 years; 4 years) to match share of flipped transactions in 2022 (2021; 2019).

sified as flips, inflating the return due to lengthier hold periods. However, misallocation decreases as longer hold times allow assets to settle with end-users, enhancing distribution efficiency. Price changes reflect the increased competition among flippers; shorter definitions correlate with a slight price reduction, while the 4-year window shows greater price stabilization. The model's loss function remains stable across definitions, suggesting robustness to changes in flipping criteria.

Table 15: Untargeted moment: prices and intermediation

	1 Years	2 Year	4 Years
		Data	
Year	2011	2012	2014
β	-0.19	-0.21	-0.08
		Model	
β	-0.22	-0.29	-0.15

Note: The table presents results of regression from Table 7 applied to various definitions of flipping. Simulated data was run for $T = 100$ periods, burn in 20 periods with $N = 10000$ number of households

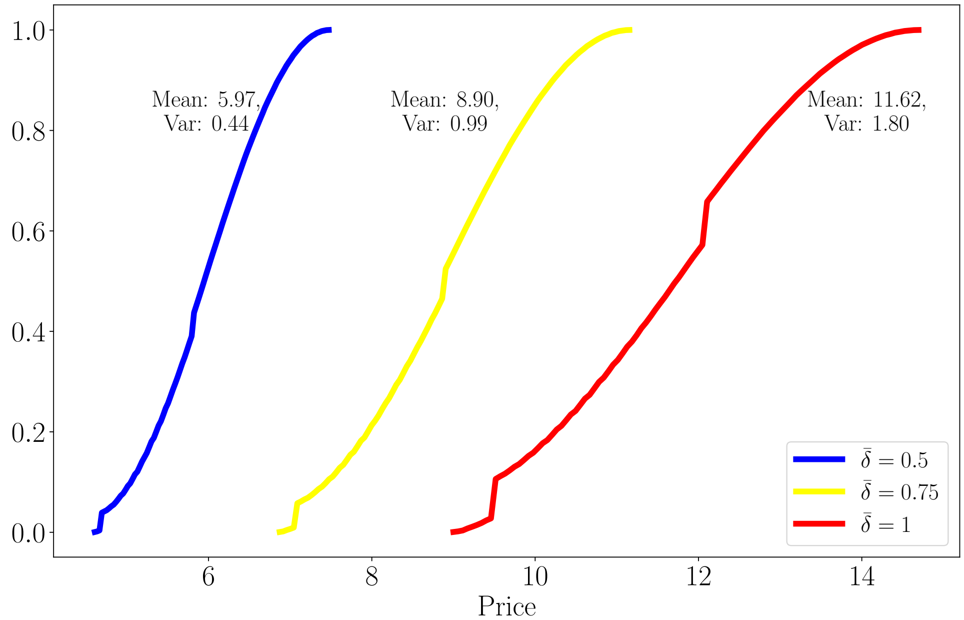
Table 15 presents untargeted moments for price responsiveness (β) across different flipping windows (1, 2, and 4 years). For each year, the model's β aligns closely with data, though slightly overestimating the price effect, particularly in the 2-year baseline. The results imply that price responsiveness to flipping intensity is stable across definitions, yet with a decreasing effect as the window extends. This suggests that short-term flips exert more competitive pressure on prices than long-term flips, as longer holding periods reduce intermediary turnover. Consequently, the model effectively captures both the direct effect of flipping on prices and the moderation of this effect with increased holding periods, indicating its ability to generalize across flipping definitions.

6.2 Role of distribution of types

Figure 10 presents the cumulative distribution of prices for various values of $\bar{\delta}$- an upper bound of exogenous distribution of types $G \sim U[0, \bar{\delta}]$. Other parameters of the model are as in the baseline calibration of the model. In baseline $\bar{\delta} = 1$. For uniform distribution changes in mean ($\frac{\bar{\delta}}{2}$) and variance ($\frac{\bar{\delta}^2}{12}$) are inseparable. Decreasing $\bar{\delta}$ decreases both the mean and variance of G, and as a result, it decreases the mean and variance of the distribution of prices in the model. Changes in G are approximately proportional to changes in price distribution, which comes from linear flow utility.

Table 16 presented results from a simulation of regressing prices on types of agents in the transaction: δ type of buyer and seller with a dummy variable for the flipper. Linear regression is a good fit even though types are unobservable to econometrician. Prices are increasing in types of buyer and seller, with a stronger effect on buyers.

Figure 10: Role of distribution of types G



Notes: Cumulative Distribution of Prices for Different Values of $\bar{\delta}$. Figure 10 shows the cumulative distribution of prices for various upper bounds $\bar{\delta}$ of the exogenous type distribution $G \sim U[0, \bar{\delta}]$. As $\bar{\delta}$ decreases, both the mean $(\frac{\bar{\delta}}{2})$ and variance $(\frac{\bar{\delta}^2}{12})$ of G decrease, leading to a corresponding decrease in the mean and variance of the price distribution. The changes in G proportionally affect the price distribution due to the linear flow utility structure of the model. The baseline model uses $\bar{\delta} = 1$.

Table 16: Regression of prices on types

Variable	**Estimate**
Constant	8.96
Buyer δ	3.2
Seller δ	2.9
Flipper	0.64
R^2	0.987

Note: Prices are increasing in types of buyer and seller, with a stronger effect on buyers. Linear regression is a good fit even though types are unobservable to econometrician.

6.3 Role of private information

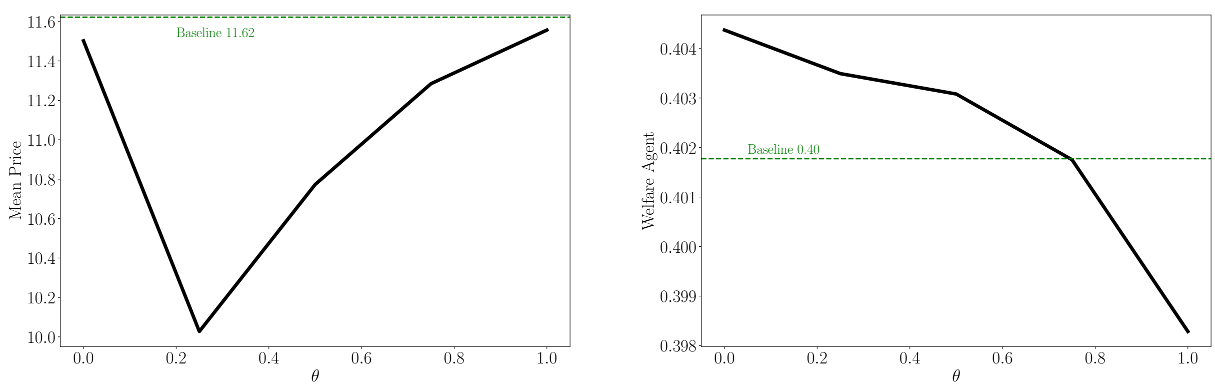
Consider an alternative price-setting mechanism in which the flipper observes the valuation of the household he trades with. The surplus in this trade is split via Nash Bargaining, with flipper weight $\theta \in (0, 1)$. Price this way depends on the type of household, and there exists one cutoff $\hat{\delta}$ above which households sell and below which they buy.

Inter-household trade is split 50-50. I relegate to the appendix J for details of that model. Figure 11 shows the mean price (left panel) and consumption equivalent of households (right panel) as a function of bargaining weight. The model was resolved for various values of θ for baseline calibration from Section 4. Prices are lower than in the baseline model. An extreme case in which all bargaining power is on the side of the household means that the price in trade with the flipper is independent of δ and equal to full surplus from the flipper. Prices are increasing in the bargaining power for the remaining considered values. The right panel of Figure 11 shows consumption equivalent of household consumption, a decreasing function of the bargaining power. The higher the bargaining weight, the more price extracts surplus of household, making households worse off. In extreme cases in which the flipper has no ability to extract any type of specific surplus, prices are lower than in the model with the flipper targeting the cutoff agent. There exists high θ, the observable type model and baseline model coincide in welfare but the price is always lower.

Figure 11: Role of private information

(a) Mean price

(b) Welfare



Note: Alternative price setting protocol in which the flipper observes the type of household, with θ bargaining power on the flipper, with ex-post trade bargaining. The figure shows prices (left) and consumption equivalent of households (right) across bargaining weights.

7 Conclusion

This paper investigates the role of flippers as intermediaries in the decentralized housing market, focusing on their impact on prices, trade volume, and welfare. By developing a decentralized trade model calibrated to universe transaction data from Ireland, I find that increased flipping activity, contrary to common beliefs, can decrease average house prices and increase trade. An increase in the number of intermediaries reduces misallocation, which can benefit certain groups, particularly non-owners, through improved access to housing. However, the presence of flippers also shifts the allocation of housing, reducing overall welfare slightly due to the hold-up of houses by new flippers. Policy experiments reveal that a sales tax on flippers, similar to a pre-2011 Irish policy, significantly reduces flipped transactions but also increases market frictions, reversing some of the welfare gains for non-owners. The findings underscore the trade-offs between improved market efficiency due to intermediary activity and the potential welfare costs arising from changes in housing allocation. Finally, this study contributes to the literature on search frictions and market intermediation by highlighting how intermediaries like flippers influence not only price dynamics but also the overall welfare distribution among market participants of different types.

Future work should include agent decisions about quality improvements of a house, which is challenging since such information is limited to small samples and not informative about the whole housing market.

Appendix

A Derivation of the model

Timing Morning t: Household (q, δ) wakes up with asset position $q \in \{0, 1\}$ and type $\delta \in [0, 1]$.

1. price is offered P_{1-q}
2. λ trade opportunity arrives [17].
3. conditional on meeting accept/reject prices $A(\delta, q; P)$
4. γ shock to type arrives
5. payoffs are realized: flow is paid $q\delta\Delta$
6. **evening** discounts with $e^{-r\Delta}$
7. move to $t + \Delta$

length of time between day shrinks, $\Delta \to 0$.
History of shocks γ, λ can be recovered from (δ, q).
Notation Household of type (q, δ) conditional on vector of prices $P = \{P_0, P_1\}$ decides about $A : (q, \delta; P_{1-q}) \to \{A, R\}$. Flipper of type q conditional on decision rule $A = \{\{A(1-q, \delta; P_q)\}_{\delta \in G}\}$ decides price P_q
Let's define Symmetric Stationary Markov Perfect Equilibrium (without cutoffs)

Definition 5 (Symmetric Stationary Markov Perfect Equilibrium)**.** *consists of*

1. *value functions* $V : (q, \delta; P_{1-q}) \to \mathbb{R}$, $W : (q; A) \to \mathbb{R}$
2. *decision rules* $A(q, \delta; P_{1-q}) \to \{A, R\}$
3. *prices* $P : (q; A) \to \mathbb{R}_+$
4. *distributions :* $H : (q, \delta) \to \mathbb{R}$, $F : (q) \to \mathbb{R}$

- *Given prices P : value functions V and A solve household problem (given by HJB equation below)*
- *Given decision rule of hh A : value functions W and prices P solve flipper problem (given below)*
- *Low of motions hold, Accounting hold*

[17] γ, λ independent with each other and exponential

Household's problem Household of type (δ, q) conditional on vector of prices $P = \{P_0, P_1\}$ and decides about $A : (q, \delta; P_{1-q}) \to \{A, R\}$ by solving

$$V(q,\delta;P_{1-q}) = \max_{A\in\{A,R\}} q\delta\Delta + \gamma\Delta(1-\lambda\Delta)\int_0^1 V_t(q,\delta';P^t)dG(\delta')+$$

$$+(1-\gamma\Delta)\lambda\Delta\max\{\underbrace{e^{-r\Delta}V(q,\delta;P_{1-q})}_{A=R},$$

$$\underbrace{(2q-1)P_{1-q}+e^{-r\Delta}V(1-q,\delta;P_{1-q})}_{A=A}\}+]$$

$$+(1-\gamma\Delta)(1-\lambda\Delta)e^{-r\Delta}V(q,\delta;P_{1-q})+$$

$$+\gamma\Delta\lambda\Delta\int_0^1\max\{\underbrace{e^{-r\Delta}V(q,\delta';P_{1-q})}_{A=R},$$

$$\underbrace{(2q-1)P_{1-q}+e^{-r\Delta}V(1-q,\delta';P_{1-q})}_{A=A}\}dG(\delta')]$$

Define $\Delta V(\delta;P) = V_t(1,\delta,1;P_0) - V(0,\delta;P_1)$. Subtract $e^{-r\Delta}V(q,\delta;P_{1-q})$, divide by Δ to get:

$$\frac{1-e^{-r\Delta}}{\Delta}V(q,\delta;P_{1-q}) = \max_A q\delta + e^{-r\Delta}\underbrace{\frac{V(q,\delta;P_{1-q})-V(q,\delta;P_{1-q})}{\Delta}}_{0}$$

$$+e^{-r\Delta}[\gamma(1-\lambda\Delta)\int_0^1[V(q,\delta';P_{1-q})-e^{-r\Delta}V(q,\delta;P_{1-q})]dG(\delta')+$$

$$+(1-\gamma\Delta)\lambda\max\{0,(2q-1)[P_{1-q}-e^{-r\Delta}\Delta V(q,\delta;P_{1-q})]\}+o(\Delta)]$$

Flipper's problem Given decision rule of agents A Flipper of type q chooses P_q to solve

$$W(q;A) = \max_{P_q}\lambda\Delta\int_0^1\mathbb{1}[\delta : A(1-q,\delta,P_q)=A]\cdot$$

$$\cdot\max\{(2q-1)P+e^{-r\Delta}W(q;A), e^{-r\Delta}W(1-q,A)\}dH(1-q,\delta)$$

$$+o(\Delta)+o(\Delta)$$

becomes

$$\frac{1-e^{-r\Delta}}{\Delta}W(q,A) = \max_{P_q}\lambda\Delta\int_0^1\mathbb{1}[\delta : A(1-q,\delta,P_q)=A]\cdot$$

$$\cdot\max\{0,(2q-1)[P_q+e^{-r\Delta}\Delta W(q,A))\}dH(\delta,1-q)+o(\Delta)+o(\Delta)$$

Envelope Define a cutoff δ_q^*:

$$\delta_0^*(P_1) = \inf\{\delta : A(0, \delta; P_1) = A\}$$

$$\delta_1^*(P_0) = \sup\{\delta : A(1, \delta; P_0) = A\}$$

The existence of cutoff comes from the monotonicity of ΔV (shown in the proof of existence). Use continuity of ΔV (proved later on) at cutoffs to notice that:

$$P_{1-q} = \frac{\delta_q^*(P_{1-q}) + \gamma \int_0^1 \Delta V(\delta') dG(\delta')}{r + \gamma}$$

Because there is no trade at each cutoff, together:

$$P_1 - P_0 = \frac{\delta_0^*(P_1) - \delta_1^*(P_0)}{r + \gamma}$$

Cutoffs are differentiable and:

$$\delta_0^{*\prime}(P_1) = \delta_1^{*\prime}(P_0) = r + \gamma$$

From the definition of cutoff as indifference between trade and no-trade:

$$P_{1-q} = e^{-r\Delta} \Delta V(\delta_q^*(P_{1-q}))$$

Suppose that ΔV is differentiable at cutoff [18] and differentiate wrt P_{1-q}

$$1 = e^{-r\Delta} \frac{\partial}{\partial \delta} \Delta V(\delta_q^*(P_{1-q})) \frac{d}{dP} \delta_q^*(P_{1-q})$$

impose stationary and take limit $\Delta \to 0$

$$1 = \Delta V'(\delta_q^*(P_{1-q})) \cdot \delta_q^{*'}(P_{1-q}))$$

[18] it is not! it would be argued later

B Proof of Proposition 1 and 2

Assume $f < s < 1$. The proof is constructive and has three parts:

1. $\forall \delta_1(P_0) < \delta_0(P_1)$ cutoffs there is unique stationary distribution, i.e.:
   (a) $\exists! F(1), dH(1, \delta)$
   (b) $0 \leq F(1) \leq f$
   (c) $0 \leq dH(1, \delta) \leq \bar{\delta}$
   (d) $dH(q, \delta), F(q)$ are monotone in $\delta_1(P_0), \delta_0(P_1)$
2. $\forall F(1), dH(1, \delta), \delta_1(P_0) < \delta_0(P_1)$ stationary distr. and cutoffs there are unique value functions $V(\cdot, \cdot), W(\cdot)$:
   (a) $\exists! \Delta V(\cdot)$
   (b) $\exists! W(1), W(0)$
   (c) $\exists! V(1, \cdot), V(0, \cdot)$
   (d) ΔV is increasing, bounded, continuous functions with non-differentiability only at cutoffs.
   (e) $V(q, \cdot), W(q)$ are monotone in $\delta_1(P_0), \delta_0(P_1), F(q), dH(q, \cdot)$
3. $\forall \Delta V$ strictly increasing, piecewise linear value functions $\forall W(1), W(0)$ exist cutoffs $\delta_0(\cdot), \delta_1(\cdot)$
   (a) $\exists! \delta_1(P_0) = \Delta V(\delta_1(P_0)), \delta_0(P_1) = \Delta V(\delta_0(P_1))$.
   (b) $\delta_1(P_0) < \delta_0(P_1)$
   (c) $P_1 - P_0 = \frac{\delta_0(P_1) - \delta_1(P_0)}{r + \gamma} = \frac{\bar{\delta}}{2(r + \gamma)}$

Proof of the existence of Markov Perfect Equilibrium follows the fixed point argument. (1) defines operator $\mathbb{H}(D)$ mapping from cutoffs to stationary distributions, (2) defines $\mathbb{V}(H, D)$ mapping from distributions and cutoffs to value functions, (3) defines $\mathbb{D}(V, H, D)$ mapping from value functions, distributions, and cutoffs to set of cutoffs. Equilibrium is a fixed point D of operator $\mathbb{T} : [0, 1]^2 \to [0, 1]^2$

$$D = \mathbb{T}(D) = \mathbb{D}(\mathbb{V}(\mathbb{H}(D), D), \mathbb{H}(D), D)$$

B.1 $\mathbb{H}(D)$.

Differentiate (xyz) (use dH as pdf - abuse $d\delta$ notation):

$$dH(0, \delta) + dH(1, \delta) = G'(\delta) = \frac{1}{\bar{\delta}} \quad \delta \in [0, \bar{\delta}]$$

Rearrange and differentiate (8) to get

$$\mathbb{1}\{\delta \geq \delta_0^*\}[\lambda F(1) \underbrace{dH(0,\delta)}_{\frac{1}{\bar{\delta}}-dH(1,\delta)}] + \gamma \underbrace{G'(\delta)}_{\frac{1}{\bar{\delta}}} \underbrace{\int_0^{\bar{\delta}} dH(1,\delta)}_{s-F(1)} = \mathbb{1}\{\delta \leq \delta_1^*\}[\lambda \underbrace{F(0)}_{f-F(1)} dH(1,\delta)] + \gamma dH(1,\delta) \quad (14)$$

Rearrange to get

$$dH(1,\delta) = \frac{\lambda F(1)\mathbb{1}\{\delta \geq \delta_0^*(P_1)\} + \gamma(s - F(1))}{\lambda(f - F(1))\mathbb{1}\{\delta \leq \delta_1^*(P_0)\} + \gamma + \lambda F(1)\mathbb{1}\{\delta \geq \delta_0^*(P_1)\}} \quad (15)$$

Then $dH(1,\cdot)$ given cutoffs is a piecewise constant function of the delta on three intervals given by cutoffs:

$$dH(1,\delta) = \begin{cases} \frac{1}{\bar{\delta}} \frac{\gamma(s-F(1))}{\lambda(f-F(1))+\gamma} & \text{if} \delta \in [0, \delta_1(P_0)] \\ \frac{1}{\bar{\delta}}(s - F(1)) & \text{if} \delta \in (\delta_1(P_0), \delta_0(P_1)) \\ \frac{1}{\bar{\delta}} \frac{\lambda F(1)+\gamma(s-F(1))}{\gamma+\lambda F(1)} & \text{if} \delta \in [\delta_0(P_1), \bar{\delta}] \end{cases}$$

Use Law of Motion applied to $\delta = \bar{\delta}$ flipper trade condition:

$$F(1) \int_{\delta_0^*(P_1)}^{\bar{\delta}} dH(0,\delta) = F(0) \int_0^{\delta_1^*(P_0)} dH(1,\delta) \quad (16)$$

applied to $dH(0,\delta)$ constant on $[\delta_0^*(P_1), \bar{\delta}]$ and $dH(1,\delta)$ constant on $[0, \delta_1^*(P_0)]$interval:

$$F(1)(\bar{\delta} - \delta_0^*(P_1))dH(0, \delta_0^*(P_1)) = F(0)\delta_1^*(P_0)dH(1, \delta_1^*(P_0))$$

define

$$g(x) = x(\bar{\delta} - \delta_0^*(P_1))(1 - s + x)(\lambda(f - x) + \gamma) - (f - x)\delta_1^*(P_0)(s - x)(\lambda x + \gamma)$$

$$g(0) = -f\delta_1^*(P_0)s\gamma < 0$$

$$g(f) = f(\bar{\delta} - \delta_0^*(P_1))(1 - s - f)\gamma > 0$$

$$g(x) < 0 \quad \forall x > \max\{s, s + \frac{\gamma}{\lambda}\}$$

$$g(x) > 0 \quad \forall x < \min\{s - 1, -\frac{\gamma}{\lambda}\}$$

Since g is a third-degree polynomial in x, from the Intermediate Value Theorem, there is exactly one $F(1)$ on $(0, f)$.
What is left is to show that $0 < dH(1,\delta) < \frac{1}{\bar{\delta}} \quad \delta \in [0, \bar{\delta}]$.
From $0 < F(1) < f < s$we get $0 < dH(1,\delta)$ in all three cases.

Case 1:$\delta \le \delta_1^*(P_0)$ $dH(1,\delta) < \frac{1}{\bar{\delta}}$: $s < 1 < 1 + F(1) \iff 0 < \gamma(1 - s + F(1)) + \lambda(f - F(1))$
Case 2:$\delta_1^*(P_0) < \delta < \delta_1^*(P_0)$ $dH(1,\delta) < \frac{1}{\bar{\delta}}$: $(s - F(1)) \iff 0 < F(1) < f < s$
Case 3: $\delta_0^*(P_1) \le \delta$ $dH(1,\delta) < \frac{1}{\bar{\delta}}$:$0 < \gamma(1 - s + F(1)) \iff s < 1 < 1 + F(1))$

Lemma 1. *$dH(0,\delta), F(1)$ are increasing in $\delta_1(P_0)$*

Proof. Define

$$G_1(x,y) = x(\bar{\delta} - y)(1 - s + x)(\lambda(f - x) + \gamma) - (f - x)\delta_1^*(P_0)(s - x)(\lambda x + \gamma)$$

From Implicit Function Theorem:

$$\frac{dF(1)}{d\delta_0^*(P_1)} = -\frac{dG_y}{dG_x}$$

$dG_y = -x(1 - s + x)(\lambda(f - x) + \gamma) < 0$ at $x = F(1)$.
Note that $G(x, \delta_0^*(P_1)) = g(x)$ and $g(x)$ is increasing on $(0, f)$ thus $dG_x > 0$. Thus $F(1)$ is increasing in $\delta_0^*(P_1)$.
When we increase $\delta_0^*(P_1)$, two things happen to $dH(1,\delta)$: the level of pdf changes, and the first case area expands. In each of three cases $dH(1,\delta)$ is decreasing function of $\delta_0^*(P_1)$ since it decreases in $F(1)$. Thus $dH(0,\delta) = \frac{1}{\bar{\delta}} - dH(1,\delta)$ is increasing in $\delta_0^*(P_1)$. □

B.2 $\mathbb{V}(H,D)$

Household's problem for a given $F(1), F(0), \delta_0^*(P_1), \delta_1^*(P_0)$ using reservation value $\Delta V(\delta) := V(1,\delta) - V(0,\delta)$ can be written as:

$$rV(0,\delta) = \gamma \int_0^{\bar{\delta}} [V(0,\delta') - V(0,\delta)]dG(\delta') + \lambda F(1)\mathbb{1}[\delta \ge \delta_0^*(P_1)][P_1 + \Delta V(\delta)] \tag{17}$$

$$rV(1,\delta) = \delta + \gamma \int_0^{\bar{\delta}} [V(1,\delta') - V(1,\delta)]dG(\delta') + \lambda F(0)\mathbb{1}[\delta \le \delta_1^*(P_0)][P_0 - \Delta V(\delta)] \tag{18}$$

Define

$$\sigma(\delta) = r + \gamma + \lambda F(1)\mathbb{1}[\delta \ge \delta_0^*(P_1)] + \lambda F(0)\mathbb{1}[\delta \le \delta_1^*(P_0)]$$

Subtract $V(0,\delta)$ from $V(1,\delta)$ to get

$$\Delta V(\delta) = \frac{\delta}{\sigma(\delta)} + \frac{\gamma}{\sigma(\delta)} \int_0^1 \Delta V(\delta')dG(\delta') + \frac{\lambda F(1)\mathbb{1}[\delta \ge \delta_0^*(P_1)]}{\sigma(\delta)}\Delta V(\delta_0^*(P_1)) + \frac{\lambda F(0)\mathbb{1}[\delta \le \delta_1^*(P_0)]}{\sigma(\delta)}\Delta V(\delta_1^*(P_0))$$

To show existence of $\Delta V(\delta)$ define operator T:

$$Tf(x) = \frac{x}{\sigma(x)} + \frac{\gamma}{\sigma(x)} \int_0^1 f(x')dG(\delta') + \frac{\lambda F(1)\mathbb{1}[\delta \ge \delta_0^*(P_1)]}{\sigma(x)} f(\delta_0^*(P_1)) + \frac{\lambda F(0)\mathbb{1}[\delta \le \delta_1^*(P_0)]}{\sigma(x)} f(\delta_1^*(P_0))$$

For bounded function f, Tf is bounded since G has bounded support.
$\forall f \leq g \Rightarrow Tf(x) \leq Tg(x)$ since

$$Tf(x) = \frac{x}{\sigma(x)} + \frac{\gamma}{\sigma(x)}\int_0^1 f(x')dG(\delta') + \frac{\lambda F(1)\mathbb{1}[\delta \geq \delta_0^*(P_1)]}{\sigma(x)} f(\delta_0^*(P_1)) + \frac{\lambda F(0)\mathbb{1}[\delta \leq \delta_1^*(P_0)]}{\sigma(x)} f(\delta_1^*(P_0)) \leq$$

$$\leq \frac{x}{\sigma(x)} + \frac{\gamma}{\sigma(x)}\int_0^1 g(x')dG(\delta') + \frac{\lambda F(1)\mathbb{1}[\delta \geq \delta_0^*(P_1)]}{\sigma(x)} g(\delta_0^*(P_1)) + \frac{\lambda F(0)\mathbb{1}[\delta \leq \delta_1^*(P_0)]}{\sigma(x)} g(\delta_1^*(P_0)) = Tg(x)$$

$\forall c \in \mathbb{R} \exists \beta \in (0,1) \Rightarrow T(f+c)(x) \leq Tf(x) + \beta c$. Explicitly

$$\beta = \frac{\gamma + \lambda F(1)\mathbb{1}[\delta \geq \delta_0^*(P_1)] + \lambda F(0)\mathbb{1}[\delta \leq \delta_1^*(P_0)]}{r + \gamma + \lambda F(1)\mathbb{1}[\delta \geq \delta_0^*(P_1)] + \lambda F(0)\mathbb{1}[\delta \leq \delta_1^*(P_0)]}$$

$$T(f(x)+c) = \frac{x}{\sigma(x)} + \frac{\gamma}{\sigma(x)}\int_0^1 (f(x')+c)dG(\delta') + \frac{\lambda F(1)\mathbb{1}[\delta \geq \delta_0^*(P_1)]}{\sigma(x)}(f(\delta_0^*(P_1)) + c) +$$
$$+ \frac{\lambda F(0)\mathbb{1}[\delta \leq \delta_1^*(P_0)]}{\sigma(x)}(f(\delta_1^*(P_0)) + c) = Tf(x) + \beta c$$

Blackwell conditions are satisfied, ΔV is a fixed point of T. Using equations 17 and 18 we can find $V(0,\cdot)$ and $V(1,\cdot)$ given $\Delta V(\delta)$ using

$$V(0,\delta) = \frac{\gamma}{r+\gamma}\int_0^{\bar{\delta}} V(0,\delta')dG(\delta') + \frac{\lambda F(1)\mathbb{1}[\delta \geq \delta_0^*(P_1)]}{r+\gamma}[-\Delta V(\delta_0^*(P_1)) + \Delta V(\delta)]$$

$$V(1,\delta) = \frac{\delta}{r+\gamma} + \frac{\gamma}{r+\gamma}\int_0^{\bar{\delta}} V(1,\delta')dG(\delta') + \frac{\lambda F(0)\mathbb{1}[\delta \leq \delta_1^*(P_0)]}{r+\gamma}[\Delta V(\delta_1^*(P_0)) - \Delta V(\delta)]$$

and confirming Blackwell conditions

Calculate reservation value in each cases

1. $\delta \leq \delta_1^*(P_0)$
$$\Delta V(\delta) = \frac{\delta + \gamma \int_0^{\bar{\delta}} \Delta V(\delta')dG(\delta') + \lambda F(0)\Delta V(\delta_0^*(P_1))}{r + \gamma + \lambda F(0)}$$

2. $\delta_1^*(P_0) < \delta < \delta_0^*(P_1)$
$$\Delta V(\delta) = \frac{\delta + \gamma \int_0^{\bar{\delta}} \Delta V(\delta')dG(\delta')}{r+\gamma}$$

3. $\delta_0^*(P_1) \leq \delta$
$$\Delta V(\delta) = \frac{\delta + \gamma \int_0^{\bar{\delta}} \Delta V(\delta')dG(\delta') + \lambda F(1)\Delta V(\delta_0^*(P_1))}{r + \gamma + \lambda F(1)}$$

Notice that reservation value is continuous, increasing, and piecewise linear on relevant intervals with the following slopes (note that value functions are nondifferentiable at kinks) :

$$\frac{d\Delta V(\delta)}{d\delta} = \begin{cases} \frac{1}{r+\gamma+\lambda F(0)} & \text{if} \delta \in [0, \delta_1^*(P_0)) \\ \frac{1}{r+\gamma} & \text{if} \delta \in (\delta_1^*(P_0), \delta_0^*(P_1)) \\ \frac{1}{r+\gamma+\lambda F(1))} & \text{if} \delta \in (\delta_0^*(P_1), \bar{\delta}] \end{cases}$$

Lemma 2. *If* $\Delta V^A(\delta) \geq \Delta V^B(\delta) \Rightarrow \delta_1^{*A}(P_0) \geq \delta_1^{*B}(P_0)$

Proof.

$$V^B(\delta_1^{*B}(P_0)) = P_0 = V^A(\delta_1^{*A}(P_0)) \geq V^B(\delta_1^{*A}(P_0))$$

□

B.3 $\mathbb{D}(V, H, D)$

Since the reservation value is monotone, then:

$$P_1 = \Delta V(\delta_0^*(P_1)) = \frac{\delta_0^*(P_1) + \gamma \int_0^1 \Delta V(\delta') dG(\delta')}{r+\gamma} \tag{19}$$

which ensures existence of $\delta_0^*(P_1)$ and expresses it as function of $\delta_0^*(P_1)$. Likewise:

$$P_0 = \Delta V(\delta_1^*(P_0)) = \frac{\delta_1^*(P_0) + \gamma \int_0^1 \Delta V(\delta') dG(\delta')}{r+\gamma} \tag{20}$$

then

$$P_1 - P_0 = \frac{\delta_0^*(P_1) - \delta_1^*(P_0)}{r+\gamma} \tag{21}$$

Differentiate cutoffs with respect to price:

$$\delta_1^{*\prime}(P_0) = \delta_0^{*\prime}(P_1) = r + \gamma$$

Flipper's problem

$$rW(0) = \max_{P_0} \lambda \int_0^{\delta_1^*(P_0)} dH(1,\delta)[-P_0 + W(1) - W(0)]$$

$$rW(1) = \max_{P_1} \lambda \int_{\delta_0^*(P_1)}^{\bar{\delta}} dH(0,\delta)[P_1 + W(0) - W(1)]$$

Note that

$$P_1 = (1 + \frac{r}{\lambda \int_{\delta_0^*(P_1)}^{\bar{\delta}} dH(0,\delta)})W(1) - W(0) \tag{22}$$

$$P_0 = W(1) - (1 + \frac{r}{\lambda \int_0^{\delta_1^*(P_0)} dH(1,\delta)})W(0) \tag{23}$$

Since Flipper is the one offering a price that gives him no nnegative surplus, we have

$$\frac{\delta_1^*(P_0) + \gamma \int_0^1 \Delta V(\delta')dG(\delta')}{r+\gamma} = P_0 \le W(1) - W(0) \le P_1 = \frac{\delta_0^*(P_1) + \gamma \int_0^1 \Delta V(\delta')dG(\delta')}{r+\gamma}$$

and $\delta_1^*(P_0) \le \delta_0^*(P_1)$

Because $dH(0,\delta)$ is constant on $[\delta_0^*, \bar{\delta}]$ and $dH(1,\delta)$ is constant on $[0, \delta_1^*]$interval we have

$$\int_0^{\delta_1^*(P_0)} dH(1,\delta) = \delta_1^*(P_0)dH(1,\delta_1^*(P_0)) = \delta_1^{*\prime}(P_0)dH(1,\delta_1^*(P_0))(-P_0 + W(1) - W(0))$$

$$\int_{\delta_0^*(P_1)}^{\bar{\delta}} dH(0,\delta) = (\delta_0^*(P_1) - \bar{\delta})dH(0,\delta_0^*(P_1)) = \delta_0^{*\prime}(P_1)dH(0,\delta_0^*(P_1))(P_1 + W(0) - W(1))$$

$$\frac{\delta_1^*(P_0)}{\delta_1^{*\prime}(P_0)} = -P_0 + W(1) - W(0) \tag{24}$$

$$\frac{\bar{\delta} - \delta_0^*(P_1)}{\delta_0^{*\prime}(P_1)} = P_1 + W(0) - W(1) \tag{25}$$

Now plug stuff back to original problem to get $W(1), W(0)$:

$$W(0) = \frac{\lambda(\delta_1^*(P_0)^2}{r(r+\gamma)} dH(1,\delta_1^*(P_0))$$

$$W(1) = \frac{\lambda(\bar{\delta} - \delta_0^*(P_1))^2}{r(r+\gamma)} dH(0,\delta_0^*(P_1))$$

sum 24 and 25:

$$\frac{\bar{\delta} - \delta_0^*(P_1) + \delta_1^*(P_0)}{r+f} = P_1 - P_0 = \frac{\delta_0^*(P_1) - \delta_1^*(P_0)}{r+\gamma}$$

$$\frac{\bar{\delta}}{2} = \delta_0^*(P_1) - \delta_1^*(P_0)$$

so

$$P_1 - P_0 = \frac{\delta_0(P_1) - \delta_1(P_0)}{r+\gamma} = \frac{\bar{\delta}}{2(r+\gamma)}$$

B.4 $\mathbb{D}(V, H, D)$

Use 20,19, 22,23 and denote $\mathbb{E}\Delta V := \int_0^1 \Delta V(\delta')dG(\delta')$

$$\delta_0^*(P_1) = (r+\gamma)((1+\frac{r}{\lambda\int_{\delta_0^*(P_1)}^{\bar{\delta}} dH(0,\delta)})W(1) - W(0)) - \gamma\mathbb{E}\Delta V$$

$$\delta_1^*(P_0) = (r+\gamma)(W(1) - (1+\frac{r}{\lambda\int_0^{\delta_1^*(P_0)} dH(1,\delta)})W(0)) - \gamma\mathbb{E}\Delta V$$

Result 1. *We can express cutoffs as function of distributions, ΔV and cutoffs only*

$$\delta_1^*(P_0) = -\frac{\gamma}{2}\mathbb{E}\Delta V + \frac{\lambda}{2r}[(\bar{\delta} - \delta_0^*(P_1))^2 dH(0, \delta_0^*(P_1)) - (\delta_1^*(P_0))^2 dH(1, \delta_1^*(P_0))]$$

$$\delta_0^*(P_1) = \frac{1}{2} - \frac{\gamma}{2}\mathbb{E}\Delta V + \frac{\lambda}{2r}[(\bar{\delta} - \delta_0^*(P_1))^2 dH(0, \delta_0^*(P_1)) - (\delta_1^*)^2 dH(1, \delta_1^*(P_0))]$$

The left-hand side defines $n+1$ iteration of cutoffs, with outcomes of nth step on the right. What is left to show is that those recursions are monotone and bounded. Observe that

$$\delta_1^*(P_0) = -\frac{\gamma}{2}\mathbb{E}\Delta V + \frac{\lambda}{2r}[(\bar{\delta} - \delta_0^*(P_1))^2 dH(0, \delta_0^*(P_1)) - (\delta_1^*(P_0))^2 dH(1, \delta_1^*(P_0))] \leq$$

$$\leq 0 + \frac{\lambda}{2r}[(\bar{\delta} - \delta_0^*(P_1))^2 \frac{1}{\bar{\delta}} - (\delta_1^*(P_0))^2 \frac{1}{\bar{\delta}} + (\delta_1^*(P_0))^2 dH(0, \delta_1^*(P_0))] \leq \frac{\lambda}{4r\bar{\delta}}[\bar{\delta} - \delta_1^*(P_0)]$$

Rearranging we get In a similar way

$$\delta_0^*(P_1) \leq \frac{1}{2} + \frac{\lambda}{4r\bar{\delta}}[\bar{\delta} - \delta_0^*(P_1)]$$

To show that $\delta_0^*(P_1)$ is convergent focus on inequality:

$$x_{n+1} \leq \frac{1}{2} + (1-x_n)^2 \frac{\lambda}{2r} = f(x_n)$$

Let's find a fix point $x = f(x)$ and assess that $x \in (\frac{1}{2}, 1)$.

$$x = \frac{1}{2} + (1-x)^2 \frac{\lambda}{2r} \quad \iff \quad x = \frac{(1+\frac{\lambda}{r}) - \sqrt{(1+\frac{\lambda}{r})^2 - 4\frac{\lambda}{2r}\frac{1}{2}(1+\frac{\lambda}{r})}}{2\frac{\lambda}{2r}}$$

$$\frac{1}{2} < x < 1 \quad \iff \quad \frac{\lambda}{2r} < (1+\frac{\lambda}{r}) - \sqrt{1+\frac{\lambda}{r}} < \frac{\lambda}{r}$$

which is always true. Since $\delta_0^{*,n}(P_1)$ converges $\delta_1^{*,n}(P_0) = \frac{1}{2} - \delta_0^{*,n}(P_1)$ converges as well.

Proof. of Proposition 2.4 Note that for any G from Flipper problem

$$\frac{\int_0^{\delta_1^*(P_0)} dH(1,\delta)}{\delta_1^{*\prime}(P_0)dH(1,\delta_1^*(P_0))} = -P_0 + W(1) - W(0)$$

$$\frac{\int_{\delta_0^*(P_1)}^{\bar{\delta}} dH(0,\delta)}{\delta_0^{*\prime}(P_1)dH(0,\delta_0^*(P_1))} = P_1 + W(0) - W(1))$$

from Household problem $\delta_0^{*\prime}(P_1) = \delta_1^{*\prime}(P_0) = r + \gamma$ and $P_1 - P_0 = \frac{\delta_0^*(P_1) - \delta_1^*(P_0)}{r+\gamma}$ then

$$\frac{\delta_0^*(P_1) - \delta_1^*(P_0)}{r+\gamma} = P_1 - P_0 = \frac{\int_{\delta_0^*(P_1)}^{\bar{\delta}} dH(0,\delta)}{\delta_0^{*\prime}(P_1)dH(0,\delta_0^*(P_1))} + \frac{\int_0^{\delta_1^*(P_0)} dH(1,\delta)}{\delta_1^{*\prime}(P_0)dH(1,\delta_1^*(P_0))} \leq$$

$$\leq [\frac{(\bar{\delta} - \delta_0^*(P_1)) \sup_{\delta\in(\delta_0^*(P_1),1]} dH(0,\delta)}{dH(0,\delta_0^*(P_1))} + \frac{\delta_1^*(P_0)) \sup_{\delta\in[0,\delta_1^*(P_0))} dH(1,\delta)}{dH(1,\delta_1^*(P_0))}]\frac{1}{r+\gamma} \leq$$

$$= \frac{\bar{\delta} - \delta_0^*(P_1) + \delta_1^*(P_0)}{r+\gamma}$$

and $\leq$ inequality becomes $=$ for $G \sim U[0,\bar{\delta}]$ □

C Summary of empirical fidnings

Findings from section 3 can be summarized by the following list with changes calculated for the years 2012 and 2021:

Finding 1 The number of flipped transactions was 4.55% of total volume of transactions in 2012 and nearly double to 8.05% in 2021.

Finding 2 Observables explain 40% of variation of house prices.

Finding 3 Real house prices grew by 76%, average house price grew by 68% and expressed in number of years of average consumption by 47%.

Finding 4 Mortgage rates decreased from 3.62% to 2.47%.

Finding 5 Total trade volume of trade increased by 135%.

Finding 6 There is negative correlation between prices and level of intermediation.

Finding 7 Average gross return on flipped houses increased from 1.29 to 1.32. And are higher than on other multiply traded houses in the sample.

D Algorithm

Solving the model uses policy iteration: for given cutoffs, solve for distributions, then solve the value functions, and lastly, update the cutoffs.

To solve for distributions, use Law of Motion and Accountings to first solve for $H(1,\delta_1(P_0))$, sec-

ond for $H(1, \delta_0(P_1))$ and later for remaining δ of $H(1,\delta)$. Using accountings get $dH(1,\delta), dH(0,\delta)$ and find $F(1)$ and $F(0)$ using flipper trade condition.
Finding $H(1,\delta)$ is equivalent to solving quadratic equation $\rho x^2 + bx + c = 0$ in five cases:
Case 1: $\delta = \delta_1(P_0)$

$$b = \rho(1 - \delta_1 - s + F(1)) + \gamma + \lambda(f - F(1)) \quad c = -\gamma\delta_1(s - F(1))$$

Case 2: $\delta = \delta_0(P_1)$

$$b = \rho(1 - \delta_0 - s + F(1)) + \gamma \quad c = -\gamma\delta_0(s - F(1)) + \lambda(f - F(1))H(1, \delta_1)$$

Case 3: $\delta \in [0, \delta_1(P_0))$

$$b = \rho(1 - \delta - s + F(1)) + \gamma + \lambda(f - F(1)) \quad c = -\gamma\delta(s - F(1))$$

Case 4: $\delta \in (\delta_1(P_0), \delta_0(P_1))$

$$b = \rho(1 - \delta - s + F(1)) + \gamma + \lambda F(1) \quad c = -\gamma\delta(s - F(1)) + \lambda(f - F(1))H(1, \delta_1)$$

Case 5: $\delta \in (\delta_0(P_1), 1]$

$$b = \rho(1 - \delta - s + F(1)) + \gamma + \lambda F(1)$$

$$c = -\gamma\delta(s - F(1)) + \lambda(f - F(1))H(1, \delta_1) - \lambda F(1)(\delta - \delta_0 + H(1, \delta_0))$$

Next, to solve for reservation values, observe that integration is a linear operator, which allows us to use a matrix representation of a problem.

Define grid on a delta vector (denoted by Y with $M = 100$)

$$Y = [\delta^0, \delta^1, \dots, \delta^M]$$

and vector of reservation values

$$X_n = [\Delta V_n(\delta^0), \Delta V_n(\delta^1), \dots, \Delta V_n(\delta^M)]$$

Write problem in matrix form using $X_n^{\delta_1} = \Delta V_n(\delta^1)$ $X_n^{\delta_0} = \Delta V_n(\delta^0)$ and diagonal matrix Σ , upper triangular matrix $\mathbb{H}0$, lower triangle matrix $\mathbb{H}0$ and matrix dG defined as:

$$\Sigma_{i,i} = \sigma(\delta^i)$$

$$\mathbb{H}0_{i,j} = dH(0, \delta^i)\mathbb{1}[\delta^i < \delta^j]$$

$$\mathbb{H}1_{i,j} = dH(1,\delta^i)\mathbb{1}[\delta^i > \delta^j]$$

$$dG_{i,j} = \frac{1}{\bar{\delta}}$$

We can write in matrix form

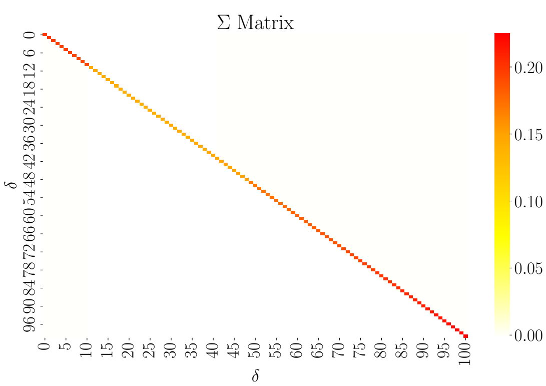
$$\Sigma X_{n+1} = Y + \gamma dG \otimes \mathbf{1}^T \lambda F(0) X_n^{\delta_1} \mathbb{1}[\delta_1 > \delta^i] + \lambda F(1) X_n^{\delta_0} \mathbb{1}[\delta_0 < \delta^i] + \frac{\rho}{2}\mathbb{H}0 + \frac{\rho}{2}\mathbb{H}1$$

which becomes

$$X_{n+1} = [Y + \lambda F(0) X_n^{\delta_1} \mathbb{1}[\delta_1 > Y] + \lambda F(1) X_n^{\delta_0} \mathbb{1}[\delta_0 < Y]][\Sigma - \gamma dG \otimes \mathbf{1}^T - \frac{\rho}{2}\mathbb{H}0 - \frac{\rho}{2}\mathbb{H}1]^{-1}$$

and iterate until convergence with tolerance 10^{-10}. This step requires a low number of iterations and is a feature continuous-time method. Figure 12 presents Σ matrix; it has quasi diagonal form and is well conditioned.

Figure 12: Σ matrix



Next step requires finding $V(1,\cdot), V(0,\cdot)$, standard value function iteration procedure until convergence (with tolerance 10^{-10}), applied to:

$$V^{n+1}(1,\delta) = \frac{\delta}{r+\gamma} + \frac{\gamma}{r+\gamma}\int_0^{\bar{\delta}} V^n(1,\delta')dG(\delta') + \frac{\lambda}{r+\gamma}F(0)(\Delta V(\delta_1) - \Delta V(\delta))\mathbb{1}[\delta < \delta_1] +$$

$$+ \frac{\rho}{r+\gamma}\int_{\delta}^{\bar{\delta}} \frac{1}{2}[\Delta V(\delta') - \Delta V(\delta)]dH(0,\delta')$$

$$V^{n+1}(0,\delta) = \frac{\gamma}{r+\gamma}\int_0^{\bar{\delta}} V^n(0,\delta')dG(\delta') + \frac{\lambda}{r+\gamma}F(1)(-\Delta V(\delta_0) + \Delta V(\delta))\mathbb{1}[\delta > \delta_0]$$

$$- \frac{\rho}{r+\gamma}\int_0^{\delta} \frac{1}{2}[\Delta V(\delta') - \Delta V(\delta)]dH(1,\delta')$$

Finally, using value function condition at cutoffs $\delta_q(P_{1-q})$ combined with value functions for flippers with its equilibrium condition allows us to express delta explicitly as a function of value functions and distributions. This way, we can introduce the next iteration using current iteration functions as:

$$\delta_0^{n+1} = \sigma^n(\delta_0^n)[(1+\frac{r}{\lambda}\frac{1}{H^n(0,1)-H^n(0,\delta_0^n)})W^n(1) - W^n(0)]-$$

$$-\frac{\rho}{2}\int_{\delta_0^n}^1 \Delta V^n(\delta')dH^n(0,\delta') - \frac{\rho}{2}\int_0^{\delta_0^n} \Delta V^n(\delta')dH^n(1,\delta') - \gamma\int_0^1 \Delta V^n(\delta')dG(\delta')$$

$$\delta_1^{n+1} = \sigma^n(\delta_1^n)[W^n(1) - (1+\frac{r}{\lambda}\frac{1}{H^n(1,\delta_1^n)})W^n(0)]-$$

$$-\frac{\rho}{2}\int_{\delta_1^n}^1 \Delta V^n(\delta')dH^n(0,\delta') - \frac{\rho}{2}\int_0^{\delta_1^n} \Delta V^n(\delta')dH^n(1,\delta') - \gamma\int_0^1 \Delta V^n(\delta')dG(\delta')$$

We look at those expressions (absolute lhs minus rhs with tolerance 10^{-5}) to find a fixed point. Those cutoffs come from proposition from section 2 and proof of the existence of reservation value from Hugonnier et al. (2020).

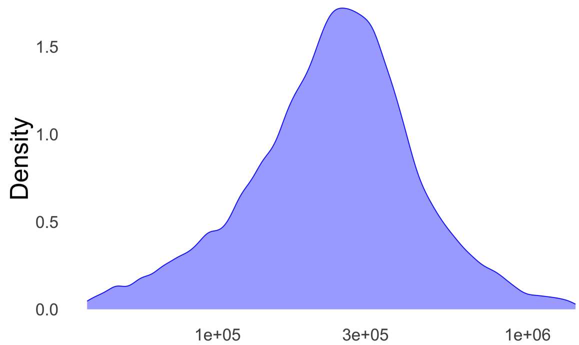
E Distribution of house prices - data

Additional data The last data set comes from the Sustainable Energy Authority of Ireland, which provides detailed information on the energy efficiency and physical characteristics of houses, such as the number of square meters, rooms, windows, and doors. Issuing energy efficiency certification is mandatory to list houses for sale.
We have a daily date for such inspection, which we will claim as putting the house on the market. The left panel of Figure 13 presents the price distribution in 2012. Running hedonic regression on City, Quarter-Year observable, we obtain the price distribution of average houses, presented on the right panel of Figure 13. Results of this and other versions of hedonic regression are presented in Table E. Scope on the market in housing literature shows that households tend to look for houses in the same city, while Quarter-Year variation is taken care of partially due to within year cyclically of house prices with most houses bought in the last quarter of the year.

Figure 14 shows spatial distributions and quality of new sellers in Ireland in 2012, with higher prices and higher quality concentrated around the east coast, around Dublin. Though we don't control for quality, the spatial correlation of quality and prices is taken care of while regressing location.

Figure 13: Price Distribution - data

(a) Prices



(b) Average House Prices

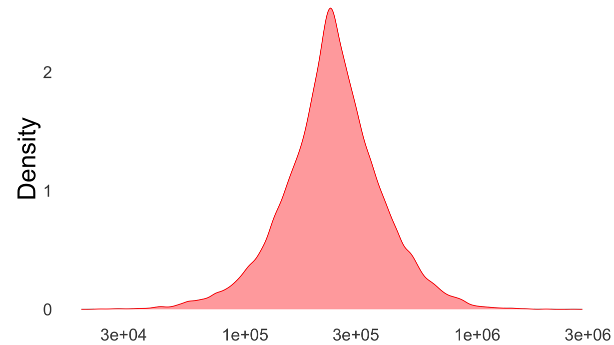


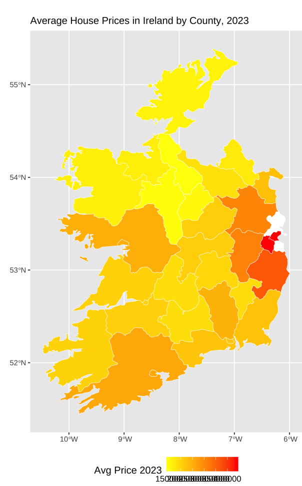
Table 17: Regression Results with Different Fixed Effects

	(1)	(2)	(3)	(4)	(5)
Location FE	**County**	**City**	**District**	**City**	**District**
Quarter-Year FE	×	×	×	✓	✓
Constant	12.16***	12.16***	12.19***	12.16***	12.18***
	(0.0008)	(0.0008)	(0.0007)	(0.0008)	(0.0007)
Observations	638,751	638,751	561,010	629,920	532,097
R-squared	0.273	0.378	0.550	0.426	0.566

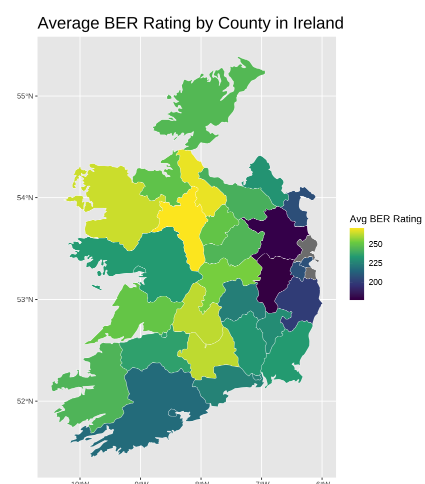
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 14: Prices and quality across space

(a) Price distribution



(b) Quality distribution



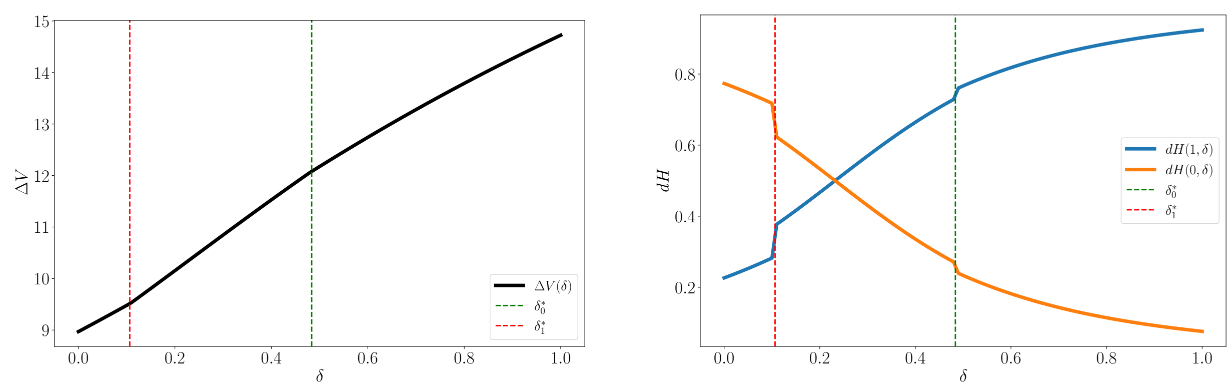
F Properties of the model

Figure 15 presents reservation values (left panel) and probability distribution functions (right) for owners (blue curve) and non-owners). The green dotted line marks cutoff δ_1^* below which household homeowner trades with flipper without a house, conditional on meeting. Above this cutoff, the owner household won't meet and trade with a non-nonowner. Similarly, a household at cutoff δ_0^* denotes indifference delta for a non-ownership meeting with a flipper who has a house. The section between $[\delta_1^*, \delta_0^*]$ marks an inaction region where trade is only possible between households. The size of this inaction region shrinks compared to Section 2[19]. Reservation values are strictly increasing continuous function with kinks at both cutoffs.

The right panel of Figure 15 shows the probability distribution functions of owners (blue) and non-owners). The mass of owners is increasing in type, while non-owners are decreasing, with jumps at the cutoffs.

Figure 15

(a) $\Delta V(\delta)$ (b) $dH(q, \delta)$



F.1 Prices

Price distribution presented in the left panel of Figure 16 is characterized by symmetric shape, relatively small variance, and kinks.

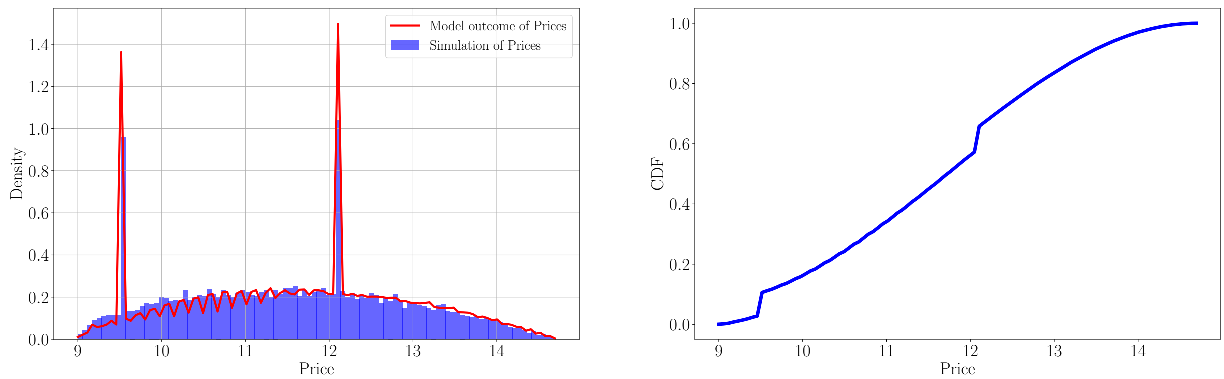
Kinks come from the propagation of cutoffs through prices, with the most significant two coming from flipper trade prices. Two spikes in price distribution are prices from flipper trade, and height comes from the grid on G, with such prices being of measure zero. The right panel of Figure 16 presents the cumulative distribution function of prices with visible jumps at prices corresponding to flipper-household trade.

[19] Where was equal to half of the mass of the household, the biggest for uniform G.

Figure 16: Distribution of prices from model

(a) Prices pdf

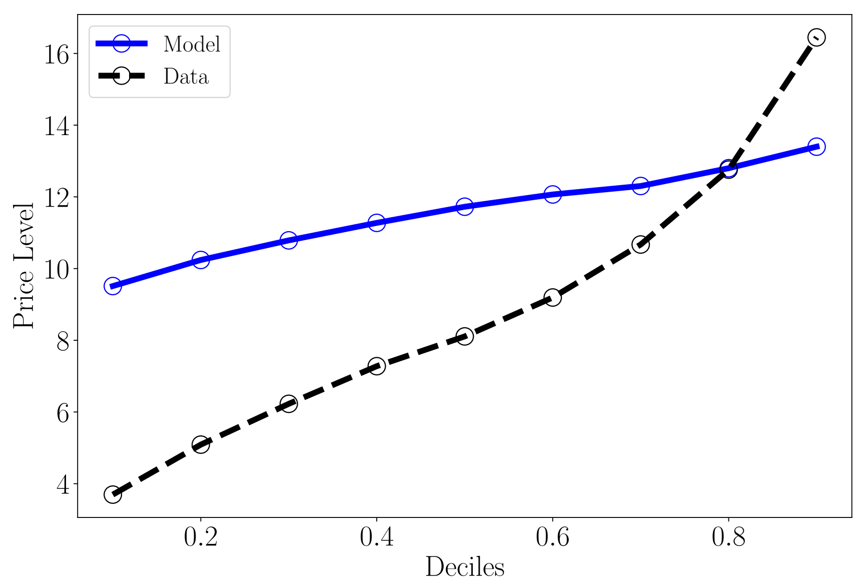
(b) Prices cdf



F.2 Price dispersion: model vs data

Plot 17 shows the model's performance against data for price distributions. The model calibrated to mean not quite well explains other moments of the price distribution, a feature of search models discussed among others in Rekkas et al. (2020)[20].

Figure 17



[20]Magnitude of mismatch of variance of prices is similar to that paper, in which authors focus on estimating distribution G in a directed search model of housing with one sided heterogeneity on buyers only.

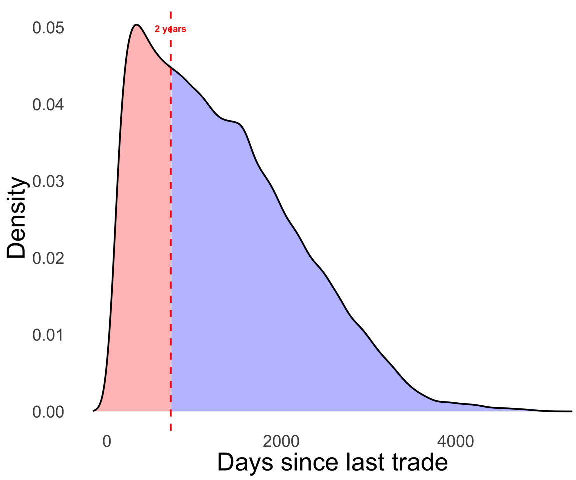
G Matching data to model

In particular, there are non-trivial masses of trade of households with households within 2 years and flippers with households in over 2 years between trades. The former rate is equal:

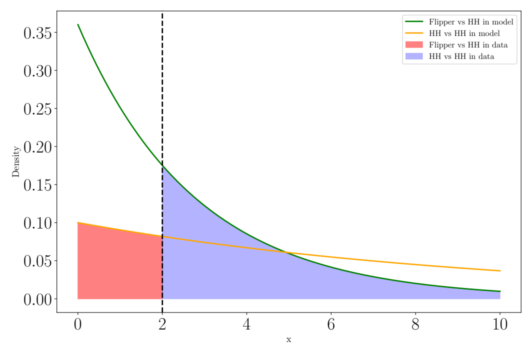
$$\rho \int_0^1 \int_\delta^1 dH(0,\delta') * \exp(-2\rho \int_0^\delta dH(1,\delta''))dH(1,\delta)$$

And the latter is equal:

$$\lambda F(0) \int_0^{\delta_1} dH(1,\delta')(1-\exp(-2\lambda \int_{\delta_0}^1 dH(0,\delta''))) + \lambda F(1) \int_{\delta_0}^1 dH(0,\delta')(1-\exp(-2\lambda \int_0^{\delta_1} dH(1,\delta'')))$$



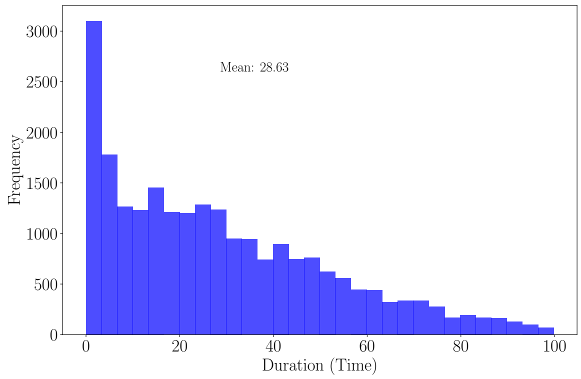
Data



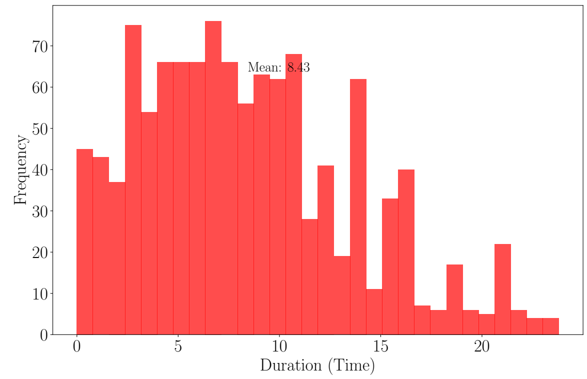
Model

Figure 18: Tenure time distribution

(a) Households



(b) Flippers



H Misallocation, welfare cost of search, excess rates

Misallocation

$$M(\delta) = \int_0^{\delta} \mathbb{1}\{\delta' < \delta^*\} dH(1,\delta') + \int_0^{\delta} \mathbb{1}\{\delta' \geq \delta^*\} dH(0,\delta')$$

it's density

$$M'(\delta) = \mathbb{1}\{\delta < \delta^*\} dH(1,\delta) + \mathbb{1}\{\delta \geq \delta^*\} dH(0,\delta)$$

Welfare cost of search friction

$$S(\delta) = \sum_q \int_0^{\delta} V(q,\delta') dH(q,\delta') - \sum_q \int_0^{\delta} V^F(q,\delta') dH^F(q,\delta')$$

it's density

$$S'(\delta) = V(0,\delta) dH(0,\delta) + V(1,\delta) dH(1,\delta) - \ V^F(0,\delta)\mathbb{1}\{\delta < \delta^*\} - V^F(1,\delta)\mathbb{1}\{\delta \geq \delta^*\}$$

where the value function of owners in the frictionless economy is

$$V^F(1,\delta) = \frac{\frac{(1-s)(r-1)}{r}\mathbb{1}\{\delta < \delta^*\} + \delta\mathbb{1}\{\delta \geq \delta^*\} + \frac{\gamma(1-s)^2}{r} + \frac{\gamma}{r-1}(\frac{1}{2} - \frac{(1-s)^2}{2})}{r+\gamma-1}$$

with pdf $dH(1,\delta) = \mathbb{1}\{\delta \geq \delta^*\}$ the value function of nonowners in the frictionless economy is

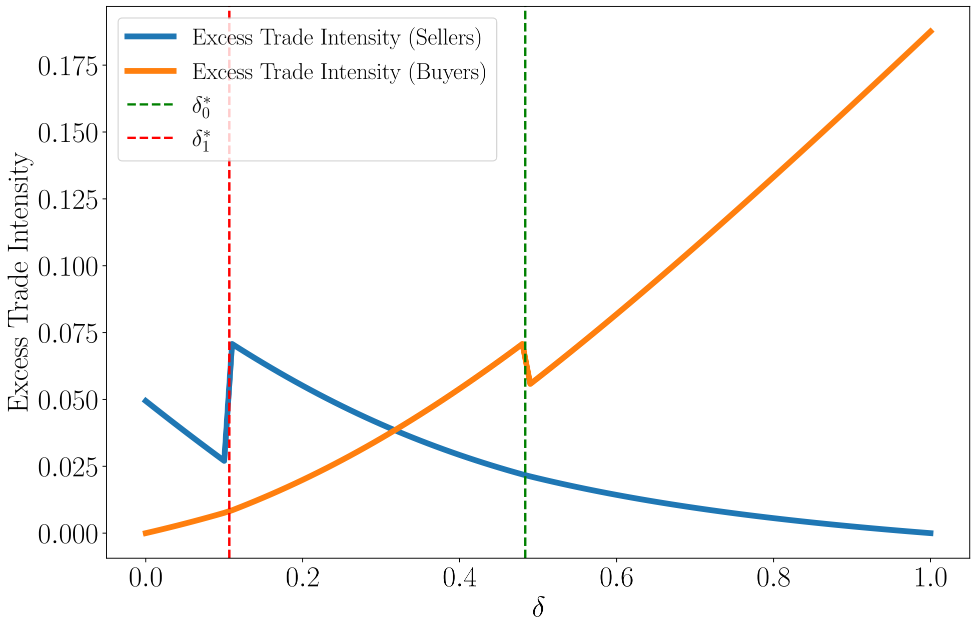
$$V^F(0,\delta) = \frac{[\delta - \frac{(1-s)(r-1)}{r}]\mathbb{1}\{\delta \geq \delta^*\} - \frac{\gamma s(1-s)}{r} + \frac{\gamma}{r-1}(\frac{1}{2} - \frac{(1-s)^2}{2})}{r+\gamma-1}$$

with pdf $dH(0,\delta) = \mathbb{1}\{\delta < \delta^*\}$.

Note that $\Delta V^F(\delta) = \frac{\delta^*}{r}$

Excess rate Figure 19 illustrates the overall meeting rate for each level of delta and each household type (blue sellers and yellow buyers), excluding the overall rate of meeting flippers.

Figure 19: Excess Trade intensities gross of meeting flipper



I Welfare

Consumption equivalent per capita is calculated using the

$$c_q/r = \frac{\int_0^1 V(q,\delta)dH(\delta,q)}{\int_0^1 dH(\delta,q)}$$

where current owners are denoted by c_1 and current nonowners by c_0.
The consumption equivalent of the households per capita is equal to

$$c/r = \frac{\sum_q \int_0^1 V(q,\delta)dH(\delta,q)}{\underbrace{\sum_q \int_0^1 dH(\delta,q)}_{=1}}$$

The consumption equivalent of all agents per capita is equal to

$$c^*/r = \frac{\sum_q \int_0^1 V(q,\delta)dH(\delta,q) + \sum_q F(q)W(q)}{\underbrace{\sum_q \int_0^1 dH(\delta,q) + \sum_q F(q)}_{=1+f}}$$

J Model with observable types

Conditions below correspond to the model with public information about types and ex-post bargaining with weight θ. The main difference with the baseline model is in cutoff $\hat{\delta}$ and in the flipper's problem.

Introduce the reservation value of flippers:

$$\Delta W = W(1) - W(0)$$

Prices

$$P_0(\delta) = \theta\Delta V(\delta) + (1-\theta)\Delta W$$

$$P_1(\delta) = \theta\Delta V(\delta) + (1-\theta)\Delta W$$

surplus of household buyers satisfies

$$0 \leq P_0(\delta) - \Delta V(\delta)$$

$$0 \leq -P_1(\delta) + \Delta V(\delta)$$

Denote by $\hat{\delta}$ agent who is indifferent between trade and no trade, coincides for both buyers and sellers. It comes from a lack of transaction cost and the constant reservation value of the flipper.
Stationary distribution **Homeownership (inflow and outflow to** $[0,\delta], q = 1$)

$$\underbrace{\lambda F(1)\int_{\hat{\delta}}^{\max\{\delta,\hat{\delta}\}} dH(0,\delta')}_{\text{F \textbf{sells} to HH}} + \underbrace{\gamma G(\delta)\int_{\delta}^{1} dH(1,\delta')}_{\text{inflow from change of type from}[\delta,1]} = \tag{26}$$

$$= \underbrace{\lambda F(0)\int_{0}^{\min\{\delta,\hat{\delta}\}} dH(1,\delta')}_{\text{F \textbf{buys} from HH}} + \underbrace{\gamma(1-G(\delta))\int_{0}^{\delta} dH(1,\delta')}_{\text{outflow from change of type to}[\delta,1]} + \underbrace{\rho\int_0^{\delta} dH(1,\delta')\int_{\delta}^{1} dH(0,\delta')}_{\text{HH trades with HH}} \tag{27}$$

Flippers problem

$$rW(0) = \lambda \int_0^{\hat{\delta}} \theta(\Delta W - \Delta V(\delta'))dH(1,\delta')$$

$$rW(1) = \lambda \int_{\hat{\delta}}^{\bar{\delta}} \theta(\Delta V(\delta') - \Delta W) dH(0, \delta')$$

$$\Delta W = \frac{\lambda\theta \int_{\hat{\delta}}^{\bar{\delta}} \Delta V(\delta') dH(0,\delta') + \lambda\theta \int_0^{\hat{\delta}} \Delta V(\delta') dH(1,\delta')}{r + \lambda\theta \int_{\hat{\delta}}^{\bar{\delta}} dH(0,\delta') + \lambda\theta \int_0^{\hat{\delta}} dH(1,\delta')}$$

Household problem

$$\sigma(\delta)\Delta V(\delta) = \delta + \gamma \int_0^1 \Delta V(\delta') dG(\delta') + \lambda(1-\theta)F(0)\Delta W \mathbb{1}[\delta < \hat{\delta}] + \lambda(1-\theta)F(1)\Delta W \mathbb{1}[\delta > \hat{\delta}] +$$

$$+ \frac{\rho}{2} \int_\delta^1 \Delta V(\delta') dH(0,\delta') + \frac{\rho}{2} \int_0^\delta \Delta V(\delta') dH(1,\delta')$$

$$\sigma(\delta) = r + \gamma + \lambda(1-\theta)F(0)\mathbb{1}[\delta < \hat{\delta}] + \lambda(1-\theta)F(1)\mathbb{1}[\delta > \hat{\delta}] + \frac{\rho}{2} \int_\delta^1 dH(0,\delta') + \frac{\rho}{2} \int_0^\delta dH(1,\delta')$$

K Data validation

How good is the data set used in 3 in matching price indexes- common for literature on house price indexes test? Figure 20 considers that. On the left panel, the green line uses transaction data from 3 - it takes pairs of houses transacted which are not flipped[21] between 2010 and 2021 and calculates the rate of change for each year using expenditure weights. The Violet line is a Case-Shiller type index reported by the Central Statistics Office Ireland (CSO). The difference in those samples comes from the fact that the statistical offices can identify trades in the past, making the price index depend on more observations- repeated sales. My data in the early years of a sample does not have too many observations by construction, and in that part of the figure, rates of change in HPIs don't match well. Later on, post-2015, the two curves are similar in shape and behavior. In constructing the green sample, we took a conservative stance on flipped transactions, assuming that all those trades importantly change the quality of housing, therefore excluding it from constant quality HPI.

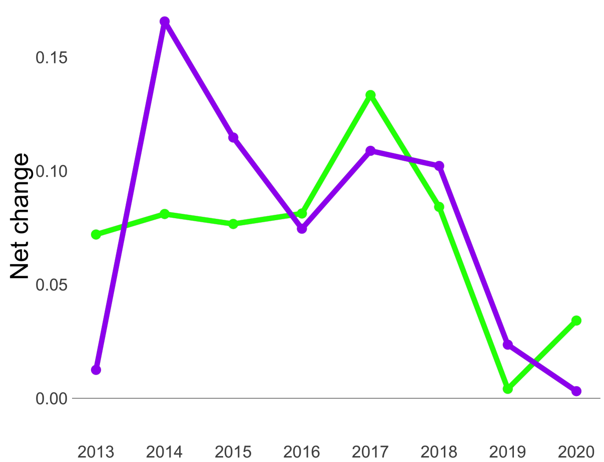
What would be the behavior of the house price index when we don't exclude flippers? The right panel of Figure 20 presents unweighted (red) and expenditure weighted HPI presents the behavior of changes in HPI between years when we add flipped transactions.

Left panel of 21 presents average prices using both transactions on survey data (left panel) and volume of trade from transaction data (right panel). Using the fourth panel of HFCS, we marked (as x) average prices at the time of acquisition. Average prices from transaction data (blue dotted line) show true average prices. For almost all years, survey responses overestimate house prices. This highlights the importance of using full-price distribution and tax data instead of sur-

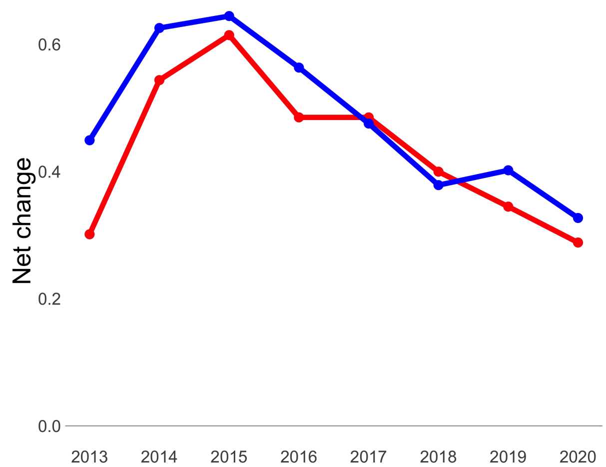
[21] with restricting at 90 days from below between trade- common Case-Shiller condition

Figure 20: Price indexes- Data Validation

(a) Data vs Statistical Office (CSO) changes in HPI



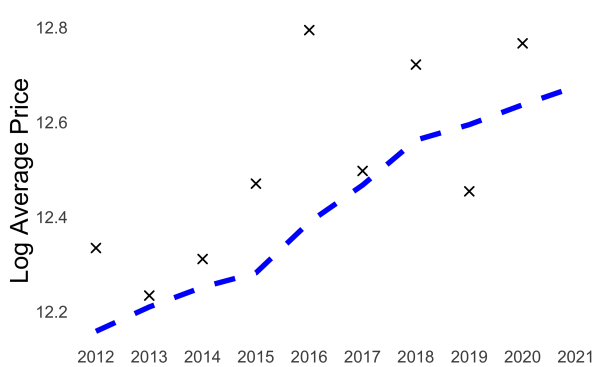
(b) Changes of HPI calculated including all flipped trades



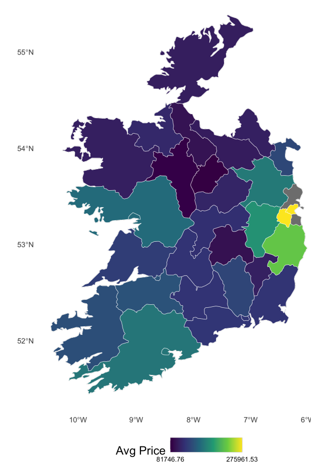
vey sources. The right panel shows average prices in 2021 across 26 counties of Ireland. Higher prices are observed in the east part of Ireland, specifically around the county of Dublin, the capital city.

Figure 21: Prices and Quantities

(a) Average Prices



(b) Across space



Note: The left panel compares average house prices derived from survey data (HFCS) and actual transaction data across years, highlighting a tendency for survey data to overestimate prices at the time of acquisition. The blue dotted line represents the more accurate transaction-based price data. This comparison underscores the importance of using detailed transaction records for accurate market analysis. The right panel maps the average house prices in 2021 across Ireland's 26 counties, with notably higher prices around Dublin, reflecting spatial price disparities.

References

Albrecht, James, Axel Anderson, Eric Smith, and Susan Vroman, "OPPORTUNISTIC MATCHING IN THE HOUSING MARKET," *International Economic Review*, 2007, *48* (2), 641–664. Publisher: Department of Economics, University of Pennsylvania and Osaka University Institute of Social and Economic Research Association.

_, Pieter Gautier, and Susan Vroman, "Directed Search in the Housing Market," *Review of Economic Dynamics*, 2016, *19*, 218–231. Publisher: Elsevier for the Society for Economic Dynamics.

Allen, Jason, Robert Clark, and Jean-François Houde, "Search Frictions and Market Power in Negotiated-Price Markets," *Journal of Political Economy*, August 2019, *127* (4), 1550–1598. Publisher: The University of Chicago Press.

Andrew Haughwout,, Donghoon Lee,, and Joseph Tracy, and Wilbert van der Klaauw, "Real Estate Investors, the Leverage Cycle, and the Housing Market Crisis - Federal Reserve Bank of New York - FEDERAL RESERVE BANK of NEW YORK."

Bayer, Patrick, Christopher Geissler, Kyle Mangum, and James W Roberts, "Speculators and Middlemen: The Strategy and Performance of Investors in the Housing Market," *The Review of Financial Studies*, November 2020, *33* (11), 5212–5247.

Cahuc, Pierre, Fabien Postel-Vinay, and Jean-Marc Robin, "Wage Bargaining with On-the-Job Search: Theory and Evidence," *Econometrica*, 2006, *74* (2), 323–364. Publisher: [Wiley, Econometric Society].

Davis, Morris A. and Stijn Van Nieuwerburgh, "Chapter 12 - Housing, Finance, and the Macroeconomy," in Gilles Duranton, J. Vernon Henderson, and William C. Strange, eds., *Handbook of Regional and Urban Economics*, Vol. 5 of *Handbook of Regional and Urban Economics*, Elsevier, January 2015, pp. 753–811.

Depken, Craig A., Harris Hollans, and Steve Swidler, "An Empirical Analysis of Residential Property Flipping," *The Journal of Real Estate Finance and Economics*, October 2009, *39* (3), 248–263.

Diamond, Rebecca and William Diamond, "Affordability of Owner-Occupied Housing across US Cities," *AEA Papers and Proceedings*, May 2024, *114*, 340–345.

Duffie, Darrell, Nicolae Gârleanu, and Lasse Heje Pedersen, "Over-the-Counter Markets," *Econometrica*, 2005, *73* (6), 1815–1847. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1468-0262.2005.00639.x.

Favilukis, Jack, Sydney C. Ludvigson, and Stijn Van Nieuwerburgh, "The Macroeconomic Effects of Housing Wealth, Housing Finance, and Limited Risk Sharing in General Equilibrium," *Journal of Political Economy*, February 2017, *125* (1), 140–223. Publisher: The University of Chicago Press.

Gavazza, Alessandro, "An Empirical Equilibrium Model of a Decentralized Asset Market," *Econometrica*, 2016, *84* (5), 1755–1798. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA10847.

Head, Allen, Huw Lloyd-Ellis, and Hongfei Sun, "Search, Liquidity, and the Dynamics of House Prices and Construction," *American Economic Review*, April 2014, *104* (4), 1172–1210.

Hugonnier, Julien, Benjamin Lester, and Pierre-Olivier Weill, "Frictional Intermediation in Over-the-Counter Markets," *The Review of Economic Studies*, May 2020, *87* (3), 1432–1469.

Iacoviello, Matteo, "House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle," *American Economic Review*, June 2005, *95* (3), 739–764.

Kopczuk, Wojciech and David Munroe, "Mansion Tax: The Effect of Transfer Taxes on the Residential Real Estate Market," *American Economic Journal: Economic Policy*, May 2015, *7* (2), 214–257.

Krainer, John and Stephen F. LeRoy, "Equilibrium valuation of illiquid assets," *Economic Theory*, February 2002, *19* (2), 223–242.

Lagos, Ricardo and Guillaume Rocheteau, "Liquidity in Asset Markets With Search Frictions," *Econometrica*, 2009, *77* (2), 403–426. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA7250.

Lee, Jin Man and Jin Wook Choi, "The Role of House Flippers in a Boom and Bust Real Estate Market," *The Journal of Economic Asymmetries*, December 2011, *8* (2), 91–109.

Ngai, L. Rachel and Silvana Tenreyro, "Hot and Cold Seasons in the Housing Market," *American Economic Review*, December 2014, *104* (12), 3991–4026.

Piazzesi, Monika, Martin Schneider, and Johannes Stroebel, "Segmented Housing Search," *American Economic Review*, March 2020, *110* (3), 720–759.

Rekkas, Marie, Wright, and Yu Zhu, "How Well Does Search Theory Explain Housing Prices?," October 2020.

Rosen, Sherwin, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy*, 1974, *82* (1), 34–55. Publisher: The University of Chicago Press.

Sommer, Kamila and Paul Sullivan, "Implications of US Tax Policy for House Prices, Rents, and Homeownership," *American Economic Review*, February 2018, *108* (2), 241–274.

Weill, Pierre-Olivier, "The Search Theory of Over-the-Counter Markets," *Annual Review of Economics*, August 2020, *12* (Volume 12, 2020), 747–773. Publisher: Annual Reviews.

Wheaton, William C., "Vacancy, Search, and Prices in a Housing Market Matching Model," *Journal of Political Economy*, 1990, *98* (6), 1270–1292. Publisher: University of Chicago Press.

Øystein Daljord, Denis Nekipelov, and Minjung Park, "A Simple and Robust Estimator for Discount Factors in Optimal Stopping Dynamic Discrete Choice Models," September 2019.

Üslü, Semih, "Pricing and Liquidity in Decentralized Asset Markets," *Econometrica*, 2019, *87* (6), 2079–2140. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA14713.

İmrohoroğlu, Ayşe, Kyle Matoba, and Şelale Tüzel, "Proposition 13: An Equilibrium Analysis," *American Economic Journal: Macroeconomics*, April 2018, *10* (2), 24–51.