

# What Problem Do Intermediaries Solve? Evidence From Real Estate Markets

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## Abstract

We study intermediation in the housing market. Using data from an online platform utilized by real estate agents to generate leads, we identify exogenous intermediary attention arising from the quasi-randomized ordering of potential listings. Greater intermediary attention leads to an increased probability of listing with an agent and selling quickly, and a higher transaction price. The listing and transaction probabilities of neighboring properties decrease in intermediary attention. These results contrast sharply with endogenous correlations and provide causal evidence that intermediaries resolve property-level frictions deriving from search, information, or behavioral considerations but do not mitigate neighborhood-level information asymmetries. (*JEL* G24, D83, R31)

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Intermediation is ubiquitous in the real economy, by some accounts representing an estimated 25% of U.S. economic activity (Spulber 1996). Empirically assessing the causal effects of intermediation, however, has proven challenging because intermediation rarely occurs randomly. Trades more likely to be facilitated through an intermediary often feature assets or counterparties that differ along observable or unobservable quality dimensions (as in Hortaçsu and Syverson (2004)), making it difficult to disentangle the effects of intermediary-reduced costs from other aspects of the transaction.

In this paper we provide causal estimates of the effects of intermediation on volume and price in a setting in which we can measure quasi-random variation in intermediary activity. Using data from an online platform that generates leads for U.S. residential real estate agents, we observe a variable that describes the exogenous level of attention each property receives from a broad set of agents operating in the area. Properties that are given more attention are more likely to be listed by an agent and are listed by more distant and wide-ranging agents. The role that real estate agent attention plays in the dynamics of residential housing markets is of first-order importance—particularly following a recent settlement involving the National Association of Realtors (WSJ 2024).<sup>1</sup>

We emphasize three main points in our analysis. First, we show that a plausibly exogenous increase in intermediary attention leads to a greater likelihood of a quick sale and a higher sales price. Second, we find that intermediary attention generates negative spillovers, as it results in fewer listings and sales for immediately proximate properties. Our findings are therefore consistent with intermediaries' resolving property-level frictions arising from search, information or behavioral considerations, but intermediaries do not appear to mitigate neighborhood-level information asymmetries. Third, our estimates of the impacts of intermediary attention differ in a number of respects from those generated from endogenous correlations between whether a

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<sup>1</sup>Following this settlement, buyers are likely to gain flexibility in selecting the level of service they receive from their agents, and sellers must navigate how best to attract attention to their property without being able to explicitly advertise offered commissions

property is listed publicly with an agent and various outcome variables, suggesting that empirical estimates of endogenous search relationships should be treated with significant caution.

The online platform that provides our data gathers for-sale-by-owner (FSBO) and for-rent-by-owner (FRBO) listings from various online sources. FSBO and FRBO listings generally do not appear on platforms primarily reserved for listings acquired by intermediary agents. The collected leads are cleaned, culled for relevant information, and displayed on the online platform. Agents who subscribe to the platform contact the provided leads with the objective of securing the listings.

The platform's data-gathering procedure takes place multiple times throughout the day for each data source, leading to the creation of different upload batches. The display order of the leads within each batch is determined by a lead identification number that is generated by the software in an automated way and executed without reference to lead quality. As a result, the list order of displayed properties on a computer screen is exogenous to property and seller characteristics. We confirm the randomization of lead display order by documenting that there is no meaningful correlation between lead sort rank within a batch and property characteristics such as square feet, number of bedrooms or number of bathrooms.

Our experimental design is based on the argument that affiliated agents who subscribe to the platform devote greater attention to higher-displayed leads than to leads displayed near the bottom. We find evidence in support of this claim: an interquartile increase in lead ranking (i.e., an increase in rank from the third to the first quartile) increases the probability that an agent affiliated with the online platform secures the property listing by 0.6%, which is 3% of the mean. Might it be the case that higher lead rankings are simply correlated with an unobserved variable associated with a higher probability of a listing? Such a relationship would not be consistent with the online platform's quasi-random method of generating lead ordering or with the lack of correlation between the rank order and various observed property characteristics. As an additional test, however, we consider whether higher-ranked properties are also more likely to be listed by agents who do not subscribe to the service, as one would expect to observe if sort order

proxies for an unobserved proclivity to be listed. We find, by contrast, that unaffiliated agents are less likely to list higher-ranked properties. This is inconsistent with the argument that lead order measures a general propensity to be listed. The findings suggest that higher-ranked listings receive more attention only from affiliated agents and that, given the attempts of affiliated agents to acquire the listings, unaffiliated agents are less likely to do so. Further, we show that highly-ranked leads are significantly more likely to be listed with an agent within 3 days of the creation of the lead, which is an indication that it is these leads' appearance on the online platform that allows affiliated agents to secure the listings.

We find that the technology platform appears to provide access to potential listings to new types of agents. Agents affiliated with the platform acquire listings of properties that are geographically further from their prior listings. An interquartile increase in the rank of a listing results in the hiring of an agent whose previous listings were approximately 4.5% more distant from the property. This relatively large impact suggests that one of the primary effects of the platform is to attract a broader set of agents to properties. Moreover, agents who secure listings through the platform demonstrate larger geographic dispersion in their listings in general.

We also find that affiliated agents are more likely to serve as buyer's agents (as opposed to listing agents) for properties with more prominent leads, showing that lead ordering promotes intermediation through multiple mechanisms.

We examine the impact of intermediation on volume by first analyzing the endogenous correlation between an agent-listed property and quick sale outcomes (sold within 60 days of lead creation) or a sale within a year. We find that relative to non-agent-listed properties, properties listed with an agent are less likely to have a quick sale but are significantly more likely to be sold within a year. These endogenous correlations could be interpreted to show that agents require some time to access their networks and market a property but that they are very effective in the medium term. We find, by contrast, that an exogenous increase in intermediary attention increases the probability of a quick sale but has no impact on sale within a year. An interquartile increase in lead ordering increases the probability of a quick sale by 0.2%, which is 2.4% of

the mean. These causal results indicate that agents' networks and efforts are helpful in negotiating quick transactions but that over the course of a year, properties that owners wish to sell will be sold irrespective of the involvement of an agent. The endogenous relationships in our data, which likely reflect selection in the types of buyers who hire agents, thus offer precisely misleading conclusions.

In a price analysis we find that properties receiving greater intermediary attention transact at higher values. Given the multiple mechanisms by which intermediary attention affects the presence, type, and incentives of agents (Barwick, Pathak, and Wong 2017; Kenney 2023), we cannot draw conclusions about whether the pure price benefits of hiring an agent are equal to the costs; our data also do not contain precise measures of agent fees. We explore potential mechanisms driving the pricing results and find that intermediary attention has a larger effect on prices in thick markets and for properties more similar to surrounding properties. These results are consistent with the notion that intermediaries improve match quality when a larger number of properties are competing for buyers.

The findings described thus far linking intermediary attention to quick sales and higher prices are consistent with agents' promoting trade by resolving frictions at either the property or neighborhood level. In order to distinguish between these competing explanations, we consider the spillover impact of intermediary attention on the leads in the online platform to neighboring residences. Given the scale and importance of intermediation in the broad economy, it is useful to understand whether agent activities generate positive or negative externalities. For these tests we analyze the full set of nearby properties drawn from the Zillow database. We study local listing intensity, which we define as the ratio of other-property listings within a quarter-mile of the focal property to other-property listings within 2 miles.<sup>2</sup>

If increased intermediary attention acts mainly at the property level to facilitate matches be-

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<sup>2</sup>Our spillover radius is similar in size to papers studying other types of spillovers in residential real estate. Gupta (2019) and Fisher, Lambie-Hanson, and Willen (2015) evaluate slightly tighter geographies while Anenberg and Kung (2014) are of similar size or larger to our spillover radius.

tween potential buyers and the focal property seller, then increased intermediary attention could discourage rival listings and thereby *decrease* the local listing intensity of other neighborhood properties. If instead agents' most important role is to supply information about the local market (both for buyers and sellers), then heightened intermediary attention should encourage listings of neighboring properties and therefore *increase* the local listing intensity.

Endogenous correlations show that the listing of a property with an agent is associated with a higher subsequent local listing intensity, suggesting that listings are positively correlated, but this may be driven by unobserved variables such as localized demand shocks (Gilbukh and Goldsmith-Pinkham 2019). Our causal analysis, however, shows that higher intermediary attention leads to a lower subsequent local listing intensity. The focal property listing appears to capture the attention of prospective local buyers and to discourage other local listings. This is evidence in favor of property-specific agent effects.

If intermediary attention mainly serves to promote the focal property itself and results in a quick sale for that property, then it will remove a potential buyer from the pool and reduce the sale probability for neighboring properties. If agents supply information about the local market (potentially by generating price data from the sale of the focal property), then intermediary attention should diminish local information asymmetries and promote the sale of neighboring houses.

We find clear evidence that heightened intermediary attention decreases the local transaction intensity. For a focal property in an area with a median number of transactions, an interquartile increase in listing rank leads to 0.14 fewer property sales in the neighborhood over the following 365 days, which is a meaningful spillover effect.

Given the multi-pronged impact of intermediary attention on the probability of hiring a listing agent, the type of listing agent hired, and the likelihood of buyer's agent involvement, we cannot quantify the causal effect of any single one of these mechanisms on housing outcomes. We therefore undertake a simple calibration exercise to assess, under reasonable conjectures, the relative magnitudes of each of the channels. We find that under plausible assumptions a main

driver of our results is that the online platform expands the set of agents who may list a property, thereby allowing owners to select higher-quality and better-matched agents. The increased likelihood of the provision of standard agent services, by contrast, does not appear to explain much of the overall impact of intermediary attention that we find.

We consider the implications of our results for three theories of intermediation: search, information and behavioral. Search theories argue that intermediaries exist primarily to reduce search frictions that hinder exchanges between potential counterparties in markets for real and financial assets, particularly in decentralized markets for heterogeneous goods.<sup>3</sup> Our results that increased intermediary attention leads to quicker sales and higher prices thus support the main intuition of search models that feature intermediation such as [Rubinstein and Wolinsky \(1987\)](#), [Duffie, Gârleanu, and Pedersen \(2005\)](#) and [Duffie, Gârleanu, and Pedersen \(2007\)](#).<sup>4</sup> In a search setting, agent attention on the focal property can divert prospective buyers from other neighborhood houses, resulting in the negative listing and transaction spillovers that we observe. Our findings are thus broadly consistent with the predictions of search models.

Information theories argue that intermediaries reduce information asymmetries between buyers and sellers and thereby promote trade and minimize lemon discounts ([Milgrom and Stokey 1982](#); [Myers and Majluf 1984](#); [Li 1998](#); [Glode and Opp 2016](#)), so these theories suggest that intermediary attention should result in quicker sales and higher prices, which we find. The predictions of information theories for spillovers depend on the precise information asymmetries that agents

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<sup>3</sup>Search and matching explanations of housing market outcomes, which began with [Wheaton \(1990\)](#), have taken on a recent prominence, with studies emphasizing heterogeneous search across buyers ([Gargano, Giacoletti, and Jarnecic 2020](#)) and intra-ethnic group matching ([Agarwal, Choi, He, and Sing 2019](#)). From a financing perspective, search considerations also offer a natural rationale for the positive impact of local branch presence on residential mortgage originations ([Benetton 2021](#)) and for dispersion in mortgage rates ([Bhutta, Fuster, and Hizmo 2020](#)). In commercial real estate as well, search models have been advanced to explain inefficient allocation of assets in bankruptcy ([Bernstein, Colonnelli, and Iverson 2019](#)), price dynamics ([Sagi 2021](#)), and counterparty matching ([Badarinsa, Ramadorai, and Shimizu 2021](#)).

<sup>4</sup>Reduced-form estimates of intermediaries' causal role in alleviating search frictions have been difficult to obtain. [Gavazza \(2016\)](#) and [Salz \(2022\)](#) use structural models to evaluate the welfare effects of intermediaries in the market for used aircraft and the New York City waste market, respectively. [Hendel, Nevo, and Ortalo-Magné \(2009\)](#) compare the relative performance of a real-estate listing service with homes listed for sale by owner.

resolve. If agents provide property-specific information, then potential buyers may be drawn to the focal property and away from neighboring houses, which is consistent with the negative listing and transaction spillovers we observe. Our results, however, are not consistent with agents' mitigating neighborhood-level information issues, as increased intermediary attention should then lead to positive spillovers, which we do not find.

Agents may also influence property outcomes via behavioral mechanisms. Increased intermediary attention could lead either to excess optimism about the property value on the part of a seller who receives many agent calls or it could promote greater realism on the seller's part as the agents provide objective information about the true value. We find evidence in favor of the first effect: higher intermediary attention generates elevated list prices for properties. In common with earlier studies ([Genesove and Mayer 2001](#); [Andersen, Badarinza, Liu, Marx, and Ramadorai 2022](#); [Giacoletti and Parsons 2023](#)), we find that sellers have reference dependent views and that the list prices they set are increasing in the original purchase prices they paid. Intermediary attention does not have an impact on this effect.

The relative importance of intermediaries in resolving asset-specific or wider market frictions is likely to differ across settings. The method we develop in this paper of distinguishing these two roles through an analysis of the effect of exogenous intermediary activity on nearby or similar assets can be applied in other markets. Such inquiries could assist in improving our understanding of the pervasiveness and broad influence of intermediaries throughout the economy.

## 1 Data

We obtain data on residential properties that are listed as for-sale-by-owner (FSBO) and for-rent-by-owner (FRBO) from an online platform that collects leads from various classified advertisement websites and displays them to their customers—local residential real estate agents. These data contain a small number of hedonic features (bedrooms, bathrooms, square footage, two-car garage indicator) as well as very precise geographic information (street address supplemented

with latitude and longitude). Additionally, the online platform has supplemented information about these leads with detailed information regarding the eventual listings of these leads with agents as well as with the neighborhood listing activity of the surrounding area. The online platform provided leads that were collected between 1/3/2016 and 7/31/2018.

We obtain property-level data from the Zillow Transaction and Assessment Dataset (ZTRAX). ZTRAX is a large national real estate database with information on more than 374 million detailed public records across 2,750 U.S. counties. Data includes transaction prices (where available) and transaction dates. It also includes detailed assessor data including property characteristics, geographic information, and valuations on over 200 million parcels in over 3,100 counties. These data have been used by [Aiello, Bernstein, Kargar, Lewis, and Schwert \(2021\)](#), among others.

Our final dataset includes 654,991 FSBO and FRBO leads from the online platform that contain valid address matches into the ZTRAX county assessor's data. Table 1 reports descriptive statistics for the merged dataset. As described in Panel A of Table 1, our final sample consists of 41% FRBO leads. The leads have a median of 3 bedrooms, 2 bathrooms, and 1,700 square feet. Thirty-three percent of these leads ultimately hired an agent to list their property, with 20% using an agent affiliated with the online platform and 13% using an agent that is not. The median number of days until the property was listed publicly with an agent was 77. As shown in Panel B of Table 1, *Proximate Agent Listings*, the properties in our data are quite similar in size to agent listings close in time and space to our FSBO and FRBO leads (i.e., properties listed by agents within one year and a quarter-mile of the lead).

In Panel C of Table 1 we provide direct comparisons between our sample properties and nearby general agent listings. We average, for each sample lead, the property characteristics of the proximate general listings and calculate the difference between the sample lead characteristic and the neighboring average. While many of the property characteristic differences are statistically significant, all of them are small in magnitude (e.g., our sample properties have 0.016 more bedrooms, on average, than neighboring properties). One meaningful difference that does arise between our sample properties and neighboring general listings is that sample properties,

once listed with an agent, tend to spend 46.4 days ( $t$ -statistic=50.38) longer on the market. This could be consistent with the claim that FSBO and FRBO sellers may have unrealistic expectations about potential sales prices. In support of this point, we find that 41% of our sample properties are sold within a year, relative to the 63% that [Gilbukh and Goldsmith-Pinkham \(2019\)](#) document in their Multiple Listings Services data during boom periods such as our data time span. Once listed with an agent, our sample properties sell with probability 55% within a year. Weighing against the argument that it is particularly difficult to consummate transactions with our sample sellers is the fact that our properties have  $-\$3,682$  ( $t$ -statistic=12.63) lower listing prices than neighboring houses. When coupled with the observation that they ultimately realize  $\$10,464$  ( $t$ -statistic=28.23) higher sales prices, these summary statistics are consistent with the hypothesis that FSBO sellers exhibit more patience.

Figure 1 demonstrates the geographic scope of the matched lead sample with a county-level map.

## 2 Empirical Methodology

We study the effects of increased intermediary attention on a property in order to understand how agents influence the housing market. We explore outcomes such as whether the property was listed with an agent, the probability and speed of a sale and the transacted price. We also consider spillover effects on neighboring properties.

Agent interest in a property is obviously endogenous; certain types of properties and sellers are likely more drawn to agents, and these properties and sellers almost certainly have important unobserved characteristics. We seek to assess the causal impact of heightened agent interest by making use of quasi-randomized sorting of displayed properties on an online platform used by agents to seek leads.

The online platform offers affiliated agents access to proprietary lists of FSBO and FRBO properties. These leads are collected daily from various sources by automated programs that run in

parallel and collect FSBO/FRBO advertisements in multiple batches per source per state per day. The online platform describes the parallel collecting processes as chaotic and completed without reference to the quality of the leads. The properties are assigned lead numbers in the order they enter the online platform’s system. The platform displays listings from a given day in an order determined by the lead number: properties with larger lead numbers appear higher on the page viewed by affiliated agents. Our measure of rank is the order of the lead number within a given state on a specific day. As leads are displayed contiguously on a screen to real estate agents in a manner influenced by user-determined parameters, salience thresholds (such as discontinuities around leads displayed per results screen) are not easily measured.

We view the variation in lead ordering arising from this process as quasi-random, and we show in tests that the ordering is unrelated to observable characteristics of the leads. See Figure 2 for an example of the user interface experienced by real estate agents affiliated with the online platform.

We hypothesize that leads displayed higher in the platform are more likely to garner the attention of affiliated agents (Fedyk 2020) and that the strength of this effect will likely diminish as the lead number declines and listings are placed towards the bottom of the page. For all leads within a state on a given day, we therefore rank the lead numbers (i.e., the highest ranked lead is rank = 1) and define

$$\begin{aligned} \text{Intermediary Attention}_{i,t} & \qquad \qquad \qquad (1) \\ & = -\log(\text{rank of lead number of property } i \text{ created on day } t)/\log(3) \end{aligned}$$

The scaling of the log of the rank by  $\log(3)$  enables us to describe an interquartile increase in rank (i.e., an increase in rank from the third to the first quartile) as an increase of one unit in intermediary attention, which facilitates the interpretation of our results.<sup>5</sup>

We investigate the impact of increased intermediary attention on transaction outcomes for

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<sup>5</sup>That is, defining  $N$  to be the number of leads for a state on a specific day, we have  $-\log\left(\frac{N}{4}\right) + \log\left(\frac{3N}{4}\right) = \log(3)$ .

property  $i$  with a lead created on day  $t$  by estimating the regression

$$\begin{aligned} & \text{Property outcome}_{i,t} & (2) \\ & = \alpha + \beta * \text{Intermediary Attention}_{i,t} + \gamma * \text{controls}_{i,t} + \lambda_{\text{batch}(i,t)} + \delta_{(\text{county}(i), \text{month}(t))} + \epsilon_{i,t}, \end{aligned}$$

where  $\lambda_{\text{batch}(i,t)}$  is a fixed effect for the specific batch (with multiple batches per day at the FSBO/FRBO by state by data source level) that includes the lead for this property,  $\delta_{(\text{county}(i), \text{month}(t))}$  is a county-month fixed effect and  $\epsilon_{i,t}$  is an error term. We cluster standard errors jointly at the level of the county and lead creation week. We also consider spillover effects of intermediary attention by examining outcomes such as future transactions and listings for other properties within a quarter mile of the focal property.

We note that the observations within a batch generally have ranks that are contiguous and that do not overlap with other batches.<sup>6</sup> While batch fixed effects are important for controlling for unobserved characteristics, this does imply that the within-batch variation in intermediary attention that we exploit for identification is not unrestricted. The average standard deviation of within-batch intermediary attention (averaging across batches) is 0.26, which may be compared to the overall sample standard deviation of intermediary attention of 1.00.

## 3 Results

### 3.1 Covariate Balance

We view the variation in lead ordering arising from the batching process as quasi-random. We investigate this description by regressing various property characteristics on intermediary attention and the controls described in equation (2). We show in Table 2 that the number of bedrooms, the number of bathrooms, the log of property square footage and an indicator for a two-car garage

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<sup>6</sup>Of the 134,477 batches in the sample, only 54 have observations with non-contiguous ranks.

are all insignificantly related to intermediary attention. In Section 3.7 we describe a hedonic regression that we conduct using Zillow data of log sales price on various property characteristics. As shown in the fifth column of Table 2, the predicted log sales price from this regression is also not significantly correlated with intermediary attention. We acknowledge that unobserved characteristics such as seller patience (Hendel, Nevo, and Ortalo-Magné 2009) may also affect outcomes, though we have no reason to expect them to be correlated with quasi-random lead ordering. The null results we display in Table 2 for observable variables offer evidence in support of the argument that our measure of intermediary attention is not driven by underlying property characteristics.

### 3.2 The Hiring of Listing Agents

Intermediary attention describes the prominence of a listing on the online platform. Do listings placed higher on the screen indeed garner greater interest from agents and lead to an increased probability that an agent is hired by the seller as the listing agent for the property? Only agents affiliated with the technology platform view these listings, so we should expect increased hiring of affiliated agents. We examine this issue by regressing an indicator for whether an affiliated agent is hired as a listing agent by the property owner subsequent to the lead creation on increased intermediary attention and the controls outlined in equation (2). We find a significant positive impact of increased intermediary attention on affiliated listing agent hiring (coefficient=0.00597 and  $t$ -stat=4.23), as displayed in the first column of Table 3. An interquartile increase in listing rank (i.e., a move from the third quartile to the first quartile of listings, which is equivalent to a one-unit increase in intermediary attention) thus results in a 0.60% higher probability of hiring an affiliated listing agent, which is 3.0% of the mean.

A more prominent listing on the online platform should not increase the probability that a listing is secured by a unaffiliated agent. In fact, a property owner who might have eventually hired an unaffiliated agent is less likely to do so if he is approached by many affiliated agents

who are all seeking his listing. Consistent with that intuition, we show in the second column of Table 3 that increased intermediary attention has a negative (coefficient=-0.002 and  $t$ -stat=-1.95) effect on the hiring of an unaffiliated listing agent.

This result may also be interpreted as an additional placebo test for the exogenous nature of intermediary attention. If intermediary attention is acting as a proxy for some unobservable property characteristic associated with a higher listing probability (despite its lack of correlation with observed characteristics, as shown in Table 2), then it should be associated with a higher probability of hiring unaffiliated listing agents as well as affiliated listing agents. We find, however, that it is only associated with a greater likelihood of affiliated listing agent retention- there is, in fact, a negative effect on the retention of unaffiliated agents, which indicates that intermediary attention is not correlated with an unobservable variable associated with generally higher agent hiring.

Overall, due to the strong impact on affiliated agent hiring, we find that the probability that any listing agent is retained increases in intermediary attention (coefficient=0.0038 and  $t$ -stat=2.34), as described in the third column of Table 3. Further supporting the argument that it is the online platform that is the mechanism driving agent hiring, we show that the probability of a listing agent being hired within 5 days of the lead's being posted is increasing in intermediary attention (coefficient=.0023 and  $t$ -stat=3.49), as outlined in the fourth column of Table 3. Even within three days of the lead post date, we find that properties with higher intermediary attention are more likely to retain a listing agent (coefficient=0.0021 and  $t$ -stat=3.95). This result is shown in the fifth column of Table 3. An interquartile increase in listing rank results in a 0.21% increase in the probability of an agent's being retained within 3 days of the lead being posted, which is 14.4% of the mean. This marked effect for higher-ranked leads specifically within 3 days of the posting is evidence that lead ordering has a meaningful impact in generating listings for affiliated agents.

### 3.3 Attracting New Types of Listing Agents

The results in Table 3 show that the prominent display of a lead on the online platform increases the probability that an affiliated listing agent secures the focal property listing. In order to better understand how this mechanism operates, we examine how the characteristics of the retained agent change when a lead is given a higher placing. Specifically, for each listing agent we calculate the geographical centroid of her prior listings. We regress the log of the distance between this centroid and the focal property on intermediary attention and the standard controls. We find that higher intermediary attention leads to the retention of agents whose previous listings are more distant from the property (coefficient=0.0443 and  $t$ -statistic=3.73), as displayed in the first column of Table 4. An interquartile increase in the rank of a listing results in the hiring of an agent whose previous listings were approximately 4.5% more distant from the property. In other words, the online platform allows non-local agents to access leads that were likely previously inaccessible to her. The relatively large size of this effect suggests that the one of the primary channels by which the platform influences outcomes is through broadening the listing market to include more distant agents.

We define an agent's listing dispersion to be the average of the distance of her previous listings from the agent's listing centroid; this is a measure of an agent's geographic scope. We regress the log of the retained agent's dispersion on intermediary attention and the controls. An increase in intermediary attention brings about the hiring of more geographically dispersed listing agents (coefficient=0.0423 and  $t$ -statistic=3.02), as shown in second column of Table 4. The platform therefore generates listings for agents who are both more distant and who range over wider areas. These are agents who may have less personal visibility into potential local leads, and the platform enhances their ability to secure these listings. Consistent with this claim, we provide marginal evidence, detailed in third column of Table 4, that increased intermediary attention engenders the hiring of listing agents who had no prior listings within a quarter-mile of the focal property (coefficient=0.0045 and  $t$ -statistic=1.84).

We also find that higher intermediary attention leads to the hiring of listing agents who generally secure higher prices. We calculate for each agent the average of her log sale to list price ratio across all her prior listings, and we show in the fourth column of Table 4 that increased intermediary attention leads to the hiring of agents with marginally higher (coefficient=0.0051 and  $t$ -statistic=1.96) ratios; these agents appear to achieve higher prices, on average, for their clients. (We analyze below in Section 3.7 the effect of intermediary attention on the sales price of the focal property itself.) Intermediary attention does not have a significant effect (coefficient=-0.034 and  $t$ -statistic=1.24) on the count of prior listings of the retained agent, as shown in the fifth column of Table 4. Taken together, however, the results in Table 4 present compelling evidence across a variety of metrics that higher intermediary attention leads to the retention of listing agents drawn from a broader pool.

The results in Table 4 may partly reflect the fact that the agents active on the online platform are different from other agents. Indeed, in Table A.1 in the Appendix, we show that online platform agents are more distant from their properties and exhibit greater listing dispersion. In contrast with the causal results, however, affiliated agents are less likely to be new to the local area of the listing. Moreover, the online platform agents are more experienced than other agents but do not have higher average log sale to list price ratios. Greater intermediary attention thus not only offers a seller access to new types of agents but also allows the seller potentially to choose a different kind of agent within this broader set.

### 3.4 Buyers' Agents

The agents we analyze in Sections 3.2 and 3.3 are listing agents hired by sellers to market their properties. A higher lead ordering on the online platform, however, may also have an impact on buyers' agents who assist prospective purchasers in finding a home. In particular, affiliated agents may take note of properties with prominent lead orderings as potential purchase opportunities for their buyers and may be more likely to direct their clients to these properties.

Information on buyers' agents is provided in our data, but it is somewhat more sparse than for listing agents. We can identify the listing agent associated with 33% of leads, but the buyer's agent is reported for only 16.4% of leads. Partly this reflects the fact that every listing involves a listing agent while only consummated transactions involve a buyer's agent, but it may also be a result of incomplete reporting. If buyer's agent reporting is correlated in some way with lead ordering that may generate misleading conclusions. We explore this concern by regressing an indicator for any reported buyer's agent on intermediary attention and the standard controls and we find, as reported in the first column of Table 5, an insignificant effect (coefficient=-0.00017 and  $t$ -statistic=-0.14). There is no apparent bias in the reporting of buyer's agent identity that is linked to lead ordering.

We assess whether affiliated agents are more likely to serve as buyers' agents on properties with high lead orderings by regressing in the full data set an indicator for an affiliated buyer's agent on intermediary attention and the controls. We find that an increase in intermediary attention increases the probability of an affiliated buyer's agent by 0.13% ( $t$ -statistic=1.73), which is 2.5% of the mean. This result is detailed in the second column of Table 5. To account for the fact that the the buyer's agent is often a missing data item, we restrict attention to the sample in which this information is available, and we find that intermediary attention increases the probability that the buyer's agent is affiliated (coefficient=0.0111 and  $t$ -statistic=2.22), as displayed in the third column of Table 5. These buyer agent results are not driven by cases in which the buyer agent is also a listing agent. For observations for which we observe both the buyer and listing agent, 19.2% of transactions use at least one agent in common on both ends. Considering the sample with both buyer and listing agent information and including a control for identical buyer and listing agent little changes the coefficient on intermediary attention (coefficient=0.0105 and  $t$ -statistic=1.81), as we show in the fourth column of Table 5. These results across different specifications show that higher-ranked leads are more likely subsequently to involve affiliated buyers' agents.

### 3.5 Causal Effects of Intermediary Attention

Tables 3, 4 and 5 establish that an increase in intermediary attention has three distinct causal effects on a property: it heightens the probability of affiliated listing agent retention, it attracts the interest of more distant and geographically dispersed listing agents, and it improves the likelihood that an affiliated buyer's agent will be involved in the sale transaction. Intermediary attention thus both increases the probability of intermediation and changes the types of agents who participate in the listing.

In the analysis that follows, we relate intermediary attention to subsequent outcomes for focal properties. Given the multi-pronged effects of intermediary attention, we cannot isolate the impact of any single channel.<sup>7</sup> Our main focus is on assessing the causal effects of agent interest on focal properties, and our empirical estimates reflect all three mechanisms jointly.

### 3.6 Does Intermediary Attention Generate Quick Sales?

We begin by considering whether heightened agent interest leads to quicker sales. One of the key features of intermediaries is that they can connect buyers and sellers and thereby facilitate more rapid transactions. We define a property sale within 60 days of the lead creation date to be a quick sale. As a starting point we regress an indicator for a quick sale on a dummy for whether a listing agent was hired and the standard controls. The agent hiring dummy is obviously endogenous: various unobservable seller and property characteristics are almost certainly correlated with the agent retention decision. Nonetheless, partial correlations in the data may be informative. In addition to the standard controls we include the ratio of historical transactions to listings within one-quarter of a mile in the previous 90 days (winsorized at the 1%- and 99%-levels) as a measure of how active the market is. We find that property owners who hire a listing agent are substantially less likely to quickly sell their properties (coefficient=-0.0314 and  $t$ -stat=-

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<sup>7</sup>A 2SLS regression approach, for example, would improperly attribute the full causal impact of intermediary attention to the one selected endogenous explanatory variable while ignoring the potential influence of the other mechanisms.

7.75), as displayed in the first column of Table 6. By contrast, however, property owners who hire an agent are significantly more likely to sell their property within a year (coefficient=0.121 and  $t$ -stat=21.14), as shown in the second column of Table 6.

These endogenous patterns in the data suggest a preliminary reasonable narrative for the effectiveness of agents in facilitating sales: listing agents are initially slow to close transactions as it takes time for them to access their networks and meet potential new buyers, but in the medium-term hiring an agent meaningfully improves the probability of a sale. We show below that this preliminary interpretation of the endogenous correlations in the data is actually incorrect and misleading.

We contrast the endogenous findings with an analysis based on exogenous changes in intermediary attention. We regress an indicator for a quick sale on intermediary attention and the previous controls, and we find, as described in the third column of Table 6, that increased intermediary attention increases the probability of a quick sale (coefficient=0.00219 and  $t$ -stat=2.19). An interquartile increase in listing rank increases the probability of a quick sale by 0.22%, which is 2.4% of the mean. By contrast, we show in the fourth column of Table 6 that an increase in intermediary attention has an insignificant effect (coefficient=0.000320 and  $t$ -stat=0.19) on the probability of a sale within one year.

Our exogenous measure of intermediary attention thus yields results that contrast notably with those from the endogenous correlations. An increase in intermediary attention generates quick sales but has no differential impact on sales in the medium term. Presumably potential local buyers who were already in the market can be more quickly directed to the focal property after an increase in agent attention. We do not find, however, that agent attention brings a broader set of buyers to the property over the course of a year. Sellers who wish to sell within a year can apparently do so even without heightened intermediary interest. This result is similar in spirit to [Gavazza \(2016\)](#) who shows that in the market for used business aircraft, intermediaries facilitate transactions (and thus earn transaction fees) that may have occurred absent intermediation.

The endogenous findings likely arise from significant selection in which owners choose to

hire a listing agent. The results may be explained by the argument that serious sellers often first try to sell their property on their own and only turn to agents after some time if they have been unsuccessful. The hiring of an agent is therefore negatively correlated with a quick sale, because these sellers only hire agents when they cannot execute a quick sale without an intermediary. Agent retention, however, is positively correlated with a sale within a year because serious sellers who cannot sell quickly seek out agents in the medium-term and sell their properties. While these patterns are interesting, they do not provide evidence on the causal effects of an increase in agent interest in a property. The misleading preliminary endogenous narrative supplied above incorrectly interprets the data. Our measure of intermediary attention shows that the direct impact of heightened agent interest is to increase quick sales, but it has no effect on sales within a year. Our results on quick sales are consistent with the findings in [Hendel, Nevo, and Ortalo-Magné \(2009\)](#) that agent-listed properties sell more quickly than those marketed as FSBOs and with the results in [Barwick, Pathak, and Wong \(2017\)](#) that increased commissions to agents of buyers result in faster transactions.

In Table [A.2](#) in the Appendix, we show that our sample properties are 11.6% less likely to be sold within 60 days when compared to general agent-listed properties. When controlling for location and property characteristics, this difference drops to 1.5%. When accounting for these characteristics, an interquartile increase in intermediary attention therefore accounts for about 15% of the average difference in quick sale probabilities between our properties and general agent-listed properties. The remaining difference may partly be explained by the heterogeneity in seller attributes that we describe in [Section 1](#).

In the fifth column of [Table 6](#) we display the result from regressing an indicator for ever selling the property on intermediary attention and find an insignificant result (coefficient=0.00234 and  $t$ -stat=1.47); this is consistent with the null effect on selling within one year.

We find some evidence that an increase in intermediary attention leads to a higher probability of a sale after two years (coefficient=0.00166 and  $t$ -stat=1.94), as described in the sixth column of [Table 6](#). A listing agent retained shortly after the lead creation is perhaps unlikely to keep

the listing for two years, so this result may reflect the results in Table 5 that we described above: affiliated buyers' agents may keep the property in mind when attempting to find houses for future clients.

### 3.7 Intermediary Attention and Prices

The findings in Table 6 show that higher agent interest generates quick sales. In this section we analyze the impact of intermediary attention on the transaction price. For every transacted property in the Zillow database, we implement a hedonic regression of the log of the sales price on fixed effects at the level of zip code-year-month-number of beds-square foot buckets, where the square foot buckets have a size of 100 square feet. This provides a price residual for a property relative to a set of quite similar properties. We assign to each lead from the platform database that was eventually sold the winsorized price residual (at the 1% and 99% levels) from the Zillow model.

We provide a descriptive sense of the data by regressing this price residual on an indicator for whether the property was listed with an agent; we include the standard controls and a control for the average historical price residual for all properties sold within a quarter mile in the 90 days before the lead creation date, where this average residual is winsorized at the 1% and 99% levels. We find that properties listed with an agent have price residuals that are 2.64% higher ( $t$ -statistic=6.38), as shown in the first column of Table 7. This endogenous correlation could indicate that agents reap higher prices for their clients or it may reflect some unobserved difference between property owners who do or who do not retain agents.

We analyze the causal impact of heightened agent interest on pricing by regressing the focal property price residual on intermediary attention, the average historical price residual and the standard controls. We find that increased intermediary attention results in a higher price residual (coefficient=0.00645 and  $t$ -stat=1.88), as displayed in the second column of Table 7. An interquartile increase in the rank of a listing generates a 0.65% higher price. When agents are

more interested in a property, it sells for a higher price.<sup>8</sup>

As an alternative specification, we regress the log of the sales price (i.e., not the residual) on intermediary attention and include as an explanatory variable the log predicted sales price from the hedonic regression along with the standard controls. This yields a similar positive coefficient on intermediary attention (coefficient=0.00759 and  $t$ -stat=1.80), as detailed in the third column of Table 7. (As expected, the  $R^2$  is quite high in this regression, which includes the log predicted sales prices as an explanatory variable, relative to the regressions in the first two columns in which the dependent variable is the log sales price residual.)

Greater intermediary attention thus both increases the probability of a quick transaction and leads to higher prices. Related work (Genesove and Mayer 2001; Hendel, Nevo, and Ortalo-Magné 2009; Barwick, Pathak, and Wong 2017) has emphasized the trade-off between faster sales and higher prices, but we find that intermediary attention enhances both of these aspects of a transaction from the perspective of the seller. Our analysis, however, does not account for agent commissions, which we do not observe, and which are analyzed in some of these other studies.

We explore the mechanism by which intermediary attention influences prices by estimating its effect across several split samples. We first consider the thickness of the local market, for which we proxy with the ratio of new listings relative to transactions over the prior 90 days within a quarter-mile of the focal property. When this inventory-to-sales ratio is high (i.e., above the median), we view the market as thick: there is a relatively large number of properties available for sale. As shown in the first two columns of Table 8 Panel A, we find in the endogenous tests that the hiring of an agent is associated with higher prices in both relatively thick (high inventory-to-sales ratio) and thin (low inventory-to-sales ratio) markets. In the first two columns of Table 8 Panel B, however, we show that increased intermediary attention leads to higher prices in thick markets (coefficient=0.0115 and  $t$ -stat=2.56) but not in thin markets (coefficient=0.0032 and  $t$ -

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<sup>8</sup>This finding may be interpreted to be consistent with the result in Hendel, Nevo, and Ortalo-Magné (2009) showing higher prices for properties initially marketed as FSBOs and later sold on the MLS. Our approach differs in our focus on the impact of a quasi-random increase in intermediary attention.

stat=0.50).

These findings are consistent with the argument developed in Section 3.6 that agents are particularly effective in directing potential local buyers who were already in the market to the focal property, but that agents do not, apparently, augment the pool of potential buyers. Under this understanding of the role of agents, they should be more effective in raising prices in thick markets, in which there is a relatively large number of properties competing for buyers. Agents can assist in steering potential buyers to the focal property. In thin markets with few competing properties, it is relatively less important to have an agent seize the attention of potential buyers; buyers will likely make their way to the focal property irrespective of whether it has an agent.

In columns three and four of Table 8 Panel A we show that agent retention is endogenously correlated with higher sales prices in both properties that have a typical number of beds relative to surrounding properties within a quarter-mile radius and in properties that have an atypical number of beds. (Typical properties are those in the 2nd, 3rd, or 4th quintiles of beds, while atypical properties lie in the 1st or 5th quintiles). In the causal regressions in columns three and four of Table 8 Panel B, we find that intermediary attention has an impact for typical properties (coefficient=0.0174 and  $t$ -stat=2.13) but not for atypical properties (coefficient=-0.0032 and  $t$ -stat=-0.51). This result supports the interpretation that agents have a greater impact in increasing prices for more common properties with many similar competitors. On the other hand, as displayed in the fifth and sixth columns of Table 8 Panel B, this distinction between typical and atypical properties does not hold when sorting on square footage, so it should be regarded with some caution. Taken together, the findings in Table 8 provide weak evidence that intermediary attention generates higher sales prices particularly in thick markets with many competing properties.

The results in Table 8 may also be used to assess whether intermediary attention is likely to have stronger or weaker effects on general agent-listed properties relative to the estimates for our sample properties. Columns three and four of Table 8 Panel B show that the causal impact of intermediary attention is greatest for properties with bedroom counts in the middle quintiles. We find that only 35.5% of our sample properties have bedroom counts in the middle quintiles

of their local properties. This is evidence that the causal effects of intermediary attention may be larger in the general agent-listed sample. Given the uniform effects we find in Table 8 Panel B across properties with different square footage, however, it is likely that any such differences will be relatively small.

### **3.8 Listing Spillovers**

Consider a focal property that receives increased intermediary attention. We have shown that such properties are more likely to be listed and sold quickly. We now consider the spillover effects of intermediation. Does increased intermediary attention on a given property divert attention from neighboring properties and result in reduced listings and transactions in nearby homes? Or, by contrast, does heightened intermediary attention on the focal property generate neighborhood-level benefits that facilitate other local listings and sales? More broadly, do intermediaries mainly resolve frictions at the asset or market level?

We evaluate the empirical evidence on these competing hypotheses. Our tests to this point have focused on the impact of intermediary attention on the leads in the online platform. We now shift attention to the full set of properties in the Zillow database.

We exploit variation in intermediary attention to the online platform leads in order to study potential spillovers on the broad set of properties in the wide-ranging Zillow data. That is, we are considering the spillover effect on all residential properties, not only on FSBOs and FRBOs. This expansion of the analysis has the added benefit of alleviating concerns about the relevancy of FSBOs and FRBOs as it demonstrates their impact on the broader market. It is important in these tests to control for shifting neighborhood conditions, so we use as our measure of local listing intensity the ratio of other listings within a quarter mile of the focal property to other listings within 2 miles of the focal property. This variable, which excludes the focal property listing, describes the frequency of listings very close to the property while controlling for neighborhood effects.

We begin by considering endogenous patterns of correlations between a listing of the focal property and the local listing intensity of neighboring properties. In this analysis we include controls for the historical listing intensity and for the historical transaction intensity, where the latter is defined as the ratio of neighboring property sales within a quarter of a mile to neighboring property sales within two miles. Specifically, we regress the local listing intensity on an indicator for a focal property agent listing, fixed effects for historical listing and transaction intensities in the previous 90 days (rounded to the nearest hundredth) and the previous controls. We show in the first column of Panel A of Table 9 that when the focal property is listed with an agent, this is followed by an increase in the local listing intensity (coefficient=0.0011 and  $t$ -stat=3.69) over days 0 to 30 after the lead creation date. A similar pattern is seen across time horizons out to 1 year. The results displayed in Panel A of Table 9 provide convincing evidence that listings tend to increase in concert within neighborhoods. The endogenous nature of listing choices, however, makes it difficult to know if the listing of the focal property actually drives neighboring listings.

We evaluate whether a given listing has a causal impact on other local listings by regressing the subsequent local listing intensity on intermediary attention and the controls. We find, as shown in the first column of Panel B of Table 9, that an increase in intermediary attention reduces (coefficient=-0.0006 and  $t$ -stat=-3.03) local listings relative to those in the broader neighborhood over days 0 to 60. An interquartile increase in listing rank decreases the local listing intensity by 0.06%. This negative effect of intermediary attention on local listing intensity is concentrated within the first 90 days following lead creation.

These clear negative impacts stand in direct contrast to the endogenous positive correlations documented in Panel A. Taken together, these findings indicate that unobserved local shocks lead to many listings occurring at the same time in a neighborhood, but the causal impact of greater intermediary attention on a given focal property is to reduce neighboring listings. The main effect of intermediation is to ameliorate property-level, not neighborhood-level, frictions.

### 3.9 Transaction Spillovers

We also consider the spillover effects of intermediary attention on local transactions. We calculate for each focal property the local transaction intensity which is defined as the ratio of other properties sold within a quarter-mile to other properties sold within two miles. This measure excludes the focal property, and we calculate it over various horizons following the lead creation date. In these tests, as for the neighbor listing analysis above, we consider the spillover impact of intermediary attention on the full set of Zillow database properties.

We begin by considering the endogenous correlation between the local transaction intensity and a quick sale (i.e., a dummy for whether a focal property was sold within 60 days of the lead creation date). We regress the local transaction intensity on a quick sale indicator, fixed effects for historical transactions and listing intensities in the previous 90 days (rounded to the nearest hundredth) and the standard controls. As shown in Panel A of Table 10, the coefficient on quick sale is positive and significant over all horizons ranging from 0 to 30 days to 0 to 365 days. This indicates that transactions are geographically clustered; a quick sale of the focal property is associated with sales of other nearby properties. This may be driven by many potential factors such as shifts in highly localized housing demand or in area amenities.

A quick sale of a property may depend on various unobserved variables, so these positive coefficients do not offer a straightforward interpretation. We seek to understand the causal effect of heightened agent interest by regressing local transaction intensity on our quasi-random measure of intermediary attention and the previously described controls. As we show in the first two columns of Panel B of Table 10, intermediary attention has an insignificant effect on neighboring transactions in the 30 and 60 days after the lead creation. This is perhaps unsurprising as a focal property quick sale will likely require some lead time to have an impact on neighboring properties. Moreover, intermediary attention first decreases local listing intensity at a 60-day horizon (as displayed in Table 9), and one would expect to observe an effect on listings before transactions. For example, in January 2018 Zillow reported a mean 54-day period for a listing to

switch to pending status. In the same month, the mean closing period for mortgages was 47 days, as described in Ellie Mae's *Origination Insight Report*.<sup>9</sup>

At longer horizons we find a negative and significant effect of intermediary attention on neighboring property sales: there is a meaningful negative impact at horizons of 180, 270 and 365 days. This lagged effect relative to the impact on listings that is observed beginning at a 60-day horizon is consistent with the roughly 100-day period it takes for a property to enter escrow and then for the transaction to close. Intermediary attention may also have a negative spillover effect on FSBOs which, as show in Table 1, spend a longer time on the market than properties that were originally agent-listed. In Table A.8 we find that the negative impact of intermediary attention on neighboring transactions peaks at the 180-270 day period. Figure A.1 depicts this result graphically.

In the eighth column of Panel B of Table 10, we show that at a 365-day horizon an interquartile increase in listing rank decreases the local transaction intensity by 0.028% ( $t$ -stat=-2.78). For a focal property in an area with a median number of transactions, an interquartile increase in listing rank leads to 0.14 fewer property sales in the neighborhood over the following 365 days, indicating sizeable spillovers.<sup>10</sup> Our results documenting negative spillovers on transaction intensities complement work finding that owner characteristics can lead to negative price spillover effects (Giacoletti and Parsons 2023). These transaction results offer further evidence that intermediaries in this market act mainly to facilitate property-level outcomes, rather than addressing market-wide challenges.

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<sup>9</sup>Sources: <https://www.zillow.com/research/data/> and *Business Wire*, March 21, 2018.

<sup>10</sup>We calculate the -0.14 reduction in transactions by multiplying our coefficient in column 8, Panel B, of Table 10 by the median number of transactions within a 2-mile radius in the 365 days following the lead appearing on the online platform. This allows us to recover the predicted decrease in transactions within a 1/4-mile. Thus, our results indicate that an interquartile increase in intermediary attention towards one property decreases neighboring transactions by 0.14 housing units within a 1/4 mile.

### 3.10 Heterogeneity of Effects

The previous analysis establishes that an exogenous increase in intermediary attention leads to an increased probability of retaining an affiliated listing agent, the entry of more distant listing agents into the market, a greater likelihood of the involvement of an affiliated buyer's agent, quicker sales, higher sales prices and fewer neighboring listings and transactions. In this section, in order to further elucidate the underlying mechanism, we consider whether more prominent lead placement in the online platform has a heterogeneous impact on properties with varying characteristics.

Our main heterogeneity hypothesis is that greater intermediary attention should matter more for properties that have, *ex ante*, a relatively low probability of being serviced by an agent. For properties that were likely to be listed with an agent in any event, a prominent lead placement should matter less. The counter hypothesis is that increased agent interest will only matter for properties with a high initial propensity to be listed. Perhaps owners who are resistant to listing are unlikely to be swayed by the calls of multiple prospective listing agents.

As a first approach, we consider the fraction of historical transactions within a quarter-mile of the focal property over the past 90 days that were listed with an agent. Under the main heterogeneity hypothesis, increased intermediary attention should be less effective in areas in which most transactions are regularly listed with an agent. We regress an indicator for whether the owner retained an affiliated agent on intermediary attention, the fraction of historical transacted properties listed with an agent, the interaction between these two variables and the standard controls. We find, as displayed in the first column of Table 11, that the interaction is negative (coefficient=-0.006 and *t*-stat=-2.47): increased intermediary attention does indeed have less of an impact in neighborhoods in which agents are already very active. This is evidence in support of the main heterogeneity hypothesis.

Agents are more likely to be retained to market large properties. In an unreported regression of an indicator for hiring an affiliated agent on the log of property square feet, lead creation

month-county fixed effects and batch fixed effects, we find that the coefficient on log of square feet is positive and highly significant (coefficient=0.08 and  $t$ -stat=20.62). An analogous regression replacing log of square feet with number of bedrooms yields a positive and significant coefficient on number of bedrooms (coefficient=0.02,  $t$ -stat=16.28). These results suggest that owners of larger properties typically hire agents so that an increase in intermediary attention is less likely to affect the agent retention decision. In the second and third columns of Table 11, we describe results confirming this intuition. The interaction between intermediary attention and log square feet is negative (coefficient=-0.008 and  $t$ -stat=-3.55), as is the interaction between intermediary attention and the number of bedrooms (coefficient=-0.003 and  $t$ -stat=-2.98).

The results described in Table 11 offer uniform support to the main heterogeneity hypothesis that intermediary attention is most important for properties that are naturally less likely to be listed by agents. Increased agent interest in these properties can encourage owners who had perhaps not been thinking of pursuing a formal listing to retain an intermediary.

## 3.11 Robustness and Magnitude Calibration

### 3.11.1 Robustness

In Table A.3 in the Appendix, we show that our main results are largely driven by the differential effects of top-quartile and non-top-quartile leads. Agent attention appears to be mainly focused on properties that are ranked in the top quartile. Table A.4 in the Appendix displays the results for the second through fourth quartiles. The effect is broadly monotonic across the quartiles, and the strongest effects are clearly found for top quartile properties.

In Table A.5 we show results interacting intermediary attention with indicators for vacant land and one-bedroom houses. We do not find that the interactions are significant: the effects of intermediary attention do not appear to vary significantly with the property type.

### 3.11.2 Magnitude Calibration

As described in Section 3.5, the multi-faceted impact of intermediary attention does not allow us to conduct a 2SLS analysis. Specifically, the results in Tables 3, 4 and 5 describe three distinct mechanisms by which intermediary attention affects properties: it heightens the probability of listing agent retention, it attracts the interest of more distant and geographically dispersed listing agents, and it improves the likelihood that an affiliated buyer's agent will be involved in the sale transaction. We therefore cannot isolate the causal effect of any given channel. Using a basic model relating property outcomes to the three mechanisms and making assumptions about parameter values lying in reasonable ranges, however, we can use a calibration to provide a general assessment of the relative importance of the magnitudes.

In the Appendix we provide details on the simple model we use. It reflects the effects of hiring a listing agent, the maximal distance from a property for which an agent will consider seeking the listing and whether a buyer's agent is interested in bringing her client to the property. This basic model ignores potential cross-effects of the three mechanisms, and it also rules out other mechanisms such as the effects of increasing the interest of more experienced agents. This approach can therefore only provide general guidance on the relative importance of the three mechanisms.

We use the estimated results from Tables 3, 4 and 5 to calculate the effect of an increase in intermediary attention on each of these mechanisms. For each of the main outcome variables in the paper, we then decompose the estimated effect of intermediary attention into the impacts of the three mechanisms. This requires some subjective assumptions. For example, the sample frequency of quick sales is 10%, and we assume that the maximum plausible impact of hiring a listing agent would be to double this number. We similarly assume that the maximal effect of attracting a listing agent is to increase the probability of a quick sale by 10%. Under these generous assumptions, we then calibrate the impact on quick sales of increasing the radius of potential agents so that we match the total impact of intermediary attention estimated in the third

column of Table 6. We then calculate the fraction of the overall impact of intermediary attention that arises due to each of the three mechanisms. As outlined in the third column of Panel A of Table A.6, we find that even assuming quite large effects on quick sales of hiring a listing agent and attracting a buyer's agent, a substantial impact (32.6% of the total) comes from increasing the radius of prospective agents. Under this calibration, a 10% increase in the radius of prospective agents (i.e., a 21% increase in the catchment area of agents) would result in approximately a 0.17 percentage point increase in the probability of a quick sale. Given these assumptions, 17.2% of the total effect of intermediary attention arises from hiring a listing agent and 50.2% of the overall impact derives from attracting a buyer's agent.

We show in Table A.6 that under reasonable assumptions for each of our main outcome variables, a large effect appears to arise from the mechanism by which increased intermediary attention leads to a broader pool of potential listing agents, while the direct impact of simply hiring any listing agent is quite modest. This has two implications. First, it suggests that agent heterogeneity is meaningful. Gaining access to higher-quality (or better-matched) listing agents can have a substantial impact on transaction speeds and prices. Second, the relatively small fraction of the overall effect that we attribute to hiring any listing agent indicates that the provision of standard agent services (e.g., managing paperwork or granting access to a group of agents who only cooperate with other agents), appears not to drive our results. That is not to say that the calibration results show that hiring an agent has a small influence on property outcomes; indeed, in some of the specifications we presume that its impact is quite large. It does demonstrate, however, that the intermediary attention we study affects price and volume largely through increasing the set of interested agents rather than by increasing the probability that any listing agent is retained.

## 4 Implications for Theories of Intermediation

Section 3 presents results describing the impact of an exogenous increase in intermediary attention on listings, agent characteristics, transaction speeds, prices and spillovers. In this sec-

tion, we evaluate the implications of these findings for three theories of intermediation: search, information and behavioral.

## 4.1 Search Theories

Search models such as [Duffie, Gârleanu, and Pedersen \(2005\)](#) emphasize the role that intermediaries play in reducing the frictions impeding trade and facilitating the matching of sellers and buyers. From the perspective of search theory, an increase in intermediary attention increases the probability of an encounter between an agent and the property owner. An increase in the probability of such an encounter is predicted to increase the probability of agent retention ([Duffie, Gârleanu, and Pedersen 2005](#); [Gavazza 2016](#)), and that is precisely what we find in [Table 3](#).

In [Table 6](#) we show that greater intermediary attention leads to a higher sale probability within 60 days but has no impact on whether the property is sold within a year. A search theory view of these results is that agents hasten the meeting of interested buyers with sellers, resulting in quicker sales. Over a long period of time, however, buyers may encounter sellers on their own, even without the assistance of an agent.

We display in [Table 7](#) the finding that heightened intermediary attention leads to higher sales prices. This result is consistent with the intuition from theories of search that intermediaries promote better matches between sellers and buyers which results in higher transaction prices. For example, in [Duffie, Gârleanu, and Pedersen \(2005\)](#) intermediaries can facilitate the sale of an asset to a buyer with a higher valuation. By reducing search frictions in this way, intermediaries help sellers garner better pricing. A similar intuition emerges in the model of [Vayanos and Weill \(2008\)](#), who show that assets with more buyers and short-sellers sell at a premium due to diminished search frictions.

The predictions of search theories also comport with our findings in [Tables 9](#) and [10](#) that increased intermediary attention reduces neighboring listings and transactions. Search models indicate that increased intermediary attention on a focal property will reduce the frequency of

neighboring property listings: the focal property captures the attention of potential buyers and therefore discourages rival listings. In essence, properties compete for the interest of prospective local buyers, and greater intermediary attention on the focal property reduces the notice that will be paid to neighboring properties. This is particularly true if, as we show in Table 4, the increase in intermediary attention attracts active listing agents who range over a broad geographical scope.

Further, from a search theory perspective, a prominent listing on the online platform leading to a quick sale of the focal property serves to remove a potential local buyer of area properties from the pool. In effect, greater agent interest in the focal property captures a local buyer and thereby reduces sale probabilities of neighboring properties.

Our negative transaction spillover results are consistent with theories of segmented search. We establish that a certain subset of potential buyers is interested in purchasing properties within a given narrow geographical area. If buyers did not segment themselves in this way, then we would not observe negative spillovers to nearby properties; the buyers redirected to the focal property would arrive from all over the city and this would not have a particularly negative effect on transactions in closely adjacent properties. A negative spillover to local properties is therefore evidence in favor of search theories generally and supports the importance of segmented search in particular (Piazzesi, Schneider, and Stroebel 2020).<sup>11</sup> Taken together, our empirical findings are broadly consistent with implications of search theories.

## 4.2 Information Theories

In information models intermediaries reduce the informational disadvantage suffered by potential buyers; this can encourage market participants to make purchases (Milgrom and Stokey 1982). Information theories thus suggest that increased intermediary attention should generate quick property transactions, as we observe.

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<sup>11</sup>While our contribution is to produce causal empirical estimates of intermediation, a large empirical literature evaluates search frictions in real and credit markets. Relevant papers include Hortaçsu and Syverson (2004), De los Santos, Hortaçsu, and Wildenbeest (2012), Alexandrov and Koulayev (2018), Allen, Clark, and Houde (2019) and Agarwal, Grigsby, Hortaçsu, Matvos, Seru, and Yao (2020).

From an information theory perspective, intermediaries can certify asset qualities and reduce information discounts, which increases prices (Myers and Majluf 1984). This prediction is consistent with our finding that greater intermediary attention leads to higher prices.

The implications of information theories for listing and transaction spillovers depend on the type of information asymmetries that agents mitigate. If agents serve to reduce asymmetric information about neighborhood characteristics, then greater intermediary attention on the focal property has distinct information effects on buyers and sellers, both of which should lead to more neighborhood listings. From the standpoint of buyers, agents supply information about the neighborhood, and the listing of the property itself provides useful price information to potential purchasers of nearby properties. From the perspective of sellers, they receive information about the state of the market from the listing, and they may learn more about the listing agent herself. In a rational information herding setting (Banerjee 1992; Bikhchandani, Hirshleifer, and Welch 1992), a choice by the focal property owner to list may induce neighbors to also list, as the neighbors interpret the focal property listing as a signal about increasing demand for the area. This suggests that greater intermediary attention should lead to more neighboring listings, but we find the opposite.

Similarly, greater agent interest in the focal property should minimize information issues and encourage transactions for neighboring properties as well. The price at which a quick sale transacts will be useful data for potential buyers. Information theories therefore predict that heightened intermediary attention on the focal property should increase neighboring transactions, but we show that local transactions decrease in intermediary attention. Our listing and transaction spillover results are therefore not consistent with agents' reducing information asymmetries

about the neighborhood.<sup>12</sup>

It is appropriate to note, however, that we show in Table 4 that, conditional on hiring an agent, the agents drawn to the focal property by higher listing placement in the online platform tend to be from more distant locales and are more likely to be new to the area. Perhaps these agents, in particular, are less likely to supply information about the neighborhood. As a contrasting point, we do find in Table A.1 that affiliated agents, in general, are more experienced than other agents and are less likely to have never had a prior local listing, so the online platform is attracting to the property a group of reasonably informed intermediaries.

If the information asymmetries that agents reduce concern the property itself, however, then greater intermediary attention should lead to quicker sales and higher prices, which we find. It may also be the case that the reduction in information issues for the focal property diverts buyers to that property in particular; if the number of potential buyers in a given area is effectively fixed, then greater intermediary attention on the focal property will generate the negative spillover effects on neighboring listings and transactions that we observe. In other words, our results are broadly consistent with agents' acting to mitigate property-specific information issues.

### 4.3 Behavioral Theories

Agents may also influence property outcomes via behavioral mechanisms. For example, an exogenous increase in intermediary attention may cause the seller to develop an exaggerated sense of the demand for her property, as she fields many calls from agents who wish to represent her. This could lead the seller to select a higher list price. Conversely, intermediaries may provide objective assessments of the property's value that may shift the seller from her over-optimistic

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<sup>12</sup>Our results do not rule out the existence of neighborhood-level asymmetric information in intermediated real estate markets. Indeed, [Garmaise and Moskowitz \(2004\)](#), [Levitt and Syverson \(2008\)](#), and [Kurlat and Stroebel \(2015\)](#) demonstrate that valuable private information about neighborhood characteristics can influence equilibrium outcomes in real estate markets. These papers demonstrate the existence of asymmetric information about the local area but do not pursue the question we pose in this paper, namely, whether intermediaries primarily serve to reduce asymmetric information frictions. Recent work argues that the information advantage of housing agents may not be as large as previously thought ([Liu, Nowak, and Smith 2020](#)).

beliefs. In that case, increased intermediary attention could reduce list prices. There is evidence that sellers tend to fasten on the price they themselves paid for the property (Genesove and Mayer 2001; Andersen et al. 2022; Giacoletti and Parsons 2023), and intermediaries may help to modify these reference dependent beliefs.

We investigate these contrasting hypotheses by analyzing the initial list price (defined as either the identified original list price, when available, or the first list price displayed) for properties that were eventually listed by agents (list prices on the online platform were not supplied to us). We regress the residual log initial list price on intermediary attention, the residual log of the last purchase price and the standard controls and display the results in Table 12.<sup>13</sup> As shown in the first column, the initial list price is increasing (coefficient=0.00636 and  $t$ -statistic=1.99) in intermediary attention; in support of the first hypothesis, we find that agents lead to higher listing prices. We also find, consistent with previous work, that the initial list price is increasing in the residual log of the last purchase price (coefficient=0.121 and  $t$ -statistic=19.16). To test if agents help to mitigate reference-dependent beliefs, we include as an additional explanatory variable the interaction between intermediary attention and the residual log of the last purchase price. As displayed in the second column of Table 12, this interaction is insignificant (coefficient=-0.001 and  $t$ -statistic=-0.24). There is no evidence that greater intermediary attention reduces the importance of sellers' reference-dependent beliefs. Consistent with the argument that greater agent presence raises list prices, in the third column of Table 12 we show that relative to the original purchase price, list prices are increasing in intermediary attention (coefficient=0.013 and  $t$ -statistic=2.06).

We further consider whether intermediary attention results in more frequent list price changes, perhaps arising from the higher initial list prices that we document. As we show in the fourth and fifth columns of Table 12, higher intermediary attention does not generate more frequent list

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<sup>13</sup>These residual log initial list prices are calculated using the following set of fixed effects: year-month, zip code-year, zip code-number of beds and zip code-hundred square foot buckets. Using the same fixed effects we employed for the price residuals described in Section 3.7 (i.e., zip code-year-month-number of beds-hundred square foot buckets) yields qualitatively similar findings, as shown in Table A.7, but results in a much reduced observation count.

price changes, either directly or when interacted with the log of the ratio of the list price to the original purchase price.

#### 4.4 Property-specific Agent Effects

There are other potential agent functions that can affect outcomes. For example, agents may specialize in staging properties or in ensuring that negotiated deals are consummated.<sup>14</sup> Both these agent roles could lead to quicker transactions (Table 6), higher sales prices (Table 7), and potentially negative spillovers to neighboring properties (Tables 9 and 10) if they divert prospective buyers to the focal house. We do not observe staging characteristics or failed escrows, so we cannot provide direct evidence on these mechanisms, but property-specific agent effects of these kinds would be consistent with our main findings.

## 5 Conclusion

We study the role of intermediation in the U.S. residential housing market by exploiting exogenous variation in the attention paid by agents to listings on an online platform. We show that properties quasi-randomly displayed higher on the screen receive greater intermediary attention: they are more likely to be listed by agents affiliated with the platform even though they do not differ in their observable qualities. Higher-ranked properties are listed by more distant agents who range over broader geographical areas. We find that increased intermediary attention leads to a higher probability of a quick sale of a property and a higher transaction price. Our analyses suggest that the main driver of these results is that enhanced intermediary attention leads to a richer pool of potential listing agents; the direct impact of simply hiring any listing agent is modest.

Heightened intermediary attention reduces the listing and transaction intensities of neigh-

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<sup>14</sup>We thank an anonymous referee for these points.

boring properties. These latter results provide causal evidence in favor of search, information and behavioral theories that agents act mainly to reduce frictions at the property level rather than at the neighborhood level.

Online platforms are often thought to promote disintermediation, but our findings show that intermediary-oriented platforms can act as a powerful mechanism to encourage greater use of agents. The focused market attention and personal networks of intermediaries are thus likely to remain critical for facilitating transactions even in environments in which technology acts to reduce overall frictions.

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**Table 1**  
**Summary Statistics**

<i>Panel A: Online Platform Leads</i>	Obs.	Mean	Std. Dev.	Q5	Q25	Q50	Q75	Q95
FRBO	654,991	0.41	0.49					
# Bedrooms	621,204	3.04	0.82	2	3	3	4	4
# Bathrooms	617,742	2.34	0.73	1	2	2	3	3
Sq Ft	605,822	1,861	867	800	1,200	1,700	2,300	3,600
Two-Car Garage	157,997	0.81	0.39					
Lead Create Date	654,991	5/9/2017	279 Days	3/4/2016	8/24/2016	5/16/2017	1/18/2018	6/28/2018
Rank of Lead Number	654,991	18.02	23.49	2	5	11	22	61
Batch Size	654,991	12.68	16.91	2	4	7	15	41
Intermediary Attention	654,991	-2.11	1.00	-3.74	-2.81	-2.18	-1.46	-0.63
Hired Agent	654,991	0.33	0.47					
Hired Affiliated Agent	654,991	0.20	0.40					
Hired Unaffiliated Agent	654,991	0.13	0.33					
Days Until Agent Hiring	221,178	251.22	333.02	4	23	77	387	1,008
Ever Sold	654,991	0.55	0.50					
Sold Within One Year	654,991	0.41	0.49					
Quick Sale	654,991	0.10	0.29					
Sales Price (\$ '000s)	252,895	295.47	261.43	60	155	239	360	695
Sales Price Residual	82,407	0.09	0.42	-0.44	-0.07	0.06	0.25	0.75
<i>Panel B: Proximate Agent Listings</i>	Obs.	Mean	Std. Dev.	Q5	Q25	Q50	Q75	Q95
# Bedrooms	2,014,886	3.05	0.98	2	2	3	4	5
# Bathrooms	1,982,319	2.17	0.78	1	2	2	2.5	3.5
Sq Ft	2,429,241	1,815.30	892.13	838	1,202	1,603	2,190	3,551
<i>Panel C: Online Platform Lead less Proximate Agent Listing Mean</i>	Obs.	Mean	t-stat					
# Bedrooms	475,873	0.0155***	(9.52)					
# Bathrooms	475,873	0.0002	(0.18)					
Sq Ft	416,553	-29.92***	(-24.45)					
Building Age	417,757	-1.433***	(-48.30)					
Sales Price (\$ '000s)	205,518	10.46***	(28.23)					
Time on Market	63,489	46.37***	(50.38)					
Initial List Price (\$ '000s)	321,241	-3.68***	(-12.63)					

Panel A of this table presents summary statistics for our sample of leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. Panel B, relating to Proximate Agent Listings, reports property characteristic summary data for the properties listed by agents that occurred within 1-year and a quarter-mile of a lead on the online platform, that themselves did not appear as leads on the online platform. Panel C reports compares the characteristics of the leads from the online platform less the average of the properties listed by agents that occurred within 1-year and a quarter-mile of the focal lead, averaged across the focal leads.

**Table 2**  
**No Relationship Between Lead Order and Observables**

	Number Of Bedrooms (1)	Number Of Bathrooms (2)	Log Square Feet (3)	Two-Car Garage (4)	Predicted Log Sales Price (5)
Intermediary Attention	-0.000385 (-0.13)	-0.00268 (-0.97)	0.00285 (1.55)	0.00193 (0.64)	-0.000160 (-0.03)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes
Number of observations	615,482	611,773	596,093	106,403	121,483
Adj. R <sup>2</sup>	0.129	0.200	0.157	0.055	0.385
Dependent Variable Average	3.04	2.13	5.13	0.81	12.15

This table presents estimates from regressions where the dependent variables are various observable characteristics associated with the focal lead. Columns (1)-(4) utilize the number of bedrooms, the number of bathrooms, the log of the square footage of the structure, and an indicator for whether the property includes a two-car garage, respectively. Column (5) utilizes the fitted value for the focal lead, conditional on sale, from a hedonic model of log sales price, fit over the entire sample of ZTRAX transactions. The explanatory variable of interest utilized throughout is a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform. The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. The samples are further restricted to observations with valid, non-missing, values for the covariate utilized as the dependent variable in the particular regression reported. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. Additionally, the average of the dependent variable in the regression sample is reported. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 3**  
**Lead Order Drives Hiring of Affiliated Agents**

	Hired Affiliated Agent (1)	Hired Unaffiliated Agent (2)	Hired Agent (3)	Hired Agent, Within 5 Days (4)	Hired Agent, Within 3 Days (5)
Intermediary Attention	0.00597*** (4.23)	-0.00221* (-1.95)	0.00376** (2.34)	0.00232*** (3.49)	0.00213*** (3.95)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes
Number of observations	654,991	654,991	654,991	654,991	654,991
Adj. R <sup>2</sup>	0.172	0.143	0.213	0.013	0.007
Dependent Variable Average	0.20	0.13	0.33	0.023	0.015

This table presents estimates from regressions where the dependent variables are various outcome measures associated with whether agents were hired to list the focal lead. Columns (1)-(3) utilize an indicator for whether the lead was ever listed with an agent that is affiliated with the online platform, an indicator for whether the lead was ever listed with an agent that is not affiliated with the online platform, and an indicator for whether the lead was ever listed with an agent irrespective of their association with the online platform, respectively. Columns (4) and (5) utilize indicators constructed similarly to that used in column (3), but focusing on whether the agent was hired to list the lead within 5 days and 3 days, respectively, of the lead appearing on the online platform. The explanatory variable of interest utilized throughout is a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform. The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. Additionally, the average of the dependent variable in the regression sample is reported. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 4**  
**Attracting New Types of Agents**

	Log Distance From Hired Agent Center (1)	Log Hired Agent Listing Dispersion (2)	Hired Agent has no Prior Listings Within 0.25 Miles (3)	Average of Agent's Log Sales to List Price Ratio (4)	Hired Agent Listing Count (5)
Intermediary Attention	0.0443*** (3.73)	0.0423*** (3.02)	0.00446* (1.84)	0.00513* (1.96)	0.0338 (1.24)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes
Number of observations	127,299	119,431	125,207	104,257	134,817
Adj. R <sup>2</sup>	0.031	0.026	0.021	0.164	0.654

This table presents estimates from regressions where the dependent variables are various outcome measures associated with the characteristics of the agents that were ultimately hired to list the focal lead. Columns (1) and (2) utilize the log distance of the focal property lead listed with a real estate agent to the geographic centroid of that agent's past listings and the log of the average distance of that agent's past listings from their geographic centroid, respectively. Column (3) is an indicator for whether the hired agent has ever listed a property within a quarter-mile of the focal lead. Column (4) utilizes the average of the listing agent's past log sale to list price ratios. Column (5) utilizes the total number of past listings for the listing agent and is a Poisson pseudo-likelihood specification. The explanatory variable of interest utilized throughout is a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform. The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. The samples are further restricted to leads that were ultimately listed with an agent, and where there was only a single agent associated with that listing. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. The Adj. R<sup>2</sup> for column (5) reports the pseudo-R<sup>2</sup> out of the Poisson pseudo-likelihood specification. Additionally, the average of the dependent variable in the regression sample is reported. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 5**  
**Buyer's Agents**

	Listing Records Buyer Agent Name (1)	Affiliated Buyer Agent (2)      (3)		Affiliated Buyer Agent (4)
Intermediary Attention	-0.00017 (-0.14)	0.0013* (1.73)	0.0111** (2.22)	0.0105* (1.81)
Same Buyer and Listing Agent				0.184*** (15.33)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes
Listing Records Buyer Agent Name			Yes	Yes
Listing Records Listing Agent Name				Yes
Number of observations	654,991	654,991	72,779	58,899
Adj. R <sup>2</sup>	0.260	0.095	0.111	0.119
Dependent Variable Average	0.164	0.052	0.309	0.358

This table presents estimates from regressions assessing whether affiliated agents are more likely to serve as buyer's agents for properties with more prominent leads, ultimately demonstrating that lead ordering promotes intermediation through multiple mechanisms. As dependent variables, Column (1) utilizes an indicator for whether or not the listing recorded a buyer's agent name at all whereas Columns (2) through (4) utilize an indicator for whether the listing recorded a buyer's agent name that is affiliated with the online platform. These dependent variables are regressed on a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform. Column (4) includes as a control an indicator as to whether the listing and buyer's agents are the same. The samples in Columns (3) and (4) are restricted to leads from the online platform that where the listing recorded a buyer's agent name. The sample in Column (4) is further restricted to leads from the online platform that where the listing recorded the listing agent name. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. Additionally, the average of the dependent variable in the regression sample is reported. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 6**  
**Intermediary Attention Leads to Quicker Sales**

	Quick Sale (1)	Sold Within One Year (2)	Quick Sale (3)	Sold Within One Year (4)	Ever Sold (5)	Sold After Two Years (6)
Agent Hired	-0.0314*** (-7.75)	0.121*** (21.14)				
Intermediary Attention			0.00219** (2.19)	0.000320 (0.19)	0.00234 (1.47)	0.00166* (1.94)
Ratio of Historical Transactions to Listings, 1/4-Mile, 90 Days	0.00119*** (3.82)	0.00332*** (4.78)	0.00154*** (4.85)	0.00187*** (2.78)	0.000786 (1.36)	0.0000250 (0.07)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	393,380	393,380	393,380	393,380	393,380	393,380
Adj. R <sup>2</sup>	0.093	0.325	0.091	0.312	0.282	0.023
Dependent Variable Average	0.09	0.38	0.09	0.38	0.52	0.05

This table presents estimates from regressions where the dependent variables are various outcome measures associated with whether and how quickly the focal lead was sold. Columns (1) and (3) utilize an indicator, *Quick Sale*, of whether the property was sold within 60 days of the lead appearing on the online platform. Columns (2) and (4) utilize an indicator of whether property was sold within a year of the lead appearing on the online platform. Columns (5) and (6) utilize indicators of whether the property was ever sold and whether the property was sold more than two years after the lead appeared on the online platform, respectively. The explanatory variable of interest utilized in columns (1) and (2) is an endogenous indicator for whether the lead was ever listed with an agent. The explanatory variable of interest utilized in columns (3)-(6) is a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform. Included throughout as a control is the ratio of historical transactions to historical listings within 1/4-Mile of the focal lead, measured over the 90 days prior to the lead appearing on the online platform and winsorized at the 1% and 99% levels. The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. Further sample restrictions occur when the number of historical listings utilized in the denominator of the control variable are zero. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. Additionally, the average of the dependent variable in the regression sample is reported. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 7**  
**Intermediary Attention Leads to Higher Priced Sales**

	Log Sales Price Residual (1)	Log Sales Price Residual (2)	Log Sales Price (3)
Agent Hired	0.0264*** (6.38)		
Intermediary Attention		0.00645* (1.88)	0.00759* (1.80)
Log Predicted Sales Price			0.844*** (110.33)
Average Historical Sales Price Residuals, 1/4-Mile, 90 Days, Winsorized	0.179*** (14.61)	0.179*** (14.62)	0.201*** (15.69)
Lead Creation Month by County FE	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes
Number of observations	82,407	82,407	79,116
Adj. R <sup>2</sup>	0.063	0.063	0.719
Dependent Variable Average	0.09	0.09	12.26

Columns (1) and (2) of this table present estimates from regressions where the dependent variable is a regression residual for the focal lead, conditional on sale, from an hedonic model of log sales price, fit over the entire sample of ZTRAX transactions, winsorized at the 1% and 99% levels. Column (3) presents estimates from a regression where the dependent variable is the log sales price of the focal lead, conditional on sale. The explanatory variable of interest utilized in column (1) is an endogenous indicator for whether the lead was ever listed with an agent. The explanatory variable of interest utilized in columns (2) and (3) are a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform. Included in column (3) is a control for the fitted value of the focal lead, conditional on sale, from an hedonic model of log sales price, fit over the entire sample of ZTRAX transactions. Included throughout as a control is the average of all log sales price residuals within 1/4-Mile of the focal lead, measured over the 90 days prior to the lead appearing on the online platform and winsorized at the 1% and 99% levels. The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. The samples are further restricted to leads that were ultimately sold with a valid sales price populated and that were not dropped from the hedonic model due to singleton fixed effects cells or data availability issues. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. Additionally, the average of the dependent variable in the regression sample is reported. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 8**  
**Sales Price, Thick Markets, and Property Heterogeneity**

<i>Panel A</i>						
	Log Sales Price Residual					
	(1)	(2)	(3)	(4)	(5)	(6)
Agent Hired	0.0241*** (3.51)	0.0302*** (4.05)	0.0331*** (2.78)	0.0150** (2.21)	0.0273*** (3.96)	0.0285*** (2.99)
Average Historical Sales Price Residuals, 1/4-Mile, 90 Days, Winsorized	0.190*** (8.66)	0.178*** (10.29)	0.120*** (3.96)	0.163*** (9.97)	0.132*** (11.16)	0.150*** (8.12)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample	High Inventory to Sales Ratio	Low Inventory to Sales Ratio	Beds, Middle Quintiles	Beds, Tail Quintiles	Sqft, Middle Quintiles	Sqft, Tail Quintiles
Number of observations	29,375	28,259	10,404	28,880	23,733	18,530
Adj. R <sup>2</sup>	-0.005	0.015	-0.093	-0.011	-0.036	-0.043

<i>Panel B</i>						
	Log Sales Price Residual					
	(1)	(2)	(3)	(4)	(5)	(6)
Intermediary Attention	0.0115** (2.56)	0.00320 (0.50)	0.0174** (2.13)	-0.00324 (-0.51)	0.00578 (1.06)	0.00974 (1.23)
Average Historical Sales Price Residuals, 1/4-Mile, 90 Days, Winsorized	0.190*** (8.67)	0.179*** (10.33)	0.121*** (3.96)	0.163*** (9.96)	0.133*** (11.19)	0.150*** (8.14)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample	High Inventory to Sales Ratio	Low Inventory to Sales Ratio	Beds, Middle Quintiles	Beds, Tail Quintiles	Sqft, Middle Quintiles	Sqft, Tail Quintiles
Number of observations	29,375	28,259	10,404	28,880	23,733	18,530
Adj. R <sup>2</sup>	-0.006	0.014	-0.094	-0.011	-0.037	-0.044

This table presents estimates from regressions where the dependent variable is a regression residual for the focal lead, conditional on sale, from an hedonic model of log sales price, fit over the entire sample of ZTRAX transactions, winsorized at the 1% and 99% levels. The explanatory variable of interest utilized throughout Panel A is an endogenous indicator for whether the lead was ever listed with an agent. The explanatory variable of interest utilized throughout Panel B is a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform. Included throughout as a control is the average of all log sales price residuals within 1/4-Mile of the focal lead, measured over the 90 days prior to the lead appearing on the online platform and winsorized at the 1% and 99% levels. The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. The samples are further restricted to leads that were ultimately sold with a valid sales price populated and that were not dropped from the hedonic model due to singleton fixed effects cells or data availability issues. Samples in Columns (1) and (2) are restricted to leads in which the new listings to transaction ratio over the prior 90 days within a quarter mile of the lead is above or below the median, respectively. Zero new listings with non-zero transactions is classified as "high" and zero transactions with non-zero new listings is classified as "low." Samples in Columns (3) through (6) are restricted as reported where the middle quintiles (tail quintiles) are the sub-samples of FSBO/FRBO leads that exist in the 2nd, 3rd, or 4th (1st or 5th) quintiles of the distribution of properties in the leads' surrounding 1/4-mile radius, by either bedrooms or square footage as applicable. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 9**  
**Listing Spillovers**

*Panel A*

	Local Listing Intensity 0 to 30 Days (1)	Local Listing Intensity 0 to 60 Days (2)	Local Listing Intensity 0 to 90 Days (3)	Local Listing Intensity 0 to 120 Days (4)	Local Listing Intensity 0 to 150 Days (5)	Local Listing Intensity 0 to 180 Days (6)	Local Listing Intensity 0 to 270 Days (7)	Local Listing Intensity 0 to 365 Days (8)
Agent Hired	0.00110*** (3.69)	0.000926*** (3.96)	0.000928*** (4.57)	0.00101*** (5.00)	0.00105*** (5.39)	0.00102*** (5.74)	0.00109*** (6.91)	0.00117*** (8.13)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical Listing and Transaction Intensity FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	500,749	513,936	519,533	522,638	524,738	526,121	528,582	529,831
Adj. R <sup>2</sup>	0.372	0.453	0.501	0.536	0.559	0.579	0.620	0.647
Dependent Variable Average	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

*Panel B*

	Local Listing Intensity 0 to 30 Days (1)	Local Listing Intensity 0 to 60 Days (2)	Local Listing Intensity 0 to 90 Days (3)	Local Listing Intensity 0 to 120 Days (4)	Local Listing Intensity 0 to 150 Days (5)	Local Listing Intensity 0 to 180 Days (6)	Local Listing Intensity 0 to 270 Days (7)	Local Listing Intensity 0 to 365 Days (8)
Intermediary Attention	-0.000442 (-1.56)	-0.000646*** (-3.03)	-0.000407** (-2.06)	-0.000267 (-1.58)	-0.000215 (-1.38)	-0.000186 (-1.21)	-0.000106 (-0.78)	-0.000104 (-0.78)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical Listing and Transaction Intensity FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	500,749	513,936	519,533	522,638	524,738	526,121	528,582	529,831
Adj. R <sup>2</sup>	0.372	0.453	0.501	0.536	0.559	0.579	0.620	0.647
Dependent Variable Average	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

This table presents estimates from regressions where the dependent variables are measures of the *Local Listing Intensity* of the area surrounding the focal lead. Specifically, this is the ratio of agent listings within a 1/4-Mile of the focal lead to those within 2 miles of the focal lead, measured at increasing time intervals from the lead appearing on the online platform. The explanatory variable of interest utilized throughout Panel A is an endogenous indicator for whether the lead was ever listed with an agent. The explanatory variable of interest utilized throughout Panel B is a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform. The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Fixed effect cells of size 0.01 for the *Local Listing Intensity* and *Local Transaction Intensity* over the 90 days preceding the lead appearing on the online platform are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. Additionally, the average of the dependent variable in the regression sample is reported. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 10**  
**Transaction Spillovers**

Panel A

	Local Transaction Intensity 0 to 30 Days (1)	Local Transaction Intensity 0 to 60 Days (2)	Local Transaction Intensity 0 to 90 Days (3)	Local Transaction Intensity 0 to 120 Days (4)	Local Transaction Intensity 0 to 150 Days (5)	Local Transaction Intensity 0 to 180 Days (6)	Local Transaction Intensity 0 to 270 Days (7)	Local Transaction Intensity 0 to 365 Days (8)
Quick Sale	0.000674** (2.20)	0.000726*** (2.90)	0.000626*** (2.72)	0.000595*** (2.82)	0.000570*** (2.87)	0.000574*** (2.93)	0.000429** (2.31)	0.000444** (2.44)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical Listing and Transaction Intensity FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	529,536	532,547	533,461	533,831	534,011	534,117	534,294	534,403
Adj. R <sup>2</sup>	0.473	0.582	0.637	0.671	0.692	0.705	0.726	0.739
Dependent Variable Average	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

Panel B

	Local Transaction Intensity 0 to 30 Days (1)	Local Transaction Intensity 0 to 60 Days (2)	Local Transaction Intensity 0 to 90 Days (3)	Local Transaction Intensity 0 to 120 Days (4)	Local Transaction Intensity 0 to 150 Days (5)	Local Transaction Intensity 0 to 180 Days (6)	Local Transaction Intensity 0 to 270 Days (7)	Local Transaction Intensity 0 to 365 Days (8)
Intermediary Attention	0.0000772 (0.04)	-0.000154 (-1.09)	-0.000218* (-1.71)	-0.000139 (-1.03)	-0.000169 (-1.46)	-0.000203* (-1.79)	-0.000279** (-2.49)	-0.000281*** (-2.78)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical Listing and Transaction Intensity FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	529,536	532,547	533,461	533,831	534,011	534,117	534,294	534,403
Adj. R <sup>2</sup>	0.473	0.582	0.637	0.671	0.692	0.705	0.726	0.739
Dependent Variable Average	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

This table presents estimates from regressions where the dependent variables are measures of the *Local Transaction Intensity* of the area surrounding the focal lead. Specifically, this is the ratio of transactions within a 1/4-Mile of the focal lead to those within 2 miles of the focal lead, measured at increasing time intervals from the lead appearing on the online platform. The explanatory variable of interest utilized throughout Panel A is an endogenous indicator for whether the lead was ever listed with an agent. The explanatory variable of interest utilized throughout Panel B is a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform. The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Fixed effect cells of size 0.01 for the *Local Listing Intensity* and *Local Transaction Intensity* over the 90 days preceding the lead appearing on the online platform are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. Additionally, the average of the dependent variable in the regression sample is reported. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 11**  
**Heterogeneity of Effects**

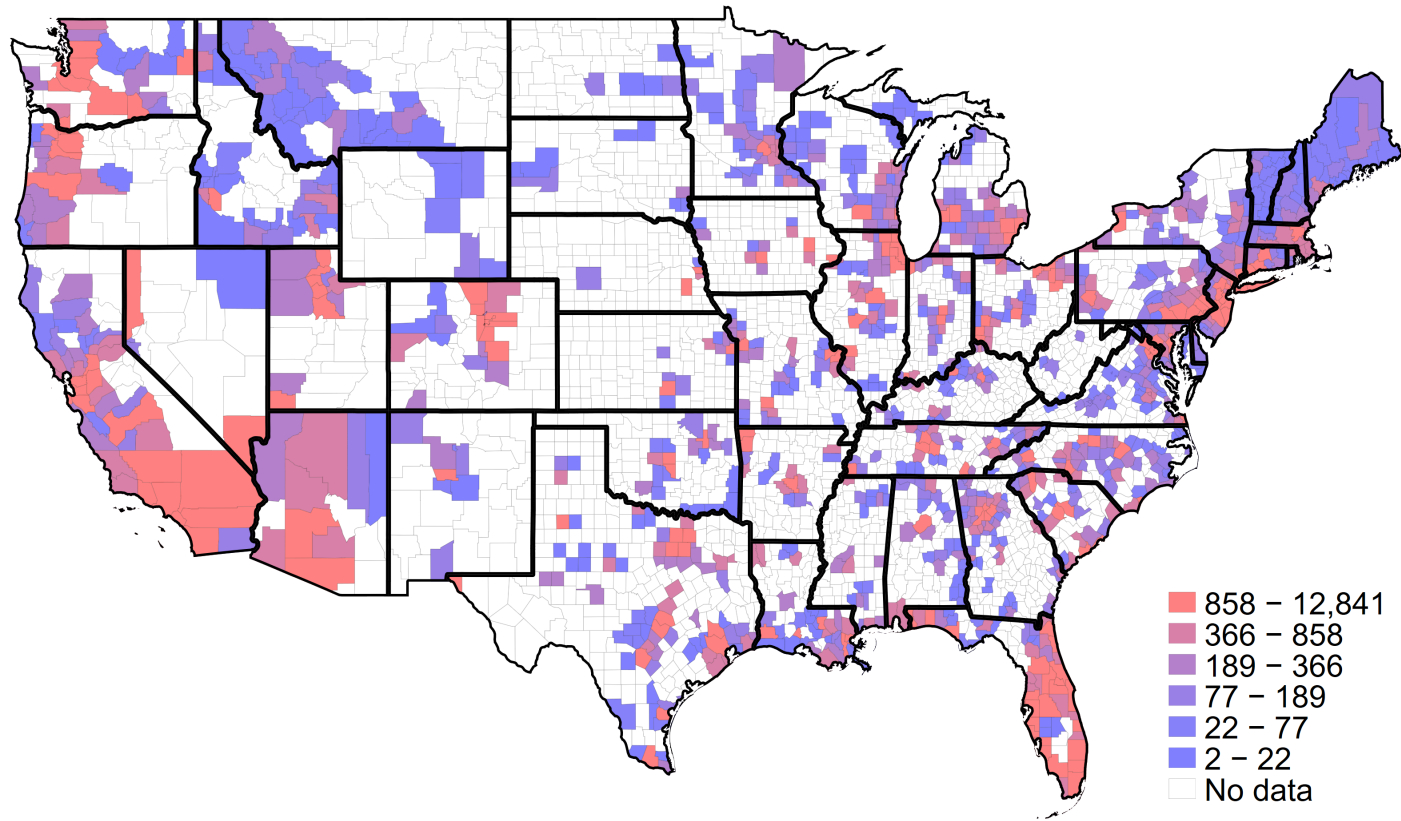
	Hired Affiliated Agent		
	(1)	(2)	(3)
Intermediary Attention	0.0102*** (5.15)	0.0467*** (4.01)	0.0147*** (4.51)
Relevant Interaction	-0.00644** (-2.47)	-0.00798*** (-3.55)	-0.00295*** (-2.98)
Fraction of Historical Transactions Listed with Agent, 1/4-Mile, 90 Days	0.0221*** (3.85)		
Log Square Feet		0.0601*** (12.29)	
Number Of Bedrooms			0.0169*** (8.23)
Lead Creation Month by County FE	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes
Number of observations	507,659	596,093	654,991
Adj. R <sup>2</sup>	0.162	0.181	0.175
Dependent Variable Average	0.21	0.21	0.20

This table presents estimates from regressions where the dependent variable is an indicator for whether the lead was ever listed with an agent that is affiliated with the online platform. The explanatory variables of interest utilized throughout are a measure of exogenous *Intermediary Attention* derived from a lead's placement on the online platform, a measure of ex-ante increased probability of hiring an agent, and the relevant interaction between the two. Columns (1)-(3) utilize, as respective measures of ex-ante increased probability of hiring an agent, the fraction of historical transactions listed with an agent over the 90 days preceding the lead appearing on the online platform and within 1/4-Mile of the focal lead, the log of the square footage of the structure, and the number of bedrooms. The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. Additionally, the average of the dependent variable in the regression sample is reported. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 12**  
**Behavioral Effects of Intermediary Attention**

	Initial List Price, Log Residual		Log(Initial List Price / Original Purchase Price)	List Price Ever Changed	
	(1)	(2)	(3)	(4)	(5)
Intermediary Attention	0.00636** (1.99)	0.00640** (1.99)	0.0125** (2.06)	0.00247 (0.64)	0.00493 (1.07)
Original Purchase Price, Log Residual	0.121*** (19.16)	0.118*** (7.61)			
Log Tenure in Home			0.0359*** (5.85)		
Log(Initial List Price / Original Purchase Price)				0.0210*** (6.16)	0.00950 (1.05)
Relevant Interaction		-0.00131 (-0.24)			-0.00470 (-1.31)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes
Number of observations	43,665	43,665	87,672	85,708	85,708
Adj. R <sup>2</sup>	0.026	0.025	0.038	0.042	0.042

Columns (1) and (2) of this table present regressions where the dependent variable is the residual from a hedonic regression model where the outcome variable is log of the initial list price on a platform primarily reserved for listings acquired by intermediary agents regressed onto four dimensions of fixed effects—zip code by year, listing year by listing month, zip code by number of bedrooms, and zip code by square footage buckets. The explanatory variables of interest for these columns are a measure of exogenous *Intermediary Attention* derived from a lead’s placement on the online platform, as well as a regression residual for the price at which the current owner of the focal lead purchased their home, from an hedonic model of log sales price, fit over the entire sample of ZTRAX transactions, and the relevant interaction between the two in the case of Column (2). Column (3) of this table presents a regression where the dependent variable is the log of the ratio of the initial listing price on a platform primarily reserved for listings acquired by intermediary agents to the price at which the current owner of the focal lead purchased their home. The explanatory variables of interest for these columns are a measure of exogenous *Intermediary Attention* derived from a lead’s placement on the online platform, as well as the log of the number of years the seller has lived in their current home. Columns (4) and (5) of this table present regressions where the dependent variable is an indicator for whether or not the listing price was ever adjusted subsequent to an initial posting on a platform primarily reserved for listings acquired by intermediary agents. The explanatory variables of interest for these columns are a measure of exogenous *Intermediary Attention* derived from a lead’s placement on the online platform, as well as the log of the ratio of the initial listing price on a platform primarily reserved for listings acquired by intermediary agents to the price at which the current owner of the focal lead purchased their home, and the relevant interaction between the two in the case of Column (5). The samples are restricted to leads from the online platform that had valid address matches into the ZTRAX Assessment dataset. Fixed effects for the creation month of the lead interacted with the county of the lead as well as for the batch the lead was loaded into the platform in are included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.



**Figure 1**  
**Geographic Scope**  
This figure presents the geographic variation of the 654,991 leads in the baseline regression specifications of Table 3.

Agent Name	Phone Number	Status	Price	Sq Ft	Address
Rufus Agicatus	801-832-9510 +1	Contacted	\$304,900	2,948 sqf	5358 S Gaynel Autumn Cir TAYLORSVILLE, UT 84129
Andrew West	801-875-9407 +1	New	\$15,500	900 sqf	155 S 1200 W OREM, UT 84058
Winston Adler	801-563-8752 +1	New	\$464,900	5,043 sqf	251 W. 1100 S. LEHI, UT 84043
Victoria Burbank	801-756-8686	New	\$220,000	1,590 sqf	422 N 1322 E LEHI, UT 84043
Jerry Rogers	801-336-4708 +1	New	\$209,000		405 Deer Ridge Drive Lot #5 SALT LAKE CITY, UT 00000
Spencer Stauffer	801-584-7781 +1	New	\$875,000	6,967 sqf	12568 N Angels Gate HIGHLAND, UT 84003
Kylie Woodman	801-785-9925	New	\$289,900	2,653 sqf	7264 S Santa Maria Cir WEST JORDAN, UT 84084
Steven Olsen	801-756-1387	New	\$126,000	1,070 sqf	876 Greenridge Ave PAYSON, UT 84651
Joe Ellis	385-895-5455	New	\$132,000	1,160 sqf	California Ave At South State PROVO, UT 00000
Shannon Blackham		New	\$299,950	2,735 sqf	1191 E 1025 S GRANVILLE, UT 84650

**Figure 2**  
**Online Platform Sample User Interface**

This figure presents a screenshot from training material related to an agent's use of the online platform's user interface. Layout and structure are identical to that experienced by an affiliated agent during our sample period. Actual data displayed is stylized by the online platform to avoid disclosing personally identifying information. Not all fields were provided by the online platform.

# Internet Appendix

## A.1 Robustness

Table A.3 displays the main tests in the paper in specifications using an indicator for properties that rank in the top quartile of leads for their state on a given day. Table A.4 displays the results for the second through fourth quartiles.

In Table A.5 we show results interacting an indicator for vacant land with intermediary attention. In some information theories agents act in a certifying role, attesting to the quality of the property, but this consideration is clearly muted for vacant land. Under these certification theories, we would expect intermediary attention to have a much smaller impact on outcomes for vacant land than for properties with structures, but Table A.5 shows no meaningful difference between the two classes of properties. These results do not support a certification interpretation of our findings. Under search theories, or under information theories that focus on an agent's role in resolving asymmetries about neighborhood characteristics, there is no obvious distinction between an agent's impact on vacant land or improved properties and, indeed, we find none. As discussed above, the negative spillover effects of intermediary attention on the listing and transaction intensities in the local area offer evidence in favor of search theories over information theories. Table A.5 also shows the interaction of an indicator for 1-bedroom houses with intermediary attention. In this specification as well, the property type does not interact significantly with intermediary attention.

## A.2 Magnitude Calibration

Tables 3, 4 and 5 document three distinct mechanisms by which an increase in intermediary attention has causal effects on a property: it heightens the probability of listing agent retention, it attracts the interest of more distant and geographically dispersed listing agents, and it improves the likelihood that an affiliated buyer's agent will be involved in the sale transaction. In this

section we outline a simple calibration approach to assessing the relative magnitudes of these mechanisms.

As described in Section 3.5, the multi-faceted impact of intermediary attention does not allow us to conduct a 2SLS analysis. Using a basic model relating property outcomes to the three mechanisms and making assumptions about parameter values lying in reasonable ranges, however, we can provide a general assessment of the relative importance of the magnitudes. Specifically, we assume that the three mechanisms have the following impact:

$$\begin{aligned} & \text{Property outcome}_{i,t} && \text{(A.1)} \\ & = \kappa + \mu_1 * \text{Hire Listing Agent}_{i,t} + \mu_2 * \text{Log(Radius of Prospective Agents)}_{i,t} + \mu_3 * \text{Attract Buyer's Agent}_{i,t}, \end{aligned}$$

where *Hire Listing Agent* is an indicator for hiring a listing agent, *Log(Radius of Prospective Agents)* describes the maximal distance from a property for which an agent will consider seeking the listing and *Attract Buyer's Agent* is an indicator for whether a buyer's agent is interested in bringing her client to the property.

This basic model ignores potential cross-effects of the three mechanisms, and it also rules out other mechanisms. For example, equation (A.1) reflects the second mechanism under which intermediary attention can lead the property to receive interest from more distant agents, but it ignores the related possibilities that the property may receive interest from more dispersed or more experienced agents. This approach can therefore only provide general guidance on the relative importance of the three mechanisms.

We use the estimated results in the regressions in the tables in the paper to calculate the effect of an increase in intermediary attention on each of these variables. The effect on *Hire Listing Agent* is calculated using the estimate in the third column of Table 3. The effect on *Log(Radius of Prospective Agents)* is calculated from the first column of Table 4. Strictly speaking, this estimate reflects the impact on the average distance of hired listing agents rather than the maximum potential radius of interested agents, but the latter is not observable. The effect on *Attract Buyer's Agent* is calculated via the third column of Table 5. The Buyer Agent field is so often zero that we cannot

directly estimate the effect of intermediary attention on the presence of a buyer's agent. We find in column three of Table 5 that an interquartile increase in intermediary attention increases the probability of an affiliated buyer's agent by 1.1 percentage points. We assume it has no effect on non-affiliated buyer's agents and that the overall impact is to increase the probability of a buyer's agent by 1.1 percent.

For each outcome variable, we decompose the estimated effect of intermediary attention into the impacts of the three mechanisms. This requires some subjective assumptions. For example, the sample frequency of quick sales is 10%, and we assume that the maximum plausible impact of hiring a listing agent would be to double this number. That is, we presume that in the quick sale version of equation (A.1),  $\mu_1 = 10\%$ . We similarly assume that the maximal impact of attracting a buyer's agent is to increase the probability of a quick sale by 10% (i.e.,  $\mu_3 = 10\%$ ). Under these generous assumptions, we then use equation (A.1) to calibrate the value of  $\mu_2$  that matches the total impact of intermediary attention estimated in the third column of Table 6. As shown in Panel A of Table A.6, this value is  $\mu_2 = 1.8\%$ . Applying the estimated effects of intermediary attention on each of the three mechanisms as outlined in the previous paragraph, we then calculate the fraction of the overall impact of intermediary attention that arises due to each of the three mechanisms. As outlined in the third column of Panel A of Table A.6, we find that even assuming quite large effects on quick sales of hiring a listing agent and attracting a buyer's agent, a very large impact (32.6% of the total) comes from increasing the radius of prospective agents. Specifically, we find in column three of Table 6 that an interquartile increase in intermediary attention raises the probability of a quick sale by 0.22 percentage points. The results in Panel A of Table A.6 show that 0.04 percentage points of this effect is due to the increased likelihood of the hiring of a listing agent, 0.07 percentage points of the effect is due to the presence of a broader range of prospective agents and 0.11 percentage points of the effect is due the higher probability that a buyer's agent will be involved in the transaction. Under this calibration, a 10% increase in the radius of prospective agents (i.e., a 21% increase in the catchment area of agents) would result in approximately a 0.17 percentage point increase in the probability of a quick sale.

Panel B of Table [A.6](#) displays the results from assuming that listing and buyer's agents have no impact on quick sales. The other panels in the table provide similar ranges of calibrated results for the log sales price residual, the local listing intensity and the local transaction intensity.

**Table A.1**  
**Affiliated Agents**

	Log Distance From Hired Agent Center	Log Hired Agent Listing Dispersion	Hired Agent has no Prior Listings Within 0.25 Miles	Average of Agent's Log Sales to List Price Ratio	Hired Agent Listing Count
	(1)	(2)	(3)	(4)	(5)
Affiliated Agents	0.688*** (21.55)	1.015*** (36.70)	-0.0494*** (-14.25)	0.00355 (0.46)	1.510*** (33.78)
Beds×SqFt×Year×Month×Zip FE	Yes	Yes	Yes	Yes	Yes
Number of observations	9,604,402	9,333,194	10,328,341	8,142,616	10,267,121
Adj. R <sup>2</sup>	0.302	0.169	0.390	0.592	0.729

This table presents estimates from regressions where the dependent variables are various outcome measures associated with the characteristics of the agents that were ultimately hired to list the focal listing and contain observations for listings on a platform primarily reserved for listings acquired by intermediary agents. Columns (1) and (2) utilize the log distance of the focal listing to the geographic centroid of that agent's past listings and the log of the average distance of that agent's past listings from their geographic centroid, respectively. Column (3) is an indicator for whether the agent associated with the focal listing has ever listed a property within a quarter-mile of the focal listing. Column (4) utilizes the average of the listing agent's past log sale to list price ratios. Column (5) utilizes the total number of past listings for the listing agent and is a Poisson pseudo-likelihood specification. The explanatory variable of interest utilized is an indicator for whether the hired agent is affiliated with the online platform and an interacted fixed effect of number of bedrooms, square footage buckets, listing year and month, and property zip code that is identical to that used in our hedonic model of sales price, is included throughout. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered separately at the county level and at the listing month level. The Adj. R<sup>2</sup> for column (5) reports the pseudo-R<sup>2</sup> out of the Poisson pseudo-likelihood specification. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A.2  
Quick Sales and Platform Leads

	Quick Sale	
	(1)	(2)
Listing Ever a Lead on Platform	-0.1157*** (-4.90)	-0.0146*** (-3.93)
Beds×SqFt×Year×Month×Zip FE		Yes
Number of observations	10,016,380	3,651,082
Adj. R <sup>2</sup>	0.005	0.229

This table presents estimates from regressions where the dependent variable is an indicator, *Quick Sale*, of whether the property was sold within 60 days of the listing appearing on a platform primarily reserved for listings acquired by intermediary agents. The explanatory variable of interest utilized is an indicator for whether the listing ever appeared as a lead on the online platform. Column (2) includes an interacted fixed effect of number of bedrooms, square footage buckets, listing year and month, and property zip code that is identical to that used in our hedonic model of sales price. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and listing month level. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table A.3**  
**Robustness: Top Quartile Intermediary Attention**

	Hired Affiliated Agent (1)	Quick Sale (2)	Log Sales Price Residual (3)	Local Listing Intensity 0 to 60 Days (4)	Local Transaction Intensity 0 to 365 Days (5)
Top Quartile Relative Rank of Lead Number	0.00627*** (3.61)	0.00409*** (2.77)	0.0108** (2.38)	-0.000868*** (-2.65)	-0.000309* (-1.96)
Ratio of Historical Transactions to Listings, 1/4-Mile, 90 Days		0.00155*** (4.75)			
Average Historical Sales Price Residuals, 1/4-Mile, 90 Days, Winsorized			0.179*** (14.62)		
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes
Historical Listing and Transaction Intensity FEs				Yes	Yes
Number of observations	654,991	393,380	82,407	513,936	534,403
Adj. R <sup>2</sup>	0.172	0.091	0.063	0.453	0.739

This table presents robustness results related to an alternate construction of our measure of *Intermediary Attention* by substituting it for an indicator for whether the focal lead was ranked in the top quartile of the leads in a state on a specific day in a series of specifications replicating the central results of our paper. Column (1) replicates column (1) of Table 3. Column (2) replicates column (3) of Table 6. Column (3) replicates column (2) of Table 7. Column (4) replicates column (2) of Panel B of Table 9. Column (5) replicates column (8) of Panel B of Table 10. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table A.4**  
**Robustness: Intermediary Attention Quartiles**

	Hired Affiliated Agent (1)	Quick Sale (2)	Log Sales Price Residual (3)	Local Listing Intensity 0 to 60 Days (4)	Local Transaction Intensity 0 to 365 Days (5)
Second Quartile Relative Rank of Lead Number	-0.00497*** (-2.87)	-0.00426*** (-2.76)	-0.0104** (-2.24)	0.000814** (2.47)	0.000333** (2.01)
Third Quartile Relative Rank of Lead Number	-0.00796*** (-3.49)	-0.00505*** (-2.66)	-0.00615 (-1.04)	0.000948** (2.40)	0.000244 (1.28)
Fourth Quartile Relative Rank of Lead Number	-0.0117*** (-4.72)	-0.000854 (-0.40)	-0.0221*** (-2.95)	0.00106** (2.05)	0.000290 (1.42)
Ratio of Historical Transactions to Listings, 1/4-Mile, 90 Days		0.00154*** (4.79)			
Average Historical Sales Price Residuals, 1/4-Mile, 90 Days, Winsorized			0.179*** (14.61)		
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes
Historical Listing and Transaction Intensity FEs				Yes	Yes
Number of observations	654,991	393,380	82,407	513,936	534,403
Adj. R <sup>2</sup>	0.172	0.091	0.063	0.452	0.739

This table presents robustness results related to an alternate construction of our measure of *Intermediary Attention* by substituting it for quartile (top quartile is the base level) indicators for the focal lead rank relative to the leads in a state on a specific day in a series of specifications replicating the central results of our paper. Column (1) replicates column (1) of Table 3. Column (2) replicates column (3) of Table 6. Column (3) replicates column (2) of Table 7. Column (4) replicates column (2) of Panel B of Table 9. Column (5) replicates column (8) of Panel B of Table 10. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table A.5**  
**Robustness: No Property Type Heterogeneity**

	Quick Sale		Log Sales Price Residual		Local Listing Intensity 0 to 60 Days		Local Transaction Intensity 0 to 365 Days	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intermediary Attention	0.00407** (2.02)	0.00170* (1.71)	0.00681* (1.67)	0.00586 (1.64)	-0.00122*** (-3.70)	-0.000610*** (-2.80)	-0.000421** (-2.54)	-0.000279*** (-2.69)
Vacant Land Indicator	-0.0509*** (-4.21)		-0.240*** (-4.39)		-0.00116 (-0.61)		-0.00283*** (-2.89)	
Intermediary Attention × Vacant Land Indicator	-0.00309 (-0.59)		0.00917 (0.42)		0.000685 (0.97)		-0.000250 (-0.70)	
One Bedroom Indicator	0.000251 (0.04)		-0.125*** (-3.35)		0.00455*** (3.23)		0.00428*** (5.72)	
Intermediary Attention × One Bedroom Indicator	-0.000597 (-0.34)		-0.0141 (-1.04)		0.000409 (0.81)		0.000165 (0.63)	
Ratio of Historical Transactions to Listings, 1/4-Mile, 90 Days	0.00242*** (2.86)	-0.000120 (-0.24)						
Average Historical Sales Price Residuals, 1/4-Mile, 90 Days, Winsorized			0.174*** (12.45)	0.178*** (12.78)				
Lead Creation Month by County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical Listing and Transaction Intensity FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FSBO Only Sample	Yes		Yes		Yes		Yes	
Number of observations	192,941	368,995	58,895	65,741	282,308	483,190	297,841	502,530
Adj. R <sup>2</sup>	0.046	0.093	0.057	0.060	0.364	0.447	0.674	0.734

This table presents robustness results related to interactions of our measure of *Intermediary Attention* and two measures of property type in a series of specifications replicating the central results of our paper. Columns (1), (3), (5) and (7) are conditioned on FSBO and the interaction is with an indicator for whether the lead was likely to be for vacant land (zero bedrooms, zero bathrooms, and zero square feet reported on the lead platform). For columns (2), (4), (6) and (8) the interaction is with an indicator for whether the lead was listed as being for a property with one bedroom. Columns (1) and (2) replicate column (3) of Table 6. Columns (3) and (4) replicate column (2) of Table 7. Columns (5) and (6) replicate column (2) of Panel B of Table 9. Columns (7) and (8) replicate column (8) of Panel B of Table 10. Reported *t*-statistics in parentheses are heteroskedasticity-robust and clustered at both the county and lead creation week level. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table A.6**  
**Magnitude Calibration**

Explanatory Variable	Coefficient (1)	Determined By (2)	Fraction of Effect (3)
<i>Panel A: Dep Var Quick Sale</i>			
Hire Listing Agent	10%	Assumed	17.2%
Log(radius of prospective agents)	1.8%	Calibrated	32.6%
Attract buyer's agent	10%	Assumed	50.2%
<i>Panel B: Dep Var Quick Sale</i>			
Hire Listing Agent	0%	Assumed	0%
Log(radius of prospective agents)	5.6%	Calibrated	100%
Attract buyer's agent	0%	Assumed	0%
<i>Panel C: Dep Var Log Sales Price Residual</i>			
Hire Listing Agent	10%	Assumed	5.8%
Log(radius of prospective agents)	12.7%	Calibrated	77.1%
Attract buyer's agent	10%	Assumed	17.1%
<i>Panel D: Dep Var Log Sales Price Residual</i>			
Hire Listing Agent	0%	Assumed	0%
Log(radius of prospective agents)	16.2%	Calibrated	100%
Attract buyer's agent	0%	Assumed	0%
<i>Panel E: Dep Var Local Listing Intensity 0-60 Days</i>			
Hire Listing Agent	-1%	Assumed	5.8%
Log(radius of prospective agents)	-1.27%	Calibrated	77.0%
Attract buyer's agent	-1%	Assumed	17.2%
<i>Panel F: Dep Var Local Listing Intensity 0-60 Days</i>			
Hire Listing Agent	0%	Assumed	0%
Log(radius of prospective agents)	-1.65%	Calibrated	100%
Attract buyer's agent	0%	Assumed	0%
<i>Panel G: Dep Var Local Transaction Intensity 0-365 Days</i>			
Hire Listing Agent	-1%	Assumed	13.4%
Log(radius of prospective agents)	-0.34%	Calibrated	47.5%
Attract buyer's agent	-1%	Assumed	39.1%
<i>Panel H: Dep Var Local Transaction Intensity 0-365 Days</i>			
Hire Listing Agent	0%	Assumed	0%
Log(radius of prospective agents)	-0.72%	Calibrated	100%
Attract buyer's agent	0%	Assumed	0%

This table describes calibration results decomposing the impact of intermediary attention on the specified dependent variables into the effects arising from hiring a listing agent, increasing the radius of prospective listing agents and attracting the interest of a buyer's agent. The direct impacts of intermediary attention on each of these mechanisms are derived from the estimates in Tables 3, 4 and 5, respectively, as described in Section A.2 in the Appendix. The effects of intermediary attention on the dependent variables are derived from Table 6 for Panels A and B, Table 7 for Panels C and D, Table 9 for Panels E and F, and Table 10 for Panels G and H. Coefficients are determined by either assumption or calibration to match the overall impact of intermediary attention, as described in the second column. The third column displays the fraction of the overall impact attributable to each mechanism under the described coefficients.

**Table A.7**  
**Behavioral Effects of Intermediary Attention - Full List Price Residual**

	Initial List Price, Log Residual	
	(1)	(2)
Intermediary Attention	0.0263* (1.96)	0.0273* (1.96)
Original Purchase Price, Log Residual	0.176*** (8.67)	0.142** (2.40)
Relevant Interaction		-0.0122 (-0.58)
Lead Creation Month by County FE	Yes	Yes
Lead Batch FE	Yes	Yes
Number of observations	4,660	4,660
Adj. R <sup>2</sup>	0.026	0.025

This table replicates columns (1) and (2) of Table 12 but instead of the hedonic residual for the list price outcome variable as described there, columns (1) and (2) utilize a hedonic regression of interacted bedrooms, square footage buckets, listing year and month, and zip code that is identical to that used in our hedonic model of sales price.

**Table A.8**  
**Marginal Listings and Transactions**

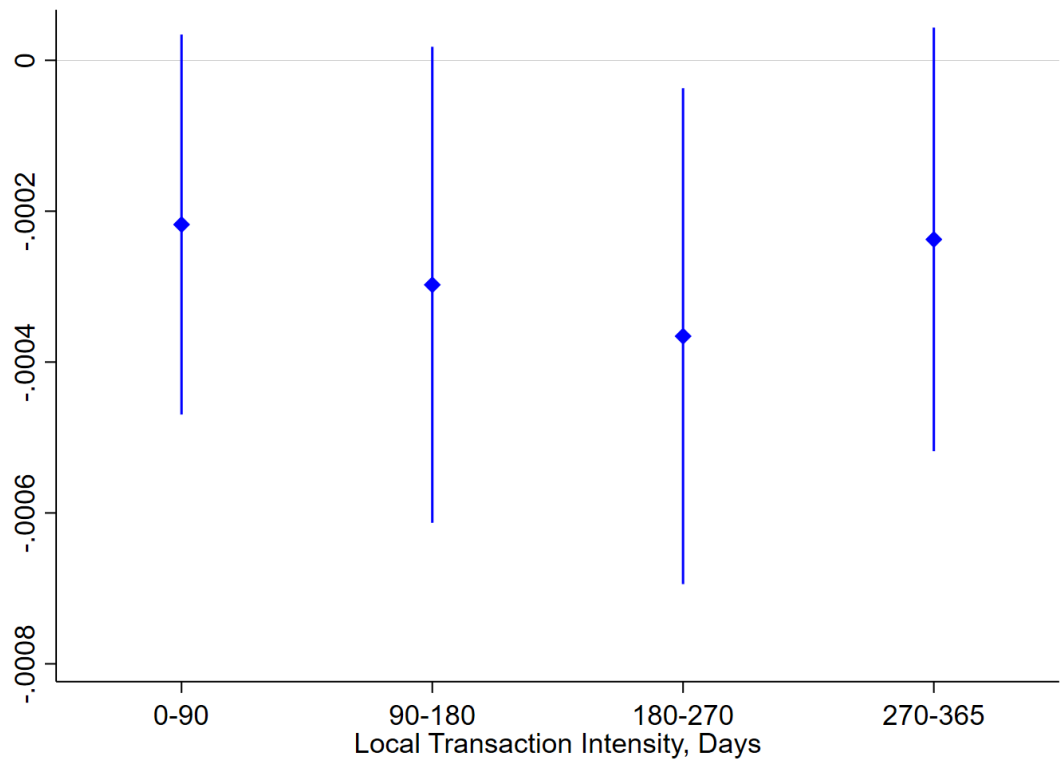
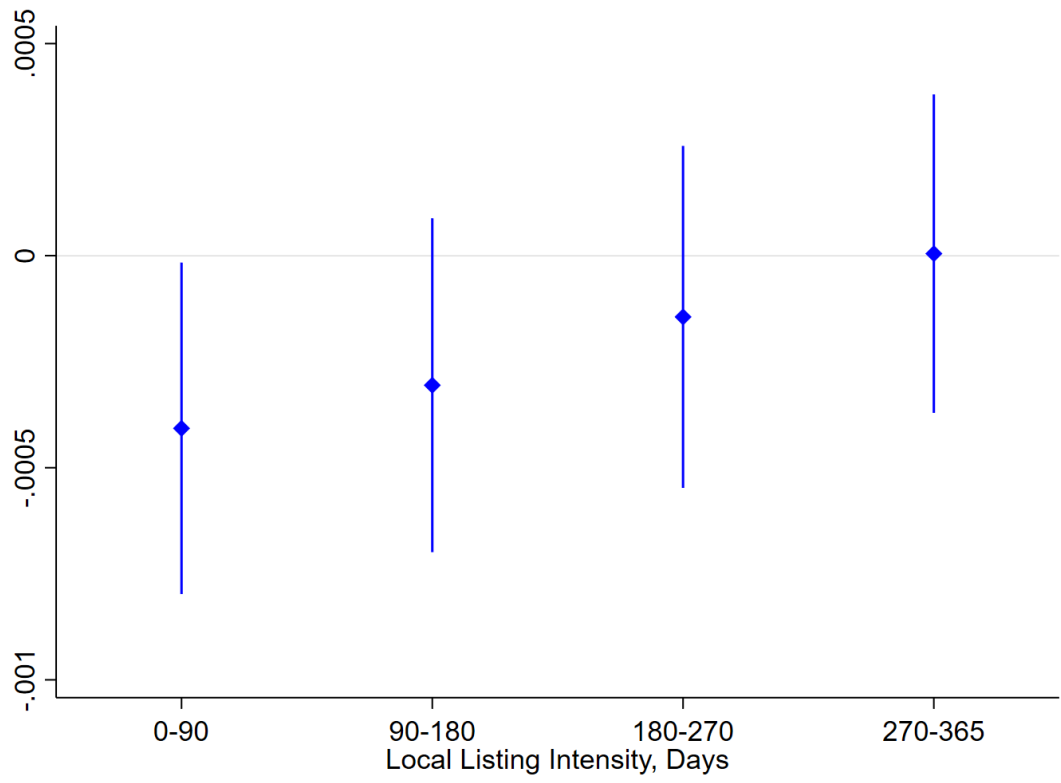
*Panel A*

	Local Listing Intensity 0 to 90 Days (1)	Local Listing Intensity 90 to 180 Days (2)	Local Listing Intensity 180 to 270 Days (3)	Local Listing Intensity 270 to 365 Days (4)
Intermediary Attention	-0.000407** (-2.06)	-0.000305 (-1.53)	-0.000144 (-0.71)	0.00000481 (0.03)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes
Historical Listing and Transaction Intensity FEs	Yes	Yes	Yes	Yes
Number of observations	519,533	518,398	517,773	516,489
Adj. R <sup>2</sup>	0.501	0.493	0.496	0.508
Dependent Variable Average	0.06	0.06	0.06	0.06

*Panel B*

	Local Transaction Intensity 0 to 90 Days (1)	Local Transaction Intensity 90 to 180 Days (2)	Local Transaction Intensity 180 to 270 Days (3)	Local Transaction Intensity 270 to 365 Days (4)
Intermediary Attention	-0.000218* (-1.71)	-0.000298* (-1.87)	-0.000366** (-2.20)	-0.000237* (-1.67)
Lead Creation Month by County FE	Yes	Yes	Yes	Yes
Lead Batch FE	Yes	Yes	Yes	Yes
Historical Listing and Transaction Intensity FEs	Yes	Yes	Yes	Yes
Number of observations	533,461	533,334	533,186	533,268
Adj. R <sup>2</sup>	0.637	0.609	0.582	0.591
Dependent Variable Average	0.06	0.06	0.06	0.06

This table depicts the impact of intermediary attention on listing and transaction intensities over various distinct time horizons.



**Figure A.1. Marginal Listings and Transactions** This figure presents the coefficients reported in Appendix Table A.8.