# Optimal Compensation and Value Added in Commercial Real Estate Brokerage

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**Abstract**

This paper 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 consistent with the predictions of the model.

Keywords: Agency theory, brokerage, commercial real estate, intermediary, market microstructure.

*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.*

# 1 Introduction

Do real estate brokers add value? 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 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.

# 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.[1]

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.

# 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.[2] 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.[3] 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

[1]A 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 $V - R$.

[2]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 $v$.

[3]This corresponds to a smaller density of higher "willingness to pay" buyers.

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 $c(P - v) = \frac{\alpha(P-v)^2}{2}$ 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

$$U \equiv P - B(P) \tag{1}$$

and the profit of the risk-neutral broker as

$$\Pi \equiv B(P) - \frac{\alpha(P - v)^2}{2} \tag{2}$$

where the profit of the broker depends on the (privately-known to the broker) underlying value of the property, $v$.[4]

[4]We characterize the owner and broker as having risk-neutral utility. Based on the seminal work of Hölmstrom (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.

## 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.[5]

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

$$\max_{P,B} U \; subject\,to \, \Pi \geq K \tag{3}$$

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*

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

$(ii) B^*(v) \;=\; \frac{1}{2\alpha}$.

Proof: Given $v$ we may write the Lagrangian expression associated with (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

[5]Note that the contract $B(P)$ can be recovered by inverting $P(v)$ to obtain $v(P)$, and substituting the result into $B(v)$.

$\frac{\partial L}{\partial B} = -1 + \lambda = 0$

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 $P$.

## 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, 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

$$\Pi(P(v), B(v)|v) \geq \Pi(P(\hat{v}), B(\hat{v})|v), \qquad \forall v, \hat{v} \in [0, 1] \tag{4}$$

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

$$\frac{d\Pi}{d\hat{v}} = B'(\hat{v}) - (P(\hat{v}) - v)P'(\hat{v})\alpha = 0 \tag{5}$$

at $\hat{v} = v$.

As long as the brokerage contract satisfies (5), we know that the broker will always truthfully report her type, so the broker's utility may be written as:

$$\Pi(P(v), B(v)|v) = B(v) - \frac{\alpha(P(v) - v)^2}{2} \tag{6}$$

Taking the total derivative of (6) with respect to $v$ and substituting from (5) yields the envelope result,

$$\frac{d\Pi}{dv} = \alpha(P(v) - v) \tag{7}$$

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,

$$\int_0^1 U(P(v), B(v))\, dv \tag{8}$$

subject to the truth-telling constraint (4) and the broker's zero-profit constraint,

$$\Pi(P(v), B(v)|v) \geq 0, \qquad \forall v \in [0, 1] \tag{9}$$

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 (2), we may write

$$B = \Pi + \frac{\alpha(P - v)^2}{2} \tag{10}$$

which, upon substitution into (1) yields

$$U = P - \Pi - \frac{\alpha(P-v)^2}{2} \tag{11}$$

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

$$H = P - \Pi - \frac{\alpha(P-v)^2}{2} + \phi(v)\alpha(P-v) \tag{12}$$

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 (7). We have not formally introduced the broker's zero profit constraint (9); the approach is to solve the less constrained problem (12) and then to demonstrate that a solution satisfies (9).

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

$$\frac{\partial H}{\partial P} = 1 - \alpha(P-v) + \alpha\phi = 0; \quad and \tag{13}$$

$$\frac{d\phi}{dv} = 1 \tag{14}$$

Integrating both sides of (14) and recognizing the transversality condition $\phi(1) = 0$ gives

$$\phi = v - 1 \tag{15}$$

which upon substitution into (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

$$P - \frac{\alpha(P-v)^2}{2} = P - B + \int_0^v \Pi_v(t)\, dt \tag{16}$$

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

$$B = \frac{\alpha(P-v)^2}{2} + \int_0^v \alpha(P(t) - t)\, dt \tag{17}$$

Solving condition ($i$) of the theorem for $P - v$, substituting the result into (17), performing the integration and simplifying yields condition ($ii$).

Finally, substituting ($i$) and ($ii$) into (2) yields $\Pi(v) = \frac{\alpha v^2}{2} + v(1-\alpha)$, so condition (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 $\frac{d^2B}{dP^2} = \frac{\alpha}{2}$, 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.

# 4 Data

We have obtained a sample of proprietary contracts from a leading commercial brokerage firm that operates across the United States. Since these agreements contain property addresses, we are able to match many of the properties covered by the contracts to the database compiled by CoStar, a leading commercial real estate data vendor, which provides property and market characteristics for commercial real estate properties. Through this link, data has been obtained for property type (office, flex, industrial, multi-family, and retail) and information on the characteristics for similar properties within a specified geographic radius. Focusing on the brokerage contracts for which CoStar data were available resulted in a sample of 118 contracts governing the sale of commercial properties signed between 1997 and 2008.

The structure of the brokerage commissions varies substantially across the contracts in the sample. Of the 118 contracts, 82 stipulate that the broker commission is to be calculated as a straight percentage of the ultimate selling price, and 36 exhibit a commission structure in which the marginal commission rate varies with the selling price. In the discussion that follows, we will refer to the former as "flat commission" agreements, while the latter will be referred to as "kinked commission" contracts. Amongst commercial brokers, the kinked commission structure is commonly referred to as a "waterfall" arrangement.

To illustrate the difference between these commission structures, consider the following examples. Figure 2 illustrates the payment to the broker for the sale of a property under an agreement with a flat commission of 3%. In contrast, Figure 3 presents an example of a typical kinked commission in which the broker receives a payment of 3% for the first $1 million in sales price, and in addition is paid a commission of 5% on that portion of the sales price in excess of $1 million. Thus, the commission as a function of the sales price exhibits a kink at a price of $1 million, and we will refer to the commission rate below the kink as the "base" and that above the kink as "kink1". While in this particular example the commission has only a single kink, there are in the data examples with multiple kinks. So, for example, in Figure 4 we illustrate in which the commission is calculated as 3% of the first million of the sales price, plus 5% of that portion of the sales price between $1 million and $2 million, plus 10% of any portion of the sales price in excess of $2 million. In this example, the rate above the second kink will be referred to as "kink2". As noted in Table 1, 69.5% of the contracts in our sample have a flat commission structure, 23.7% exhibit a single-kinked commission, and 6.8% have commissions with more than one kink.

In order to demonstrate more clearly the degree of variation in the rates associated with the flat commission contracts, Figure 5 presents a kernel density estimate of the density of these rates using the data in our sample. While the flat commission rates in the sample vary from a minimum of 0.3% to a maximum of 6%, the rates are most heavily clustered in the 1-2% range, which is in notable contrast to the typical residential commission rate of 6%. Turning to the kinked commission agreements, Figure 6 provides a plot of the base rate and kink1, which is the rate that applies above the kink.[6] Noting for reference the 45-degree line, it is clear that the kinked contracts in the sample exhibit a convex structure in which the marginal commission is increasing in the sales price.

Another interesting aspect of the commercial brokerage agreements in our data, and another point of contrast with traditional residential contracts, is the relative absence of listing prices. So, for example, only 56% of the flat commission contracts have a selling price stipulated in the brokerage contract and, amongst the kinked contracts, only one-third have a formal listing price. This lends some credence to the notion that the owners are not particularly well-informed about the likely value of the properties that they are trying to sell.

It is also noteworthy that, of the single-kinked contracts having a formal listing price, in three of the cases the listing price and the kink coincide and that, in the others, the listing price is always higher than the kink by an average of 11.9%. Of the three two-kinked contracts having a listing price, in two of the cases the listing price is above the second (highest) kink, and in the third the listing price is between the two kinks. It appears that the sellers are trying to incentivize the brokers by placing the listing price in the portion of the contract with the higher marginal commissions.

[6]We have also included in Figure 6 the 8 contracts with multiple kinks and have in these cases plotted the base rate that applies before the first kink and the final rate that applies above the last kink. More precisely, and using the terminology we developed earlier, in a contract with n kinks, the plot is of the "base" and "kinkn".

# 5 Empirical Results

The commercial brokerage agreements described in the previous section provide a unique opportunity to test the predictions of the theoretical model. These contacts vary in the degree of convexity from none, as in the case of the flat commission agreements, to those structured to include highly convex kinked ("waterfall") commissions. Our goal in this section is to provide a test of Corollary 2, and we frame the hypothesis as follows.

*Brokerage Commission Hypothesis: A (convex) kinked contract is more likely as the difficulty to the broker of obtaining higher offers increases.*

In order to test this hypothesis, we need to identify a variable that may serve as a proxy for the difficulty of generating higher-priced offers. Using the addresses of the properties contained in the brokerage agreements, we are able to obtain from the CoStar data base information on the vacancy rates for similar properties located in the same geographic market as the properties in question. More precisely, we are able whether the property type is classified as an office, retail, industrial, multi-family, or flex, use and within the appropriate classification we are able to determine the average vacancy rate for such properties within a one-half mile radius of the subject property, which we use to construct the variable *Vacancy Rate*. In order to focus on the effect of the vacancy rate on the contract type selected, we calculate the vacancy rate for the calendar quarter preceding the quarter in which the brokerage agreement was signed.

The intuition is that the vacancy rate is a useful proxy to determine whether the market is "hot", so that demand is high relative to supply as evidenced by a low rate of vacancies, or whether the market is "cold", so that an excess of supply relative to demand generates a lot of empty units.[7] Our assumption is that an increase in the vacancy rate in the submarket occupied by the property would have the effect of shifting the distribution of potential offers to the left, indicating a lowered willingness to pay by potential buyers, which would increase the difficulty the broker faces in obtaining a higher-priced offer.

Table 2 presents an overview of the variables used in our analysis. Of the 118 contracts that we were able to match with the CoStar database, 31% have at least one kink and 69% are therefore flat commission agreements. In addition, 69% of the brokerage contracts deal with office complexes, 5% are retail establishments, 7% are industrial sites, and 16% are multi-family units.[8] In terms of the timing of the contracts, the majority of them were signed between 2003 and 2007 (83%), with the remainder spread out over the other years. Finally, the vacancy rates in the property submarkets occupied by the properties vary from 6% to 46%, with an average vacancy rate in the sample of 11.84%.

To test the brokerage compensation hypothesis, we examine the determinants of the occurrence of the waterfall agreements as a function of various factors. Specifically, we estimate a probit model of the form

$$Pr[Y = 1] = \Phi[\beta_0 + \beta_1 \, Property\, Type + \beta_2 \, Vacancy\ Rate + \epsilon] \tag{18}$$

in which the dependent variable, Y, is binary and takes on the value of 1 for a kinked

[7] This proxy has been utilized, for example, by Bar-Isaac and Gavazza (2015) in their recent study of residential brokerage agreements in Manhattan.

[8] CoStar defines the remaining property type, flex, as a 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.

commission contract and the value of 0 for a flat commission agreement. *Property Type* represents fixed effects for the various property types, and *Vacancy Rate* is a proxy for the difficulty facing the broker in securing higher-priced offers.

Table 3 presents the estimation results for several different model specifications. The most parsimonious specification is Model 1 in which the coefficient of *Vacancy Rate* is positive and significant at the 1% level, indicating that higher vacancy rates as associated with kinked commission structures. Model 2 adds the fixed effects for property types and, while the coefficients on these characteristics are not significant, the coefficient on *Vacancy Rate* remains positive and significant at the 1% level. Finally, Model 3 is estimated including fixed effects for both property type and the year in which the contract was signed, and the coefficient on *Vacancy Rate* remains positive and significant at the 1% level. These results are clearly consistent with the *Brokerage Commission Hypothesis*, and indicate a desire by those drafting the brokerage agreements to incentivize the broker to bear the cost of identifying higher-value purchasers when the market is soft.

# 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. Commercial real estate brokerage involves incentive-based contracts that vary, based on the nature of the property and overall market conditions, through the design of convex contracts.

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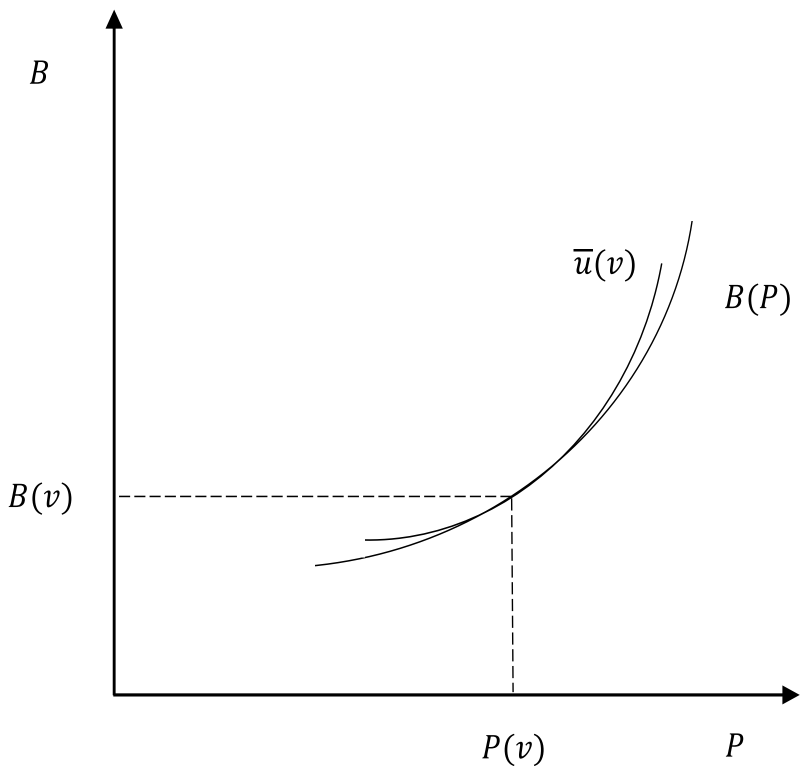
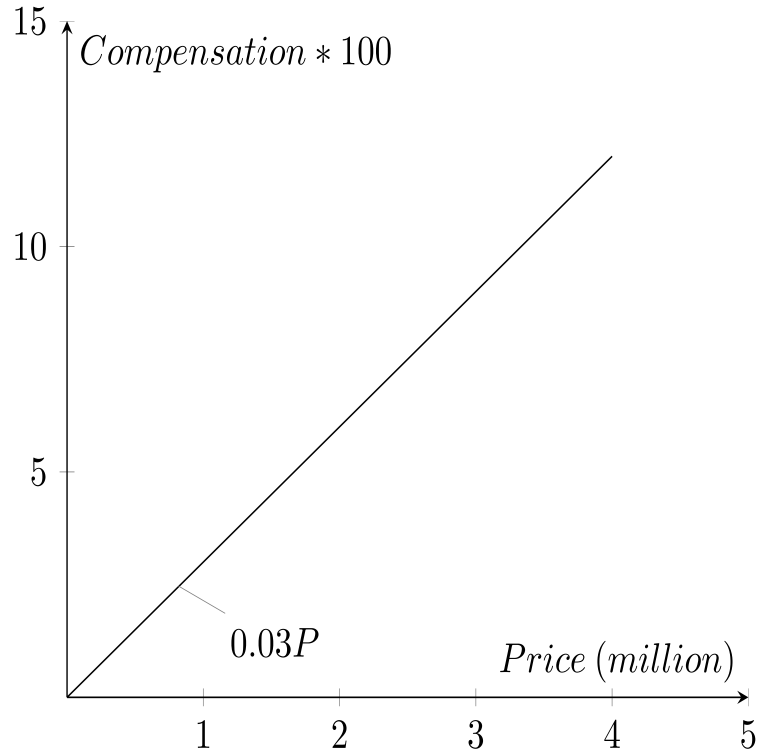
Figure 1: *Optimal Brokerage Contracts.*



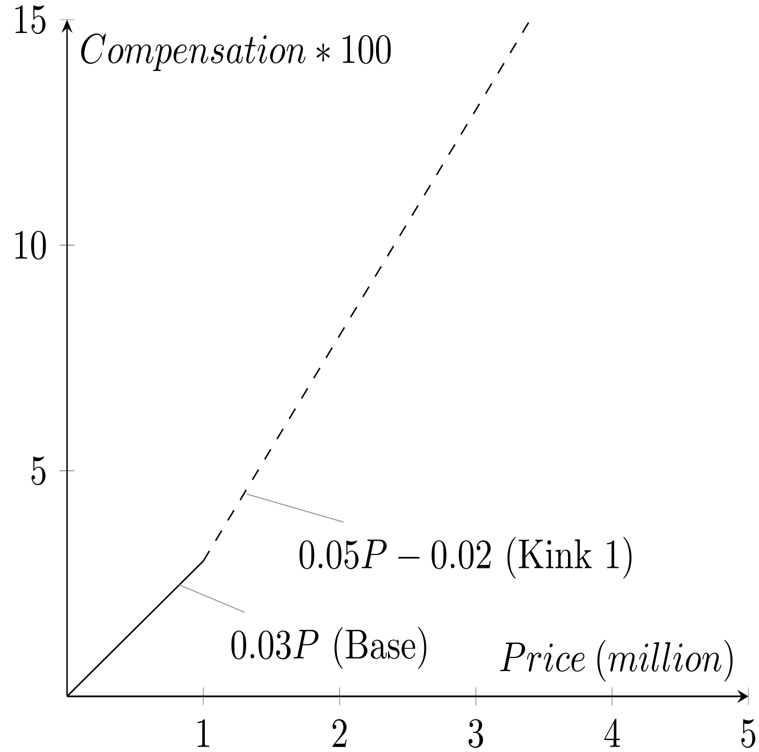

Note: This figure presents an illustration of the brokerage contract. The broker generates an offer at which the broker's indifference curve in $(B, P)$ space is tangent to $B(P)$. Given $B(P)$, the broker will generate the offer $P(v)$ and receive the associated commission $B(v)$.

Figure 2: *Constant Commission Rate Contracts.*



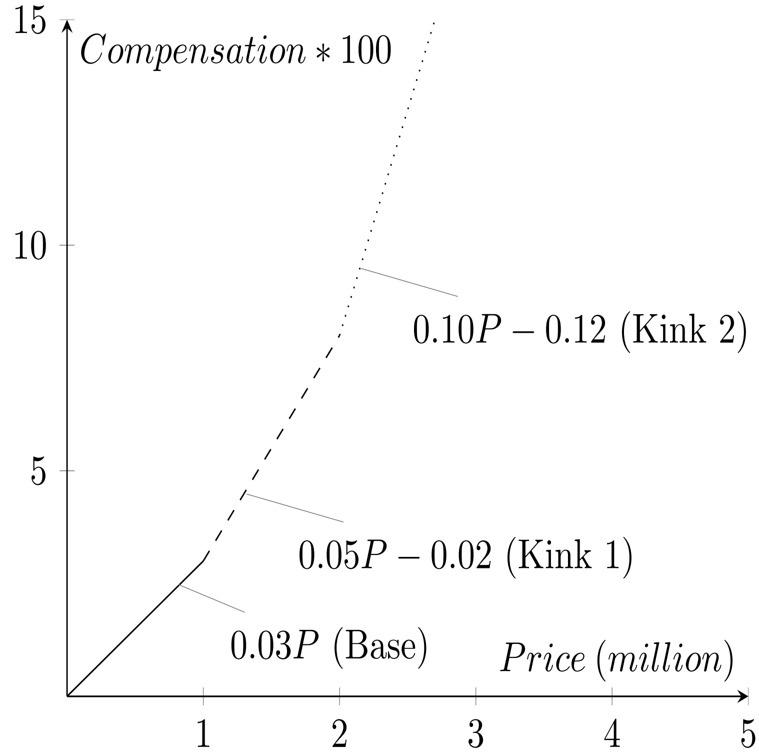

Note: This figure presents an example of a constant commission rate contract. The graph indicates a commission payoff of 3% for sale of the property.

Figure 3: *Single Kink Commission Rate Contracts.*



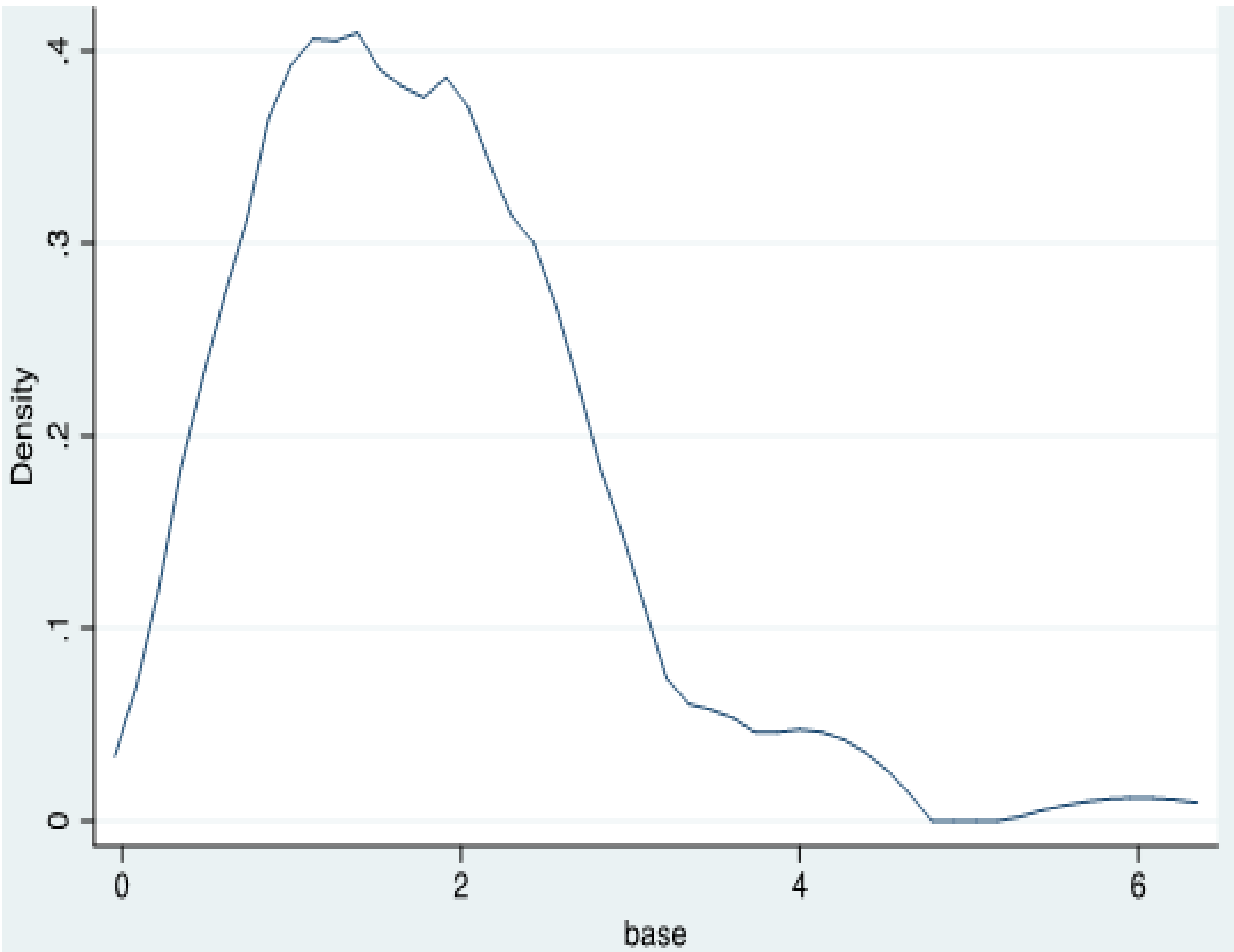

Note: This figure presents an example of a single kinked commission contract. The graph indicates a commission payoff of 3% for sale of the property up to $1 million, and 5% of the amount that exceeds $1 million.

Figure 4: *Two Kinked Commission Rate Contracts.*



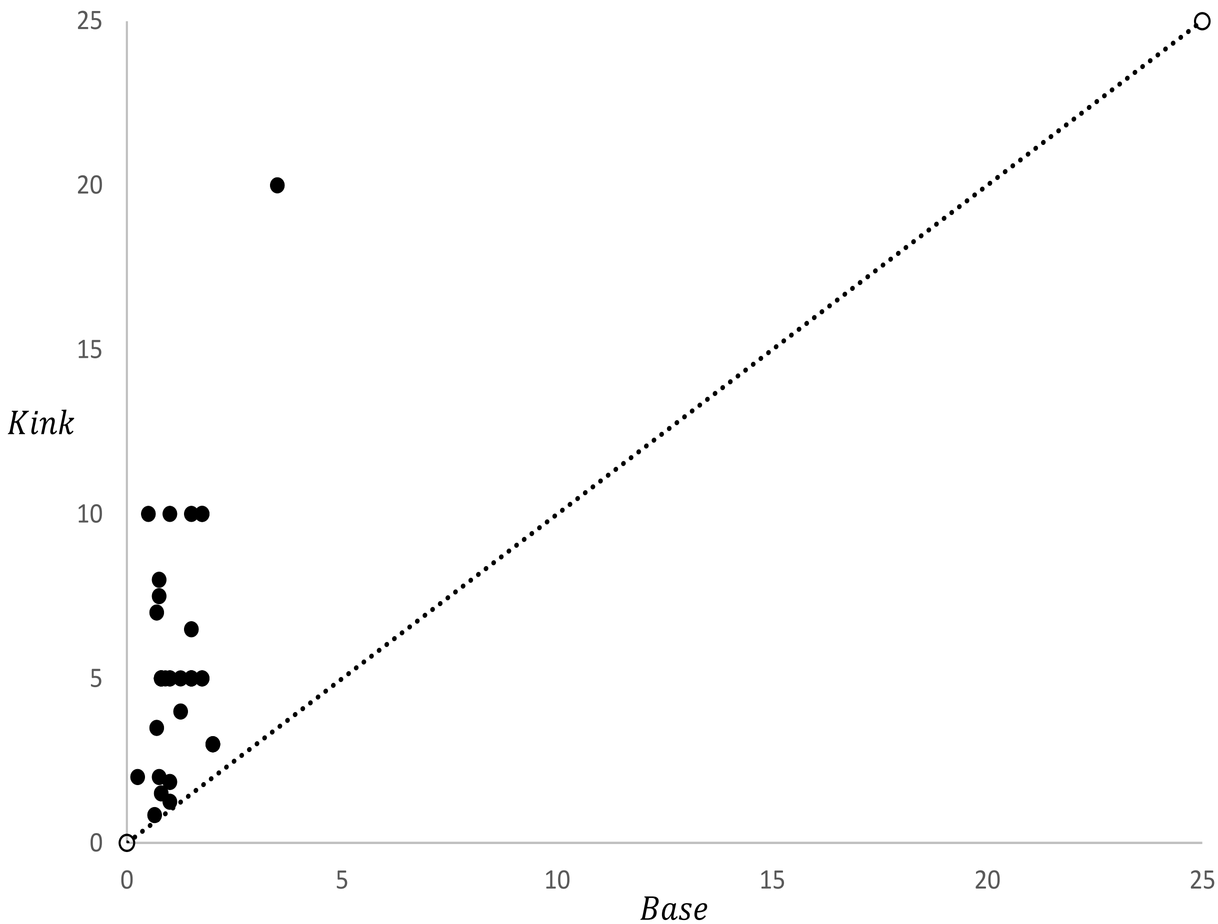

Note: This figure presents an example of a two kinked commission contract. The graph indicates a commission payoff of 3% for sale of the property up to \$1 million, 5% of the amount that exceeds \$1 million, and 10% of the amount that exceeds \$2 million.

Figure 5: *Kernel Density of Flat Commission Rate Contracts.*




Note: This figure presents the kernel density of flat commission contracts in the sample.

Figure 6: *Characterization of Base and Kinked Structure of Waterfall Style Contracts.*




Note: This figure plots the base and maximum kink for each of the kinked commission contracts.

Table 1: Distribution of brokerage contracts.

| Kinks | Frequency | Percent |
| --- | --- | --- |
| 0 | 82 | 69.5 |
| 1 | 28 | 23.7 |
| 2 or more | 8 | 6.8 |
| Total | 118 | 100 |

Note: This table presents the distribution of contracts across a flat rate, 1 kink, 2 kinks or more. The second column gives the counts, whereas the third column indicate the percentage across all the contracts.

Table 2: Summary Statistics of brokerage contracts based data.

| *Variable* | *N* | *Mean* | *Std. deviation* | *Median* | *Min* | *Max* |
|---|---|---|---|---|---|---|
| Kinked | 118 | 0.31 | 0.46 | 0.00 | 0.00 | 1.00 |
| Office | 118 | 0.69 | 0.46 | 1.00 | 0.00 | 1.00 |
| Retail | 118 | 0.05 | 0.22 | 0.00 | 0.00 | 1.00 |
| Industrial | 118 | 0.07 | 0.27 | 0.00 | 0.00 | 1.00 |
| Multi-Family | 118 | 0.16 | 0.37 | 0.00 | 0.00 | 1.00 |
| Flex | 118 | 0.02 | 0.16 | 0.00 | 0.00 | 1.00 |
| Vacancy Rate | 118 | 11.84 | 8.88 | 9.85 | 0.60 | 46.20 |
| Year 1997 | 118 | 0.0085 | 0.0921 | 0.0000 | 0.0000 | 1.0000 |
| Year 1998 | 118 | 0.0085 | 0.0920 | 0.0000 | 0.0000 | 1.0000 |
| Year 1999 | 118 | 0.0169 | 0.1296 | 0.0000 | 0.0000 | 1.0000 |
| Year 2001 | 118 | 0.0169 | 0.1296 | 0.0000 | 0.0000 | 1.0000 |
| Year 2002 | 118 | 0.0593 | 0.2372 | 0.0000 | 0.0000 | 1.0000 |
| Year 2003 | 118 | 0.1186 | 0.3247 | 0.0000 | 0.0000 | 1.0000 |
| Year 2004 | 118 | 0.0932 | 0.2920 | 0.0000 | 0.0000 | 1.0000 |
| Year 2005 | 118 | 0.1780 | 0.3441 | 0.0000 | 0.0000 | 1.0000 |
| Year 2006 | 118 | 0.2627 | 0.4420 | 0.0000 | 0.0000 | 1.0000 |
| Year 2007 | 118 | 0.1780 | 0.3841 | 0.0000 | 0.0000 | 1.0000 |
| Year 2008 | 118 | 0.0593 | 0.2372 | 0.0000 | 0.0000 | 1.0000 |

Note: This table presents the summary statistics of 118 brokerage contracts. These are depicted across contract types. Kinked is a binary indicator for kinked commission contracts. Similarly, Office, Retail, Industrial, Multi-Family, Flex are binary indicators for the property types. Vcanacy rate represents the vacancy rate of the sub-market of the property. Year indicators are characterized across the years 1997 to 2008.

Table 3: Variation of the level of convexity across kinked vs. constant commission rate brokerage contracts.

| | *Model 1* | *Model 2* | *Model 3* |
|---|---|---|---|
| Intercept | -1.09*** | -1.36** | -0.95 |
| | (0.22) | (0.65) | (0.81) |
| Vacancy | 0.05*** | 0.05*** | 0.05*** |
| | (0.01) | (0.01) | (0.01) |
| Flex | - | 0.65 | 1.28 |
| | | (0.98) | (1.12) |
| Industrial | - | 0.58 | 0.53 |
| | | (0.78) | (0.82) |
| Multi-family | - | 0.29 | 0.48 |
| | | (0.72) | (0.76) |
| Office | - | 0.22 | 0.29 |
| | | (0.66) | (0.68) |
| Year f.e. | - | - | Yes |

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 36 kinked and 82 constant commission rate contracts. Standard errors are noted in parenthesis. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.