ESSAYS ON ECONOMIC INCENTIVES IN REAL ESTATE

A Dissertation in
Business Administration

by
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Abstract

This thesis comprises three essays on economics incentives in real estate. The first essay presents a model characterizing a Pareto optimal brokerage agreement between a seller of a property and a real estate broker who has private information about the market valuation of the property. Under the assumption that the broker faces increasing costs of securing higher offers for the property, the model predicts that an optimal brokerage commission should be a convex function of the size of the offer that the broker secures for the property. In addition, we present a novel sample of actual contracts from a major commercial real estate broker that is largely consistent with the predictions of the model.

The second essay argues against a highly debated externality question by presenting a self-selection model that indicates homeowners as having a greater incentive than renters to select jobs with productivity that matches their ability. Differential search and mobility costs inherent across housing tenure result in homeownership serving as a signal for job match quality. Additionally, through the lens of the self-selection hypothesis, this chapter presents a job match quality explanation for varying unemployment and employment duration across tenure. Finally, we present empirical evidence that provides support for the self-selection model and suggests that homeowners are indeed better matched than renters.

The third essay presents a framework to examine the trading decisions of institutional investors and the information content of credit ratings. Funds that are affiliated to underwriters/servicers may have a lower cost of acquiring information on the risk of the rated security than unaffiliated funds. A comparison of the trading activity of low information acquisition cost investors and ratings issued by credit rating agencies may enable a framework to examine the information content of ratings.
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Preface

Through various seminal articles, Ronald Coase demonstrated the importance of transaction costs. Essentially, the world with and without transaction costs is viewed differently. Building upon this conceptual framework, this thesis presents a unique view of real estate brokerage, housing tenure and institutional investment. Specifically, this thesis comprises three essays that are threaded by a common theme of the importance of transaction costs embedded within its intuition.

For example, why do brokers exist and do they add value? Following a transaction cost based intuition where brokers as intermediaries have a lower cost on acquiring information for securing a match between buyers and sellers, the first chapter studies the optimal compensation structure of real estate brokers. This chapter presents a model that characterizes the optimal compensation structure and predicts that the compensation should vary based on the cost of securing offers. This essay uniquely informs the debate on brokerage value by presenting a theoretical model that predicts that the commission structure should vary through convexity in the sale price of the contracted property. Additionally, a novel sample of brokerage contracts from the commercial real estate market is presented and an inference on the value of brokers is discussed.

In the absence of transaction costs, housing tenure choice will be independent of job search based matches. The second chapter presents an argument based on the search cost arising from housing tenure choice. Homeowners have a “greater mobility” cost relative to renters. We present a self-selection model that indicates that homeowners have a greater incentive than renters to select jobs with productivity that matches their ability. The essay’s unique contribution lies in the self-selection model that layers an optimal housing tenure based job match decision on to the classical investment-consumption trade-off.

In the Spirit of Coase’s ‘nature of the firm’ (Coase (1937)), the third chapter builds on the
argument that information costs differs based on the institutional framework of being within or beyond the umbrella of the firm. The ‘nexus of contracts’ within a firm enables a lower cost for information transmission. Thus, institutional investors that are affiliated with mortgage backed securities’ underwriters or servicers have a lower cost of acquiring information. This essay presents a framework that examines the trades of institutional investors that have a low cost of acquiring information underlying the rated security and the information underlying ratings.

Overall, the three chapters highlight the role of transaction costs on brokerage, housing tenure choice and institutional investment. Essentially, in the event of zero transaction costs none of the problems and incentives depicted would exist. Additionally, this thesis may motivate further avenues of research. For example, examining the effect of institutional features between the commercial and residential market on the brokerage contracts observed. We now proceed and present the economic discussion underlying this thesis.
I am very grateful to my committee members, Brent W. Ambrose, Ed Coulson, Keith Crocker, Austin Jaffe and Charles Cao for guiding me on my quest for knowledge. I am also very grateful to a commercial broker for sharing real world insights. A wise man once told me that getting a PhD is like creating a surfboard that will enable to master the seas. Learning in the program over the past few years under the guidance of the faculty, I have developed my surfboard comprising of knowledge and economic intuition. I thank my committee members and look forward to further academic pursuits.
Dedication

To my dear mother, Lina and my wife, Mercedes.
Chapter 1  
Optimal Compensation and Value Added in Commercial Real Estate Brokerage

1.1 Introduction

Do real estate brokers add value?\textsuperscript{1} This question has been extensively studied by academic researchers over the past three decades, whose approach has focused on residential real estate as a testing platform. Interestingly, the overwhelming conclusion drawn by these studies has been that brokers do not add value. In contrast, this paper presents a theoretical model of Pareto optimal brokerage contracts and empirical evidence in the context of commercial brokerage, and concludes that commercial brokers operate in an environment within which they add value. This paper uniquely informs the debate on brokerage value through three main

\textsuperscript{1}Economists are baffled. The internet has squelched inefficient middlemen in other industries, from insurance brokers to travel agents. Why not American realtors? - The Great Realtor Rip-Off - May 5th 2012, The Economist.
contributions. First, the theoretical model predicts that the optimal commission structure should vary based on the cost of securing offers in a very specific way. Second, a sample of brokerage contracts from a major commercial real estate broker is presented. Finally, the sample of commercial real estate brokerage contracts is shown to be consistent with the theoretical predictions of an optimal contracting model.

Past work has overwhelmingly suggested that real estate brokers do not add value. For example, Hendel et al. (2009) study the value added by brokerage by contrasting the sale of residential properties across a For-Sale-By-Owner (FSBO) platform and Multiple Listing Service (MLS) and infer that brokers do not add value as sale through a broker does not result in a greater price when contrasted with sale through the non-brokerage platform. Furthermore, Bernheim and Meer (2008) present a sample of non-MLS listings that comprise of the sale outcomes of faculty and staff homes at the Stanford University campus and provide evidence that suggests that brokers do not add significant value.

Overall, the conclusions of previous studies are based on conventional compensation schemes that can be broadly classified as a flat-fee amount, percentage commission or net-listing contract. Through an optimal compensation approach, we diverge from past work in this area by explicitly characterizing an optimal compensation structure for real estate brokers. In the model, we assume that brokers have better information on the market value of the property than do the owners, and also that brokers incur a cost of generating higher offers that are increasing with the magnitude of the offer, presumably to account for the incremental difficulty in securing higher sale offers. The model’s main prediction is that the optimal commission structure should vary based on the cost of securing offers and most importantly that the brokerage commission should be a convex function of the offer generated.
by the broker. We find that convex commission structures are manifested in the data on commercial contracts through the use of brokerage commissions that exhibit “kinks.” For example, the following hypothetical commission structure has two kinks: a commission rate of 5% for a sale up to $1 million, 7% of the amount in excess of $1 million for a sale between $1 million and $2 million, and 11% of the amount in excess of $2 million for a sale that exceeds $2 million. By contrast, residential brokerage contracts generally involve a fixed 6% commission rate. This makes sense in the context of the model, as residential brokers tend to be more passive when it comes to generating offers, simply waiting for interested parties to materialize as a consequence of the Multiple Listing Service and so do not need the higher powered incentives favored in commercial settings in which brokers actively invest in generating offers. The kinked commission structure predicted by the model is referred to as a “Waterfall” structure in commercial real estate. An analysis of a sample of such contracts suggests that a steep waterfall structure is more likely in an environment where the property involves a higher brokerage cost of generating offers. The primary prediction of the theoretical model is that the contract design, that is, the steepness of the waterfall, should vary with the complexity of the sale.

This paper presents a new perspective on the received view of the value added by brokers. In contrast with the often-studied case of residential brokers, commercial real estate brokerage involves sophisticated participants who recognize the need to compensate brokers through a range of incentive-based contracts that vary based on the nature of the property and overall market conditions through the design of kinks. This paper provides new evidence that counters the view that brokers do not add value and presents a new narrative on the value of commercial real estate brokers. The next section presents an institutional background on real
estate brokerage, followed by the optimal compensation model in Section 3 and a description of the data in Section 4. Section 5 develops and tests the research hypothesis based on the predictions of the theoretical model. Finally, Section 6 concludes with an overall inference of value in commercial real estate brokerage.

1.2 Institutional Background

The debate on value added by real estate brokers originates with Yinger (1981), who presents a theoretical model that determines a broker’s response to uncertainty about the number of buyers, listings and matches between buyers and listings. Yinger (1981) suggests that search activity is inefficiently high as brokers compete for a fixed number of sales that results in excessive search. Zorn and Larsen (1986) continue to explore brokerage value when they argue that first-best effort is achieved only when the agent is the principal. Since observing brokers’ effort is costly, the second-best optimal reservation price is lower and the principal should sacrifice the price dimension to gain closer alignment of interest as it is costly to monitor effort. On similar lines, Carroll (1989) suggests that brokers allocate effort across clients based on the commission rate (marginal benefit) and search cost (marginal cost). Hence, tying brokers’ compensation to marginal costs increases effort.

Arnold (1992) suggests that the percentage commission is the only contract that can induce an incentive compatible, first-best effort and not the other two (flat-fee, net-listing). Furthermore, Yavas (1995) studies efficiency and the incentive compatibility problem through the lens of resource allocation of a buyer and models the double moral hazard problem due to unobserved effort by the broker and seller. As in Arnold (1992), only the percentage commission can induce first-best effort, and efficiency requires that each player searches as if
each will receive the full surplus. In contradiction to Arnold (1992), Yavas (1996) suggests that the net-listing based contract maximizes buyer/seller surplus and broker profit when compared to percentage commission and flat-fee. As an alternative arrangement to maximize broker effort, Miceli (1989) suggests that a limitation on the duration of the sale contract provides an incentive for brokers to act in the interest of the seller as a cost is imposed upon expiration of the contract. Miceli (1991) examines the effect of split commissions between the seller’s and buyer’s broker and infer that effort is maximized when the broker that identifies a buyer first secures the entire commission. Additionally, Fisher and Yavas (2010) study a contract where a ‘race’ for agents is set up. These contract forms too are based on a fixed commission styled contract and induce higher effort through a winner-takes-all type contract.

Additionally, several studies have shed light on the question of the value added by real estate brokers. For example, Rutherford et al. (2005) present a theoretical model that incorporates the tradeoff between securing a higher sale price and a lower likelihood of finding a buyer at a higher price. The model predicts that brokers will select a higher price for the sale of their own property when contrasted with a client owned property. Through a sample of residential sales, brokers are shown to capitalize on their informational advantage while selling their own property at a price premium of 4.5%. On similar lines, Levitt and Syverson (2008) examine the informational advantage of brokers that sell their own home by contrasting the sale of client owned and self-owned properties. Through a sample comprising of home sales, the authors conclude that information asymmetry results in self-owned homes being sold at a significantly higher price. Inherent in the conclusions of Levitt and Syverson (2008) and Rutherford et al. (2005) is that brokers add less value when selling client owned properties.
Hendel et al. (2009) study the value added by brokerage through a more direct approach by comparing the sale of residential properties across a For-Sale-By-Owner (FSBO) platform and MLS. The absence of a broker in FSBO transactions enables a unique contrast of the value of brokerage services that is present in MLS transactions. The empirical evidence suggests that brokers do not add value as sale through a broker (MLS) does not result in a greater sale price when contrasted with sale through the FSBO platform. Furthermore, Bernheim and Meer (2008) present a sample of non-MLS listings that comprise of the sale outcomes of faculty and staff homes at the Stanford University campus. Through an empirical comparison of sales that differ by the usage of a broker, the authors conclude that brokers do not add significant value and present evidence that the use of brokers does not result in higher sale prices.

Furthermore, several studies have examined the value of various brokerage arrangements. For example, Jia and Pathak (2010) study the impact of commission on sales in Greater Boston. Through data on commissions of buyers’ brokers, the authors show that a higher commission is associated with a higher likelihood of sale but no effect on the sale price. Rutherford and Yavas (2012) compare discount brokerage to non-discount brokerage and find that the transacted sale prices are equal across both platforms, however, discount brokerage is associated with a lower likelihood of sale and a longer time on market. Additionally, Bernheim and Meer (2013) question whether brokers add any value to sellers by contrasting the sale of properties when listing services are unbundled from sale services. The authors infer that when listings are unbundled from brokerage services, the use of a broker results in a lower sale price implying that agency costs exceed the advantage of brokerage. Lastly, Barwick et al. (2015) study the fixed commission puzzle by examining variation in commissions of
the buyer’s broker through a sample comprising of a large number of properties in eastern Massachusetts. The empirical evidence suggests that lower commission rates result in a lower likelihood of sale and a longer time on the market.

Finally, the last strand of literature pertains to brokerage entry. Hsieh and Moretti (2003) document that low barriers to entry are socially inefficient as brokers chasing after high house prices results in fewer houses sold. Furthermore, Barwick and Pathak (2015) study the costs of free entry and infer that broker entry reduces the average service quality. Using MLS data from Greater Boston, the authors provide empirical evidence that implies that a 50% cut in commissions results in 40% fewer agents, social savings of 23% of the industry revenue, and 73% more transactions for the average broker.2

Overall, past work has focused on a linear commission structure as a basis for compensating real estate brokers. Additionally, the question on value added by real estate brokers has featured residential real estate as a testing platform. The next section deviates from an assumption of a linear commission structure and derives the optimal compensation for brokers by allowing the compensation to vary by the cost of generating offers.

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2A subset of the literature on broker compensation is discussed due to the vast number of studies over the past three decades. Yavas (1994) and Yavas (2007) provides a review of the economics of brokerage. In summary, past work has focused on the value of real estate brokers based on conventional compensation schemes that can be broadly classified as follows:

1. Flat-fee structure – The broker is not incentivized to increase effort. Additionally, inherent in this contract is an incentive to under-report and complete the sale at the lowest offer so as to reduce the time on market and seal the deal before expiration of the contract.

2. Percentage Commission – The percentage commission induces effort that equates marginal benefit to the marginal cost, thereby incentivizing the broker to secure a higher sale price.

3. Net Listing – The broker and seller agree to a reservation price $R$, and the broker gets the difference between the sale price and reported price $R$. The broker has an incentive to under-report the true value $V$, but prefers to maximize the time on market so as to get larger gains from the difference $V - R$. 

1.3 A Model of Optimal Brokerage Contracts

The environment consists of a property owner who engages the services of a broker to sell the property. Properties differ based on their index of underlying market value, denoted as $v$, and this is privately known to the broker.\footnote{We can think of brokers as playing the role of an intermediary in reducing the transaction costs of securing a match between the buyer and seller. The broker, armed with superior information on the value of the property compared to other owners, and also having better information of who those other alternative owners are likely to be, can incur costs to generate offers that exceed $v$.} The task of the broker is to bring an offer, $P$, to the owner. We assume that the broker incurs higher costs of procuring larger offers.\footnote{This corresponds to a smaller density of higher “willingness to pay” buyers.} Specifically, the broker’s cost of generating the offer $P$ when the property has the underlying value $v$ is $c(P - v)$, where $c', c'' > 0$ and we normalize the cost function by assuming $c(0) = 0$. Thus, it is costless for the broker to produce an offer equal to the property’s underlying value, but larger offers are increasingly costly to generate. For simplicity, we will assume quadratic costs, so that $c(P - v) = \alpha \frac{(P - v)^2}{2}$ where $0 < \alpha \leq 1$ is an exogenous cost parameter, and that the underlying value of the property is uniformly distributed on the interval $[0, 1]$.

In order to compensate the broker for incurring the costs of generating an offer on the property, the owner will pay a commission $B$ to the broker which may depend on the offer, $P$, that the broker produces. Accordingly, we will refer to the function $B(P)$ as the brokerage contract, and the goal in this section is to characterize a Pareto optimal agreement.

Given the notation introduced so far, we may write the utility of the risk-neutral property owner as

$$U \equiv P - B(P) \quad (1.1)$$
and the profit of the risk-neutral broker as

\[ \Pi \equiv B(P) - \frac{\alpha(P - v)^2}{2} \]

(1.2)

where the profit of the broker depends on the (privately-known to the broker) underlying value of the property, \( v \).\(^5\)

### 1.3.1 First-Best Brokerage Contracts

Before proceeding, we will characterize as a benchmark the “first-best” optimal contract if the underlying valuation of the property is publicly observable. In this setting, we may think of the brokerage contract as the pair \([P(v), B(v)]\) that specifies, for each value of \( v \), the offer to be procured by the broker and the associated payment to the broker by the owner.\(^6\)

As demonstrated by Samuelson (1954), a Pareto optimal contract may be characterized by a solution to a straightforward constrained optimization problem, which in the environment may be written as

\[ \max_{P, B} U \text{ subject to } \Pi \geq K \]

(1.3)

where \( K \) is an arbitrary level of utility that we will for convenience normalize to zero.

**Proposition 1:** A First-best Pareto optimal brokerage contract \([P^*(v), B^*(v)]\) is characterized by

\(^5\)We characterize the owner and broker as having risk-neutral utility. Based on the seminal work of Hölstrom (1979), the optimal contract would involve the owner selling the property to the broker for the expected sale price. However, we do not observe such sale transactions where brokers hold inventories of properties. Hence, we characterize the problem within a hidden information framework.

\(^6\)Note that the contract \( B(P) \) can be recovered by inverting \( P(v) \) to obtain \( v(P) \), and substituting the result into \( B(v) \).
\( (i) P^*(v) = v + \frac{1}{\alpha}; \) and
\( (ii) B^*(v) = \frac{1}{2\alpha}. \)

Proof: Given \( v \) we may write the Lagrangian expression associated with (1.3) as
\[ L = P - B + \lambda(B - \frac{\alpha(P - v)^2}{2}) \]
where \( \lambda \) is an undetermined multiplier. The First-order (necessary) conditions for a solution are:
\[ \frac{\partial L}{\partial P} = 1 - \lambda \alpha (P - v) = 0; \] and
\[ \frac{\partial L}{\partial B} = -1 + \lambda = 0 \]
The second condition implies \( \lambda = 1 \) which, upon substitution into the first condition, yields \( (i) \). Substitution of \( (i) \) into the constraint \( \Pi = 0 \) yields \( (ii) \). QED.

It is worth noting that, when the underlying value of the property is publicly observable, the broker receives a constant payment that does not depend on the underlying value of the property, \( v \), nor on the offer \( P \).

1.3.2 Second-Best Brokerage Contracts

We may now consider Pareto optimal brokerage contracts when the broker possesses private information about \( v \). In contrast to the first-best scenario examined above in which the offer required from the broker could depend explicitly on the publicly-observed value of \( v \), in this section the offer is chosen by the broker who possesses private information on the underlying market value of the property.

Faced with the brokerage contract \( B(P) \), the broker must decide what offer maximizes her utility. As depicted in Figure 1.1, the broker will generate the offer at which the broker’s indifference curve in \((B, P)\) space is tangent to \( B(P) \). Since the broker’s indifference curve depends on her private knowledge regarding \( v \), we know that, given \( B(P) \), the broker will
choose to generate the offer \( P(v) \) and receive the associated commission \( B(v) \).

With private information, the usual approach is to apply the revelation principle (Myerson (1979)) which states that there is no loss in generality by restricting the search for a Pareto optimal contract to those that result from the implementation of a “Direct Revelation Mechanism” under which the broker announces her private information to be \( \hat{v} \) and then receives the brokerage contract \([P(\hat{v}), B(\hat{v})]\) that satisfies the condition

\[
\Pi(P(v), B(v)|v) \geq \Pi(P(\hat{v}), B(\hat{v})|v), \quad \forall v, \hat{v} \in [0, 1]
\]  

(1.4)

This condition, which is often referred to as the “truth-telling” constraint, guarantees that the broker who has the private information \( v \) will always prefer the contract \([P(v), B(v)]\) to \([P(v'), B(v')]\) for every \( v' \neq v \). In the discussion that follows, we will refer to the broker’s private information as her “type”.

The utility of a \( v \)-type broker that reports \( \hat{v} \) and receives the contract \([P(\hat{v}), B(\hat{v})]\) is written as

\[
\Pi(P(\hat{v}), B(\hat{v})|v) = B(\hat{v}) - \frac{\alpha(P(\hat{v}) - v)^2}{2}
\]

which condition (1.4) requires to be maximized at \( \hat{v} = v \). Taking the first-order condition with respect to \( \hat{v} \) yields,

\[
\frac{d\Pi}{d\hat{v}} = B'(\hat{v}) - (P(\hat{v}) - v)P'(\hat{v})\alpha = 0
\]

(1.5)

at \( \hat{v} = v \).

As long as the brokerage contract satisfies (1.5), we know that the broker will always
truthfully report her type, so the broker’s utility may be written as:

$$\Pi(P(v), B(v)|v) = B(v) - \frac{\alpha(P(v) - v)^2}{2} \quad (1.6)$$

Taking the total derivative of (1.6) with respect to $v$ and substituting from (1.5) yields the envelope result,

$$\frac{d\Pi}{dv} = \alpha(P(v) - v) \quad (1.7)$$

which represents the “information rents” that must be paid to the privately informed broker to ensure truth-telling.

A second-best Pareto optimal contract in this setting may be characterized as a solution to the problem of maximizing the expected utility of the seller,

$$\int_0^1 U(P(v), B(v)) \, dv \quad (1.8)$$

subject to the truth-telling constraint (1.4) and the broker’s zero-profit constraint,

$$\Pi(P(v), B(v)|v) \geq 0, \quad \forall v \in [0, 1] \quad (1.9)$$

The next theorem characterizes a solution.

**Theorem 1:** A second-best Pareto optimal constraint $[P(v), B(v)]$ is characterized by the following conditions:

(i) $P(v) = 2v + \frac{1-\alpha}{\alpha}$; and

(ii) $B(v) = \alpha v^2 + 2(1-\alpha)v + \frac{(1-\alpha)^2}{2\alpha}$.
Proof: From (1.2), we may write

\[ B = \Pi + \frac{\alpha(P - v)^2}{2} \]  

(1.10)

which, upon substitution into (1.1) yields

\[ U = P - \Pi - \frac{\alpha(P - v)^2}{2} \]  

(1.11)

We may now use control theory to solve the optimizing problem by writing the Hamiltonian as:

\[ H = P - \Pi - \frac{\alpha(P - v)^2}{2} + \phi(v)\alpha(P - v) \]  

(1.12)

where \( P \) is the control variable, \( \Pi \) is the state variable, \( v \) is the variable of integration, and \( \phi(v) \) is the co-state variable associated with the equation of motion (1.7). We have not formally introduced the broker's zero profit constraint (1.9); the approach is to solve the less constrained problem (1.12) and then to demonstrate that a solution satisfies (1.9).

The Pontryagin (necessary) conditions for a solution are \( \frac{\partial H}{\partial P} = 0 \) and \( \frac{d\phi}{dv} = -\frac{\partial H}{\partial \Pi} \), which yield:

\[ \frac{\partial H}{\partial P} = 1 - \alpha(P - v) + \alpha\phi = 0; \quad \text{and} \]

\[ \frac{d\phi}{dv} = 1 \]  

(1.13)

(1.14)

Integrating both sides of (1.14) and recognizing the transversality condition \( \phi(1) = 0 \) gives

\[ \phi = v - 1 \]  

(1.15)
which upon substitution into (1.13) yields part (i) of the Theorem. Now we will recover the commission $B$. Total surplus must be divided between the owner and the broker, so that

$$P - \frac{\alpha(P-v)^2}{2} = P - B + \int_0^v \Pi_v(t) \, dt$$

(1.16)

where $\Pi_v = \alpha(P-v)$. Solving for $B$, we obtain

$$B = \frac{\alpha(P-v)^2}{2} + \int_0^v \alpha(P(t) - t) \, dt$$

(1.17)

Solving condition (i) of the theorem for $P-v$, substituting the result into (1.17), performing the integration and simplifying yields condition (ii).

Finally, substituting (i) and (ii) into (1.2) yields $\Pi(v) = \frac{\alpha v^2}{2} + v(1-\alpha)$, so condition (1.9) is satisfied by this solution. QED.

We now have all we need to characterize the optimal brokerage contract.

**Corollary 1:** The second-best Pareto optimal brokerage contract is given by:

$$B(P) = \frac{\alpha P^2}{4} + \frac{(1-\alpha)P}{2} - \frac{(1-\alpha)^2}{4\alpha}$$

Proof: Solve part (i) of Theorem 1 for $v$ and substitute into (ii). QED.

Given that we have a closed form solution for the second-best Pareto optimal brokerage contract $B(P)$, we now can obtain the following result.

**Corollary 2:** An increase in the cost parameter $\alpha$ results in a more convex brokerage contract $B(P)$.

Proof: Since $\frac{\partial^2 B}{\partial P^2} = \frac{\alpha}{2}$, the result is immediate. QED.
The intuition is that as the cost of producing higher offers increases, the broker is efficiently incentivized through a contract in which the marginal commission is increasing in the size of the offer generated. We now turn to an analysis of the contractual data.

1.4 Data

This section presents a proprietary sample of commercial brokerage contracts obtained from a leading brokerage firm that operates across the U.S. for the time period spanning the years 1997 to 2008, comprising of 218 sale contracts.\textsuperscript{7} The contracts vary by the terms of the incentives offered to the selling broker. We note that the sale commission ranges from a fixed dollar amount to contracts with highly incentivized commission structures such as a kinked commission structure. A kinked commission structure also referred to as a “Waterfall” represents a contract that is convex in the sale price. For example, the following commission structure has two kinks: a commission rate of 5% for a sale up to $1 million, 7% of the amount in excess of $1 million for a sale between $1 million and $2 million, and 11% of the amount in excess of $2 million for a sale that exceeds $2 million.

We initiate a discussion on the variation in commercial brokerage contracts by describing the incentive structure as designed in the commission schedules. Table 1.1 presents an overview of the types of contracts in the study sample. Out of a total of 218 contracts, the majority of the sample (66%) comprises of no kinks i.e. a constant commission rate, followed by 17% for one kink and 4% for two-kinked contracts. Furthermore, we define a set of contracts that are not characterized by either a simple flat-commission rate or kinked

\textsuperscript{7} A small sample size is typical in the contracting literature as the focus is the intuition underlying contract design.
commission structure as a set of “odd-ball” contracts and note that 14% of the contracts fall in this category.

Table 1.2 presents data on the distribution of constant commission rate based contracts. We sort and compute the average commission rate by deciles and note that the rate varies substantially, in contrast to residential brokerage where it tends to be 6%. The average rate for the first decile is relatively low at 0.64% implying a relatively less incentivized contract. At the other end of the spectrum, the highest decile comprises of an average commission rate of 3.63% of the sale price depicting a highly incentivized commission rate. Furthermore, the standard deviation of the commission rate is 0.94% and depicts variation in the marginal incentives across contracts and contrasts residential brokerage that generally involve a flat 6% commission rate.

Next, we turn to a discussion of the “single kinked” contracts. Figure 1.2 presents the commission payoff for a contract that specifies a constant commission rate of 3% of the sale price. In contrast, Figure 1.3 presents an example of a single kinked commission contract. Specifically, the plot indicates a commission of 3% for sale of the property up to $1 million, and 5% of the amount that exceeds $1 million. Hence, the slope of the commission payoff is 0.03 up to $1 million and increases to 0.05 for a sale that exceeds $1 million. Table 1.3 presents a summary of the single kinked contracts through the average deciles of the base and first kink commission rates. The contracts are sorted based on the base rate and then re-sorted for the first kink to obtain the averages across deciles. The base commission rate varies from 0.49% for the bottom decile to 5.00% for the highest decile while the average commission of the first decile for the kink is 2.25% and increases up to 20% for the highest decile. Additionally, we present a comparison of the base rate and kinked commissions across

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8The commission payoff for a sale at $1 million is 0.05(1) - 0.02 = 0.03 and increases for higher offers.
contracts through the absolute and relative differences in the incentive scheme that are computed as follows:

\[
\text{Absolute difference} = \textit{Kink 1 Commission} - \textit{Base Commission} \tag{1.18}
\]

\[
\text{Relative difference} = \frac{\textit{Kink 1 Commission} - \textit{Base Commission}}{\textit{Base Commission}} \tag{1.19}
\]

We note that the absolute difference of the first decile is 1.25% and increases to 16.50% for the highest decile. Additionally, the relative difference is 0.70% for the first decile and 19.00% for the highest decile. Taken together, the absolute and relative difference implies that the incremental marginal incentives for securing higher priced offers varies across the range of properties contracted for sale.

Next, Figure 1.4 presents an example of a two kinked commission contract. The graph indicates a commission payoff of 3% for sale of the property up to $1 million, and 5% of the amount that exceeds $1 million, and 10% of the amount that exceeds $2 million. Hence, the slope of the commission payoff is 0.03 up to $1 million, increases to 0.05 for a sale that exceeds $1 million, and a further marginal increase of 0.10 for a sale exceeding $2 million.\(^9\) Additionally, the “odd-ball” contracts comprise of variations such as fixed dollar amount commissions, commission structure based on number of properties sold, time to sale, etc.

Having described the contractual data, the next section develops a framework to test the theoretical model’s prediction on the design of contracts.

\(^9\)The commission payoff for a sale at $1 million is 0.05(1) - 0.02 = 0.03 and increases for higher offers. Similarly, the commission payoff for a sale at $2 million is 0.10(2) - 0.12 = 0.08.
1.5 Empirical Results

The commercial brokerage contracts described in the previous section provide a unique testing platform as the contracts vary by the level of convexity ranging from contracts that incentivize the broker through a flat commission rate to highly convex contracts that are characterized by a Waterfall incentive structure. The optimal compensation model predicts that the compensation structure should be linked to the cost of securing offers. Additionally, the model predicts that an increase in the cost results in a more convex brokerage contract. We explicitly test the prediction in Corollary 2 and frame a testable hypothesis as:

*Brokerage Compensation Hypothesis:* A convex (kinked) compensation is more likely when the cost of generating offers is greater.

The testability of the hypothesis rests on identifying a variable that serves as a proxy for the costs of generating higher priced offers. A relevant test may involve a variable that overcomes the endogeneity problem. Thus, we seek a variable that measures the difficulty in generating higher priced offers.

If the contractual data implies empirical evidence in support of the *Brokerage Compensation Hypothesis*, then the design of commercial brokerage contracts can be inferred to match the optimal compensation structure. Overall, through the variation in compensation, the hypothesis implicitly tests for the value of commercial real estate brokers.

To test the hypothesis, we obtain a measure that captures the brokerage cost of acquiring offers to set up a test on the factors that influence the brokerage contract. Costar is a

---

10 Corollary 1 states that the Pareto optimal brokerage contract is convex in the sale price. The objective is to test the variation in levels of convexity across contracts, hence Corollary 2 forms the basis on empirical tests.
leading commercial real estate data vendor that provides property and market characteristics for commercial real estate properties and covers majority of the market in the U.S. The property data involves property characteristics such as property type and corresponding market characteristics involving the sale and lease of similar properties within a specified geographic radius. Using the address of properties in the brokerage contracts we obtain the vacancy rate in the market of each property to proxy for a measure of the “difficulty in sale.” Specifically, we obtain the vacancy rates in the sub-market by setting a radius of a half mile from the subject property.\textsuperscript{11} An increase in the vacancy rate shifts the distribution of offers to the left indicating a lower willingness to pay among potential buyers in the market. Hence, it is relatively more costly to generate a higher priced offer i.e. $P$ may be relatively more costly to generate. Additionally, the vacancy rate for the quarter preceding the contract date is obtained to represent an ex-ante measure of the environment in which it may be difficult to secure higher priced offers. The intuition is that brokers may need to be further incentivized in markets where the vacancy rates are higher thereby implying a greater transaction cost for generating higher priced matches.

Next, we refine the data to arrive at a sample of single property contracts to enable a testing platform that varies by the level of convexity. Hence, we have a reduced sample of 118 contracts from the original sample of 218 contracts.\textsuperscript{12} While the sample size is relatively small when compared to residential contracts, the economic intuition in the design of contracts and its relation with the theoretical model’s prediction is the primary focus. Out of a total of 118 contracts, 35 have a waterfall structure whereas 83 have a simple, constant rate commission.

\textsuperscript{11}On the residential side, Bar-Isaac and Gavazza (2015) use vacancy rates as a measure of market “hotness” to study the occurrence of exclusivity in lease contracts.

\textsuperscript{12}The reduced sample excludes multiple property contracts as the Costar data pertains to vacancy rates for single location properties.
structure. Table 1.4 presents an overview of the types of contracts and indicates that the majority of the underlying properties are classified as an office (68.7%). Additionally, 2.5% are flex, 7.6% are industrial, 16.1% are multi-family, and 5.1% are retail properties. Overall, the sample indicates that commercial real estate brokerage contracts vary substantially in stark contrast to residential contracts.

Furthermore, Table 1.5 presents a univariate view of the environment underlying the design of the contracts through the summary statistics of the vacancy rates of kinked and constant commission rate contracts. We note that kinked contracts have a greater mean (16.1%) and median (15.0%) vacancy rate than constant commission rate contracts (mean of 10.1% and median of 8.6%). Also, the standard deviation of kinked contracts is greater (9.9%) than constant commission rate contracts (7.8%) thereby providing a preliminary view that kinked commission rates are contracted in relatively higher vacancy rate environments than constant commission rate contracts. Next, we proceed and explicitly test the brokerage compensation hypothesis by explaining the variation in the commission structures that incentivize commercial real estate brokers.

To test the brokerage compensation hypothesis, we explain the occurrence of the waterfall contract as a function of various factors. Specifically, we model a measure of convexity in a contract as a function of the type of the property and the vacancy rate in the relevant market. The estimated probit equation is of the form:

$$Pr[Y = 1] = \Phi[\beta_0 + \beta_1 PropertyType + \beta_2 VacancyRate + \epsilon]$$

\[1.20\]

13 Costar defines a flex property as a type of building designed to be versatile, which may be used in combination with office (corporate headquarters), research and development, quasi-retail sales, and including but not limited to industrial, warehouse, and distribution uses.

14 The difference is statistically significant.
The dependent variable, $Y$, is binary and takes value 1 for a kinked commission contract and 0 for a constant commission rate contract, thereby measuring the level of convexity through the likelihood of a kinked contract. Property Type represents fixed effects for the various property types, namely, Flex, Industrial, Multi-family, Office and Retail. Vacancy Rate is a measure of the difficulty in securing higher priced offers and represents the transaction costs incurred while selling the property at the time of contract initiation.

Table 1.6 presents the estimated results of the regression modeling the variation in contract types and corresponding factors. Model 1 indicates that the coefficient of the vacancy rate is positive and statistically significant at the 1% level. Furthermore, Model 2 controls for property characteristics and indicates that the coefficients of the indicator variables for the property types are not statistically significant. However, the coefficient of the vacancy rate is positive and statistically significant at the 1% level. The interpretation is that the likelihood of a kinked contract increases as the difficulty in securing a higher priced match increases (measured by an increase in the vacancy rate) and conveys the intuition behind the design of brokerage contract. The likelihood of a kinked contract increases if the broker needs to be further incentivized and compensated for higher marginal costs associated with a sale while experiencing a market that is characterized by a greater cost in generating higher priced offers. Finally, we include year fixed effects in the Model 3 specification and note that the inference is unchanged. Overall, the empirical results provide strong support for the brokerage compensation hypothesis.

The theoretical model predicts that the optimal compensation structure should be convex and contingent on the cost of generating offers. Following this prediction, the estimated regression results suggest that the convexity variation in commercial real estate contractual
design matches the theoretical prediction where brokers add value. Hence, commercial real
estate brokerage represents an environment where brokers add value as contracts are designed
efficiently and follow the optimal theoretical prediction.

1.6 Conclusion

Past literature has extensively questioned whether real estate brokers add value and
residential real estate has formed the basis of a testing environment. Interestingly, the
overwhelming conclusion drawn is that brokers do not add value. We explicitly characterize
the optimal compensation structure for real estate brokers and the theoretical model predicts
that optimal commission structure should vary based on the cost of generating offers.

We test the model’s prediction through a sample of commercial real estate brokerage
contracts. An analysis of the contracts reveal substantial variation and the design of contracts
is shown to vary based on the cost of acquiring offers. Additionally, we explicitly test the
optimality of commercial real estate brokerage contracts by explaining the variation in the
commission structures and find that kinked commission structures are more likely if the cost
of generating higher priced offers is greater and the broker needs to be further incentivized to
account for a higher transaction cost. Overall, the results show that the commission structure
is tied to the marginal cost of generating offers and matches the theoretical environment of
brokers adding value.

In summary, this paper provides new evidence that counters the general view that brokers
do not add value and presents a theoretical and empirical basis on the value of commercial real
estate brokers. In contrast with the often-studied case of residential brokers, commercial real
estate brokerage involves sophisticated participants who recognize the need to compensate
brokers through a range of incentive-based contracts that vary, based on the nature of the property and overall market conditions, through the design of convex contracts.
Note: This figure presents an illustration of the brokerage contract. The broker generates an offer at which the broker’s indifference curve in \((B, P)\) space is tangent to \(B(P)\). Given \(B(P)\), the broker will generate the offer \(P(v)\) and receive the associated commission \(B(v)\).
Figure 1.2. *Constant Commission Rate Contracts.*

Note: This figure presents an example of a constant commission rate contract. The graph indicates a commission payoff of 3% for sale of the property.
Figure 1.3. Single Kink Commission Rate Contracts.

Note: This figure presents an example of a single kinked commission contract. The graph indicates a commission payoff of 3% for sale of the property up to $1 million, and 5% of the amount that exceeds $1 million.
Figure 1.4. Two Kinked Commission Rate Contracts.

Note: This figure presents an example of a two kinked commission contract. The graph indicates a commission payoff of 3% for sale of the property up to $1 million, 5% of the amount that exceeds $1 million, and 10% of the amount that exceeds $2 million.
Table 1.1. Distribution of brokerage contracts.

<table>
<thead>
<tr>
<th>Kinks</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>143</td>
<td>66</td>
</tr>
<tr>
<td>1</td>
<td>37</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Odd-ball</td>
<td>30</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>218</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: This table presents the distribution of contracts across a constant rate, 1 kink, 2 kinks or odd-ball commission structure. The second column gives the counts, whereas the third column indicate the percentage across all the contracts.
Table 1.2. Summary Statistics of constant commission rate contracts.

<table>
<thead>
<tr>
<th>Decile</th>
<th>Avg. Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.64</td>
</tr>
<tr>
<td>4</td>
<td>1.14</td>
</tr>
<tr>
<td>7</td>
<td>1.93</td>
</tr>
<tr>
<td>10</td>
<td>3.63</td>
</tr>
<tr>
<td>Sd.</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Note: This table presents an overview of the constant rate commission contracts. The average commission rate by deciles and overall standard deviation of the contracts is presented. The sample comprises of 143 contracts.
Table 1.3. Summary Statistics of single kink brokerage contracts.

<table>
<thead>
<tr>
<th></th>
<th>Base</th>
<th>Kink 1</th>
<th>Absolute Difference</th>
<th>Relative Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.49</td>
<td>2.25</td>
<td>1.25</td>
<td>0.70</td>
</tr>
<tr>
<td>4</td>
<td>0.96</td>
<td>5.00</td>
<td>3.50</td>
<td>2.83</td>
</tr>
<tr>
<td>7</td>
<td>1.61</td>
<td>5.38</td>
<td>4.41</td>
<td>4.76</td>
</tr>
<tr>
<td>10</td>
<td>5.00</td>
<td>20.00</td>
<td>16.50</td>
<td>19.00</td>
</tr>
<tr>
<td>Sd.</td>
<td>0.89</td>
<td>3.25</td>
<td>2.87</td>
<td>3.20</td>
</tr>
</tbody>
</table>

Note: This table presents an overview of the single kink commission contracts. The average commission rate by deciles and overall standard deviation of the contracts is presented. The Absolute and Relative differences are computed as follows:

**Absolute difference** = \( \text{Kink 1 Commission} - \text{Base Commission} \)

**Relative difference** = \( \frac{\text{Kink 1 Commission} - \text{Base Commission}}{\text{Base Commission}} \)

The variable in each column is sorted separately to compute the average across deciles. The sample comprises of 38 contracts. Figure 3 provides a corresponding plot that depicts the Base rate and Kink 1.
Table 1.4. Summary Statistics of Property Types across brokerage contracts.

<table>
<thead>
<tr>
<th>Type</th>
<th>All</th>
<th>Kinked</th>
<th>Constant Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flex</td>
<td>2.5</td>
<td>2.9</td>
<td>2.4</td>
</tr>
<tr>
<td>Industrial</td>
<td>7.6</td>
<td>11.4</td>
<td>5.0</td>
</tr>
<tr>
<td>Multi-Family</td>
<td>16.1</td>
<td>11.4</td>
<td>18.1</td>
</tr>
<tr>
<td>Office</td>
<td>68.7</td>
<td>71.4</td>
<td>67.5</td>
</tr>
<tr>
<td>Retail</td>
<td>5.1</td>
<td>2.9</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Note: This table presents the percent of contracts that are classified as flex, industrial, multi-family, office and retail. The second column gives the percentages for all the brokerage contracts, whereas the third and fourth column indicate the percentages for kinked and constant commission rate contracts respectively. The sample comprises of 35 kinked and 83 constant commission rate contracts.
Table 1.5. Summary Statistics of the vacancy rates across brokerage contracts.

<table>
<thead>
<tr>
<th>Type</th>
<th>Mean</th>
<th>Median</th>
<th>Standard deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinked</td>
<td>16.1</td>
<td>15.0</td>
<td>9.9</td>
<td>2.0</td>
<td>46.2</td>
</tr>
<tr>
<td>Constant Rate</td>
<td>10.1</td>
<td>8.6</td>
<td>7.8</td>
<td>0.6</td>
<td>42.7</td>
</tr>
</tbody>
</table>

Note: This table presents the summary statistics of the vacancy rates of the market within a half mile radius of the contracted property. The statistics for kinked and constant commission rate contracts are reported separately. The sample comprises of 35 kinked and 83 constant commission rate contracts.
Table 1.6. Variation of the level of convexity across kinked vs. constant commission rate brokerage contracts.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.11***</td>
<td>-1.37**</td>
<td>-0.87</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.65)</td>
<td>(0.80)</td>
</tr>
<tr>
<td>Vacancy</td>
<td>0.05***</td>
<td>0.05***</td>
<td>0.05***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Flex</td>
<td>-</td>
<td>0.65</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td>(0.99)</td>
<td>(1.12)</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>-</td>
<td>0.58</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>(0.78)</td>
<td>(0.81)</td>
<td></td>
</tr>
<tr>
<td>Multi-family</td>
<td>-</td>
<td>0.29</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>(0.72)</td>
<td>(0.75)</td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>-</td>
<td>0.18</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>(0.66)</td>
<td>(0.68)</td>
<td></td>
</tr>
<tr>
<td>Retail</td>
<td>-</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Year f.e.</td>
<td>-</td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: This table presents the probit regression results explaining the variation in the level of convexity. The dependent variable, \( Y \), is binary and takes value 1 for a kinked commission contract and 0 for a constant commission rate contract. The variable Vacancy measures the vacancy rate of the market within a half mile from the subject property. Flex, Industrial, Multi-family, Office and Retail are indicators for the type of the property. The sample comprises of 35 kinked and 83 constant commission rate contracts. Standard errors are noted in parenthesis. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.
Chapter 2  
Housing Tenure and Labor Market Self-Selection

2.1 Introduction

Urban economists have long debated the benefits of homeownership. Additionally, the effect of housing tenure choice on labor market outcomes is a highly studied subject. Oswald (1997) postulated the argumentative hypothesis that depicts homeowners as having a negative effect on the labor market. But does homeownership really impose such adverse effects on the labor market? This paper argues against a highly debated externality question by presenting a self-selection model that indicates homeowners as having a greater incentive than renters to select jobs with productivity that matches their ability. Differential search and mobility costs inherent across housing tenure result in homeownership serving as a signal for job match quality. Additionally, through the lens of the self-selection hypothesis, this paper provides a

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1 Refer to the debate on ‘Should home-ownership be discouraged’ in The Economist archives (Sep 19, 2012) with economist Andrew Oswald defending and Richard K. Green against the motion.
job match quality based explanation for varying unemployment and employment duration across tenure.

The ‘Oswald Hypothesis’ sets the stage for a strand of literature that connects housing tenure and the labor market. Dohmen (2005) predicts an association between higher unemployment and homeownership rates, hence signifying a negative labor market outcome due to homeownership. Additionally, Munch et al. (2006) suggest that homeownership has a negative effect on the unemployment likelihood and a positive effect on wages. On the other end of the spectrum, Coulson and Fisher (2009) find a differential impact of individual and aggregate homeownership on the labor market. A recent claim inherent in Blanchflower and Oswald (2013) is that homeownership creates negative externalities for the labor market. The focal point of this intuition is that homeownership inhibits mobility and is a cost incurred that subsequently results in inferior labor market outcomes. Additionally, the authors elicit a call for a policy change due to the hypothesis that homeownership ‘damages’ the labor market. Overall, past work has overwhelmingly implied a negative externality on the labor market and this paper deviates by providing theoretical and empirical evidence to the contrary. This chapter contributes to the debate by arguing that homeowners, relative to renters, are more likely to self-select into matched jobs. The unique contribution lies in the self-selection model that presents an optimal housing tenure based job match decision layered on to the classical investment-consumption trade-off characterized by Henderson and Ioannides (1983). Additionally, the model’s prediction is consistent with stylized facts on the housing market such as longer unemployment and employment durations for homeowners with the main lever being the transaction cost associated with either owning or renting.

Before initiating the discussion on the effect of housing tenure as a signal of job match match
quality we trace back to the seminal work of Stiglitz (1975) where the theory of ‘screening’ to
signal ability originates. The benefits of screening are illustrated when individuals of differen-
tial ability sort according to their ability by signaling through a costly process. Following a
similar argument, Guasch and Weiss (1981) suggest a costly testing framework that provides
workers having private knowledge of ability with an incentive to self-select into jobs that
match their ability. In this setup, firms cannot observe the ability of applicants perfectly, but
can administer a costly test and only ‘high’ skill type workers apply (self-select) for the job.

Besides an explicit costly screening process, past work has identified an implicit testing
process that results in self-selection based on private ability. Montgomery (1991) argues that
job referral is an effective signal of worker ability and ‘connected’ workers fare better. Firms
are better off hiring through referrals as it enhances the ability-productivity match quality.
Here, firms learn the ability of an employee during the first period, and then rely on the
signal of employee referrals. Existing employees refer high ability or matched workers as it is
costly to deviate and refer an unmatched worker. Essentially, referrals represent an effective
implicit screening mechanism where firms and employees are better off when hiring through
referral channels. Simon and Warner (1992) find empirical evidence that shows that workers
hired through ‘old boy networks’ reduce employers’ uncertainty about workers’ privately
known ability levels, and firms and workers are better off through this hiring setup.

Following the implicit screening process, this paper presents a self-selection mechanism
where homeowners have a greater incentive to sort into matched jobs than renters. The
implicit screening lies in differential search/mobility costs arising from either housing tenure
status. Although the cost is subtle, the effect on the labor market outcome is shown to differ
substantially with regard to tenure. Additionally, empirical results using the Current Popula-
tion Survey data implies that housing tenure is an endogenous variable that signals the level of match between worker ability and job productivity. Furthermore, the model predictions are consistent with employment and unemployment duration arguments documented by past literature. This paper presents an argument that homeowners are more likely to be matched at a job relative to renters as the transaction cost from change in tenure results in a higher likelihood of an optimal match.

The paper proceeds as follows. The next section describes the self-selection model and assumptions. Next, the main intuition behind the self-selection hypothesis and its implications for the labor market are illustrated. Finally, the paper concludes with testable implications of the model and explores further avenues for extension.

2.2 The Model

The main intuition of self-selection into the labor market based on housing tenure can be reflected through a Bellman equation. Pissarides (2000) describes that in a perfect capital market, with an infinite horizon and no dynamic changes in parameters, the discounted value of the expected stream of income from a job is adequately represented in a Bellman style equation. Through a similar argument, the self-selection model incorporates worker ability and job productivity in a concise setup. Following are a set of assumptions that will be needed,

1) Jobs are of productivity \( x \), where \( x \) is uniformly distributed on the interval \([0, X]\). Workers can perfectly see the productivity level of arriving jobs.

2) Wages are \( \rho x \). We take \( \rho \) as exogenous but it can be thought of as arising from a Nash bargain between firms and workers.
3) Workers have ability $a$, where $0 \leq d \leq a \leq X - d$, for some $d > 0$. That is, the domain of abilities is a subset of the domain of job productivities. Ability is a private signal known by workers and is hidden from employers. Workers observe job productivity levels and subsequently self-select into any job. We define $\epsilon = |x - a|$ as the level of mismatch.

4) $\sigma$ is a disutility arising from unemployment. Homeowners have a higher unemployment disutility than renters due to differential search/mobility costs, i.e. $\sigma_O > \sigma_R$.

5) Job separation likelihood is proportional to the level of mismatch. The separation likelihood is captured through a mismatch function given by $\epsilon^2 = (x - a)^2$.

6) When unemployed, a worker receives a job offer every time period. The worker observes $x$ and thus the mismatch, $\epsilon$. Each worker establishes a reservation $\epsilon$, $\epsilon^*$, such that the received job is accepted if $\epsilon \leq \epsilon^*$. Thus the matching rate is $2\epsilon$, and $\epsilon^*$ is chosen to maximize lifetime utility taking into account the fact that a small $\epsilon$ decreases the probability of layoff, but increases the matching rate. This specification of match and detachment rates can be maintained only if $\epsilon < d$, which we assume throughout, and discuss further below.

Let $W_U(x, a)$ and $W_E(x, a)$ denote the discounted value of the lifetime utility from unemployment and employment for a worker of ability $a$, while searching or at a job of productivity $x$ respectively. Following Pissarides (1994, 2000), the expected wage stream is defined through the Bellman equation as a function of the wage and change of ‘state’ to employment or unemployment. Hence, for a worker with ability $a$, the utility from unemployment, $W_U(x, a)$ is given as:

$$rW_U(x, a) = 2\epsilon[W_E(x, a) - W_U(x, a)] - \sigma \epsilon$$

(2.1)
Similarly, the expected utility from employment $W_E(x, a)$ is given as:

$$rW_E(x, a) = \epsilon^2[W_U(x, a) - W_E(x, a)] + \rho x$$  \hspace{1cm} (2.2)

Equation (2.2) depicts the higher likelihood of a change of state to unemployment due to lower match quality between worker ability and job productivity, i.e. the rate of shift to unemployment increases if $(x - a)^2$ is higher. Perfectly matched workers have $x = a$ and will not change state into unemployment. Since an explicit solution turns out to be quite complicated and unintuitive, a numerical solution is simulated to gather the insights provided in equations (2.1) and (2.2). Most importantly, the implication of tenure choice on the level of acceptable ‘mismatched’ jobs needs to be ascertained. We are therefore interested primarily in the effect of $\sigma$ (which characterizes the difference between owners and renters) on the optimal limit to mismatch, $\epsilon$.

Figure 2.1 depicts the relation between the optimal expected utility and match quality for owners and renters separately. The equations are parameterized such that $r = 0.04, \rho = 1, a = 0.5, \sigma = 3$ or $20$. The characterization demonstrates that the optimal choice of the mismatch $\epsilon$ decreases as $\sigma$ increases. Intuitively, this implies that the optimal level of mismatch is greater for renters than homeowners as the search/transaction costs are internalized. The optimal choice accounts for an inherent trade-off between choosing a lower mismatch level and higher duration for arrival of jobs that are deemed as acceptable through the level of mismatch. An optimal choice will involve the maximization of the expected lifetime utility along with minimizing the duration of job arrival. The differential transaction costs across housing tenure results in support for the claim that homeowners have a greater incentive to self-select into better matches than renters and leads to a formalization of proposition 1:
Proposition 1: Homeowners self-select into relatively better matched jobs than renters.

Furthermore, as characterized in the previous proposition, the optimal choice of mismatch is lower for homeowners. Also, the rate of job arrivals for workers is $2\epsilon$ and the duration of unemployment is given as an inverse function of the rate of job arrival rate,

$$d(\epsilon) = \left(\frac{1}{2\epsilon}\right)$$

(2.3)

Proposition 1 implies that given the constraint due to tenure choice, the maximum level of mismatch is lower for owners than renters, or $\epsilon_O \leq \epsilon_R$. Hence the rate at which acceptable jobs arrive to owners is lower than renters and $d(\epsilon_O) > d(\epsilon_R)$, or homeowners have higher unemployment duration than renters. Essentially, this depicts the main trade-off between the duration of unemployment and costs arising from the job match quality. Compared to renters, owners stay in an unemployed state longer for better matches as the penalty from deviating is higher and we characterize proposition 2 as:

Proposition 2: Homeowners have a higher unemployment duration than renters.

Next, we relate employment duration to housing tenure based on the optimal choice of job mismatch. Equation (2.2) characterizes the rate of job destruction due to a mismatch as $\epsilon^2$. Since the optimal choice across tenure is lower for owners, $\epsilon_O < \epsilon_R$, the rate of shift to unemployment is lower for homeowners (due to initial matching from self-selection). Hence, owners have a higher employment duration than renters. The explanation that homeowners have a higher employment duration due to an initial self-selection that results in a ‘matched’ job is in stark contrast to the negative externality explanations offered by past literature that
is attributed to a relatively immobile situation. The self-selection explanation suggests that in addition to the immobility constraint, the level of worker ability and job productivity match is high, thereby reducing the likelihood of detachment. Comparatively, renters self-select into less matched jobs and stay at the job for a shorter duration. Thus, proposition 3 is formalized as follows:

**Proposition 3:** Homeowners have a higher employment duration than renters that is attributed to an initial self-selection into relatively better matched jobs.

This section elaborates on the implication of a setup in which workers have a choice to change tenure while at a job (matched or unmatched). The expected utility of a renter while changing housing tenure to homeownership, $W_{E \rightarrow O}(\epsilon)$ is given by,

$$rW_{E \rightarrow O}(\epsilon) = \epsilon^2 [W_U^O(\epsilon) - W_{E \rightarrow O}(\epsilon)] + \rho x \quad (2.4)$$

Similarly, the expected wage stream of a renter without a change in tenure, $W_{E \rightarrow R}(\epsilon)$ is given by,

$$rW_{E \rightarrow R}(\epsilon) = \epsilon^2 [W_U^R(\epsilon) - W_{E \rightarrow R}(\epsilon)] + \rho x \quad (2.5)$$

Here, the change of state to unemployment is based on the initial selection $\epsilon$, and subsequently the new tenure based utility is either $W^O_E(\epsilon)$ or $W^R_E(\epsilon)$ that is contingent on continuation at mismatched job $\epsilon$. Re-writing we get,

$$W_{E \rightarrow O}(\epsilon) = \frac{\epsilon^2 W_U^O(\epsilon) + \rho x}{r + \epsilon^2} \quad (2.6)$$
Renters in ‘bad’ matches change tenure to homeownership if \( W_{E \rightarrow O}^R(\epsilon) > W_{E \rightarrow O}^R(\epsilon) \), or,

\[
W_{E \rightarrow R}^R(\epsilon) = \frac{\epsilon^2 W_{U}^O(\epsilon) + \rho x}{r + \epsilon^2}
\] (2.7)

Or equivalently, if \( W_{U}^O(\epsilon) > W_{U}^R(\epsilon) \), which is not true as unemployment utility for a given mismatch level is always higher for renters. Hence renters in ‘bad’ matches do not change tenure to homeownership. An interesting point to note in the inequality is that \( \epsilon \) plays the role of a weight that determines if tenure change is optimal. If the mismatch \( \epsilon \) is high then the weight attributed to \( W_{U}^O(\epsilon) \) and \( W_{U}^R(\epsilon) \) is correspondingly high and a change of tenure to homeownership is not optimal as mobility is essential to account for mismatched jobs.

Next, we consider an alternate scenario where renters in ‘good’ matches may change tenure to homeownership if \( \epsilon \) tends to zero. In a perfectly matched worker ability - job productivity scenario, \( \epsilon = 0 \). Hence, the comparison results in equality on either side of inequality (2.8),

\[
\frac{0 \times W_{U}^O(\epsilon) + \rho x}{r + 0} = \frac{0 \times W_{U}^R(\epsilon) + \rho x}{r + 0}
\]

This implies that renters in perfectly matched jobs are indifferent between remaining in current rental status or changing tenure to homeownership, as the expected payoff from either choice is,

\[
W_{E \rightarrow R}^R(\epsilon) = W_{E \rightarrow O}^R(\epsilon) = \frac{\rho x}{r}
\] (2.9)

If a consumption benefit from homeownership, \( b_o \) is added, then the comparison results in:

\[
\frac{\epsilon^2 W_{U}^O(\epsilon) + \rho x}{r + \epsilon^2} + b_o > \frac{\epsilon^2 W_{U}^R(\epsilon) + \rho x}{r + \epsilon^2}
\] (2.10)
Or equivalently, renters in ‘good’ matches change tenure to homeownership if $W^O_U(\epsilon) + b_o > W^R_U(\epsilon)$. Hence, in the event of good matches, the tenure choice decision reduces to the classical trade-off between investment and consumption as characterized in Henderson and Ioannides (1983). Overall, the transition equations depict housing tenure choice as a function of the labor market mismatch and is represented by the following proposition:

*Proposition 4: Job match quality influences housing tenure transitions.*

Following a similar argument, it can be shown that homeowners in good jobs remain owners, and those in bad jobs change housing tenure. In summary, the quality of match between worker ability and job productivity plays a pivotal role in housing tenure choice.

### 2.3 Empirical Implications

The previous section illustrates the implication of housing tenure choice on job match quality due to differential mobility and search constraints. To test the main predictions of the model, the March Supplement of the Current Population Survey (CPS) dataset offers a unique framework. The CPS dataset comprises of annual information on socioeconomic variables of a subset of the population in the years 2005 to 2012. Using a similar dataset (IDA dataset), Groes et al. (2015) find that occupational mobility is ‘U-shaped’ and directional. The U-shaped aspect implies that low and high wage earners within an occupation have a higher probability of separation, and the low (high) earners tend to move to new occupations with lower (higher) average wages. An interesting argument is presented where the wages of
workers are shown to proxy for worker ability at the occupation. This chapter builds on the occupational mobility framework documented in Groes et al. (2015) and argues that housing tenure is based on occupational mobility. The self-selection hypothesis involves an empirical basis for worker ability and job productivity and the CPS dataset offers a unique testing opportunity through occupation level data.

In order to test the main hypothesis that homeowners self-select into good matches more than renters, the employee level micro dataset offers a relevant occupation change and sorting environment. Proposition 1 implies that the optimal level of job mismatch is lower for homeowners than renters. Essentially, the main testable prediction is that compared to renters, homeowners’ wages are more centered around the ‘true’ mean of the occupation. Hence, the self-selection model predicts that renters’ wage distribution will have a higher variation than homeowners.

Furthermore, the self-selection model predicts a higher unemployment duration for homeowners than renters as the arrival rate of jobs is lower due to a smaller range of acceptable jobs. Additionally, the model predicts a higher employment duration for homeowners as the worker ability and job productivity match quality is better than that of renters. This contrasts with the argument posted by extant literature where longer employment duration is attributed to constraints on mobility. On the contrary, the self-selection model suggests that homeowners stay at jobs longer as the high quality of match predisposes a need for mobility across jobs. Table 1 presents evidence that supports the self-selection hypothesis.3

2Besides presenting empirical results on occupation mobility, Groes et al. (2015) provide a theoretical basis for observed wages serving as a proxy for ability.

3Longer unemployment and employment durations are stylized facts documented by past studies and hence not further tested in this paper.
The following regression equations are estimated:

\[
\hat{\text{logwage}} = \mu_1 \text{Renter} + \mu_2 \text{factors} + \hat{\epsilon} \tag{2.11}
\]

\[
\hat{\epsilon}^2 = \beta_1 \text{Renter} + \beta_2 \text{factors} + \lambda \tag{2.12}
\]

\(\hat{\text{logwage}}\) is the predicted logarithmic function of the wage explained by factors such as occupation, industry, education, age, gender, race, year fixed effects, number of children, marital status and housing tenure. The square of the fitted residual, \(\hat{\epsilon}^2\), is the dependent variable in equation (2.12) and is explained by housing tenure and a set of controls. Table 2.1 presents the estimated regression results across various specifications. Model 1 indicates that the coefficient of \(\text{Renter}\) is positive and statistically significant implying that renters have a greater wage mismatch. Model 2 controls for factors influencing the dependent variable and the result that renters have a greater wage mismatch is unchanged. Models 3 and 4 instrument for homeownership through the MSA level structure rate and the NBER mortgage interest subsidy. Here too the coefficient of the predicted tenure is statistically significant and suggests that homeownership implies a greater job match than renter-ship.

Overall, the regression results implies that housing tenure is an endogenous variable that signals the level of match between worker ability and job productivity. Groes et al. (2014) find that in occupations with steeply rising (declining) productivity, lower (higher) paid workers within an occupation tend to leave. This translates to a higher likelihood of separation in the event of a productivity shock that result in a worker ability and job productivity mismatch. An empirical question that follows is: Does a productivity shock that results in bad matches predispose renters to a low likelihood of change of tenure status to maintain mobility? Or
equivalently, are renters ‘doomed’ to permanent renter-ship due to prolonged mismatch and economic shocks that predispose a bad level of match quality? This extension can be tested using macro level productivity and housing tenure data.4

2.4 Conclusion

This paper argues against a highly debated question on the negative externalities of homeownership by presenting a self-selection model that indicates that homeowners have a greater incentive than renters to select jobs with productivity that match their ability. Essentially, the main feature of the self-selection model is a subtle difference in search and mobility costs inherent across housing tenure. Through the differential search costs, homeownership is shown to serve as a signal for job match quality. The predictions of the self-selection hypothesis are consistent with job match quality explanations for varying unemployment and employment duration across tenure. Finally, tenure choice is presented as a decision that is influenced by the level of match between worker ability and job productivity.

This chapter presents empirical evidence that supports the self-selection model and suggests that homeowners are indeed better matched than renters, thereby presenting a novel argument on housing tenure based mobility and labor market outcomes. Past work has overwhelmingly implied that homeownership imposes a negative externality on the labor market. This chapter contributes to the debate by presenting an argument to the contrary and suggests that homeowners, relative to renters, are more likely to self-select into matched jobs. Extensions may involve the inclusion of firm reaction to self-selection based on tenure status. Also, a Nash bargain that captures the equilibrium incentives to select mismatched

4The extension is beyond the scope of this chapter and is deferred to a later stage.
jobs and the option to change tenure may result in a comprehensive self-selection model.
Figure 2.1. Optimal choice of mismatch across housing tenure.

Note: This figure presents the optimal job mismatch across housing tenure choice. Homeowners optimally select better matches relative to renters.
Table 2.1. Regression estimates for the tenure choice model.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renter</td>
<td>0.0706***</td>
<td>0.0489***</td>
<td>0.3530**</td>
<td>0.3184**</td>
</tr>
<tr>
<td></td>
<td>(0.0039)</td>
<td>(0.0044)</td>
<td>(0.1475)</td>
<td>(0.1459)</td>
</tr>
<tr>
<td>Occupation f.e.</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry f.e.</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Education f.e.</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Age f.e.</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Gender f.e.</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Race f.e.</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Year f.e.</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Children</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Marital Status f.e.</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>R-Square</td>
<td>0.0013</td>
<td>0.0285</td>
<td>0.0010</td>
<td>0.0311</td>
</tr>
<tr>
<td>N</td>
<td>255,325</td>
<td>255,325</td>
<td>190,150</td>
<td>190,150</td>
</tr>
</tbody>
</table>

Note: This table presents the estimates for the regression equation: 
\( \hat{\epsilon}^2 = \beta_1 Renter + \beta_2 factors + \lambda \). The square of the fitted residual, \( \hat{\epsilon}^2 \), is the estimated residual in the equation, \( \log \hat{wage} = \mu_1 Renter + \mu_2 factors + \hat{\epsilon} \) and is explained by housing tenure and a set of controls. Model 1 and 2 represents the base regression and Models 3 and 4 represent the instrumented regression results. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.
Chapter 3  |  Information Content of Credit Ratings: Evidence from Institutional Mortgage Backed Securities Holdings

3.1 Introduction

Since the recent financial crisis, the informative-ness of credit ratings issued for mortgage related securities have been a contentious issue. The demand side of the mortgage backed securities (MBS) and collateralized debt obligations (CDOs) based asset market comprises of institutional investors such as mutual funds, pension funds, and life insurance companies that may rely on Credit Ratings Agencies (CRAs) to provide a signal of the risk underlying securitized instruments. Through the lens of the recent financial crisis, this chapter presents
a framework to study the trading decisions of institutional investors and the information content of credit ratings of mortgage backed securities.

Griffin and Tang (2012) present evidence on the varying incentives of departments within a credit rating agency. Evidence suggests that the sale department of CRAs initially allocated favorable ratings for CDOs when compared to the rating updates by the surveillance department within the same CRA. Originators, Underwriters and CRAs represent the supply side of the market and investors that buy securities represent the demand side. Past work such as Keys et al. (2008) study the supply side of the mortgage market and screening incentives of subprime lenders. But what role did institutional investors and the information content of credit ratings play in the propagation of the securitized mortgage crisis?

Coase’s seminal work on the ‘nature of the firm’ (Coase (1937)) motivates the argument that information costs differ based on the institutional framework of being within or beyond the umbrella of the firm. The ‘nexus of contracts’ within a firm enables a lower cost for information transmission. Furthermore, Ritter and Zhang (2007) show that underwriters favorably allocate IPOs to affiliated mutual funds, thereby presenting an argument that underwriters and affiliated funds may have a lower cost on information acquisition. Additionally, Massa and Rehman (2008) present evidence on information flow for firms by studying the effect of relations between mutual funds and banks within the same financial group. Following a similar argument, this chapter builds on the concept that low information acquisition cost investors (affiliated mutual funds) have an asymmetric information advantage, and presents a contrast to the risk implied by credit ratings. Underwriters and servicers of MBS may have an informational advantage on the risk underlying the securities. Hence, funds affiliated to underwriters/servicers have a relatively lower cost on acquiring information underlying
Past work has studied the role of institutional investors and crises. For example, Abreu and Brunnermeier (2003, 2002) present a model that suggests that institutional investors maximize profits by riding a bubble, thereby propagating a crisis. Manconi et al. (2012) find that liquidity-constrained investors with exposure to securitized bonds played a role in propagating the crisis from securitized to corporate bonds. Furthermore, Griffin et al. (2011) present evidence of the propagation of the technology bubble by institutional investors. To gauge the impact of institutional investors, Manconi et al. (2012) indicate that institutional investors’ holdings of securitized bonds increased fourfold during the sample period, with a value of $2 trillion in 2007 and holdings increased steadily for mutual funds over the pre-crisis period. However, it does not explicitly address questions relating to the trades of securities based on measures of risk and the information content of credit ratings as available to institutional investors.

This chapter presents a framework to study the trades of institutional investors and the information content of credit ratings. Credit ratings are an integral component of the securitization process and past work has studied the informativeness of ratings. For example, Jorion et al. (2005) study the information content of credit ratings through the framework of a change in disclosure regimes based on Regulation Fair Disclosure (FD) enacted in 2000. Specifically, Regulation FD prohibits nonpublic disclosures to favored investment professionals and the change in asymmetric information released results in an increase in the information content of credit ratings in the post-FD period. Next, Tang (2009) exploits an exogenous source of variation introduced by the Moody’s 1982 credit rating refinement and concludes that credit market information asymmetry significantly influences firms’ real outcomes. This
paper digresses from past work and presents a framework to examine the trades of institutional investors and the information content of MBS credit ratings.

Through a view of institutional holdings, this chapter seeks to present a framework that may enable an empirical platform to answer questions on the financial crisis based on the trading decisions of institutional investors and the information content of credit ratings. Section 2 outlines the research hypotheses, followed by a description of the data in Section 3 and empirical methodology in Section 4. Finally, Section 5 presents the empirical results and Section 6 concludes with the general intuition and primary findings.

### 3.2 Hypotheses Development

Funds that are affiliated to MBS underwriters/servicers may have a lower cost to acquire information on the collateral comprised in the deal. Thus, through the research motivation discussed in the previous section, the following hypotheses are set up to test corresponding empirical implications,

\[(H1) \text{ Funds traded in the direction of ratings.}\]

The hypothesis tests if investors relied on ratings and traded based on the signal implied by the CRAs.

\[(H2) \text{ Affiliated funds traded on an information advantage and traded differently than unaffiliated funds (based on ratings).}\]

The hypothesis tests for differential trades based on information costs by contrasting trades of affiliated funds with unaffiliated funds. Additionally, the hypothesis may form a basis of an indirect test of the information content of credit ratings underlying securitized deals.
If mutual funds that are affiliated to underwriters/servicers trade in the direction of credit ratings, then it would imply that ratings are informative.\(^1\)

Having defined the main hypotheses, the next section proceeds and elaborates on the testing platform and empirical procedures to examine the trading decisions of institutional investors and the information content in credit ratings.

### 3.3 Data

Several data sources are merged to provide a testing platform for examining the holdings of institutional investors. The Thomson Reuters eMaxx database provides bond holdings across institutional investors such as mutual funds, pension funds and life insurance companies. Holdings are recorded in par amounts depicting quantity changes in individual fund positions. These include holdings of securitized mortgage related deals across MBS.\(^2\) Table 3.1 presents the summary statistics of the par amount change in holdings of securitized deals held by affiliated and unaffiliated investors (for the years 2004 to 2007). The change in holdings represents the par amount change over snap-shots of reporting periods and affiliated funds have smaller average net changes in holdings (-$154,450 vs. -$354,250), thereby implying potential variation in net trades across affiliation status.

Additionally, Bloomberg provides historical data on ratings and subsequent changes across the credit rating agencies, namely, S&P and Moody’s. The Blackbox data library comprises of origination risk characteristics and performance updates for mortgage level

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\(^1\) Further work is needed to conclusively test the information content of ratings based on this methodology. Additionally, parallel hypotheses are based on the deal level loss and tests if funds traded in the direction of performance updates.

\(^2\) Due to SEC guidelines, bond positions of investment management companies are reported on Form N-Q. Correspondingly, equity positions can be obtained from Form 13F filings.
information in each individual RMBS. A merge across the data sources results in a unique testing environment for the hypotheses based on holdings of institutional investors. The next section proceeds and describes the empirical methodology based on the hypotheses and relevant empirical framework.

3.4 Empirical Methodology

The main intuition in the hypotheses is tested in a framework comprising of bond holdings snap-shots over time. Massa and Rehman (2008) study the information flow within financial conglomerates by computing the change in fund holdings of firms over a 6-month period before and after a loan deal. Through the change in holdings over the yearly period, affiliated mutual funds increase their holdings in firms that borrow from the fund’s management company. Furthermore, Shive and Yun (2013) study the flows of mutual funds trades across 13F filings and show that traders profit from flow-induced trades of mutual funds. On parallel lines, through the lens of the hypotheses specified in the previous section, the following holdings based methodology is implemented for formal tests. Estimate the change in holdings given a change in the rating of the security, and cost to information acquisition,

\[ \Delta Holdings_{(i,j,t)} = f(\Delta Rating_{t+1}, Affiliated_i, Affiliated_i \times \Delta Rating_{t+1}, controls) \]  

where \( \Delta Holdings_{(i,j,t)} \) is the net change in the holdings for fund \( i \) in security \( j \) and is modeled as a function of a variable signifying a change in the rating and appropriate controls. A positive and statistically significant coefficient of the rating change measure will imply that institutional investors traded in the direction of ratings. Additionally, a positive coefficient
for the interaction between the rating change measure and affiliation indicator will suggest that affiliated funds traded differently than unaffiliated funds based on the ratings’ signal. Through the testing framework described, the next section presents initial empirical results that provide an inference for the research hypotheses.

### 3.5 Empirical Results

Having discussed the hypotheses and empirical methodology, this section presents initial evidence on the trading decisions of institutional investors and the information content of credit ratings. Table 3.2 presents the estimated regression results of the net changes in holdings of mutual funds that are affiliated or unaffiliated to underwriters/servicers. The coefficient of the rating change measure (Net SP Change) is negative and statistically significant. This suggests that funds did not explicitly trade in the direction of ratings. The results of Model 3 imply the same inference after controlling for fund level characteristics depicting management and 12b1 fees. Hence, we reject Hypothesis (1) and conclude that investors did not trade in the direction of ratings. Additionally, the interaction of the rating change measure with the affiliation indicator is not significant and implies that affiliated investors did not trade differently than unaffiliated funds based on the ratings’ signal. Next, Table 3.3 presents the regression results of the change in holdings based on the total rating change. The total rating change is the overall change of the rating and accounts for the overall effect of varying levels of changes in the rating. The inference that affiliated funds did not trade differently than unaffiliated funds based on the ratings’ signal is unchanged based on an alternate measure of rating updates.

Furthermore, Table 3.4 presents the regression results of the change in holdings on the
aggregate rating change. The aggregate rating change is the sum of the total rating change across the rating agencies and reflects an overall effect of changes across rating agencies. Model 3 depicts that the coefficient of the aggregate rating change measure is negative and marginally statistically significant. However, the interaction term between the affiliation indicator and aggregate rating change measure is not significant. Hence, it implies a lack of evidence to suggest that affiliated funds traded differently than unaffiliated funds based on the ratings’ signal.

Overall, the hypotheses contrasts the net trades of investors that have a low cost to information acquisition with credit ratings. The results suggest that affiliated funds, that have a lower information cost, did not trade differently than unaffiliated investors based on the signal implied by ratings.

3.6 Conclusion

The information content of credit ratings and the role of institutional investors is highly debated since the recent financial crisis. In contrast to the supply side arguments for factors that are hypothesized to have augmented the recent financial crisis, this paper presents a framework to examine the role of institutional investors and the information content of credit ratings in the propagation of the financial crisis from a demand side perspective. Through the hypotheses posed, an overall view of the impact of institutional trades and the information content of credit rating can be inferred. A comparison of the trading activity of low information acquisition cost investors and the rating stamp of the credit rating agencies

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3 Further work may involve explicitly testing for the information content of ratings based on this methodology. Additionally, using the deal level loss instead of the rating change measure implies a similar result.

4 This chapter presents preliminary results and further tests are needed to conclusively imply the findings.
may reveal the true information content of credit ratings. Overall, this chapter presents a framework to study the trading decisions of institutional investors and the relevance of credit ratings of mortgage backed securities.
Table 3.1. Change in holdings across investors.

<table>
<thead>
<tr>
<th>Funds</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affiliated</td>
<td>-154.45</td>
<td>1021.47</td>
<td>-38.00</td>
</tr>
<tr>
<td>Unaffiliated</td>
<td>-354.25</td>
<td>4184.57</td>
<td>-28.00</td>
</tr>
</tbody>
</table>

Note: This table presents the summary statistics of the par amount (in 000's) of the change in holdings of securitized deals held by affiliated and unaffiliated investors. Change in holdings represents the par amount change over successive snap-shots of reporting periods.
Table 3.2. Change in holdings based on net rating change.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-359.27***</td>
<td>-359.42***</td>
<td>-402.32***</td>
</tr>
<tr>
<td></td>
<td>(23.26)</td>
<td>(23.27)</td>
<td>(48.15)</td>
</tr>
<tr>
<td>Net SP Change</td>
<td>-466.33*</td>
<td>-474.99*</td>
<td>-474.36*</td>
</tr>
<tr>
<td></td>
<td>(247.24)</td>
<td>(249.40)</td>
<td>(249.90)</td>
</tr>
<tr>
<td>Net Moody’s Change</td>
<td>-60.18</td>
<td>-65.32</td>
<td>-66.52</td>
</tr>
<tr>
<td></td>
<td>(150.10)</td>
<td>(150.74)</td>
<td>(151.05)</td>
</tr>
<tr>
<td>Affiliation</td>
<td>204.33</td>
<td>208.86</td>
<td>198.20</td>
</tr>
<tr>
<td></td>
<td>(143.91)</td>
<td>(144.57)</td>
<td>(145.72)</td>
</tr>
<tr>
<td>Affiliation x Net SP Change</td>
<td>-</td>
<td>226.41</td>
<td>237.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2029.74)</td>
<td>(2033.81)</td>
</tr>
<tr>
<td>Affiliation x Net Moody’s Change</td>
<td>-</td>
<td>534.69</td>
<td>534.39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1656.90)</td>
<td>(1660.22)</td>
</tr>
<tr>
<td>Management Fee</td>
<td>-</td>
<td>-</td>
<td>-4.64</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4.14)</td>
</tr>
<tr>
<td>12b1</td>
<td>-</td>
<td>-</td>
<td>-0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.79)</td>
</tr>
<tr>
<td>R-Square</td>
<td>0.0002</td>
<td>0.0002</td>
<td>0.0002</td>
</tr>
<tr>
<td>N</td>
<td>32,814</td>
<td>32,814</td>
<td>32,683</td>
</tr>
</tbody>
</table>

Note: This table presents the estimated regression results on holdings of mutual funds. The dependent variable is the change in the holdings. Affiliation indicates the affiliation status of funds. Net SP Change and Net Moody’s Change are the Net SP and Moody’s rating change. Management Fee and 12b1 fee are mutual funds’ characteristics. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.
Table 3.3. Change in holdings based on total rating change.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-358.26***</td>
<td>-358.41***</td>
<td>-401.35***</td>
</tr>
<tr>
<td></td>
<td>(23.25)</td>
<td>(23.25)</td>
<td>(48.15)</td>
</tr>
<tr>
<td>SP Change</td>
<td>260.70</td>
<td>-260.94</td>
<td>-260.78</td>
</tr>
<tr>
<td></td>
<td>(190.08)</td>
<td>(191.15)</td>
<td>(191.53)</td>
</tr>
<tr>
<td>Moody’s Change</td>
<td>-74.31</td>
<td>-82.64</td>
<td>-83.55</td>
</tr>
<tr>
<td></td>
<td>(132.27)</td>
<td>(133.53)</td>
<td>(133.81)</td>
</tr>
<tr>
<td>Affiliation</td>
<td>202.85</td>
<td>208.40</td>
<td>197.74</td>
</tr>
<tr>
<td></td>
<td>(143.91)</td>
<td>(144.47)</td>
<td>(145.62)</td>
</tr>
<tr>
<td>Affiliation x SP Change</td>
<td>-</td>
<td>97.40</td>
<td>107.51</td>
</tr>
<tr>
<td></td>
<td>(1817.07)</td>
<td>(1820.71)</td>
<td></td>
</tr>
<tr>
<td>Affiliation x Moody’s Change</td>
<td>-</td>
<td>424.45</td>
<td>425.38</td>
</tr>
<tr>
<td></td>
<td>(978.33)</td>
<td>(980.29)</td>
<td></td>
</tr>
<tr>
<td>Management Fee</td>
<td>-</td>
<td>-</td>
<td>-4.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4.13)</td>
</tr>
<tr>
<td>12b1</td>
<td>-</td>
<td>-</td>
<td>-0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.78)</td>
</tr>
<tr>
<td>R-Square</td>
<td>0.0002</td>
<td>0.0002</td>
<td>0.0002</td>
</tr>
<tr>
<td>N</td>
<td>32,814</td>
<td>32,814</td>
<td>32,683</td>
</tr>
</tbody>
</table>

Note: This table presents the estimated regression results on holdings of mutual funds. The dependent variable is the change in the holdings. Affiliation indicates the affiliation status of funds. SP Change and Moody’s Change are the SP and Moody’s rating change. Management Fee and 12b1 fee are mutual funds’ characteristics. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.
Table 3.4. Change in holdings based on aggregate rating change.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-358.18***</td>
<td>-358.34***</td>
<td>-401.23***</td>
</tr>
<tr>
<td></td>
<td>(23.25)</td>
<td>(23.25)</td>
<td>(48.14)</td>
</tr>
<tr>
<td>Aggregate Rating Change</td>
<td>-142.89</td>
<td>-148.49*</td>
<td>-149.84*</td>
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<tr>
<td></td>
<td>(89.11)</td>
<td>(89.84)</td>
<td>(90.02)</td>
</tr>
<tr>
<td>Affiliation</td>
<td>201.88</td>
<td>206.45</td>
<td>195.84</td>
</tr>
<tr>
<td></td>
<td>(143.90)</td>
<td>(144.21)</td>
<td>(145.35)</td>
</tr>
<tr>
<td>Affiliation x Aggregate Rating Change</td>
<td>-</td>
<td>345.32</td>
<td>348.79</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(705.86)</td>
<td>(707.27)</td>
</tr>
<tr>
<td>Management Fee</td>
<td>-</td>
<td>-</td>
<td>-4.68</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4.14)</td>
</tr>
<tr>
<td>12b1</td>
<td>-</td>
<td>-</td>
<td>-0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.79)</td>
</tr>
<tr>
<td>R-Square</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0002</td>
</tr>
<tr>
<td>N</td>
<td>32,814</td>
<td>32,814</td>
<td>32,683</td>
</tr>
</tbody>
</table>

Note: This table presents the estimated regression results on holdings of mutual funds. The dependent variable is the change in the holdings. Affiliation indicates the affiliation status of funds. Aggregate Rating Change is the aggregate of the SP and Moody’s rating change. Management Fee and 12b1 fee are mutual funds’ characteristics. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.


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**RESEARCH INTERESTS**

**REFEREEED JOURNAL PUBLICATIONS**
- *Real Estate Risk and Hedge Fund Returns* *Journal of Real Estate Finance and Economics* (forthcoming), with Brent W. Ambrose, Charles Cao.

**ACADEMIC PRESENTATIONS**
- **Financial Management Association Annual Conference,** Nashville, TN (2014). “Real Estate Risk and Hedge Fund Returns”

**AD HOC REFEREE**
- **Real Estate Economics**

**PROFESSIONAL EXPERIENCE**
- **The Hartford Financial**
  Intern, Hartford CT (05/07-12/08, 05/09-08/09)
- **Indian Institute of Technology**
  Research Assistant, Department of Mathematics, Mumbai, India (09/05 - 05/06)
- **St. Xavier’s College**
  Lecturer, Department of Statistics, Mumbai, India (06/04 - 04/05)