Conflicts of Interest and the Realtor Commission Puzzle*

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This paper documents uniformity in real estate commission rates across markets and time using a dataset on realtor commissions for 653,475 residential listings in eastern Massachusetts from 1998-2011. Newly established real estate brokerage offices charging low commissions grow more slowly than comparable entrants with higher commissions. Properties listed with lower commission rates experience less favorable transaction outcomes: they are 5% less likely to sell and take 12% longer to sell. These adverse outcomes reflect decreased willingness of buyers' agents to intermediate low commission properties (steering) rather than heterogeneous seller preferences or reduced effort of listing agents. While all agents and offices prefer properties with high commissions, firms and agents with large market shares purchase a disproportionately small fraction of low commission properties. The negative outcomes for low commissions provide empirical support for regulatory concerns that steering reinforces the uniformity of commissions.

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JEL Classification Codes: D4, L1, L8, R2, R3

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1 Introduction

Buyers are routinely advised by salespeople or intermediaries who are compensated by sellers. In many settings, there are concerns that buyers are steered towards products that may not be in their interest.[1] We study this phenomenon for residential real estate, where intermediaries play an important role. In 2014, there were 4.94 million existing home sales valued in aggregate at $1.26 trillion dollars, and real estate agents assisted in 88% of sales (NAR, 2014a,b).

A puzzling aspect of the residential brokerage industry is the relative uniformity of commission rates, despite low entry barriers and advances in technology that have reduced search costs for buying and selling properties. In the conventional compensation arrangement where sellers pay for the commissions of their listing agents and potential buyers' agents, the latter have an incentive to prioritize properties that offer higher commissions. This kind of steering is thought to lead to uniformly high commissions.[2] According to a 1983 report by the Federal Trade Commission (FTC), "(s)teering ... may make price competition a potentially unsuccessful competitive strategy, and it is our belief that this is the most important factor explaining the general uniformity of commission rates" (FTC, 1983, p. 12). The lack of variation in commissions remains an important subject of policy debate and regulatory concern today (GAO, 2005; FTC, 2007).

Our analysis examines the consequences of listing with a low commission and sheds light on the realtor commission puzzle by exploiting rich variation in a dataset that includes 653,475 listed properties in eastern Massachusetts from 1998 to 2011. Importantly, we observe the commission rates offered to buyers' agents, in addition to detailed information on property attributes, agents, and brokerage offices that are involved in each transaction. Ninety percent of properties in our sample have a buying commission of 2.0 or 2.5 percent,[3] corroborating the common perception that commission rates are uniform. In addition, even in periods with substantial turnover among real estate brokerage firms and agents, the average commission rate exhibits only modest fluctuation.

After documenting limited commission variation in our sample, we track the performance of offices with different commission rates. We find that offices charging lower commission rates are much less likely to become the top 25% firms in terms of commission revenue, relative to comparable offices that charge higher commissions. Standard competitive forces, whereby a firm competes with rivals using lower prices, do not seem effective under the current commission arrangement.

This finding motivates our core analysis that examines the sales outcomes of properties listed with different buying commission rates. Consistent with real estate agents steering buyers to properties with

[1] See Cummins and Doherty (2006) for a discussion on insurance products, Chan et al. (2015) for mortgages, Inderst and Ottaviani (2012) for financial advice, Christoffersen et al. (2013) for mutual funds, Jiang et al. (2012) for bond ratings, and Shapiro (2015) for the health sector.

[2] Steeering is known as "sell to the commission" in the industry (The Washington Post, 2015). Agents can influence buyers' decisions in several ways, including which properties to show, how to present each property, and how much effort to exert during the offer and negotiation stages.

[3] These correspond to a total commission of 4% or 5%, respectively, if commissions are equally split between listing agents and buying agents.

high commissions, we find that if a property has a buying commission rate less than 2.5 percent, it is 5% less likely to be sold and takes 12% longer to sell. There is little effect on the sale price. While it is possible that lower commission rates are associated with less desirable property attributes, our estimates are robust to specifications that include a rich set of property level measures that control for time-varying attributes and property fixed effects that control for time-invariant attributes.

We address two additional threats to our empirical analysis. First, the poor performance of low commission properties may reflect reduced listing agent effort, rather than an unwillingness of buyers' agents to be involved in low commission properties. To investigate this possibility, we report specifications focusing on properties that are more homogenous and relatively easier to sell. Then we control for time-invariant agent attributes using listing agent fixed effects. Third, we construct 'pairs' of properties that are listed by the same agent in the same year with listing commission revenues within a $500 bin, but offer *different* commission rates to the buying agent. Since these properties have the same payoff for the listing agent, they should induce the same level of effort from the listing agent, but may attract different number of buyers given the difference in buying commission rates. In this demanding analysis that exploits variation within an agent, property type, year, and commission bin, we continue to find that listings offering lower commission rates are associated with lower sales probabilities. All three investigations suggest that unobserved listing agent effort is not driving our main results.

The second threat we examine is that the adverse sales outcomes do not simply reflect behavior of buying agents, but the preferences of sellers. Some sellers might be more patient and willing to trade off a low sale probability with a high sale price. If these sellers are more likely to work with firms charging low commissions, then our results would be confounded by seller heterogeneity. We tackle this issue in several steps. First, we control for seller urgency using list price as a proxy. Next, we construct a patience-index, which is the ratio of the observed listing price to the predicted price from a hedonic regression. More patient sellers have higher index values. Sellers are divided into ten or a hundred groups according to this index. We use these group dummies as controls for seller patience. Finally, we merge our data with property deeds that record seller and buyer names and estimate models using seller fixed effects. Our analysis continues to report negative sales outcomes associated with lower commission rates, even accounting for seller preference.

After ruling out these alternative explanations, we show that properties that are more susceptible to steering suffer worse outcomes. For example, low commission listings in neighborhoods with a larger fraction of high commission listings experience more negative outcomes. In addition, low commission listings by entrants have worse outcomes than other low commission listings, as well as listings by offices that used lower commission rate policies in the past.

We next turn to examining how dominant agents and offices interact with low commission listings. Firms with higher market shares buy a smaller fraction of low commission properties. The same pattern holds true at the agent level. While our core analysis at the property level demonstrates that all agents prefer properties with high commissions, these results illustrate lower propensity of dominant firms to intermediate low commission properties. If we assume that dominant firms' diminished willingness to

purchase low commission properties leads to a reduced number of potential buyers, this finding can explain about forty percent of the adverse sales outcomes reported above.

These negative consequences for properties offering low commission rates provide a lens to interpret sellers' reluctance to list at low commission rates, which in turn reinforces the existing commission structure. A back-of-the-envelope calculation suggests that on average, sellers offering high commission rates are paying $4,455 more in commissions in exchange for 20 fewer days on the market. Our calculation implies an annual discount rate for sellers that is consistent with the housing literature.[4]

Our results illustrate that when a seller and her listing agency have to rely on a high commission rate to induce cooperation from buying agents, a low commission strategy becomes less viable. These results also rationalize our finding that offices charging low commission rates do not grow and that the average commission rate exhibits surprisingly modest variation in response to a huge influx of real estate brokerage offices in our sample period.

This paper makes several contributions. First, we construct a large dataset that documents individual buying commissions for about half a million properties and spans an entire housing business cycle. Second, to our best knowledge, we provide the first causal analysis of the consequence of buying agent commissions on economic outcomes and present evidence that steering contributes to the commission uniformity. Third, our paper highlights distortions when incentive schemes serve a dual role of eliciting agent effort and matching buyers and sellers. Our findings lend support to the argument that unbundling the existing compensation structure could be socially beneficial.

Our paper contributes to several literatures. The first literature studies implications of the fixed percentage commissions in the real estate brokerage industry (such as, Levitt and Syverson (2008), Hsieh and Moretti (2003), Hendel et al. (2009), and Han and Hong (2011). See Han and Strange (2015) for a review).[5] None of these papers analyzes the direct consequences of the commission compensation structure, which is our focus in this paper.

A second related literature examines whether incentive schemes have adverse consequences on agent performance. Oyer (1998) investigates the implications of non-linear incentive schemes on fiscal targets. Larkin (2014) uses data from an enterprise software vendor to demonstrate the gaming of the deal closure time by salespeople in response to the vendor's accelerating commission schedule. The negative consequences of low commissions reported here arise from the fact that sellers have only one instrument for two distinct purposes: to incentivize effort and attract buyers' agents.

A small but growing literature documents that consumers often receive advice from experts that are not in their interest. Mullainathan et al. (2012), Christoffersen et al. (2013), and Guercio and Reuter (2015) study financial advisers and broker recommendations for mutual funds, Jiang et al. (2012) analyzes bond ratings, Schneider (2012), Anagol et al. (2013), and Shapiro (2015) examine the auto repair, insurance, and health industries, respectively. Our results suggest housing transaction costs (about $130

[4] See, for example, Genesove and Mayer (1997) and Hendel et al. (2009). We discuss this in greater detail in Section 6.

[5] Other recent work on real estate agents includes Rutherford et al. (2005), Bernheim and Meer (2012), Jia and Pathak (2010), and Barwick and Pathak (2015).

billion per year) are higher when agents steer buyers to properties with high commissions.[6]

The rest of this paper is organized as follows. Section 2 discusses the institutional background, while Section 3 presents a model showing how the threat of steering leads to high commissions. Section 4 describes the data and presents descriptive patterns of the housing market and commissions during our sample period. Section 5 analyzes property level sales outcomes for low commission properties. In Section 6, we compare the costs and benefits for high versus low commission rates. Section 7 concludes.

2 Institutional background

Real estate agents are licensed intermediaries who provide services to buyers and sellers in real estate transactions. The licensing requirements for Massachusetts appear modest (see Barwick and Pathak (2015) for more details). For home buyers, agents search for houses that match their clients' preferences, arrange visits to the listings, and negotiate with sellers. For home sellers, agents help to advertise the house, suggest listing prices, conduct open houses, and negotiate with buyers.

A contract between the seller and the listing agency usually includes the term of the contract,[7] the list price and the total commission the seller is obligated to pay to the listing agency in the event of a sale.[8] Commissions are often quoted as a certain percentage of the sale price. In the greater Boston area, the norm for this rate is 5%. The National Association of Real Estate Exchanges (the predecessor to the National Association of Realtors (NAR)) institutionalized a commission rate norm when it adopted its first Code of Ethics in 1913. It stated that "(a)n agent should always exact the regular real estate commission prescribed by the board or exchange of which he is a member." In Boston, agents referred to the *Schedule of Broker's Commissions* published regularly by The Boston Real Estate Exchange. In the 1920s, the typical commission rate for the city of Boston was 2.5 percent (Benson and North, 1922).[9] This rate increased to 5 percent in 1940 and has prevailed ever since as the most common rate for listings in the area (BREE, 1940).

This paper focuses on the common practice of *bundling commissions* where a seller pays one commission to her listing agency, who then shares the total commission with the agency who finds a buyer. In particular, the commission rate paid to the buying agency is specified in the listing agreement *prior* to the knowledge of buying agents. When buying agents are informed of properties that come to the market, they observe the property attributes as well as the buying commission rate that comes with a property (buyers do not observe the commission rate). This practice began in the early twentieth century

[6] The total commissions paid by home sellers and buyers averaged $130 billion per year between 2004 and 2013 (NIPA, 2014).

[7] Throughout this paper, an 'agent' is an individual who assists buyers or sellers in housing transactions, an 'office' or a 'firm' is a broker that an agent works for, and an 'agency' refers to an agent and her broker.

[8] This is the most common arrangement in the United States. Some markets have For-Sale-by-Owner (FSBO) arrangements. In most places, the market share for FSBO is low: 9% nationally and 7% in Massachusetts (NAR, 2014c), though it can be higher in some local markets (up to 20% in Madison (Hendel et al., 2009)).

[9] The fee was 2.5 percent up to $40,000 (or $460,000 in 2011 dollars) and one percent on the balance, with a minimum fee of $100.

to minimize the problem of buyers and sellers circumventing the payment of brokerage fees (Davies, 1958).

In many cases, the commission fee is evenly split between the listing and buying agencies. The 1913 Code of Ethics, for example, specifies that the eighth duty of members is to "... always be ready and willing to divide the regular commission *equally* with any member of the Association who can produce a buyer for any client."[10] More recent data suggest this pattern of equal splits persists until today (see Section 4).

The commission to an agency is further split between agents and their brokers. According to a 2007 survey conducted by the NAR, most agents are compensated under a revenue sharing arrangement, with the median agent keeping 60% of her commissions and submitting 40% to her firm (Bishop et al., 2007). Similar to salespeople working in other professions (Joseph and Kalwani, 1998), many brokerage firms also include built-in 'accelerators' that entails proportionately higher earnings with higher gross commission revenue (NAR, 2009). For example, a major franchise, Keller Williams, has a profit sharing arrangement with "an elaborate seven-step function" that shares more with more productive agents (Inman News, 2014). Such non-linear incentive schemes that are based on revenue further enhance agents' preferences towards listings with higher commission rates.

Figure B1 in the appendix (from Realtor.com, the official website of the NAR) illustrates how commissions are typically split between agents and brokers. In the example, the commission rate for a $300,000 property is 6%, with 3% paid to the listing agency and 3% paid to the buying agency ($9000 each). This $9,000 is further split so that the agent gets 60% ($5400) and the broker receives 40% ($3600). Finally, the broker pays a small fraction ($200) to its franchise.

3 Theoretical framework

Here, we develop a stylized model of housing transactions to illustrate how the threat of steering can generate high commissions and examine the implications of unbundling commissions.

Suppose that there are two identical properties for sale with different owners, each of whom has decided to work with a particular listing agent.[11] The owner is interested in selling her property, provided that net of transaction costs, the sale price is at least her reservation value v_s, which we assume is the same for both sellers. A listing agent can exert effort $e \in \{\underline{e}, \bar{e}\}$, with corresponding costs $\{\underline{c}, \bar{c}\}$. There is one buyer's agent in the economy, who can also exert effort $e \in \{\underline{e}, \bar{e}\}$ with costs $\{\underline{c}, \bar{c}\}$. The buyer's agent decides which of the two properties to show her client, a home buyer with reservation value v_b. As in standard principal-agent models, effort is not observed, although our results remain the same otherwise. Since effort takes one of two values, we consider commission schemes with two different levels, L and H. All agents' outside options (net earnings from other professions) are assumed to be 0. In addition,

[10] Emphasis added by authors.

[11] For simplicity, we do not model the matching process between sellers and listing agents or between buyers and buying agents.

agents are risk neutral.

The setting of two sellers and one buyer means that one property will not sell. This assumption allows for steering because if all properties sell, then agent steering becomes inconsequential. It is also consistent with our sample where a third of the properties do not sell.

We make two important simplifying assumptions. The first assumption is about the sales technology. We assume that a property sells only if the buying agent shows it to her client and both the listing and buying agents exert at least the minimum effort $\underline{e}$. The fact that a buyer's agent is necessary for a transaction means that no amount of listing agent effort can substitute for the buyer's agent. The incentive scheme, therefore, plays a dual role: to incentivize effort and to attract the buyer's agent to the property.

The second assumption is that if a property sells, it sells at price p that is exogenously given, regardless of the effort of the listing and buying agent. This assumption is motivated by the empirical evidence below illustrating little relationship between sales prices and agent commissions. Moreover, it is a convenient simplification since different sales prices simply reflect transfers between sellers and buyers in this model. We assume $p > v_s + 4\underline{c}$ to ensure that the seller wishes to sell given the anticipated transaction costs, and $v_b > p + \underline{c}$ to ensure that the buyer wishes to buy even if she has to pay the buyer's agent directly.

We first examine the equilibrium commission structure and effort levels when the home seller must pay both the listing and buying agent in the event of a sale (bundled commissions). We impose the restriction that the commission is split evenly between the listing and buying agent. This scenario is motivated by the industry norm. In equilibrium, the competition for the cooperation of the buying agent forces both sellers to bid up commissions to the point that they exactly break even between selling their property and keeping it. Equating the net proceeds of selling a property $p - 2H$ with the reservation value v_s delivers $H = \frac{p - v_s}{2}$. The buying agent exerts effort $\underline{e}$ and shows her client either property with equal probability. Each listing agent exerts effort $\underline{e}$ to sell her listing, but recoups her cost only half of the time when her listing sells. The assumption that $p > v_s + 4\underline{c}$ guarantees that the listing agents are better off exerting effort than taking their outside options because $\frac{H}{2} - \underline{c} > 0$.

The buying agent earns a rent of $H - \underline{c}$, which is driven by the threat of steering. This rent exists because if one of the home sellers deviated and offered a lower commission, her property would not sell. Since the buyer's agent earns the same amount from both properties, there is no incentive to deviate from showing each property with equal probability. This is also necessary because if the buying agent shows one property more than half of the time, the listing agent of the other property would not find it optimal to exert effort. Note that the listing agents also earn rents, due to the constraint of evenly split commissions.

Next, consider the equilibrium commission structure when sellers can pay differential commissions to the listing and buying agent. This allows each seller to pay a lower commission $L' = 2\underline{c}$ to her listing agent and a higher commission $H' = p - v_s - 2\underline{c}$ to the buying agent. All agents exert effort $\underline{e}$. The listing agents no longer earn rents, but the threat of steering continues to earn the buying agent a rent of $H' - \underline{c}$.

Finally, we consider the case where commissions are unbundled, so that each seller only pays her listing agent and the buyer pays the buying agent. In equilibrium, the home buyer pays $\underline{c}$ to the buying

agent, who exerts effort $\underline{e}$, the minimum effort for a successful transaction. The seller offers her listing agent a commission of $2\underline{c}$ in the event of a sale. None of the listing agents nor the buying agent earns a rent: the absence of the threat of steering makes it unnecessary to offer artificially high commissions.

In summary, in our first and second scenarios, commissions are bundled and serve two purposes: to compensate agent effort and attract buyers. The resulting threat of steering forces both sellers to pay a high commission to the buying agent, which creates rent and leads to higher transaction costs. In contrast, when commissions are unbundled, the transaction costs are lower while other equilibrium outcomes remain the same.

4 Data and descriptive patterns

4.1 Sample coverage

The data for this study come from the Multiple Listing Service (MLS) network for eastern Massachusetts, a centralized platform containing information on property listings and sales. This area has a number of virtues for our analysis: the market experienced a boom-bust cycle during our sample period, with house prices peaking in mid-2000s and falling thereafter. The market also includes high-priced suburban towns with single-family homes and more densely populated inner urban areas where condominiums make up the bulk of transactions.

We collect information on all listed non-rental residential properties. Our sample contains 653,475 listings between 1998 and 2011, covering 85 towns and cities surrounding Boston. We combine 12 small cities with their closest neighbor. Given the size of Boston, we split it into 15 markets using Zillow's definition of neighborhoods and a variable in the MLS (*area*) that identifies neighborhoods within cities. This gives us a total of 87 markets. The appendix provides more details on the sample construction and market definition.

For each listed property, we observe listing details (the listing date and price, the listing office and agent, the commission offered to the buyer's agent, and so on), a rich set of property characteristics, and transaction details when a sale occurs (the sale price, date, the purchasing office and agent). The number of days on the market is measured by the difference between the listing date and the date the property is removed from the MLS database. We complement the MLS data with a deeds data set from a commercial vendor that records seller and buyer names for all properties that change ownership during 1998 to 2008. This allows us to track home buyers and sellers overtime. We also merge in data from the Home Mortgage Disclosure Act (HMDA) which includes information on the income of buyers.

Our sample comprises three property types: condominiums (35%), single family homes (52%), and multifamily properties (13%). The average listing in our sample has 1840 square feet, 3 bedrooms, 2 bathrooms, and is 62 years old. The median list price is $420,000 and the median sale price is $398,000 (both in 2011 dollars). The properties in our sample are comparable in size, but are older and more expensive than the average home purchased in the United States between 2013 and 2014 (NAR, 2014c),

which has 1,870 square feet, 3 bedrooms, 2 bathrooms, is 20 years old with a median sale price of $235,000.

4.2 Commission fees

There is surprisingly little information on commissions charged by real estate agents at the property level. The only exceptions that we are aware of include Schnare and Kulick (2009) that documents variation in buying commissions across seven real estate markets but does not examine the consequences of buying commissions on sales outcomes. Goolsby and Childs (1988) and Zietz and Newsome (2001) report on buying commissions for a few hundred transactions.

Critically, we observe the commission rate offered to buyers' agents for each of our 653,475 listings. The histogram in Figure 1 establishes that a lion's share of listings offer either a 2.5 percent or a 2 percent commission rate to the buyer's agent, with the rest scattering between 2 and 3 percent. Specifically, the most commonly observed rates are 2.5 percent (59% of listings), 2 percent (31% of listings), 3 percent (5% of listings), and 2.25 percent (3% of listings). Throughout our analysis, we define a *low commission rate* listing as one with a buying commission rate strictly below 2.5 percent and a *high commission rate* listing one with a rate at or above 2.5 percent.

Figure 2 displays geographical variation in commission rates. In markets such as Cambridge and Newton that are characterized by high household income and high house prices, less than 15% of their listings have buying commissions below 2.5 percent. On the other hand, in Revere, East Boston, and other markets characterized by low household income and low house prices, more than three-fourths of listings have low commission rates. Besides the cross-sectional variation in commission rates, our analysis also takes advantage of the time series variation in our sample. The average commission rate displays a modest U-shape over time, varying from 2.49 percent in 1998 to a low of 2.27 percent in 2005 before reverting back to 2.39 percent in 2011. This modest variation masks a relatively large change in the fraction of listings at 2.5 percent: about 74% in 1998, 49% in 2005 (a period with a large influx of entering agents and offices), and 62% in 2011.

Most brokerages have commission rate policies or norms. There appears to be systematic differences in commission rates charged by different offices. Among the six dominant chains – Coldwell Banker, Century 21, Remax, Hammond, Prudential, and GMAC – only Century 21 has a majority of listings at rates below 2.5 percent. Coldwell Banker, the largest chain that accounts for about 20% of all listings in our sample, rarely lists properties at rates below 2.5 percent. In contrast, about 48% of independent offices and smaller chains have a majority of listings at rates below 2.5 percent. Some of the firm level variation could reflect differences in costs, such as overhead, insurance charges, and technology and marketing costs. It could also come from brand premium or prestige. In addition, commission rates may vary depending on property attributes (condominiums usually list at high commission rates) and market conditions.

While our dataset does not contain commissions paid to listing agents, the typical split is 50/50.

To investigate the commission split between listing and buying agencies, we collect a random sample of 70 HUD-I housing settlement statements that report final compensations paid to agents, including commission rates and rebates. These commission rates are reasonably representative: the properties are listed by 39 offices in 37 of the markets in our sample from 2007 to 2012. The average sale price (not deflated) is $483,000, which is comparable to our sample average of $479,000 in 2011 dollars.[12] Our calculations suggest that 90% of transactions in our random sample have even splits of commissions. For the remaining 8 transactions, half pays more to the listing agency, and half pays more to the buying agency.

4.3 Brokerage firms and agents

There are a total of 8,888 offices and 35,129 agents in our data set. The ability to observe agent and office identifiers as well as their past transactions allows us to construct detailed measures of office and agent quality, including experience, various sales performances (such as the fraction of listings that are sold each year, the average days on market), and property portfolio (the fraction of condominiums or single-family houses). For offices, we also observe the size and quality of their agents. We collect each office's street address from a variety of data sources and use this information to construct distance between offices. Tables C1 and C2 in the appendix describe our variables in detail.

A large number of offices and agents have only a few listings throughout our sample period. Our analysis focuses on offices (agents) whose average annual listings is above 5 (2).[13] These offices (agents) are responsible for 95% (92%) of the listings.

There is substantial turnover of brokerage offices and agents that coincides with the latest housing boom and bust, as illustrated in Figure 3. The annual number of listings (the dashed line) remains around 40,000 through 2002 and increases steadily to 65,000 in 2006 before declining to 40,000 by 2011. The solid line illustrates entry and exit of offices over time that also appears to be correlated with the housing cycle. The number of offices nearly doubles from 1,700 in 1998 to 3,200 in 2011, with newly established offices accounting for four-fifths of the sample near the end of our sample period.

4.4 Growth paths of low commission firms

Figure 4 shows that entrants (brokerage firms established in 1999 or later) that offer low commissions in the past are much less likely to reach the top tier of the market in terms of revenue than entrants with high commissions. This is counterintuitive: firms charging low prices are less likely to grow. One possible explanation for this pattern is that entrants are not identical. Firms that are able to recruit talented agents or with more connections might charge a high commission rate and do well at the same time.

[12] Our sample comes from a real estate brokerage firm in one of our sample cities.

[13] The average annual number of listings is the ratio of the total number of listings by an office or agent over the total number of years that office or agent spans our data (the last year minus the first year plus one).

We refine the comparison in Figure 4 by controlling for firm attributes in the following regression:

$$1(TopRev_{lmt}) = \gamma frcRtL25_{lm,t-1} + X_{lm,t-1}\beta + \mu_{mt} + \varepsilon_{lmt}, \quad (1)$$

where $1(TopRev_{lmt})$ is 1 if office l's revenue is in the top quartile in market m and year t, X represents office controls and μ represents market-year fixed effects. The key regressor is $frcRtL25_{lmt}$, the fraction of office l's listings that is below 2.5 percent in the most recent three years $t-2$ to t.[14] The one-year lag of $frcRtL25_{lmt}$ alleviates concerns that it might be jointly determined with the dependent variable.[15]

Table 1 reports estimates of γ for entrants (Panel A) and all offices (Panel B). Column 1 includes market-year fixed effects. Column 2 adds office quality (experience, performance of listings, composition of agents, etc.). Column 3 controls for the composition of an office's listings (average number of bedrooms, average square footage, etc.), mitigating concerns that the weak performance of low commission entrants is driven by their tendency to list properties that deliver lower commission revenues. Column 4 adds office fixed effects. Firms' top-quartile status tends to be persistent over time, thus we control for a one-year lagged top status in all columns except in the specification with office fixed effects. Results without the lagged status are more pronounced. See Table C1 for a full list of controls.

Across the columns, low commission entrants are significantly less likely to be top-revenue firms, even after adjusting for observable differences among them. Our most conservative estimate suggests that an entrant that specializes in low commissions ($frcRtL25 = 1$) in the past is 5 percentage points (p.p.) less likely to report top-quartile revenues than an entrant that specializes in high commissions ($frcRtL25 = 0$). This effect is considerable given that the mean of the dependent variable is only 17%. When we repeat the analysis using all offices in Panel B, we continue to find much weaker performance for low commission offices.

Although not shown, we have estimated regressions using many different measures of dominance and different sample cuts. We find a large negative consequence of low commission policies across all of these specifications. These findings are thought provoking: competitive behavior, where offices charge *low* prices for comparable services, does not lead to successful outcomes. Instead of growing bigger, these offices are more likely to remain small.

5 Results

Motivated by the patterns discussed above, our core analysis tests whether a low commission rate offered to the buyer's agent affects the sale performance of a listing. We first show that listings offering high versus low commission rates appear to be comparable, on average. We then present robust evidence that the effect of commission rates on sales outcomes survives a rich set of controls for market conditions, property characteristics, seller, agent and office attributes, as well as an instrumental variable strategy.

[14] Results using a one-year window instead of a three-year window are similar but noisier because some entrants have few listings in a year.

[15] A two-year lag of $frcRtL25_{lmt}$ leads to similar results.

5.1 Effect of commission rate on transaction outcomes

Our main listing level regression is of the following form:

$$y_{ipklmt} = \beta_1 RL25_{ipklmt} + PROP_{ipt}\beta_2 + AGT_{kmt}\beta_3 + OFFICE_{lmt}\beta_4 + \mu_{mt} + \tau_{month} + \pi_p + \varepsilon_{ipklmt} \quad (2)$$

where y_{ipklmt} is the sale outcome for the i'th listing of property p, by agent k and office l in market m and year t. The key regressor is $RL25$, a dummy that is 1 if a listing offers a commission rate that is strictly below 2.5 percent. There are many sources of confounders in our context because houses are differentiated along multiple dimensions and many parties are involved in a housing transaction. We include controls for property characteristics ($PROP$), attributes of listing agents (AGT) and listing offices ($OFFICE$), market by year fixed effects (μ_{mt}) for time-varying market conditions, month fixed effects (τ_{month}), and property fixed effects (π_p). To conserve space, we reserve a detailed description of all controls in Table C2 in the appendix.

We examine three performance measures of a listing: the sale probability, as well as the days on market and the sale price if a listing is sold. The parameter of interest is β_1. In an ideal setting, where commission rates are randomly assigned and buying agents fully internalize interests of their clients, how much agents are compensated should not affect the sale outcome (β_1 should be 0). On the other hand, if buying agents steer their buyers towards high commission properties, β_1 will reflect negative outcomes for low commission properties. A key empirical challenge is that listings offering low commission rates may have less desirable attributes that lead to adverse outcomes (β_1 may be downward biased). Our assumption is that $RL25$ is plausibly uncorrelated with the residual of sales outcomes, conditional on our controls.

Table 2 demonstrates that observable differences between listings offering high versus low commission rates are modest. Each row reports an OLS regression at the listing level where the dependent variable is a property characteristic and the regressor is the $RL25$ dummy. These tests only have one regressor but the results are similar if we add market by year fixed effects and month fixed effects to control for market conditions. We choose a list of property characteristics that are commonly included in hedonic regressions in the housing literature.[16] Columns 1 and 2 report the mean and standard deviation of each dependent variable. Columns 3 and 4 report the coefficient on $RL25$ and the p-value. On average, low commission rate listings are 10 square feet larger, have 0.1 acre smaller lotsizes, are 8% less likely to be condominiums, 1% less likely to be single-family homes, one year older, have 0.2 more bedrooms, 0.07 fewer bathrooms, and 0.07 more other types of rooms.

Table 3 presents estimates of β_1, the causal effect of offering a low commission rate on the probability of sale. The dependent variable is a dummy that is one if the listing is sold within our sample period (the mean is 65%).[17] Standard errors are clustered at the market by year level (columns 1 to 2) and at the

[16] This small set of characteristics explains 47% of the variation in *ln(List price)* and up to 78% of the variation if we include market by year fixed effects and month fixed effects.

[17] The MLS data reports whether a listing was sold, cancelled, expired, or withdrawn. We code a listing as sold if its status

property level (columns 3 to 7). We include the full sample of 653,475 listings.

Across all specifications, low commission rate listings are significantly less likely to sell than high commission rate listings. We begin with a parsimonious specification in column 1 that controls for market conditions since commission rates tend to be correlated across markets and time, as discussed in Section 4. Conditional on market by year and listing month fixed effects, low commission rate listings are 9 p.p. less likely to sell compared to high commission listings.

Next, we show that the lower sales probability survives controls of property attributes. We find a weaker effect in column 2 but the change is modest (- 7 p.p. compared to - 9 p.p. in column 1), even after adding 148 property controls that explain 62% of the variation in *ln(List price)* and up to 85% with market by year and month fixed effects. The smaller coefficient suggests that some of the effect in column 1 is driven by unobserved property attributes that make low commission rate listings harder to sell. However, the change in the β_1 estimate is not large, which is expected given the modest differences in observed property attributes reported in Table 2.

Furthermore, the estimate remains similar when we add more than 133,000 property fixed effects in column 3 to control for time-invariant property characteristics. This restricts the sample to properties with multiple listings during our sample period.[18] Here, the model is identified by comparing the same properties that switch between low and high commission rates (which applies to 36% of properties). Notably, the R-squared increases from 10% to 46% but the effect (- 9 p.p.) remains similar.

Property fixed effects do not address time-varying property attributes, such as unobserved upgrades. We therefore construct keywords related to maintenance and renovations from property descriptions and include them as part of the 148 property controls from column 2 onwards.[19] Admittedly, regardless of how many controls are included in the regression, one can never completely eliminate the concern of unobserved attributes. However, as documented in Table 5, the *same* set of controls explains 97% to 99% of variation in sales prices. It is difficult to imagine unobserved property attributes that affect the probability of sale but not the sale price. Hence, we conclude that unobserved housing attributes are unlikely to be a major concern here.

Lower sales probabilities for low commission listings might be driven by seller preferences. In particular, we are concerned that patient sellers who are more likely to trade off higher sales prices against lower sales probabilities are also more likely to list at low commission rates (to maximize their proceeds net of commission). In column 4, we proxy for seller patience using the idea that patient sellers will list their properties at higher prices, relative to prices predicted from observed attributes. This also builds on the notion of using the list price as a proxy for the seller's reservation price (Genesove and Mayer, 2001). Patient sellers tend to have higher reservation prices than motivated sellers. We first calculate the ratio of

is sold and zero otherwise. Later, we show that our results are not driven by right-censoring issues for the *sold* dummy (listings close to the end of the sample period may sell after the sample ends).

[18] Restricting the sample might introduce a sample selection bias as properties that are listed multiple times could be properties with lower quality. However, this difference appears to be small. When we repeat the specification in column 2 for the sample of repeat listings, the effect is -8.5 p.p.

[19] We create dummies for common keywords such as "Renovated", "Remodeled", "Maintained", "Needs updating". These dummies are part of the 148 property controls. See Table C2 in the appendix for the full list of keywords.

the observed list price to a predicted hedonic price, then construct decile dummies for this ratio.[20] These decile dummies constitute our seller patience controls. With these controls, the effect becomes slightly less negative (- 6 p.p.). We explore other controls for seller patience and seller preferences in Table 7 (see Section 5.2.2 for details) and reach similar conclusions.

We further probe the robustness of these results by adding measures of listing office and agent quality. These additional controls alleviate concerns that lower quality offices or agents are more likely to list at low commission rates (columns 5 and 6). For agents, we control for their experiences over time and also whether they are star agents (ranked in the top decile using agents' average annual listings). For offices, we control for the composition of agents in the office, the performances of listings by the office in each year (such as the fraction of listings that were sold, the average days on market for sold listings) and whether an office is the dominant office in a market in terms of average transaction volume. Higher quality offices and agents have higher sales probabilities through two channels. First, they are better at selecting properties that are easier to sell. Second, they are more knowledgable about local market conditions, have better social skills, and are better at selling.

Our most saturated OLS specification implies that low commission listings are 5 p.p. less likely to sell than observably identical high commission listings (column 6). Interestingly, the estimate remains relatively stable after adding office and agent controls. This could be because the first (selection) channel has been controlled for using property controls and property fixed effects. While office and agent quality naturally affect the probability of sale, most of the variation seems to have been absorbed in our previous specifications. Additionally, our results survive more flexible controls for agent and office quality such as office fixed effects or agent fixed effects (see Section 5.2.1 for details).

While the stable estimates across the different OLS specifications above are encouraging, we reinforce our causal interpretation by implementing an instrumental variable strategy (column 7). We begin with the observation that some chains appear to have different preferences for high versus low commission rates, based on our examination of the data and discussions with realtors. Among the three largest chains in our data, Coldwell Banker, Century 21, and ReMax,[21] Coldwell Banker has the lowest fraction of low commission listings (9%) and Century 21 has the highest fraction (53%). ReMax is in the middle (36%). There is suggestive evidence that customers of Coldwell Banker are less price-sensitive than those of Century 21. For example, the median income amongst buyers who are represented by Coldwell Banker is $105,000 compared to $80,000 for buyers represented by Century 21.[22]

Our instruments include the distances between the listing office and the nearest Coldwell Banker and

[20] The hedonic regression uses our most saturated set of controls in column 6 (but drops the dummy for low commission rate) on the full sample of listings. We construct an index of seller patience associated with each listing in the full sample of 653,475 listings. We estimate property fixed effects for all properties with repeat listings. We group properties with non-repeat listings and estimate a common constant for these listings.

[21] Each of these three chains have more than 60,000 listings in our data. The next large chain (Hammond) has fewer than 20,000 listings.

[22] We obtained this data by merging our listings data with data from the Home Mortgage Disclosure Act (HMDA) through 2008. We have income data for about 25% of purchases. For Coldwell Banker, we have income data for 15,470 purchases out of 58,424 purchases. For Century 21, we have income data for 10,762 purchases out of 42,975 purchases.

Century 21 offices in each year, respectively. If prices are strategic complements, higher prices by rivals lead to higher prices by the listing office. As a result, listing offices near Coldwell Banker (Century 21) are more (less) likely to charge high commission rates. Our first stage analysis confirms this hypothesis. We regress *RL25* on the distance from listing office l to the nearest Coldwell Banker office in year t and the distance to the nearest Century 21 office in year t, while maintaining the same set of controls as in column 6. Time series variation in our distance measures is driven by changes in the listing office and entry and exit of Coldwell Banker and Century 21 offices. The t-statistics for the distances to the nearest Coldwell and Century 21 offices are 34 and -11, respectively. The F statistic for the joint test of excluded instruments is 570.

The thought experiment behind the IV strategy is to contrast the sale performance for the same property that is listed in year t by an office close to Coldwell Banker and also listed in year t' by an office close to Century 21. The distance instruments give rise to quasi-exogenous variation in *RL25* because the listings in years t and t' would have high and low commission rates, respectively. The exclusion restriction requires that distances to Coldwell Banker and Century 21 offices only affect sales outcomes through their impact on the pricing strategy of the listing office. One concern is that distances could be correlated with other determinants of sale outcomes, perhaps due to endogenous entry and exit decisions of firms. For example, higher quality firms could sort into locations closer to properties that have desirable attributes and are easier to sell. Our identification assumption is that these distances were chosen before the listing date and that predetermined factors that jointly affect firm location choice and sales outcomes (such as property attributes and market conditions) are controlled for.

Reassuringly, the IV estimate continues to imply that low commission listings are less likely to sell. The estimate in column 7 is - 8 p.p., slightly more negative but not statistically different from that in column 6. The stability of the estimates across columns 6 and 7 is encouraging as these estimation strategies (OLS vs. IV) leverage different sources of variation in the key regressor and are presumably identified from different sets of properties. We find similar results when we repeat the IV estimation but drop listings by Coldwell Banker and Century 21 offices.

Table 4 reports the results for the number of days on market for sold properties. The dependent variable is *ln(Days on market)*, where the number of days on market is censored above at 365 days. A total of 6428 listings took a year or longer to sell. The average (median) time on market is 71 (44) days. The specifications across the columns are analogous to those in Table 3. Columns 1 and 2 include all sold listings.[23] Column 3 onwards includes properties with repeat sales and controls for property fixed effects (33% of properties switch between high and low commission rates).

We find that low commission rate listings take 12% longer to sell, or 8 days for the average sold listing (column 6). The results are relatively stable between 12% and 14% across specifications. The IV estimate is larger (33%) but the standard errors are also large (12%). The test of whether the IV estimate in column 7 is different from the OLS estimate in column 6 has a p-value of 0.08.

[23] We have 421,329 sold listings. We drop 2,207 sold listings with zero days-on-market and 6 sold listings with negative days-on-market, leaving us with 419,116 sold listings for our estimation sample.

Table 5 provides results for our final transaction outcome, the sale price. The average (median) sale price is $479,000 ($398,000) in 2011 dollars. The dependent variable is *ln(Sale price)*. Our estimation samples include all sold listings (columns 1 and 2) and repeat sales with property fixed effects (columns 3 to 7).

When we only control for market conditions (column 1), low commission listings sell at higher sales prices. Adding property controls and property fixed effects in columns 2 and 3 dampens the effect. If low commission rates are associated with lower property quality, adding property controls should mitigate the downward bias and increase the coefficient from column 1 to columns 2 and 3. The patterns reported here alleviate concerns over unobserved low property quality and echo our earlier discussion that patient sellers prefer high sales prices and low commission rates. Accordingly, controlling for seller patience (column 4 onwards) offsets this upward bias and reduces the effect of low commission on the sale price to be statistically insignificant.

The results from Table 5 indicate that offering high versus low commission rates has no statistically significant impact on the sale price. This supports the assumption in our stylized model (Section 3) that the sale price is exogenously given (determined by market forces). It is possible that sellers pass through part of the agency commissions to buyers, but our sample does not have enough power to detect this, probably because the implied pass-through due to the one p.p. difference in commission rates is small.

Overall, our results provide compelling evidence that listings offering low commission rates experience adverse sales outcomes compared to high commission listings. We find that low commission rate listings are 5 p.p. less likely to sell, a sizable effect considering the sample average of 56% for repeat listings (and 65% for the full sample). In addition, conditional on a sale, low commission listings take 12% (8 days) longer to sell, but sell at comparable prices to those with high commission rates. Similarly, Hendel et al. (2009) find no indication that MLS listings deliver a higher sale price than FSBO transactions, after controlling for house and seller heterogeneity. Levitt and Syverson (2008) report that agent-owned homes sell for 3.7% higher prices but take 9.5 days longer to sell compared to non-agent-owned homes.

Our estimates are remarkably stable. They are similar across different samples (Boston versus outside of Boston, condominiums versus single family houses, big versus small offices, as reported in Table C3 in the appendix) and survive a battery of robustness checks. They are robust to market condition controls that use zipcode fixed effects, census tract fixed effects, market plus year fixed effects instead of market by year fixed effects. They are consistent across different combinations of property, agent, and office controls and are robust to using two-way clustering of standard errors (by property and year).[24] In Table C4 in the appendix, we address concerns that our probability of sale regression is affected by right censoring in our *sold* dummy (some listings in 2011 are sold after our sample period ends). We repeat our probability of sale analysis using whether a listing is sold within 30, 60, 90, and 180 days of the listing date as alternative dependent variables. We also experiment with dropping properties that are listed after 2009 and are more likely to be subject to right censoring. Our conclusions are similar in all cases.

[24] All results referenced in this paper are available upon request.

Compared to the existing literature, our analysis has several advantages. Our sample is large with ample variation. Since the typical property only transacts every four years in our setting, a long panel has the benefit of having more properties and sellers with repeated listings and sales. We have 133,903 properties with 344,832 repeat listings and 62,843 properties with 137,085 repeat sales. Our controls have a high explanatory power: the most saturated specification (column 6 in Tables 3, 4, and 5) has an R-squared of 51% for the probability of sale, 57% for days on market, and 99% for the sale price. Moreover, we control for observed attributes for all parties involved in listing a property: the listing office, listing agent, and seller. Their time-invariant attributes are controlled in a flexible manner by fixed effects (discussed below).

Next, we discuss findings from tests that address two remaining identification threats. We focus on the sale probability. Our results are similar for the other two outcomes (days on market and sale prices).

5.2 Potential threats

5.2.1 Unobserved effort by listing agents

The findings above that listings offering low buying commission rates experience worse outcomes are consistent with buying agents steering their buyers towards high commission listings. However, the worse outcomes can also reflect diminished effort from listing agents who receive less commission revenues from lower commission rates.[25] To address this issue, we first examine properties where listing agent effort is less likely to be crucial and then proxy for listing agents' effort. If the lack of listing agent effort drives the negative sales outcome, then we should expect a less negative estimate for these specifications.

We continue to find that properties that are relatively homogeneous and easy to sell suffer worse outcomes when they are listed at low commission rates, and the magnitude is remarkably similar to what we report above for the full sample. Column 1 of Table 6 shows that new properties with low commission listings are 5 p.p. less likely to sell. We obtain the same effect restricting to 11% of the listings built within five years (the median age is 63 years and 60% of the properties was built before 1960s). In addition, the coefficient is the same for condominiums, which are more homogeneous than other property types.

Next, we show that our results survive listing agent fixed effects. We add more than 9,000 agent fixed effects to the same specification in column 6 of Table 3 to flexibly control for the time-invariant quality of listing agents.[26] This is a demanding exercise with 305,000 observations and more than 142,000 controls. The effect of low commission rates on the sale probability is -3 p.p. and precisely estimated. The estimate is slightly weaker than our base case, which is likely driven by the attenuation bias exacerbated by the large number of fixed effects.

Our final strategy is to augment our empirical model to proxy for listing agents' effort using potential

[25] We do not observe commissions to listing agents. However, the commission rates offered to listing and buying agencies are usually the same (see Section 2)

[26] We restrict our analysis to agents with eight or more listings. This drops 40,212 listings with the benefit of saving 15,000 fixed effects for agents with few listings in our sample.

listing commission revenues. Assuming the buying and listing commission rates are the same, the listing commission revenue is the product of the observed commission rate and the list price. If two different properties offer the same listing commission (for example, a $500,000 property at 2% vs. a $400,000 property at 2.5%), then the agent is likely to exert the same effort in selling both properties. On the other hand, if the two properties offer different buying commission rates, then they might attract different numbers of buying agents and hence have different sales outcomes, holding constant effort by the listing agent.[27]

To implement this idea, we create bins of listings that deliver similar commission revenues for a listing agent in a given year and property type. For example, one bin could be all condominiums that are listed by Mary Smith in 2000 that generate gross listing commission revenues that differ by at most $500. Given that an agent typically keeps 60% of the gross commission revenues, the actual difference in the net commission revenues across different properties in the same bin is even smaller. We restrict each bin to the same property type to limit the extent of heterogeneity. These bins are comparable to agent by property-type by year fixed effects. Column 3 of Table 6 illustrates our result when we restrict the commission difference to a maximum of $500. We have a total of 92,191 bins, accounting for 231,550 listings. We include bin fixed effects from column 3 onwards. Our coefficient is identified from 15% of the bins with within bin variation of *RL25*. We include the same set of controls as those in column 2, with the exceptions of agent fixed effects and agent-year controls (which are absorbed by the bin fixed effects) and property fixed effects (since few properties are listed and sold more than once by the same listing agent within a year).

We find a similar negative impact of low commission rates on the sale probability, when comparing listings offering high versus low buying commission rates within the same bin, holding constant listing agent effort (column 3). While this result is reassuring, one might be concerned that without property fixed effects, we are essentially comparing outcomes across different properties. To the extent that unobserved property attributes that affect ease of sale are correlated with commission rates, our parameter estimates will be biased. First, note that even though we do not include property fixed effects, the fitness for column 3 is as good as that in our main specification in Table 3: the R-squared is 0.57, versus 0.51 in the main specification. The bin fixed effects, as well as the remaining set of controls, appear adequate to explain the variation of sale probability at the property level. Second, replacing the full set of property controls with a sparse set of eight attributes as those reported in Table 2 delivers roughly the same coefficient. If unobserved property attributes bias our results, then controlling for a richer versus a more sparse set of property controls should lead to different estimates. Columns 4 and 5 repeat the same analysis, with slightly wider bins: the maximum difference in the gross listing commission revenues is $1000 and $1500, respectively. The coefficient of *RL25* is stable across different bin sizes.

Finally, our conclusions should hold even if the listing and buying commission rates are not equal. As discussed in Section 2, a majority of listings have a 50/50 split. If the listing and buying commission rates

[27] For example, if a buyer is looking for a three-bed single-family that is worth $500,000, her buying agent has an incentive to steer her to comparable properties at around the same price range but offer high commission rates 2.5%.

are positively correlated, our measure of the potential commission revenue will be positively correlated with the true commission revenue received by the listing agent and should still proxy for listing agent effort. If they are negatively correlated, then properties with low buying commission rates have high listing commission rates and should elicit *more* effort from the listing agent. The higher effort levels cannot explain the worse outcomes that we find. We conclude that our results are not driven by unobserved listing agent effort.

5.2.2 Seller preferences

Table 7 addresses the threat that comparisons of high versus low commission listings could reflect differences in seller preferences. For example, the lower sale probabilities for low commission rates could be driven by downward biases from contrasting patient sellers (who choose to offer low commission rates and are less likely to sell) against impatient sellers.

First, we present evidence that our results are robust to alternative proxies for seller preferences. This mitigates concerns that the decile dummies in our main specification may not be fine enough and there may be residual correlation between seller attributes and the low commission dummy. In column 1, we directly control for *ln(List price)* instead of using our decile dummies. The list price proxies for the reservation price of a seller (Genesove and Mayer, 2001) and has been shown to affect bargaining and search behavior (Han and Strange, 2014). While the list price may reflect unobserved agents or property attributes, it also reflects seller patience. Therefore, augmenting our regression model with the list price allows us to assess wheter our estimates are affected by seller urgency. Next, we replace the decile dummies with one hundred percentile dummies, which constitute a finer set of patience controls. Reassuringly, we find similar results when we control for list price directly (-6 p.p.) and when we control for the percentile dummies (-5 p.p.).

Besides exploring different controls for time-varying seller attributes, we also show that our results survive the addition of seller fixed effects to control for time-invariant seller attributes (columns 3 and 4). We obtain seller names by merging our MLS data with county records that include price, transaction date, address, and seller and buyer names. We restrict the analysis to 31,407 listings by sellers with multiple listings. We include 14,213 seller name fixed effects (29% of listings switched between high and low commission rates). Standard errors are clustered at the seller level.

The specification with seller fixed effects and seller patience controls delivers a similar effect on the sale probability (-7 p.p.) compared to the -5 p.p. effect we find above. This model is identified by comparing listings by the same seller offering different commission rates, conditional on all of the controls in column 6 of Table 3 (except property fixed effects). Since some common names might represent different sellers, we drop seller names that occur more than five times in column 4 and obtain a similar estimate. In addition to specifications reported in Table 7, our results are robust to a variety of tests: whether a sparse or a full set of property controls, with or without seller patience proxies, etc.

5.3 Why do low commission listings experience adverse outcomes?

So far, our results demonstrate that the worse outcomes for listings offering low commission rates are not driven by common property, seller, listing office, and listing agent confounders. Rather, they point to buying agents best responding to commission rate incentives. Next, we provide further support to this argument by examining why listings offering low commission rates experience adverse outcomes. We first document heterogeneous effects on the probability of sale. Then, we provide direct evidence that dominant offices and agents have a lower propensity to purchase low commission rate listings.

5.3.1 Outcomes for properties more susceptible to steering

We first examine low commission listings in neighborhoods with a large fraction of high commission listings. All else equal, it is conceivable that buying agents are less likely to visit low commission listings that are surrounded by similar properties with high commission rates.[28] The key variable of interest is the interaction between the low commission rate dummy for listing i and the fraction of high commission listings in the same census block group and same listing year. We demean this fraction so that the coefficient for the low commission dummy reflects the effect for the average census block group-year.[29] We include block group-year fixed effects but exclude property fixed effects.

Our results confirm that low commission listings are harder to sell if they are surrounded by more high commission listings in the same year. The -0.03 coefficient in column 1 of Table 8 implies that a one standard deviation increase in the fraction of high commission listings nearby translates to a 1 p.p. decrease in the probability of sale (relative to the direct effect of - 5 p.p.). One concern is that low commission listings surrounded by high commission listings reflect a selected sample of relatively lower quality listings that are harder to sell. If this is the case, then the effect should change when we add more controls that affect the probability of sale. However, this effect is stable whether we use a sparse or a full set of property controls. Column 2 shows that this effect is larger for condominiums. Condominiums within a census block group are more homogeneous, and thus, the incentive to show a high commission condominium listing against a low commission listing within the same census block group is more pronounced.

We next demonstrate that low commission listings offered by independent entrants (firms that do not belong to top six chains) suffer worse outcomes. Entrants have little market power, possess few contacts, and are more dependent on other agents and brokerage offices to cooperate with them. Hence, they are more vulnerable to steering. In column 3, we extend our main specification with two additional

[28] For example, an agent asks:"Why would I sell my buyer a home for half the commission when I can take them elsewhere?" (Denver Post, 2013)

[29] That is, we augment equation 2 by keeping the direct effect of the low commission dummy for listing i in block group g in year t, $\beta_1 RL25_{igt}$, and adding an heterogeneous effect, $\rho_1 RL25_{igt} * (frcRH25_{gt} - R_{gt})$. Variable $frcRH25_{gt}$ is the fraction of listings in block group g and year t that have high commission rates and R_{gt} is the average of this fraction at the block group-year level. Therefore, β_1 measures the effect of low commission rates for listings in the average block group-year. The direct effect of $(frcRH25_{gt} - R_{gt})$ is absorbed by the block group-year fixed effect. We drop all block group-years that have fewer than 5 listings to avoid imprecision in $frcRH25$ due to small samples.

regressors: a dummy if the listing office is an entrant not affiliated with the six dominant chains and its interaction with the low commission dummy.[30] The coefficient on the interaction term suggests that low commission listings by independent entrants are an extra 2 p.p. less likely to sell, in addition to the -5 p.p. direct effect of *RL25* for all low commission listings. This effect is unlikely to be driven by the worse quality of entrants because the direct effect of entrants is small and insignificant (-0.003, s.e. 0.01) and we maintain the same set of office controls as in Table 3. Additionally, we find even more negative consequences for low commission listings by these entrants in their first three years (-3 p.p. for the interaction term), when they have even less market presence than in later years.

Our final heterogeneous analysis is motivated by accounts of retaliatory behavior by traditional agents against those who deviate from the norm and charge low commissions (column 4 of Table 8).[31] We implement this idea by investigating the dynamic consequences on offices that adopt a low commission pricing strategy in the past. In column 4, we add a proxy for an office's past pricing strategy, which is a three-year cumulative fraction of low commission listings up to year t for each office. It measures an office's propensity to list below 2.5 percent in the past three years. The -0.04 coefficient implies that a one standard deviation increase in the cumulative fraction in the past leads to a 2 p.p. decline in the sale likelihood today.[32] Results are similar when we restrict the sample to listings by active offices whose average annual listings is at least five.

Overall, these patterns consistently point towards worse outcomes for low commission listings that are more vulnerable to steering. Moreover, the findings in the last two columns echo our results above that low commission offices and entrants are less likely to grow (Table 1 and Figure 4).

5.3.2 Dominant offices and agents are less likely to purchase low commission listings

Having documented negative consequences of low commission rate policies, we now describe the purchasing patterns of offices and agents. As shown above, all offices and agents dislike low commission rate listings. In the analysis below, we ask whether dominant offices with greater market power are even less likely to purchase listings offering low commission rates. We estimate the following equation:

$$ln(FrcBL25_{lmt}) = \delta ln(Share_{lm,t-1}) + X_{lm,t-1}\beta + \mu_{mt} + \varepsilon_{lmt}, \tag{3}$$

where the dependent variable is log of the fraction of office l's purchases that has low commission rates in market m and year t. The key regressor $ln(Share_{lm,t-1})$ is log of office l's market share in market m and year $t-1$. An office's market share is its commission revenue from all of its sold listings in a

[30] We define entrants as offices that first appear in our dataset in 1999 (the results are similar if we use 2000 or 2001).

[31] In a recent survey of agents, 50% of the 503 respondents agreed that some brokers do not compete on commissions because they fear retaliation (Inman News, 2014). Several lawsuits also allege different methods of retaliation against discount brokers charging low commissions, including "group boycotts" and "blacklisting" discount brokers, offering to pay discount brokers what the industry calls "punitive splits" instead of the standard 50/50 split (see Hawker (2006) for a discussion of court cases).

[32] The direct effect of *RL25* remains similar (- 4 p.p. compared to - 5 p.p. in Table 3).

market and year divided by the aggregate listing commission revenue in the same market and year. To mitigate potential confounding factors, we exclude buying commission revenues in the calculation of market share, since an office's buying commissions in the previous year are likely correlated with the dependent variable. Office attributes $X_{lm,t-1}$ are lagged one year and similar to those in equation (1) (see Table C1 in the appendix for details). All regressions control for market by year fixed effects μ_{mt}. To reduce measurement errors, we focus on active offices with an average annual number of listings above 5. Standard errors are clustered at the office level. We first run this analysis for offices and then repeat it for agents.

Dominant offices are less likely to purchase low commission rate listings (Panel A of Table 9). The specification with office attributes and market by year fixed effects (column 2) suggests that doubling an office's market share reduces the fraction of low commission listings it purchases by 14%. One might be concerned that high quality offices are more likely to work with wealthy clients who prefer desirable properties, and that desirable properties are listed at high commission rates. To address this, column 3 controls for average attributes of office l's listings in market m and year $t-1$, including the average square footage, average number of bedrooms and bathrooms, etc.[33] The coefficient remains at -0.14. Controlling for chain fixed effects and office fixed effects (columns 4 and 5) leads to weaker but still highly significant estimates (-0.10 and -0.04, respectively). The reduction in magnitude suggests that some of the negative results might be driven by office level policies.

We explore a series of robustness checks for our finding that dominant offices buy a smaller fraction of low commission properties. It is robust across different sample cuts (e.g., offices with an average annual number of listings above 7), different definitions of market shares (e.g., using the number of listings instead of listing commissions), different ways to proxy for dominance (e.g., a three-year average of market shares), and regressions in levels of shares instead of logs. Our dominant agent analysis parallels the dominant office analysis with similar findings.

Market shares vary widely in our sample. The average market share for offices that are not affiliated with top six chains is 6%, while that for offices affiliated with top six chains is 17%. At our most conservative estimate (column 5), a threefold increase in an office's market share would translate into a 12% reduction in its fraction of purchases that go to low commission rate properties.

How does a dominant office's diminished propensity to purchase low commission properties relate to our main findings above? Under the simplifying assumptions that the matching event between a potential buyer and a seller is i.i.d. and that the successful match rate is identical across properties, the reduced purchase propensity from the six dominant chains accounts for 42% to 46% of the negative consequence of low commission policies.[34] While these calculations suffer from the obvious caveats

[33] We exclude office l's purchases in calculating these attributes to mitigate endogeneity concerns, although including them leads to almost identical estimates.

[34] We use the estimate in column 5 of Table 9 (-0.04) to calculate the reduction in the number of potential buyers visiting a low commission property. The six dominant chains account for 54% of buyers, and the average market share for offices affiliated with these chains is 17%, which is 2.8 times bigger than that for non top-chain offices. At an elasticity of 0.04, this translates to a 6 p.p. reduction (54%*2.8*.04) in the number of potential buyers. Assuming the number of potential

associated with our simplifying assumptions, they suggest a potentially important channel through which dominant offices could sustain the current commission structure.

6 Cost benefit analysis

So far, our analysis has focused on the magnitude of the negative impacts of low commissions. Is it in a seller's interest to use a low commission rate? In this section, we provide a simple cost and benefit analysis for different commission policies. More details can be found in Appendix A.

Not selling a property is costly. While some sellers relist their property and successfully sell the second time, missing the peak-season and having to sell in the off-peak season (winter time and during the school year) could lead to a much longer time on the market. Instead of examining days on market for a particular listing as in the analysis above, here we study the cumulative days on market for sold properties (days between the *first* listing date and the sold date).[35] We focus on the commission rate when a property is listed for sale the first time because few properties change commission rates during the course of a sale. In addition, since risk averse sellers care about the magnitude at the tail in addition to the mean, we report the effect of commission rate on the entire distribution of cumulative days on market.

As expected, properties that are initially listed at a low commission are more likely to stay on the market for an extended period of time. Figure 5 plots the percent of sold listings whose cumulative days on market are 0 to 30 days, ..., 120 to 150 days, and 180 days or more. The darker bars represent properties that are initially listed at a low commission rate, while the lighter bars are for properties initially at a high commission rate. The impact of commission rates is most pronounced at the lower and upper tails of the distribution. At the lower tail, 38% of high commission listings sell within 30 days compared to 32% of low commission listings. At the upper tail, 14% of high commission listings take 180 days or longer to sell compared to 17% of low commission listings. This difference reflects the fact that low commission properties are less likely to sell the first time and re-listings stay on the market longer, due to the seasonal effects discussed above.

Figure 5 does not control for property attributes. When we control for property characteristics and listing agency attributes, properties that initially list at low commission rates take on average twenty days longer to sell compared to those that initially list at high commission rates. The effect is larger at the upper tail, with a difference of 30 days at the 95th percentile and 38 days at the 99th percentile (Table C6). In addition, using the same set of controls as in column 6 of Table 4, low commission properties that are sold are 4.8 p.p. less likely to have a quick sale (cumulative days on market less than 30 days), and are 5 p.p. more likely to stay on the market for six months or longer.

What is the cost of a typical home staying on the market for six months? We ignore potential cash constraints or psychological costs this imposes on sellers and apply the user cost of owning a property

buyers varies between five and twenty (the average is ten, according to NAR (2014b)), this acounts for a 2.1 p.p. to 2.3 p.p. reduction in the sale probability.

[35] Among all sold properties, 91% are sold in their first listing and 8% are sold in their second listings.

as a conservative estimate. At the 5.3% annual user cost reported in Himmelberg et al. (2005), the six-month carrying cost for a $479,000 property would amount to $12,700, about 20% of the median annual household income of Massachusetts residents.

High commissions lead to a faster sale and a lower probability of a lengthy sale process. Among sellers who initially list at a high commission rate, 99% stay at a high commission rate and 1% switch to a low commission rate. Their expected commission fee is $23,902 ($479,000*(0.99*0.05+0.01*0.04)) for a typical home. Sellers who initially list at a low commission rate are more likely to switch to a high commission rate with a split of 94% vs. 6%. Their expected commission fee is $19,447. The difference in commissions is $4455.

The calculation above suggests that sellers choosing the high commission rate pay $4455 more (roughly 1% of the sale price) in exchange for 20 fewer days on the market compared to sellers who initially list at a low commission rate.[36] This is in line with the inter-temporal substitution patterns of home sellers in the literature. Sellers may prefer a faster sale because they rely on the sale proceeds from their existing home for the down-payment of their next house. For example, Genesove and Mayer (1997) report that sellers whose loan-to-value ratios are below 100% forgo a 4% gain in sale price in exchange for selling 70 days earlier (equivalent to trading off 1% in sale price against 18 days). Similarly, Hendel et al. (2009) find that FSBO sellers save $1625 (about 0.8% of the sale price) but their properties take 16 days longer to sell.

These patterns rationalize sellers' reluctance to list at low commission rates, which reinforces the uniform commission pattern. It is worth noting that our conclusions will be strengthened if sellers are able to pass through some of the commission fees to buyers, further incentivizing them to choose the high commission strategy.

7 Conclusion

This paper investigates the consequences of low commission rates in the residential brokerage industry. Our findings provide empirical support for regulators' long-standing concern of steering behavior contributing to the lack of variation in commission rates, despite consumers' increased access to information and lower search costs due to the internet (GAO, 2005; FTC, 1983, 2007).

Compared to other industrialized countries, commission fees in the United States are high. For example, commission rates average less than 2% in the United Kingdom and the Netherlands, compared to the typical rates of 5% and 6% in the United States (Delcoure and Miller, 2002). As highlighted by our model, unbundling commissions has the potential to eliminate steering and reduce commission fees. Given the sheer size of aggregate housing transaction values, even modest reductions in commission fees could lead to a non-trivial reduction in transactions costs. Moreover, lower commission fees will likely limit excessive entry into the residential brokerage industry, translating into additional efficiency gains

[36] This calculation does not take into consideration that high commission properties are eventually 5 p.p. more likely to sell. This is another benefit of the high commission rate strategy.

(Hsieh and Moretti, 2003; Barwick and Pathak, 2015). Finally, reduced agency conflicts with unbundled commissions could also give rise to better matches of buyers to properties.

Current development in the spirit of unbundling commissions includes firms such as Redfin which provide rebates to buyers, as well as recent efforts to lift rebate bans and relax the minimum service requirements in several states (DOJ, 2015). Understanding the implications of these alternative commission structures is an important direction for future work.

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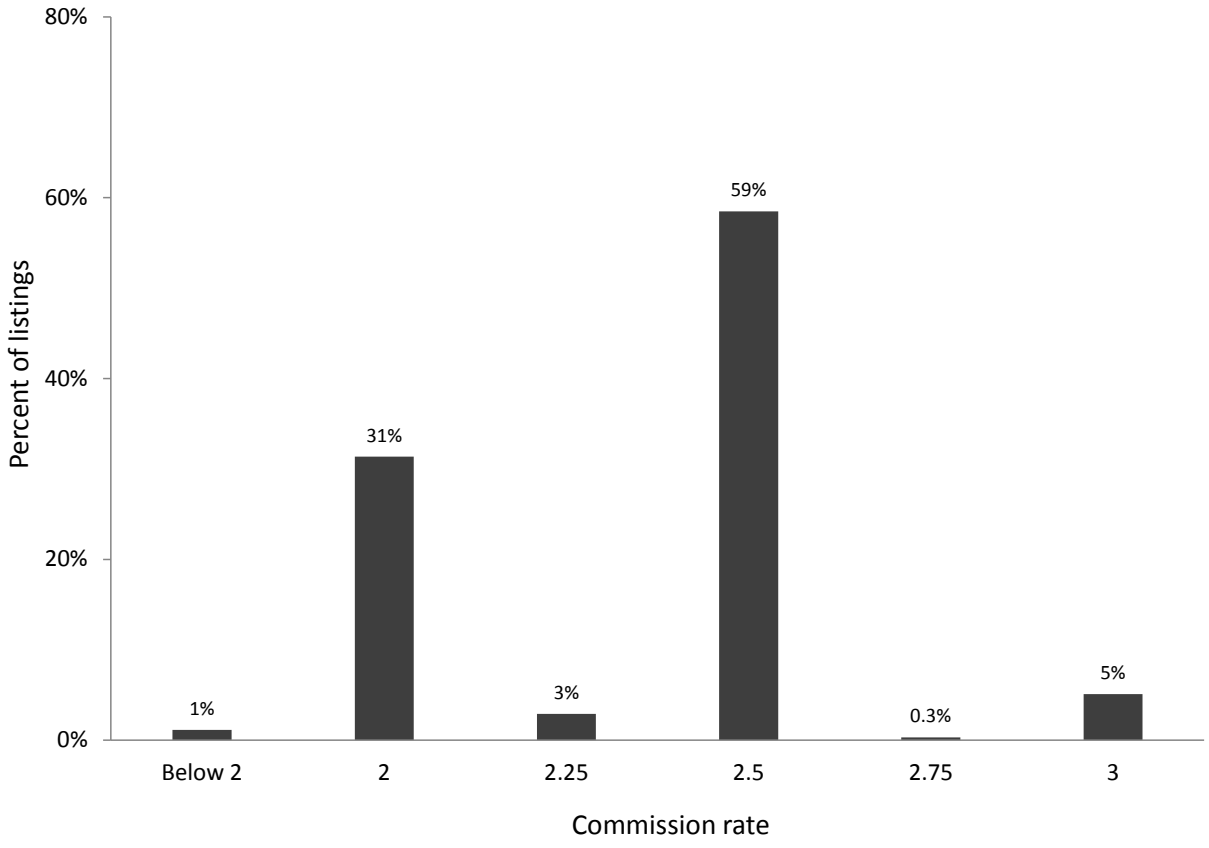
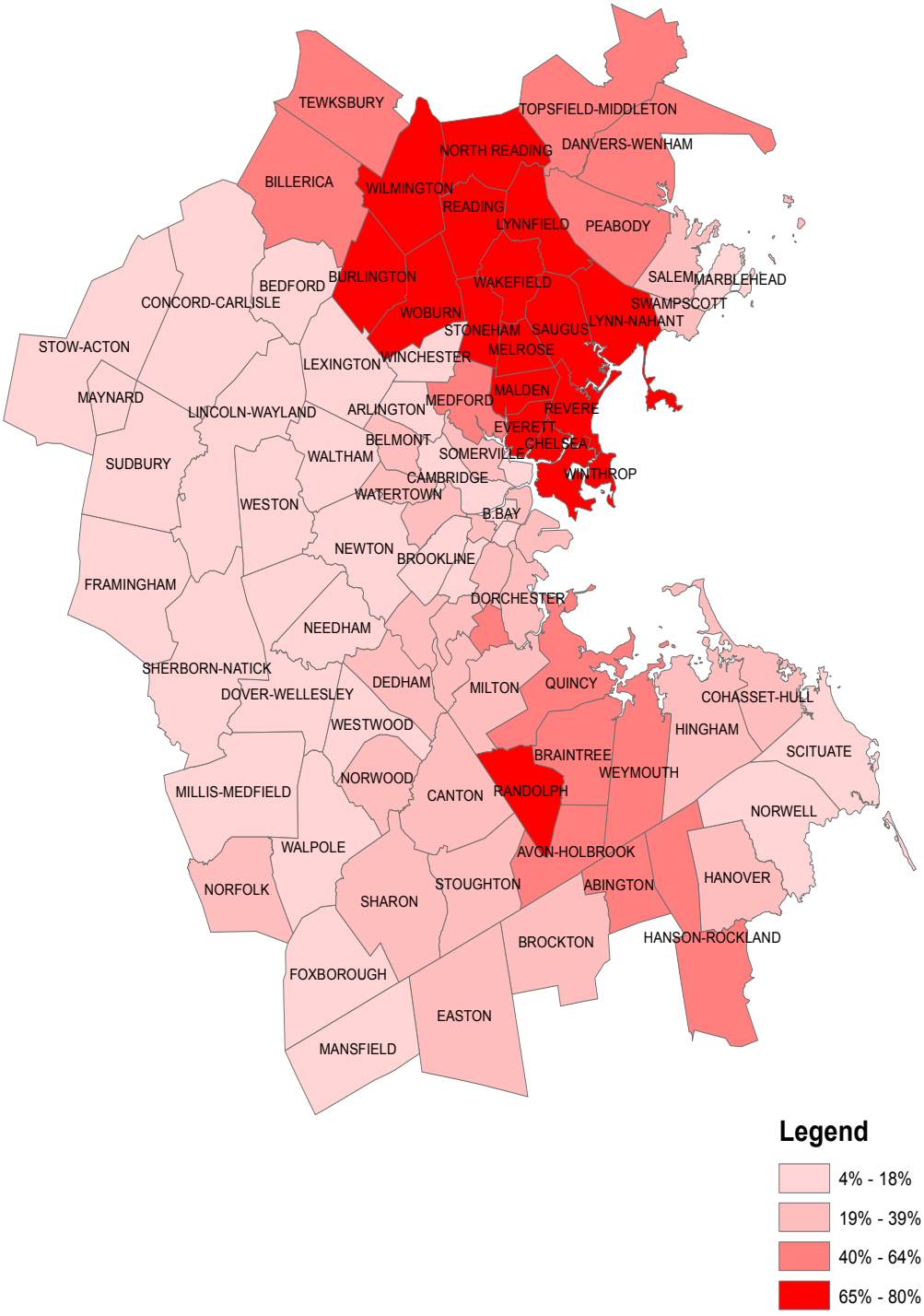
Figures

Figure 1: Distribution of commission rates



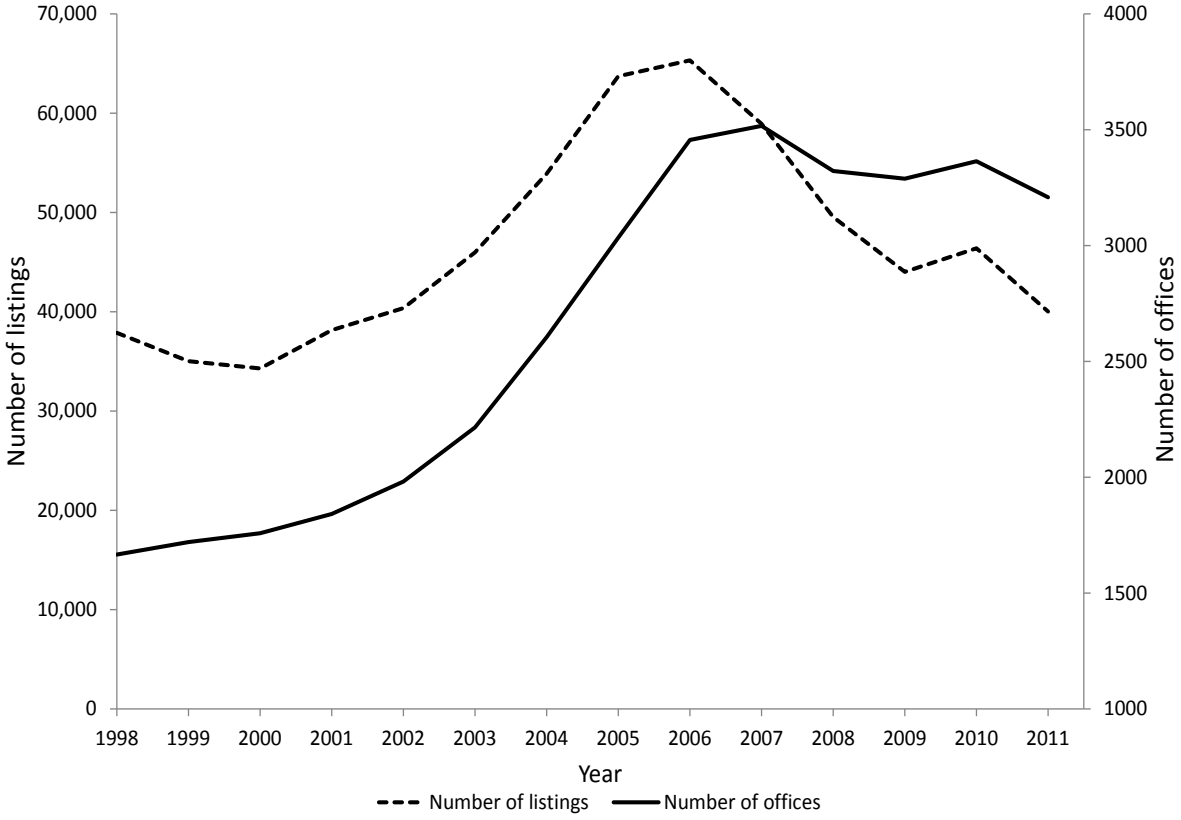
Notes: Distribution of commission rates offered to buyers' agents. The figure reports data for 99.3 percent of listings. The rest are scattered between 2 and 5 percent.

Figure 2: Percent of listings with low commission rates by market



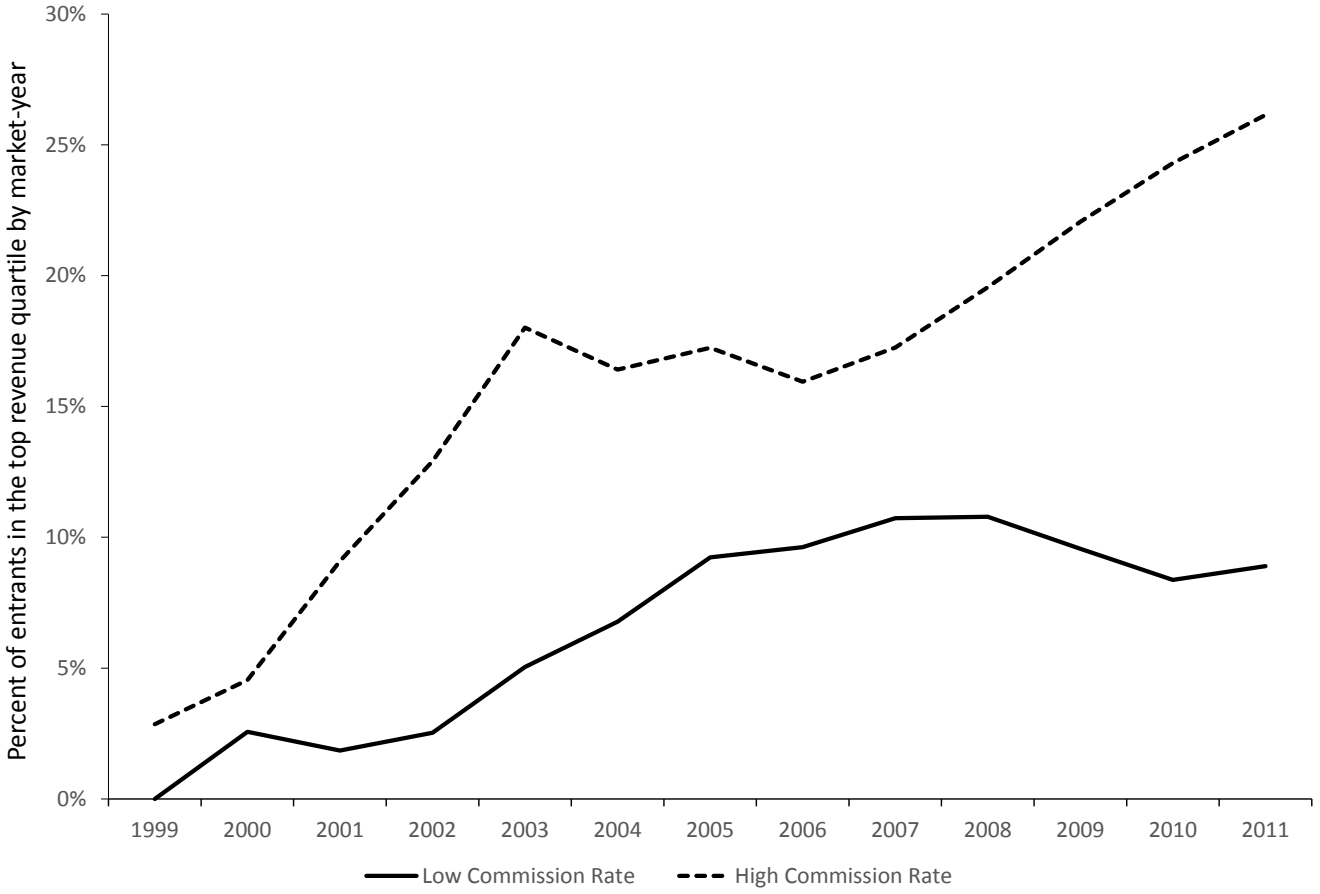
Notes: Percent of listings in a market with commission rates below 2.5 percent.

Figure 3: Number of listings and brokerage offices over time



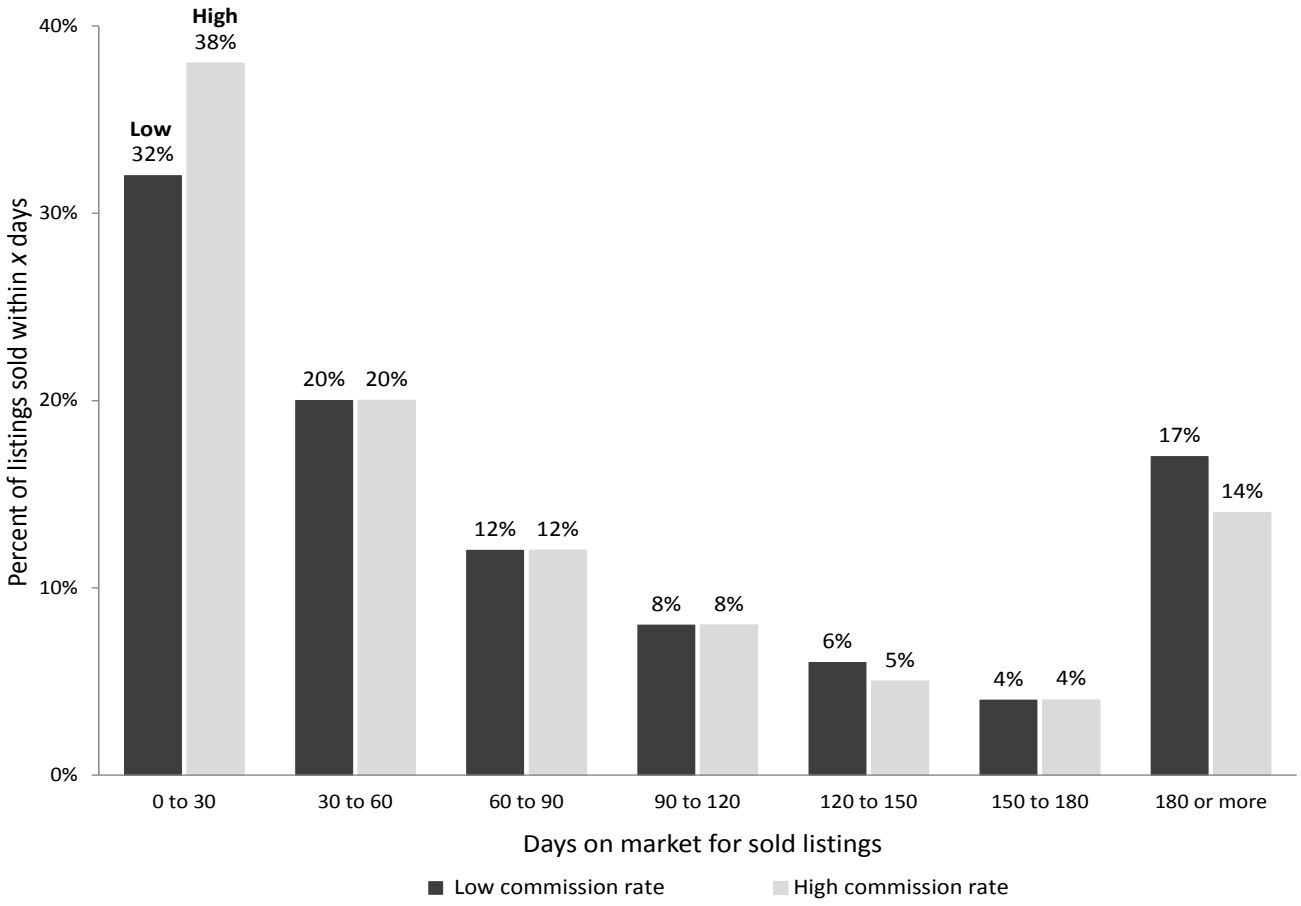
Notes: Number of listings per year (dashed line) and number of brokerage offices per year (solid line).

Figure 4: Growth paths for high and low commission entrants



Notes: Entrants are firms that first appear in our sample post 1999. We classify entrants into the *high commission rate* group and *low commission rate* group using their commission rates in the first three years. As in Table 1, this three-year window reduces the measurement error. Entrant i is in the *high commission rate* group (or *low commission rate* group) if its fraction of high commission listings in the first three years is in the top 25% (bottom 25%) among all entrants in the same market. A firm's top-revenue-quartile status is defined the same way as in Table 1, where revenue is the total listing commission revenue in a market and year, and top quartile is defined by market-year.

Figure 5: Cumulative days on market for sold listings (initially high versus initially low commission rate)



Notes: Sample includes all repeat sales, to be consistent with the regression sample. The dark (light) grey bars correspond to properties that initially list at low (high) commission rates. Each bar represents the percent of listings sold within a 30-day bin, except the last bar to the right that indicates the percent of listings sold in 180 days or more.

Tables

Table 1: Effect of past commission policy on office success

Dependent variable:	**Whether top quartile in market-year**			
	(1)	(2)	(3)	(4)
Panel A: Entrants				
Low commission offices	-0.08***	-0.06***	-0.05***	-0.12***
	(0.01)	(0.01)	(0.01)	(0.04)
N	6,294	6,294	6,294	6,294
R-squared	0.53	0.57	0.58	0.69
Panel B: All offices				
Low commission offices	-0.08***	-0.05***	-0.05***	-0.10***
	(0.01)	(0.01)	(0.01)	(0.03)
N	13,255	13,255	13,255	13,255
R-squared	0.62	0.66	0.66	0.72
Market-year FE	Y	Y	Y	Y
Office controls	N	Y	Y	Y
Portfolio controls	N	N	Y	Y
Office FE	N	N	N	Y

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table reports the effect of past commission rate policy on the probability of becoming a top quartile revenue firm, where *revenue* is total listing commission revenue, and *top quartile* is defined by market-year. Firm *i*'s fraction of listings with a low commission rate at year *t*, *frcRtL25*, is the ratio of the total number of listings under 2.5% to total listings in year *t-2* to year *t*. We use a three-year window because the number of listings is small (and hence the commission rate measure is noisy) for some firm-year combinations. Our key regressor, past commission rate, is a one-year lag of variable *frcRtL25*. Firms' top-quartile status is persistent, so we also control for its past top-quartile status (lagged one year) except for the last column with office fixed effects. Results are more significant without past top-quartile status. We only keep firms whose average annual listing is at least five (these are active firms that represent 95% of listings) and firms with more than one firm-year. Panel A restricts to entrants, i.e., firms that first appear in our sample post 1999. There are 902 market-year fixed effects in all columns and 1202 office fixed effects in the last column. Panel B uses all firms. There are 1131 market-year fixed effects and 1898 office fixed effects. Office controls and portfolio controls are lagged by a year. See Table C1 for a full list of variables used in these regressions. Standard errors are clustered at the office level.

Table 2: Observable differences between high and low commission listings

Dependent variable:	Mean	SD	Coefficient	p-value
	(1)	(2)	(3)	(4)
Square footage ('000s)	1.84	1.14	0.01***	[0.004]
Lot size (acres)	0.33	0.98	-0.10***	[0.000]
1(Property is condominium)	0.35	0.48	-0.08***	[0.000]
1(Property is single family)	0.52	0.50	-0.01***	[0.000]
Age of the property (years)	61.73	41.59	1.10***	[0.000]
Number of bedrooms	3.07	1.52	0.21***	[0.000]
Number of bathrooms	1.86	0.95	-0.07***	[0.000]
Number of other types of rooms	3.67	1.81	0.07***	[0.000]
Number of listings				**653,475**

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table reports results from OLS regressions testing whether high versus low commission rate listings have similar attributes. Each row reports results from a regression where the dependent variable is a property attribute and the regressor is a dummy for the commission rate below 2.5%. Columns 1 to 2 report the mean and standard deviation, respectively. Column 3 reports the coefficient on the low commission rate dummy. Column 4 reports the p-value. The full sample includes 653,475 listings. We lose some listings for property age (7324 listings), number of bedrooms (310 listings), and number of bathrooms (9 listings) due to missing values.

Table 3: Effect of a low commission rate on whether a listing is sold or not

Dependent variable:	**Probability of being sold**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Low commission listings	-0.09***	-0.07***	-0.09***	-0.06***	-0.05***	-0.05***	-0.08**
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.03)
N	653475	653475	344832	344832	344832	344832	344832
R-squared	0.08	0.10	0.46	0.51	0.51	0.51	0.51
Estimation	OLS	OLS	OLS	OLS	OLS	OLS	IV
Market-year FE, month FE	Y	Y	Y	Y	Y	Y	Y
Property controls	N	Y	Y	Y	Y	Y	Y
Property FE	N	N	Y	Y	Y	Y	Y
Seller patience	N	N	N	Y	Y	Y	Y
Office controls	N	N	N	N	Y	Y	Y
Agent controls	N	N	N	N	N	Y	Y

* p<0.1, ** p<0.05, *** p<0.01

Notes: Columns 1 to 6 report OLS regressions at the listing level for the effect of low commission rate (a dummy that is 1 for commission rate below 2.5%) on the probability of sale (a dummy that is 1 if the listing is sold). The full estimation sample for columns 1 and 2 includes 653,475 listings. Column 1 has 1217 market by year fixed effects. Column 2 adds 148 property controls. Column 3 onwards adds 133,902 property fixed effects and restricts the sample to properties with repeat listings only. For seller patience (column 4), we first estimate a hedonic regression of *ln(List price)* on the full set of controls in column 6 (except the low commission rate dummy). We index sellers by the ratio of their observed list price to the predicted list price and create dummies for each decile. These dummies constitute our seller patience controls. Columns 5 and 6 add controls for office and agent quality. Column 7 includes the same set of controls as column 6, but uses an instrumental variable strategy. The instruments are the distances between the listing office and the nearest Century 21 and Coldwell Banker office in that year. Standard errors are clustered by market by year (columns 1-2) and by property (columns 3 to 7). See Table C2 for a full list of controls.

Table 4: Effect of a low commission rate on days on the market for sold listings

Dependent variable:	**Ln(Days on market)**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Low commission listings	0.13***	0.11***	0.14***	0.12***	0.12***	0.12***	0.33***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.12)
N	419116	419116	136624	136624	136624	136624	136624
R-squared	0.11	0.14	0.56	0.56	0.57	0.57	0.56
Estimation	OLS	OLS	OLS	OLS	OLS	OLS	IV
Market-year FE, month FE	Y	Y	Y	Y	Y	Y	Y
Property controls	N	Y	Y	Y	Y	Y	Y
Property FE	N	N	Y	Y	Y	Y	Y
Seller patience	N	N	N	Y	Y	Y	Y
Office controls	N	N	N	N	Y	Y	Y
Agent controls	N	N	N	N	N	Y	Y

* p<0.1, ** p<0.05, *** p<0.01

Notes: The specifications are similar to those in Table 3, but the dependent variable is log of days on market. The sample includes sold properties (columns 1-2) and properties with repeat sales (columns 3 to 7). We lose 2,207 sales with 0 days on market and 6 with negative days on market after taking logs. All columns include 1217 market by year fixed effects and column 3 onwards includes 62,841 property fixed effects.

Table 5: Effect of a low commission rate on sale price

Dependent variable:	**Ln(Sale price)**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Low commission listings	0.06***	0.01***	0.03***	-0.0006	0.0003	0.0003	-0.01
	(0.004)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.01)
N	421329	421329	137085	137085	137085	137085	137085
R-squared	0.45	0.86	0.97	0.99	0.99	0.99	0.99
Estimation	OLS	OLS	OLS	OLS	OLS	OLS	IV
Market-year FE, month FE	Y	Y	Y	Y	Y	Y	Y
Property controls	N	Y	Y	Y	Y	Y	Y
Property FE	N	N	Y	Y	Y	Y	Y
Seller patience	N	N	N	Y	Y	Y	Y
Office controls	N	N	N	N	Y	Y	Y
Agent controls	N	N	N	N	N	Y	Y

* p<0.1, ** p<0.05, *** p<0.01

Notes: Similar to Table 3, but the dependent variable is log of sale price. The sample includes sold properties (columns 1-2) and properties with repeat sales (columns 3 to 7). All columns include 1217 market by year fixed effects. Column 3 onwards includes 62,842 property fixed effects.

Table 6: Robustness check, controlling for listing agent effort

Dependent variable:	**Probability of being sold**				
	(1)	(2)	(3)	(4)	(5)
Specification	New Properties	Agent FE	$500 bins	$1000 bins	$1500 bins
Low commission listings	-0.05***	-0.03***	-0.05***	-0.04***	-0.05***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.005)
N	30036	304620	231550	302246	341608
R-squared	0.67	0.58	0.57	0.53	0.51
Market-year FE, month FE					
Property, office, seller controls	Y	Y	Y	Y	Y
Property FE	Y	Y	N	N	N
Agent controls	Y	Y	N	N	N
Agent FE	N	Y	N	N	N
Bin FE	N	N	Y	Y	Y

* p<0.1, ** p<0.05, *** p<0.01

Notes: OLS regressions at the listing level for the effect of low commission rates on the probability of sale, with different specifications to control for listing agent effort. Columns 1 and 2 repeat the most saturated OLS specification in Table 3 (column 6). Column 1 restricts the sample to new properties (built within 5 years). Column 2 adds agent fixed effects and limits the sample to listings by agents with eight or more listings. This drops 40,212 listings with the benefit of saving 15,000 agent fixed effects. There are 9146 agent fixed effects. Column 3 groups listings that have the same listing agent, year, and property type, and offer commission fees within a $500 bin. Commission fee is calculated as the commission rate multiplied by the list price. Columns 4 and 5 are similar to column 3 but use $1000 and $1500 bins, respectively. We include fixed effects for 92191, 109435, 115550 bins in columns 3 to 5, respectively (agent fixed effects and agent-year controls are absorbed by these bin fixed effects). Standard errors clustered by property (columns 1-2) and bins (column 3 onwards).

Table 7: Robustness check, controlling for seller preferences

Dependent variable:	**Probability of being sold**			
	(1)	(2)	(3)	(4)
Specification	List price	Finer patience controls	Seller name	No common names
Low commission listings	-0.06***	-0.05***	-0.07***	-0.07***
	(0.004)	(0.003)	(0.02)	(0.02)
N	344832	344832	31407	30120
R-squared	0.50	0.51	0.48	0.49
Market-year FE, month FE				
Property, agent, office controls	Y	Y	Y	Y
Property FE	Y	Y	N	N
Ln(List price)	Y	N	N	N
Seller patience	N	Y	Y	Y
Seller FE	N	N	Y	Y

* p<0.1, ** p<0.05, *** p<0.01

Notes: OLS regressions at the listing level for the effect of low commission rate on the probability of sale, with different specifications to control for seller preferences. Columns 1 and 2 are similar to the most saturated OLS specification in Table 3 (column 6). Column 1 controls for ln(List price) instead of seller patience deciles. Column 2 controls for seller patience using one hundred percentile dummies. Column 3 includes 14213 seller fixed effects (defined using seller names). This specification restricts the sample to sellers with multiple listings and seller names that could be identified using the county records. Column 4 is similar to column 3, but drops common names (names that occurr more than 5 times in our data).

Table 8: Effect of a low commission rate on properties more susceptible to steering

Dependent variable:	**Probability of being sold**			
	(1)	(2)	(3)	(4)
Low commission listings	-0.05***	-0.06***	-0.05***	-0.04***
	(0.002)	(0.004)	(0.004)	(0.004)
RL25 × (Fraction of high comm. listings in block group-year)	-0.03***	-0.04***		
	(0.01)	(0.01)		
RL25 × Entrant			-0.02***	
			(0.01)	
Entrant			-0.003	
			(0.005)	
Lagged 3-year cumulative fraction of low comm. listings				-0.04***
				(0.01)
N	612210	213372	344832	313421
R-squared	0.20	0.27	0.51	0.54
Month FE, property, seller, agent, and office controls	Y	Y	Y	Y
Block group-year FE	Y	Y	N	N
Market-year FE	N	N	Y	Y
Property FE	N	N	Y	Y

* p<0.1, ** p<0.05, *** p<0.01

Notes: Similar to Table 3, but examines heterogeneous effects on the probability of sale. Column 1 includes an interaction between the low commission rate dummy *RL25* and the fraction of listings with high commission rates in the same census block group and year. This latter variable is de-meaned, so that the main estimate of *RL25* reflects the effect of low commission rates on the sale probability for the average block group-year. This specification includes 29,687 census block group by year fixed effects and drops property fixed effects (market by year fixed effects are absorbed by these block group and year fixed effects). We drop block group-years with fewer than 5 listings. Column 2 repeats the analysis in column 1 and restricts the sample to condominiums. Column 3 repeats column 6 of Table 3, but adds two regressors: a dummy for independent entrants (offices that entered post 1999 and are not affiliated with the six dominant chains) and its interaction with *RL25*. Column 4 repeats column 6 of Table 3 but adds the three-year cumulative fraction of low commission rate listings for the listing office, up to time $t-1$. We lose 31,411 listings when we include this lagged variable.

Table 9: Propensity of dominant offices and agents to purchase low commission listings

Dependent variable:	**Ln(Fraction of purchases with low commission rate)**				
	(1)	(2)	(3)	(4)	(5)
Panel A: Dominant offices					
ln(Shares), lagged 1 year	-0.14***	-0.14***	-0.14***	-0.10***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
N	10352	10352	10352	10352	10352
R-squared	0.65	0.66	0.66	0.69	0.81
Panel B: Dominant agents					
ln(Shares), lagged 1 year	-0.12***	-0.13***	-0.13***	-0.13***	-0.02***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.01)
N	32844	32844	32844	32844	32844
R-squared	0.43	0.44	0.44	0.47	0.72
Market-year FE	Y	Y	Y	Y	Y
Office or agent controls	N	Y	Y	Y	Y
Portfolio controls	N	N	Y	Y	Y
Chain FE	N	N	N	Y	Y
Office or agent FE	N	N	N	N	Y

* p<0.1, ** p<0.05, *** p<0.01

Notes: Panel A reports OLS regressions at the office-year level for the relationship between an office's lagged market share and the fraction of its purchase that are low commission rate listings. The dependent variable is ln(Fraction of purchases in an office-year that have low commission rates). The main regressor is the log of the one-year lagged market share of an office, defined using its listing commission revenues in a year. Each office is assigned to one primary market in each year. The sample includes all offices with five or more average annual number of listings. There are 172 chain fixed effects. The last column controls for 1852 office fixed effects. Standard errors are clustered at the office level. Panel B repeats the analysis for agent-year regressions, including agents with two or more average annual number of listings. There are 9,260 agent fixed effects (column 5) and standard errors are clustered at the agent level. The full list of controls is reported in the Table C1.

A Online appendix: Sample and variable construction

A.1 Housing transactions

We begin with 722,925 non-rental listings for condominiums, single-family, and multi-family properties. We first drop 52,226 duplicate listings, 221 listings with list or sale prices that are below $10,000, and 5,546 listings with problematic listing office codes. We then keep listings whose status is cancelled, expired, sold, or withdrawn (this removes 4,721 listings) and drop 4,377 listings with missing market information. We lose 1512 listings with 0 commission rates, 540 listings with missing commission rates, and 307 listings with buying commission rates greater than 5 percent (which implies a total commission rate greater than 10 percent). This leaves us with a final sample of 653,475 listings and 421,329 sold listings. We have geocoded street addresses and property identifiers for 646,460 listings. We are able to identify 133,903 properties that have repeat listings (for a total of 344,832 listings) and 62,843 properties with repeat sales (for a total of 137,085 sales).

A.2 Offices

Each office is identified by an office ID. Two big chains (Coldwell Banker and Dewolfe) merged in 2002. Some offices changed office IDs as a result of this merger but kept the same office location. We recognize them as the same office and assign them a unique office ID. In addition, offices that use the same office location (e.g., 1000 Mass Ave, Fl 2, Cambridge, 02138) during the same time period are recognized as the same office and assigned a unique office ID.

We identify 172 chains, representing 486,189 listings (74%) and 316,571 purchases (75%). We first identify offices that have multiple locations and offices that have at least 100 listings and purchases. Within this group, we group offices that have similar names as chains. For example, all offices that have "Century 21" in the name are categorized under the Century 21 chain.

Many agents and offices have only a few transactions in our sample. We determine which offices and agents are active according to the *average annual number of transactions*, which is the total number of transactions divided by the number of years an office or agent spans our data (calculated as the last year the office or agent is in our data minus the first year, plus one). We use this average to identify active and top offices and agents. Most of our analysis focuses on offices with five or more average annual number of listings, and agents with two or more average annual number of listings. They account for 95% and 92% of listings, respectively.

Each office is assigned a primary market in each year. We define a primary market by ranking the total number of listings and purchases by an office in a market in a year, followed by the total value of transactions. Ties are broken by the alphabetical order of market names. The primary market for an agent is defined analogously.

A.3 Defining markets

We have a total of 87 markets. Outside of Boston, markets are defined by cities and towns. We combine small markets with a nearby continguous market that account for the most cross-market listings by brokerage offices in these small markets. The combined markets include Cohasset-Hull, Avon-Holbrook, Lynn-Nahant, Sherborn-Natick, Topsfield-Middleton, Lincoln-Wayland, Concord-Carlisle, Danvers-Wenham, Stow-Acton, Dover-Wellesley, Millis-Medfield, and Handon-Rockland. We split the city of Boston into 15 sub-markets according to a GIS shapefile of Boston neighborhoods defined by Zillow. These sub-markets include Dorchester, Allston-Brighton, Back Bay-Beacon Hill, Charlestown, East Boston, Fenway-Kenmore, Jamaica Plain, Roslindale, Roxbury, West Roxbury, South Boston, South End, Central, Hyde Park, and Mattapan. A few thousand listings with missing cities or GIS location are assigned to a market using a variable called *area* in the MLS dataset. We end up with 87 markets from 84 cities outside Boston, less 12 small cities plus 15 neighborhoods in Boston.

A.4 Sale outcomes

A listing is sold if its reported status is sold or under agreement. There are 2,649 sold listings with missing sales prices. We replace these missing values with their listing price. Listing and sales prices are winsorized at the top 1 percent. We winsorize days on market at 365 days for 6,428 listings that take a year or longer to sell.

A.5 Distance instruments

We have two distance instruments: distance to the nearest Coldwell Banker office in each year and distance to the nearest Century 21 office in each year. We geocode office locations to obtain latitudes and longitudes. We calculate the distance between an *office centroid* and the nearest Coldwell or Century 21 office. An office's centroid is the geographic center of its listings and purchases. Eighteen Coldwell offices and ten Century 21 offices have missing latitudes and longitudes. We winsorize distances at the top percentile and replace missing distances with the median distance. The IV coefficients are similar if missing distances are not replaced with the median.

A.6 Seller fixed effects

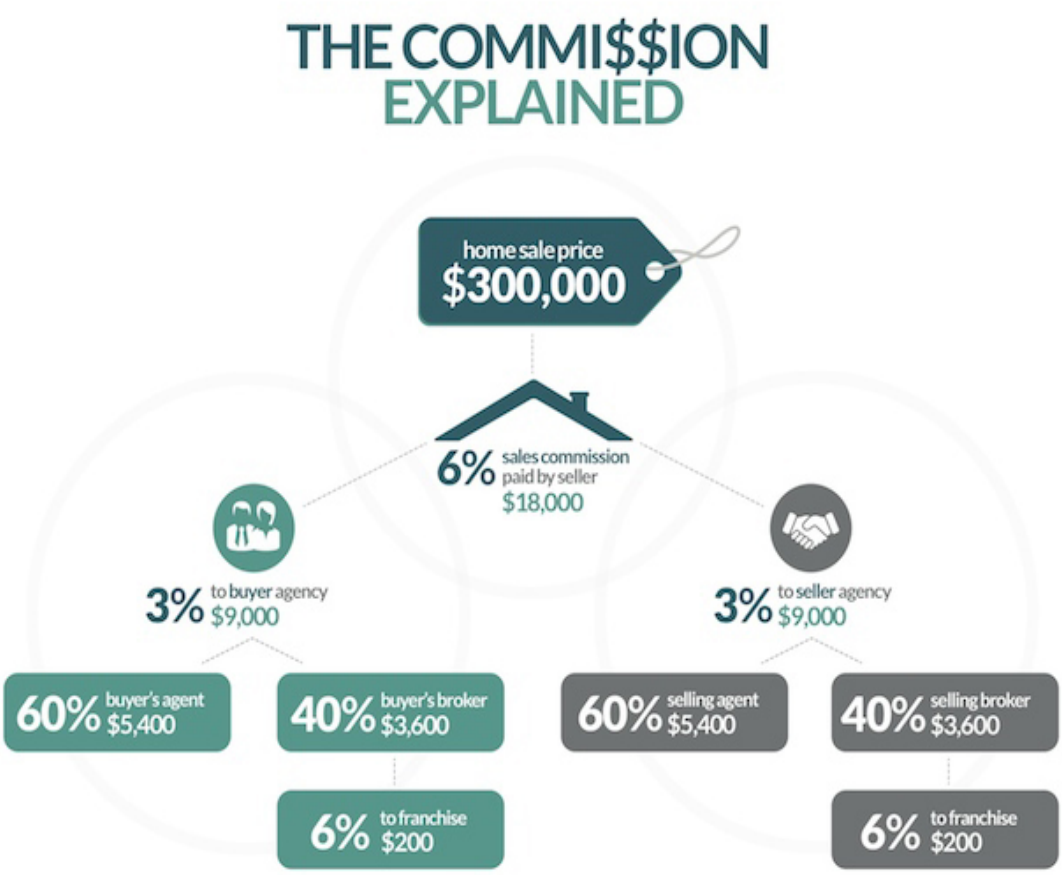
We obtain seller names for sold listings from county deed records up to 2008. We merge MLS and deeds data using property address, sale date (within 28 days), and sale price (within $10,000). We are able to fill in seller names for listings that are not merged by tracing the chain of ownership. We assume that when a property is sold, the buyer in that transaction becomes the seller of subsequent MLS listings of the same property, until the next change in ownership. Likewise, the seller of a property remains the same through different listings until the property is sold.

A.7 Cost benefit analysis

We define *cumulative days on market* by combining unsold listings for the same property into the same marketing history. For example, if we see a listing for a property on January 1st 2001 that was withdrawn on June 30th 2001, but re-listed on November 1st 2001 and sold on February 1st 2002, we combine these two listings and calculate the *cumulative days on market* as the difference between the initial listing date and the final date when the property is off the market (the cumulative days on market is $365 + 31 = 396$ days in this example). To belong to the same marketing history, listing dates have to be less than a year apart. Using the same example, if the property was also listed on January 1st 1998 and was withdrawn on June 30th 1998, we do not combine this 1998 listing with the 2001 listing. In short, each sale has a marketing history that connects all unsold listings for the same property that are listed within a year. We repeat our cost and benefit analysis combining all unsold listings (grouping the 1998 listing with the 2001 listing in the example above) and reach the same conclusions, partly because these instances are rare.

B Appendix: Figures

Figure B1: An illustration of how commissions are split



Source: Realtors.com

C Appendix: Tables

Table C1: Control variables for Tables 1 & 9

Variables
Panel A: Controls for Table 1
- Top quartile status in market *m* at time *t*, lagged by one year
- Office controls (lagged a year): Fraction of listings that are sold at time t, average days on market for sold listings, fraction of agents who are top ten percent highest performing agents, log of the number of active agents, age of the firm
- Portfolio controls (lagged a year): Fraction of listings in a year that are condos, fraction that are single family; square footage, number of bedrooms, number of bathrooms, age of the property, list price, averaged among an office's listings at time *t*
Panel B: Office controls for Table 9
- Office controls (lagged a year): Fraction of listings that are sold at time t, average days on market for sold listings, fraction of agents who are top ten percent highest performing agents, entrant dummy (1 if office appears after 1998), age of the firm interacted with entrant dummy, 1 if office location is in our list of cities, 0 if office location is out of town
- Portfolio controls (lagged a year): Fraction of listings in a year that are condos, fraction that are single family; square footage, number of bedrooms, number of bathrooms, age of the property, averaged among an office's listings at time *t*
Panel C: Agent controls for Table 9
- Lagged fraction of listings sold by an agent in a year
- 1 if agent first appears after 1998
- Entrant interacted with years in MLS
- Portfolio controls (lagged a year): Fraction of listings in a year that are condos, fraction that are single family, fraction of listings that are in Boston; square footage, number of bedrooms, number of bathrooms, age of property, number of other types of rooms, averaged among an agent's listings at time *t*

Table C2: Control variables for Tables 3 to 8

Variable
Panel A: Property controls
- Square footage in thousands of square feet (0 to 40+)
- 10 dummies for number of bedrooms, including a dummy for missing values
- 14 dummies for number of bathrooms in half bath increments
- 9 dummies for number of other types of rooms
- 9 dummies for groups of years (6-10 years, 11-25 years, and so on up to 151+ years, plus a dummy for missing age values. The omitted group is 0 to 5 years
- 1 if property type is multifamily, 0 otherwise. The omitted group is condominiums
- 1 if property type is singlefamily, 0 otherwise. The omitted group is condominiums
- Lot size in acres
- Master bathrooms: 1 if yes, 0 if no
- Finished basement is included in sqft estimation
- Beach front
- Water front
- Availability of adult community
- Basement: 1 if yes, 0 if no
- 4 dummies: 0, 1, 2 or 3 fireplaces, 99 (missing)
- Entry only: Listing agent's only service is to enter property info into MLS
- Lender owned
- Seller disclosure
- Short sale w/ lender approval required
- Sub-agency relationship offered
- 9 dummies for types of listing agreement, including Exclusive Right to Sell with Named Exclusion, Exclusive Agency, Exclusive Right To Sell With Variable Rate of Commission, Exclusive Right To Sell With Dual Rate of Commission, Facilitation/Exclusive Right To Sell, Facilitation/Exclusive, Facilitation/Exclusive Right To Sell With Variable Rate of Commission, Missing information
- 14 dummies for different types of showing methods
- Dummies for the following phrases: Needs Updating, Estate Sale, Foreclosure, Handyman, As-Is, Needs Tlc, Rehabber'S, Bank-Owned, Priced For A Quick Sale, Motivated, Potential, Youthful, Close, !, New, Spacious, Elegance, Beautiful, Appealing, Renovated, Remodeled, Vintage, State-Of-The-Art, Maintained, Wonderful, Brandnew, Fantastic, Charming, Stunning, Amazing, Granite, Immaculate, Breathtaking, Neighborhood, Spectacular, Landscaped, Art Glass, Builtin, Tasteful, Must See, Fabulous, Leaded, Delightful, Move-In, Gourmet, Copper, Corian, Custom, Unique, Maple, Newer, Hurry, Pride, Clean, Quiet, Dream, Block, Huge, Deck, Mint, Stately, Priced To Sell
Panel B: Listing office controls
- One year lagged fraction of listings sold in a year by an office
- ln(number of active agents in the Office+1), lagged by one year
- Lagged fraction of agents who are in the top 10 percentile of average annual listings and purchases
- Top 4 office in a market, by average annual number of listings
- 1(office has - 2 entry-only listings or share of exclusive right to sell listings is less than 1%, by office/market)
Panel C:Listing agent controls
- Whether among top decile of all agents, by average number of listings
- Agent's average annual number of listings is at least the median amongst listing agents (the median is 2)
- ln(Cumulative number of listings/purchases by a listing agent, up to the last year)
- Agent's experience in years

Table C3: Robustness checks across different samples for all sales outcomes

	Boston	**not Boston**	**Condos**	**Houses**	**Multifamily**	**Big Offices**	**Small Offices**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Probability of sale							
Low commission listings	-0.05***	-0.05***	-0.06***	-0.05***	-0.05***	-0.05***	-0.04***
	(0.01)	(0.004)	(0.01)	(0.005)	(0.01)	(0.01)	(0.01)
N	58474	286358	105306	191059	48467	172317	172515
R-squared	0.52	0.51	0.53	0.51	0.53	0.66	0.66
Panel B: Days on market							
Low commission listings	0.14***	0.11***	0.09***	0.13***	0.16***	0.14***	0.11***
	(0.05)	(0.02)	(0.03)	(0.02)	(0.05)	(0.04)	(0.04)
N	18443	118181	38979	82196	15449	77366	59258
R-squared	0.57	0.57	0.59	0.58	0.59	0.71	0.76
Panel C: Sale price							
Low commission listings	0.0005	0.0003	0.0009	-0.0009	0.001	-0.00004	0.0009
	(0.003)	(0.001)	(0.002)	(0.001)	(0.004)	(0.002)	(0.003)
N	18548	118537	39197	82356	15532	77590	59495
R-squared	0.99	0.99	1.00	0.99	0.98	1.00	0.99
Controls in Table 3 Column (6)	Y	Y	Y	Y	Y	Y	Y

* p<0.1, ** p<0.05, *** p<0.01

Notes: The effect of low commission rates on all three outcomes, by sub-samples. The sub-samples are: Boston only (column 1), outside Boston (column 2), condominiums (column 3), single-family (column 4), multi-family (column 5), big and small offices (columns 6 and 7, respectively). Big (small) offices have average annual number of listings above (below) 80. This cutoff is chosen to split the sample evenly. Panel A repeats column 6 in Table 3 for the effect on the sale probability. Panels B and C repeat column 6 in Tables 4 and 5, for the effect on days on market and the effect on sale price, respectively.

Table C4: Probability of being sold within 30, 60, 90, 180 days

Dependent variable:	**Sold within:**			
	30 Days	60 Days	90 Days	180 Days
	(1)	(2)	(3)	(4)
Low commission listings	-0.03***	-0.05***	-0.06***	-0.06***
	(0.003)	(0.003)	(0.003)	(0.003)
N	344822	344822	344822	344822
R-squared	0.51	0.52	0.53	0.52
Dependent variable mean	0.21	0.33	0.40	0.50

* p<0.1, ** p<0.05, *** p<0.01

Notes: The controls are the same as in column 6 of Table 3. The dependent variable for each column is whether the listing is sold within 30 days, 60 days, 90 days, and 180 days, respectively. The bottom row reports the sample mean for the dependent variable.

Table C5: Seller fixed effect regressions, 1998-2008

Dependent variable:	**Probability of being sold**	
	(1)	(2)
Specification:	Seller name	No common names
Low commission listings	-0.07***	-0.07***
	(0.02)	(0.02)
N	30581	29316
R-squared	0.48	0.49

* p<0.1, ** p<0.05, *** p<0.01

Notes: Repeat seller fixed effect regressions in columns 3 and 4 in Table 7, but drop MLS listings from 2009 to 2011 (because the deeds data we use to track seller names end in 2008).

Table C6: Quantile regression for cumulative days on market

Dependent variable:	**Cumulative days on market**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Initially low commission	20.22***	2.71***	6.68***	13.21***	23.92***	29.78***	38.42***
	(1.58)	(0.19)	(0.36)	(0.72)	(1.33)	(1.96)	(5.00)
Statistic	Mean	25th	50th	75th	90th	95th	99th
N	137081	417887	417887	417887	417887	417887	417887

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table reports results on *cumulative days on market* used in the cost benefit analysis. Column 1 replicates column 6 in Table 4, except the dependent variable is the cumulative days on market in levels and the key regressor is whether the initial listing (for each marketing history) is strictly below 2.5 percent. We drop three listings with days on market below -90 and six listings with days on market above 1500 days. Standard errors are clustered at the property level. Columns 2 to 7 reports quantile regressions for the 25th, 50th, 75th, 90th, 95th, and 99th percentiles, respectively. These regressions use all sold listings (not just repeat sales), except for the nine outliers and 3,433 sales with missing property identifiers (which is needed for cumulative days on market). The controls are similar to those in column 6 of Table 4, except we use market fixed effects and year fixed effects instead of market by year fixed effects and drop property fixed effects. We could not get the quantile regressions to converge with a large number of fixed effects.