Confronting Information Asymmetries: Evidence from Real Estate Markets*

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Abstract

There are relatively few direct tests of the economic effects of asymmetric information because of the difficulty in identifying exogenous information measures. We propose a novel exogenous measure of information based on the quality of property tax assessments in different regions and apply this to the U.S. commercial real estate market. We find strong evidence that information considerations are significant. Market participants resolve information asymmetries by purchasing nearby properties, trading properties with long income histories, and avoiding transactions with informed professional brokers. The evidence that the choice of financing is used to address information concerns is mixed and weak.

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Introduction

While a large and important theoretical literature on the importance of asymmetric information exists, there are relatively few empirical papers testing for its effects. One reason for this is the difficulty in identifying exogenous information measures in the economy. The empirical relevance of asymmetric information has been studied in the used car market (Genesove (1993) and Porter and Sattler (1999)), the labor market (Campbell and Kamlani (1997) and Landers, Rebitzer, and Taylor (1996)), the insurance market (Chiappori and Salanié (2000) and Finkelstein and Poterba (2002)) and the software contracting market (Banerjee and Duflo (2000)), among other settings. This paper studies the role of asymmetric information in the commercial real estate market by proposing a novel and exogenous measure of information based on the quality of property tax assessments.

Information considerations are likely to be important in real estate transactions. First, the market is highly illiquid and the price mechanism, therefore, is slow to convey information to market participants. Second, the assets (commercial properties and vacant land) are idiosyncratic and are, accordingly, difficult for outsiders to value. Indeed, this suggests that information considerations may be more important in the real estate market than in Akerlof's (1970) canonical example of the used car market. A 1998 used Honda Accord, to take a case in point, is a rather homogeneous and well-traded good compared to a distinctive office building in a recently gentrified neighborhood on the West Side of Chicago.[1]

Conversely, one may argue that information problems are not significant in this market; tangible real estate assets might be thought relatively easy to value and adverse selection may be alleviated through the use of hired appraisers. We find strong evidence, however, that information concerns are important in our study of commercial real estate markets in the U.S. Using direct and indirect information variables, we show that market participants mitigate information asymmetries by purchasing properties in nearby, rather than distant, locales, by trading properties with long income histories, and by avoiding trades with professional brokers, who are known to be informed. The evidence that the choice of financing is used to address information concerns is mixed and fairly weak. We also find little support for signaling theories that predict a link between sale price and financial structure.

We test several theories of asymmetric information. First, we consider the "no-trade" implications of Milgrom and Stokey (1982) who show that uninformed agents will not trade with informed counterparts. This should lead to limited market participation on the part of agents who are particularly informationally disadvantaged. If there is asymmetric information about local market conditions, then property buyers should, in general, be local and this tendency will be more pronounced when information asymmetries are severe. We find strong evidence that these two predictions hold. Likewise, uninformed buyers will focus on properties with long income histories that are easier to evaluate. This tendency will also be more pronounced when information concerns are heightened. We find evidence consistent with these predictions. Furthermore, if informed agents can be identified, then it is efficient for them to trade with other informed agents, rather than with the uninformed. This should lead to a form of market segmentation in which the informed and uninformed markets are to some degree distinguished. We find that informed brokers are likelier to sell to other informed brokers, particularly in environments where information asymmetries are severe. We argue that the proximity, selective offering, and market segmentation results clearly indicate that information asymmetries are important in this market.

In addition, we examine the effects of asymmetric information on the choice of financing. A central theme in the literature on capital structure is that the private information of insiders can have an important influence on the optimal financial organization of firms. The implications of asymmetric information for firm capital structure were studied by Myers and Majluf (1984), Myers (1984), Diamond (1991), Nachman and Noe (1994), DeMarzo and Duffie (1999), and others. We consider the implications of several adverse selection models and find only weak evidence that market participants use the form of financing to mitigate information problems in this market.

We characterize high- and low-information environments by exploiting exogenous differences in property assessment quality across regions. In the U.S. there are significant disparities in the quality of assessments across counties and local assessment jurisdictions. We exploit these exogenous differences to test whether they give rise to variation in the proximity of buyers, the types of properties brought to market, the extent of market segmentation, and the form of financing. Prior studies often employ indirect and possibly endogenous measures of information such as analyst coverage, firm size, and bid-ask spread. By employing *exogenous* variation in the information environment, we directly capture shifts in information quality.

Our data contain over 10,000 individual property transactions, providing us with substantial power. An additional advantage of using real estate data is that the financings are almost always nonrecourse.[2] Hence, the relevant information for financing decisions is information about the property itself. This is in marked contrast to many studies for which it is difficult to distinguish, for example, between information pertaining to assets in place and information pertaining to any one of many new projects.

Although the relevance of information considerations has proven difficult to document (e.g., Genesove (1993)), our tests provide compelling evidence on the importance of adverse selection in the commercial real estate market. The weak evidence we find for the importance of financing in resolving information issues is consistent with previous results in the corporate finance literature. Best and Best (1995), for instance, show that firms issuing equity have higher analyst forecast errors than firms issuing debt. If analyst forecast errors proxy for information asymmetries, then this finding is not consistent with the Myers pecking order hypothesis. Likewise, Helwege and Liang (1996) report that firms do not generally follow the pecking order in approaching the financial markets for funding. In their CFO survey, Graham and Harvey (2001) find that information considerations do not drive firms' security selections. Fama and French (2002) show that the least levered dividend nonpayers issue the most equity, inconsistent with the pecking order theory.[3]

Our results are also in harmony with the empirical literature on information signaling, which has not found much support in the data. Barclay and Smith (1995) find that signaling models do not explain cross-firm variation in corporate debt priority structure. Graham and Harvey (2001) report that the issuance of either debt or equity is motivated only very infrequently by signaling considerations.

The most supportive empirical evidence in favor of information theories has demonstrated their relevance to firms' *dynamic* capital structure. Shyam-Sunder and Myers (1999), for example, show that the funds flow deficit of firms is mainly financed by debt issues, which is consistent with the dynamic pecking order hypothesis. Fama and French (2002) find that the pecking order theory correctly predicts that historically more profitable firms have less leverage. Graham and Harvey (2001) provide evidence that firms issue new securities after the release of positive information. This timing strategy is adopted particularly by firms that do not pay dividends, firms that are likely to suffer from severe information asymmetries.[4] Given the static nature of our data, we cannot test the dynamic implications of security issuance timing or capital structure evolution.

In addition to making use of a new data set that is well-suited to testing information effects, this paper provides an analysis of the impact of asymmetric information on participation, selective offering, market segmentation, and financial choice that is novel in two respects. First, we are able to test directly some of the central implications of adverse selection models, using exogenous variation in the information environment, which few empirical papers have, as many of the predictions of information theory are abstract and difficult to test. Second, we examine property-specific financing and employ robust estimation techniques (that are consistent and asymptotically normal under rather general conditions) for both binary response and truncated regression models to gauge the impact information considerations have on capital structure. This provides a cleaner test of some of the implications of capital structure theory.

The rest of the paper is organized as follows. Section 1 outlines and discusses the theoretical hypotheses to be tested. Section 2 contains a discussion of our data set, highlighting the various forms of financing in real estate markets. Section 3 describes how we characterize exogenous variation in the information environment across regions and argues that property tax assessments provide informative signals. Section 4 details our empirical results. Finally, Section 5 concludes.

1. Theoretical Hypotheses

In this section we develop the hypotheses tested in this paper. These hypotheses are derived from empirical implications emerging from the theoretical literature on adverse selection.

In real estate markets, two broad types of asymmetric information can be distinguished. First, sellers are likely to possess superior information about current local market conditions; they are typically better informed about the economic and social dynamics in the area surrounding the property as well as local government regulations and environmental considerations that may affect property values in the neighborhood. Second, sellers will typically have more accurate information about the condition of the property itself. For example, they may be aware of possible deficiencies in the structure (this latter type of information applies more to buildings than to vacant land). In the analysis that follows, our focus is on the first type of information, the state of the local market.

Given the illiquidity and heterogeneity of commercial real estate transactions, valuing a property can be very difficult. Information about the performance of neighboring businesses and shifts in the local social dynamic is critical to a valuation. Such information may be acquired by locals, such as

the seller, in the course of time doing business in an area and through the collection of observations about a neighborhood. This information, however, is essentially inaccessible to those who do not work or reside in the area, such as distant buyers. Subtle alterations in the economic and social climate may have significant long-term implications for a district and may thus have a considerable effect on value. Although this information is in some sense public, it may be acquired only by long-term participation in and study of a neighborhood. Sellers who have operated, maintained, and monitored their properties will possess this information. Cursory surveys by outsider buyers are likely to be uninformative, especially since it is often the trend, and not the current state, of economic and social variables that is most important.

It may be argued that property brokers will act to ameliorate the buyer's informational disadvantage. We think this is unlikely for three reasons. First, brokers are quite active in this market as principals (in 6.9 percent of transactions, either the seller or the buyer is a broker acting on his own account). As a result, they essentially compete with their clients to purchase undervalued properties and are likely to retain the best opportunities for themselves. Second, brokers are typically compensated by a commission which is a percentage of the sale price, which gives them an incentive to encourage buyers to pay more for a property. Third, in many jurisdictions the buyer's broker is legally a sub-agent of the seller's broker and thus has a fiduciary responsibility to the seller, not the buyer. These three arguments strongly suggest that buyers cannot rely upon brokers to provide unbiased information. Furthermore, the first two considerations are also present for stockbrokers, and evidence suggests that stockbrokers do not help to reduce the information asymmetries faced by their clients (e.g., Easley, Kiefer, and O'Hara (1996) and Michaely and Womack (1999)).

Property appraisers are also not typically a source of valuable information. Appraisals are done fairly quickly and at low price. Information about local market conditions or income potential cannot be obtained in a hasty or perfunctory manner. Even if property inspections were capable of providing perfect information about the structural condition of the property, they are uninformative about *local market conditions*. An accurate evaluation of the latter would be of significant worth and would not be provided cheaply. In addition, the future income prospects of commercial properties depend on the future revenue from current clients, which the seller surely knows more about than an appraiser. Thus, the value-added of low-cost appraisals is not likely to be large.[5]

In the following subsections we consider the theoretical implications of the information structure described above. We identify high-asymmetric-information environments as those locations in which

sellers possess information about the value of their properties that is significantly more accurate than the information possessed by outsiders (including the buyer).

A. Limited Participation, Information Availability, and Market Segmentation

Models of adverse selection demonstrate that rational but uninformed agents will be reluctant to trade with informed counterparts (see, for example, Milgrom and Stokey (1982)). Our first prediction is that informationally disadvantaged agents will limit their participation in the real estate market. We presume that prospective buyers located far away from a property will be less knowledgeable about local market conditions. Their informational disadvantage will be further pronounced in high-asymmetric-information environments.

Prediction 1. *Property buyers are primarily drawn from nearby locales.*

Other theories would also suggest Prediction 1. If, for example, monitoring of tenants is important, then we would expect buyers to be local. Prediction 2, however, is a prediction of adverse selection models only.

Prediction 2. *The distances between buyers and properties are relatively shorter in high-asymmetric-information environments.*

Properties also vary in the amount of information available about their value and income potential. Less informed (distant) agents who might otherwise limit their participation in high-asymmetric-information environments, will choose to purchase properties with more information available. Properties with longer income and price histories provide uninformed buyers with more information than new properties and can mitigate the importance of the general information environment.

Prediction 3. *The effect in Prediction 2 will be particularly strong for properties with short income histories.*

Furthermore, properties with limited information available are less likely to be brought to market when information asymmetries are particularly severe.

Prediction 4. *Properties with short histories are less likely to be sold in high-asymmetric-information environments.*

Finally, market participants will be unwilling to trade with agents who are known to be particularly well-informed. Rather than deserting the market, as above, the less-informed may elect to participate by trading only with other less-informed agents. In equilibrium, the well-informed will prefer to sell to other well-informed agents rather than incur sizeable information costs in dealing with the less-informed. Commercial real estate brokers selling property on their own account may be regarded as identifiably well-informed traders.

Prediction 5. *Brokers selling property on their own account are more likely to sell to other brokers, particularly in high-asymmetric-information environments.*

B. Financial Structure

Information issues may also be mitigated by the appropriate design of the financial contract underlying the sale of the property. In this subsection we discuss the predictions of two models of capital structure in the presence of asymmetric information. As will be discussed in greater detail in Section 2, our data set specifies the following four types of financing for each commercial property. In our sample, we find financing provided by the seller, known as vendor-to-buyer (VTB) financing, and new mortgages provided by banks and other financial institutions. In some cases, the buyer assumes the existing mortgage on the property. Buyers pay cash for the portion of the sale price that is not financed in one of these ways. Most transactions involve a combination of these four types. The importance of finance to real estate activity is established by Hancock and Wilcox (1997).

Adverse Selection Model A: VTB and Bank Debt Substitution. This model presumes that the sale price is agreed upon prior to the arrangement of financing. The purchaser may then choose to seek financing from the seller or from a bank (or from some other financial institution). VTB financing and new mortgage financing possess very different characteristics from an information standpoint. VTB financing is provided by an investor who possesses superior information about the property; indeed, the seller almost certainly has greater familiarity with the property than the bank. As a result, financing provided by the seller will not be subject to the same information costs as financing provided by an outside investor such as a bank. (This describes a pecking order in financing as in Myers and Majluf (1984).) Sellers, however, generally face tighter liquidity constraints than banks. This generates a trade-off between the informational advantage of seller

finance and its diversification or liquidity costs. When information problems are severe, the seller's relative information advantage will be important, and the buyer will seek more financing from him. This yields our first prediction from this model.

Prediction A1. *Vendor-to-buyer financing is relatively more prevalent in high-asymmetric-information environments.*

When information problems are not severe, buyers should prefer to receive loans from well-capitalized banks rather than from liquidity-constrained sellers.

Prediction A2. *New bank financing is relatively less prevalent in high-asymmetric-information environments.*

Our data set details some transactions in which the buyer assumes the existing mortgage on the property. The data on assumed mortgages provides information on the *previous* financial structure that governed the allocation of the property's cash flows. When a seller sells a property with a large outstanding mortgage, he is in effect selling a highly levered equity claim on the property. Leveraged equity is subject to high asymmetric information costs. The purchaser, in seeking financing for a highly informationally-sensitive claim, will prefer to receive a loan from the well-informed seller. We refer to the leveraged equity claim as the seller's equity.

Prediction A3. *VTB loans are a larger proportion of the seller's equity when the existing mortgage is large.*

Adverse Selection Model B: Separating Signaling Model. In this model, the sale price and form of financing are determined simultaneously. This model is analogous to the DeMarzo and Duffie (1999) and Leland and Pyle (1977) separating signaling models which predict that sellers will retain a claim on the assets they bring to market in order to signal their quality. The retained claim perfectly signals to the market the seller's type. In these models the retained claim is an equity stake, but the retention of debt in the form of a VTB loan is an analogous transaction. In high-asymmetric-information environments, the value of the underlying assets will be more variable from the buyer's perspective. In several adverse selection models (e.g., DeMarzo and Duffie (1999)), this higher variation leads to higher average retention of equity on the part of sellers. The analogous prediction in this setting is given below.

Prediction B1. *Vendor-to-buyer financing is relatively more prevalent in high-asymmetric-information environments.*

If there is a large existing mortgage on the property, the residual seller's equity will be very risky. As a result, when information problems are grave, property owners with large mortgages should be reluctant to sell their stakes because of a severe information discount; the cost of signaling will be too high.

Prediction B2. *The sale of properties with large existing mortgages is relatively less common in high-asymmetric-information environments.*

Substantially leveraged equity claims marketed by the seller are likely to be very risky. The values of such claims will be highly variable across sellers. This higher variation will lead to greater retention.

Prediction B3. *VTB loans are a larger proportion of the seller's equity when the existing mortgage is large.*

Both models make similar predictions about financial choice. Predictions A1 and B1 are identical, as are Predictions A3 and B3. Predictions A2 and B2 differ and arise from the different assumptions made in the two models about the timing of the financing decision.

To better distinguish between the two models, we analyze whether financial choice affects the sale price of the property. Model A makes no prediction about financial design influencing the price, since prices are assumed to be set first under this model. Model B, however, claims that the seller's retained stake in the property is used as a signal of the property's quality.

Prediction B4. *The sale price of the property is positively related to the seller's retained stake in the property, particularly when information asymmetry is high.*

The next two sections describe our data and how we characterize the information environment to test these predictions.

2. Data

Our sample consists of approximately 18,700 commercial real estate transactions over a 42 month period across seven states: Nevada, Massachusetts, Maryland, Virginia, Texas, Illinois, and Colorado.[6] The data contain detailed financing information as well as a large set of buyer, seller, and property attributes.

A. The COMPS Database

The data source is from COMPS.com, a leading provider of commercial real estate sales data in the U.S. COMPS collects data on commercial real estate transactions by contacting buyers, sellers, and brokers, and then confirms their reports with each of these parties. The COMPS data are considered very accurate in the industry, and provide information on sale prices, income and expenses, financing data, property characteristics, and buyer, seller, and broker details. We are unaware of any sample selection issues materially affecting the data set.

There are 18,687 commercial real estate transactions from the COMPS database that occurred between January 1, 1996 and March 30, 1999. Of these, 10,351 met our initial data requirements (i.e., recorded sale price, financing data, identities of principals, and property location). Defining the financial center or "city" as the largest city or cities (including suburbs) in each state,[7] Table 1 reports that slightly more than half of all transactions occur in the major cities of each state.

Table 1 Panel A reports summary statistics on the COMPS database. Buyers are on average 232 km away from the property, while sellers are located more than 264 km away.[8] We group properties into three mutually exclusive types: apartments (defined as multi-family dwellings, apartment complexes, condominiums, and townhouses), vacant land, and commercial and industrial buildings. These broad classifications correspond to those used by local government assessment offices for conducting studies on the accuracy of their assessments, which is the basis of our instrument for information, discussed further in the next section. We further identify properties with planned imminent development by assuming that purchasing development firms plan to develop the property in the near future. We also presume that properties that are zoned "PUD" (planned unit development) are scheduled for immediate development.[9] These comprise almost 7 percent of all transactions in the sample.

Panel B of Table 1 contains information about pricing and property financing. The average sale price is almost $2.8 million, ranging from $20,000 to $734 million with a median price of $656,000. Forty-two of the transactions involve Real Estate Investment Trusts, which is consistent with the relatively small number of very large transactions in this market. Four types of financing appear in the data. Buyers either use cash, receive vendor-to-buyer (VTB) debt financing, assume an existing mortgage on the property, or obtain a new mortgage from a bank. In many cases, some combination of these financing types is used. While generally little equity financing is used in real

estate transactions in general, COMPS does not track the presence of equity and essentially treats it as cash. This grouping together of retained cash and outside equity complicates the evaluation of the effects of asymmetric information on financing choice, since the information costs associated with issuing equity are high, while the use of retained cash carries the lowest information costs. Consequently, our tests focus exclusively on tradeoffs between the three other types of financing, as discussed in Section 1.

B. Vendor-To-Buyer Financing

Perhaps one of the more interesting features of the commercial real estate market is the extent of Vendor-to-buyer (VTB) financing. VTB is used in 13 percent of transactions, and comprises over 62 percent of the purchase price when used.[10] The mere presence of VTB raises questions about the influence of information asymmetries on financing choice. Seller debt financing is somewhat hard to rationalize under an asymmetric information framework. The seller is better informed than either the buyer or the bank about the property, so he should be expected to take the riskiest position in the property rather than the less risky debt claim. One typical rationale for seller financing might be the seller's need for liquidity, if seller financing speeds up the sale. The seller, however, would be better off obtaining a mortgage from the bank and retaining equity in the property. This would allow him to alleviate his liquidity concerns while continuing to hold an informationally efficient stake. If the owner wishes to sell the property for other reasons and information asymmetries are important, then uninformed buyers should first acquire a relatively safe debt contract (mortgage) on the property. In only 0.8 percent of transactions in our databases did the purchaser previously hold a mortgage on the property.[11] By contrast, when buyers purchase a property and obtain VTB financing, they are first acquiring the most informationally sensitive claim and only later do they acquire the safe debt claim. This is difficult to explain in an asymmetric information framework. Because of this, and since equity stakes by sellers are not observed in the data, it may be difficult to extend the financing results to other areas outside of commercial real estate.

We do find, however, that VTB loans are typically junior to bank loans, which is consistent with information theory. We have some limited information on the priority of loans. Some properties have both a first and second trust deed and specify the type of financing used in each trust. A second trust deed is like a second mortgage and has lower priority claim on the real asset. VTB financing more typically shows up in second trusts. We find that conditional on a first trust being

present, VTB loans comprise only 20.72% of first trusts while new bank loans comprise 72.94%. Conversely, when a second trust is present, VTB loans comprise 61.52% of second trusts, while bank loans comprise only 22.06%. Moreover, when VTB is used as the first trust, 96.27% of the time there is no bank debt present at all. This signifies that VTB is typically junior to bank debt and less preferred by buyers. We will make use of loan priority for some of our tests.

Finally, one can argue that if liquidity is motivating the sale, then at least some form of vendor financing provides a signal of property quality to buyers. Although the seller should take the riskiest position, by providing VTB financing he is retaining at least some claim on the property, which should mitigate information problems. If this is the case, then the extent of VTB financing will vary with the information environment as predicted in Section 1.[12]

3. Characterizing the Information Environment

Since the aim of this study is to examine the influence of asymmetric information in the real estate market, we must clearly characterize the information environment.

A. Indirect Information Variables

We begin with several indirect measures of information asymmetry commonly used in the literature. We argue that buyers located closer to a property likely have a better understanding of local market conditions and can more easily and cheaply evaluate the property. The distance between the buyer and the property is used as a measure of the degree of information asymmetry. Many studies employ distance in a similar fashion (see Lerner (1995) and Coval and Moskowitz (1999, 2001)).

In addition, we consider the age of the property. Properties with longer income and price histories provide investors with more information about the property and the local real estate market. This is consistent with many studies that employ the age of the firm as a measure of the degree of information asymmetry associated with the firm (see Pagano, Panetta, and Zingales (1998)). Finally, our data also contain information on whether the buyer or seller is a professional broker. Since brokers are both well-informed and identifiable, we examine whether these agents predominantly trade with each other; this provides a measure of market segmentation.

B. Informative Signals: Property Tax Assessments

In addition to the indirect variables previously discussed, we employ a direct measure of information asymmetry using exogenous differences in the quality of property tax assessments. We argue that property tax assessments provide useful and accurate information about the value of real estate. This fact is widely recognized and utilized by practitioners, but is less well-known in the academic literature. Government assessments of real estate property value are conducted for the purposes of assessing property taxes. These assessed values (which are determined by various pricing models, comparison to similar properties, and site visits) are publicly available, and measures of their accuracy (relative to market value) are publicly reported. Our study makes use of the fact that these assessments vary widely in their quality across regions.

Assessments provide useful information about the value of surrounding properties. While it is the case that buyers and sellers often hire their own private appraisers to value the properties, as discussed earlier these appraisals are not always informative. Moreover, we emphasize that government assessments need not be "better" than private appraisals, but merely convey some additional information that may not be fully captured by a private appraisal. This information could be about local market conditions, about surrounding properties, or even about the property itself. As long as some additional piece of information provided by government assessments is obtained, these assessments will be useful to market participants. We surveyed nearly a dozen private appraisers across the U.S., and found that many of them acknowledged making use of public assessments. In addition, real estate brokers we have spoken with explain that they pay attention to government property assessments, often using them as a benchmark for property value. Most importantly, as we will discuss, public assessments in certain regions reflect market prices very accurately.

B.1 The Quality of Government Assessments Across Regions

Assessment practices and quality differ across states, counties, and even towns. Most states perform the assessing function at the county level, while some assess at the city or town level. In order to gauge the quality of these assessments, most states perform "ratio studies" periodically. These studies compare market values of properties recently sold to their *prior* assessed values.[13] The assessment ratio of a property is defined as the ratio of assessed value to market value. The ratio study then examines the central tendency and variation of these ratios within an assessing

jurisdiction.

The two most popular measures are the median (for central tendency) and the coefficient of dispersion (COD) around the median, defined as

$$COD = \frac{\frac{1}{N}\sum_{i=1}^{N}|R_i - R^{med}|}{R^{med}} \times 100 \quad (1)$$

where N is the number of properties, R_i is the assessment-to-market value ratio for property i, and R^{med} is the median of these ratios.

For our purposes in characterizing the information environment, we are interested in the variation of assessment ratios, not their central tendency. For example, if properties in Cook county, Illinois are uniformly assessed at 50% of market value, this is equally as informative as if they had been assessed at 100% of value, since market participants can precisely extract market prices from assessed values.

We employ the COD measure reported for each state, county, or town to characterize the informativeness of a region's assessments. We obtained the 1998 and 1999 property assessment ratio studies for each state, which report the COD measure for all assessment jurisdictions within the state. If these were not available, then we used the most recent ratio study we could find.[14] Ratio studies evaluate assessments that are made in the previous year, and hence that are available to buyers *before* the sale occurs in our database. We employ the COD measure corresponding to commercial property type (i.e., land, apartments, and commercial and industrial buildings). When the COD is large, the free public assessments are less useful and information asymmetries about local market conditions are likely to be more severe.

The last two columns of Panel A of Table 1 report the mean and standard deviation of COD across the entire sample and for several subsamples. Since COD measures are only provided for each property type within each assessing jurisdiction, we assign the COD of each jurisdiction and property type to each property that falls into this group. Hence, all apartment buildings in Chicago receive the same COD. As the table indicates, the mean COD across all properties is under 30 percent, indicating that assessments in general are of fair quality. There is, however, substantial variation in COD measures, ranging from 0.79% to over 128%. We sort all properties with assigned CODs into two groups: those below the median measure ($COD \leq 13.31$) (Low COD) and those above (High COD).

In the next section, we demonstrate that the COD is useful for characterizing the information environment (controlling for potentially confounding effects). Using the COD variable, we then examine how information asymmetries are resolved in the commercial real estate market by analyzing the relationship between our information proxies and limited participation, selective offering, market segmentation, and financial structure.

4. How Are Information Asymmetries Resolved in this Market?

We investigate the hypotheses described in Section 1 by applying robust semiparametric estimation schemes to the data. We begin by focusing on the limited participation, selective offering, and market segmentation theories, and then shift attention to property financing. In addition, we offer more direct evidence on the usefulness of the COD as a measure of information asymmetry. For reference, Table 6 provides a summary of the information theory predictions from Section 1.

A. Limited Participation, Selective Offering, and Market Segmentation

A.1 Limited Participation

Our first set of predictions from information theory is that less informed agents will limit their participation in the market. We employ the buyer's distance from the property (in km) as a proxy for the degree to which he is informationally disadvantaged. Buyer distance is used as the relevant dependent variable to test the first three predictions of Section 1 on limited participation.

Prediction 1 states that market participants will predominantly reside near the property. (See Dolde and Tirtiroglu (1997) for a study of spatial information diffusion in real estate.) The median distance between buyers and properties is a mere 47 km. The extreme proximity of market participants provides support for Prediction 1, indicating that limited participation is used in the real estate market to address information concerns.

Although there are several theories that would predict a highly localized market in commercial real estate, Prediction 2, which states that the distance between buyers and properties should also decline when information asymmetries are high, is an implication of information theory alone. If the COD measure captures exogenous variation in the degree of information asymmetry, then buyers should be closer to their properties in high COD regions, where property assessment quality is poor. To test this conjecture, we regress the distance between buyers and properties on a set of control variables and two direct measures of exogenous information, COD and HighCOD. The

former is the continuous COD measure and the latter is a dummy variable equal to one for all properties with associated COD measures above the median (13.31). The control variables include city, land, apartment, and planned development dummies, as well as the age of the property and the log and squared log of the sale price. Since it may be argued that COD will vary with local property heterogeneity and recent sales growth, we also control for these factors in our analysis. We include a measure of the price variability in the locale in which the property resides, calculated as the standard deviation of commercial property capitalization rates (net income on the property divided by sale price) within a 10 mile radius, excluding the property itself. This variable, σ_{local}, measures the variability of the income-price ratio within a local area, reflecting property quality heterogeneity, perhaps driven by recent price growth. As a direct measure of price growth, we also employ the average growth rate on the index of all housing sales within each Municipal Statistical Area (MSA) over the 1996 to 1999 period, provided by Fannie Mae and Freddie Mac. Finally, as an additional control, we employ the median age of primary housing stock in each census tract, provided by the U.S. Census Bureau.[15] Each property is identified with its MSA and census tract via its latitude and longitude coordinates.

All regressions are estimated via ordinary least squares (OLS) with White (1982)-consistent robust standard errors that assume group-wise clustering at the level at which COD is measured (i.e., by assessment jurisdiction and property type). As Table 2 reports, there is a strong negative relation between COD and buyer distance, consistent with Prediction 2. A one standard deviation increase in COD brings buyers more than 70 km closer to properties. Using the HighCOD dummy, buyers in high COD regions are located more than 90 km closer to their properties than buyers in low COD environments. Since the mean distance between buyers and properties over the whole sample is only 232 km, this local bias result is quite striking.

Prediction 3 further states that the proximity effect of COD will be strongest for young properties. The dearth of historical income and price data for these properties makes them particularly difficult to evaluate in high COD jurisdictions. While information problems relating to the internal structure of a building may become more severe over time, these problems are orthogonal to the local market condition information provided by an assessment. Careful assessments are helpful in valuing buildings without significant historical data, but they do not provide much information about potential structural deficiencies in a building. The difference between evaluating buildings in high and low COD environments should therefore be smaller for older buildings. Older buildings

in both high and low COD regions will be subject to similar degrees of building-specific uncertainty and local-market-condition uncertainty. Young buildings in both regions will be subject to a similar extent of building-specific uncertainty, but local-market-condition information asymmetries should be more severe in high COD jurisdictions. The distance effect of COD should therefore be particularly strong for recently-built properties.

Interacting the COD measure with the property's age (excluding all vacant land deals since no land has an age greater than zero), the last three columns of Table 2 show that the relation between COD and buyer distance is muted for older properties and magnified for younger ones, consistent with Prediction 3. Buyers can afford to be distant when long income histories are available, whereas proximity becomes particularly important in high COD areas when income histories are short.

The variation in COD is largely inter-state since it mainly arises from differences in state assessment practices. Hence, we cannot employ state fixed effects in our regression as this removes most of the variation in COD. A Hausman (1978) specification test demonstrates that the random effects model we employ is not rejected in favor of a fixed effects model. The p-value from the Hausman test is 0.43.

Table 1 indicates that the state of Illinois has both the smallest buyer distance and largest COD, and comprises nearly 40% of our sample. We note that Illinois also has a reputation for corruption. One alternate explanation for the negative relation between COD and buyer distance is that out-of-state buyers know that their tax assessment will be unfairly manipulated in Illinois and that they therefore avoid the state. We now consider only the properties outside of Illinois. The COD measures are significantly lower in these states, and they have less of a reputation for corruption, so this issue is less salient. Long-distance buyers are unlikely to be discouraged by the prospect of slightly worse property tax treatment, given that property taxes are only a small portion of asset value. Table 2 demonstrates that the COD and buyer distance result is robust to the exclusion of Illinois properties.

A different concern is that some non-COD state level effects may be driving the result. To control for this, we look for a state with enough intra-state variation in COD and large enough sample size to run our tests. Illinois is the only state that satisfies these requirements. Restricting the analysis to within a single state greatly reduces the predictive ability of COD. Furthermore, it should be noted that Illinois has the most volatile CODs across its jurisdictions and hence potentially the most error in measured COD, making it the state least likely to exhibit significant findings. Despite

these problems, Table 2 shows that the explanatory power of COD is remarkably robust, whether using a continuous COD measure or the dummy variable HighCOD.[16] Even within Illinois, a state with poor assessment quality, and accounting for property type and local price variance, there is a strong negative relation between buyer distance and COD. Moreover, the interaction term between COD and property age is positive for all three samples and statistically significant for the whole sample and within Illinois. These results reaffirm our previous findings despite the fact that we eliminate a significant portion of the variation in COD, making a compelling testament for COD as a useful measure of information asymmetry.

A.2 Selective Offering

Prediction 4 states that properties with relatively longer income histories will be brought to market when information asymmetries are high. The average age of properties sold in high-asymmetric-information environments should thus be higher. To test this, we regress the property's age on COD,[17] and the control variables above. The median age of housing stock in each census tract controls for the unconditional age distribution of properties in the area, since the COMPS data set contains only properties that were sold in an area. Once again, we run regressions over all properties, excluding Illinois, and within Illinois. Across all states, excluding Illinois, and within Illinois, Panel A of Table 3 demonstrates a large positive relation between age and COD, consistent with Prediction 4, and further bolstering COD as an exogenous information variable.

A.3 Market Segmentation

Finally, we examine the market segmentation hypotheses. Prediction 5 states that when brokers trade on their own account, they will likely be forced to trade with other informed brokers. We test this conjecture by determining whether the probability that the buyer is a broker increases when the seller is a broker. The dependent variable in this binary response model is one if the buyer is a broker and zero otherwise. The regressors include the control variables above, the COD, buyer distance, a dummy variable indicating if the seller is a broker, and an interaction between COD and whether the seller is a broker. The regression is estimated via logit as well as Klein and Spady's (1993) robust semiparametric binary response model, which allows the distibution of the error term to be unspecified. The coefficient on $log(Price)$ is set to -1 for scale normalization in the Klein and Spady regression, which is required by this model.[18] Panel B of Table 3 reports the results

from these regressions. Combining the coefficients on Seller is a Broker and its interaction with COD, there is a significant and positive relation between sellers who are brokers and buyers who are brokers. That is, brokers are more likely to sell to other brokers. The tendency for brokers to trade with other brokers is also evident when we exclude Illinois or look only within Illinois. This is strong evidence in support of Prediction 5. Note that the Klein and Spady and logit models produce qualitatively similar results, hence we report only the logit results in subsequent regressions.[19]

Prediction 5 further argues that the segmentation of well-informed agents (e.g., brokers) should be particularly evident in high-asymmetric-information environments. The interaction term between COD and Seller-is-a-broker is positive and highly significant in the full sample regression and when Illinois is excluded, suggesting that brokers tend to trade with other brokers much more in high-asymmetric information environments. (Within Illinois, however, the interaction term is essentially zero.) These findings are consistent with Prediction 5 and lend credence to the COD variable as a measure of information asymmetry. Well-informed agents appear to be segmented from the market in order to mitigate information concerns, particularly when assessment quality (information asymmetry) is low (high).

Table 6 summarizes the empirical predictions of information theory on limited participation, selective offering, and market segmentation and their verification in the data. The results suggest information asymmetries are important in the real estate market and that COD is a useful, exogenous variable that captures the degree of information asymmetry in this market.

B. Does Financial Structure Mitigate Information Asymmetry?

We now consider whether financing decisions are also used to mitigate information problems. We examine the influence of our information variables on the frequency and magnitude of various forms of financing using robust estimation methods. The financing variables that serve as dependent variables in our regression models are nonnegative; buyers do not, for example, take out mortgages in a negative amount. Our data are also severely censored; in many cases more than 80 percent of a financing variable's data points have a value of zero. Ordinary least squares is inappropriate for data censored in this way and adjusted estimators must be used. One solution is to apply the maximum likelihood tobit model to the data. This would, however, obscure the influence of our information variables on the frequency and magnitude of the form of financing. This is important because information theory can have different implications for the probability of a financial instrument

being used and its size (fraction of value) when it is used. Therefore, we separate these two aspects of the data. In addition, tobit estimators are not robust to an incorrect specification of the distribution of the error.[20] We analyze the censored financing data in two distinct ways: a binary response model (logit) and the truncated regression model of Powell (1986).

B.1 Seller (VTB) Financing

To test the first set of financial predictions from Section 1, we examine the extent of seller financing and its association with our information measures. Predictions A1 (VTB and bank debt substitution) and B1 (separating signaling equilibrium) predict more VTB financing when information asymmetries are high. To test these hypotheses, we regress the extent of VTB financing on the direct information variable COD as well as the indirect information variables (buyer distance, age, and whether the seller is a broker) controlling for all of the previous property and location effects above. The first column of Panel A reports results under the binary response logit model, where the dependent variable is one if VTB financing is used (and zero otherwise). States that recognize land trusts (i.e., Illinois and Virginia) are excluded from this regression since they understate the frequency of VTB financing, often misreporting it as bank financing. Standard errors on the coefficient estimates are calculated via maximum likelihood.

As Table 4 documents, there is a positive relation between COD and the frequency of VTB financing, which is marginally significant at the 10% level (t-statistic = 1.69). This is weakly consistent with information theory. There is either no relation or a perverse relation, however, between the presence of VTB and buyer distance, property age, and whether the seller is a broker, contradicting the information hypotheses.

Panel B of Table 4 reports the results from Powell's (1986) truncated regression. Here, we first truncate the data to only those property sales which employ VTB financing. The dependent variable is the magnitude of VTB financing as a fraction of the sale price. Standard errors are computed via bootstrapping to account for cross-correlations and heteroscedasticity of the error terms. Since recognition of land trusts only affects whether the loan is recorded properly as coming from the seller, it has no impact on the size of the loan. In other words, if a loan is recorded as VTB, the magnitude of the loan is reported correctly. Therefore, we *do not* exclude land trust states from this regression. As the first column of Panel B shows, there is no relation between COD and the size of VTB financing. In addition, none of the indirect information variables has a

positive influence on the size of seller financing.

B.2 Bank Financing

Prediction A.2 states that there will be less bank financing (new mortgages) when information asymmetry is high. To test this, we repeat the previous regressions using the probability and size of new mortgages as the dependent variable.[21] Panel A documents no relation between the frequency of new mortgage financing and COD or any of the indirect information proxies. Panel B demonstrates that COD has a positive effect on the size of new bank mortgages, which is opposite to that predicted by theory, and none of the indirect information variables seem to affect the size of new bank loans. These results suggest that investors are not substituting between seller and bank financing in order to mitigate information asymmetries.[22]

Likewise, Prediction B2, which states that the sale of properties with large existing bank mortgages will be less prevalent when information asymmetries are high, is not supported by the data.[23] In addition, we examine the relation between the seller's retained stake in the property and the size of the existing mortgage (Predictions A.3 and B.3). This test does not rely on the COD or any of the indirect information variables. Rather, we add the size of the assumed/existing mortgage, scaled by sale price, as an additional regressor to the binary response model. Here, we first truncate the sample to only those transactions for which an assumed mortgage exists (excluding land trust states), in order to examine only those sales for which we have information about the previous financing structure. As the third column of Panel A indicates, there is a negative but insignificant relation between the frequency of VTB financing and the magnitude of the previous mortgage assumed by the buyer. This is opposite in sign to that predicted by theory.

B.3 Second Trust Deeds and Vendor-Only Financing

Since VTB loans tend to be junior to bank debt, we also examine the presence and magnitude of VTB debt conditional on a second trust being present. The second to last columns of Panels A and B report the binary response and truncated regression results of the extent of VTB financing among all second trust deeds. As the table indicates, neither the presence nor size of VTB financing in the second trust is associated with COD. In addition, none of the indirect information proxies exhibit coefficients consistent with information theory.

The last column of each panel examines the set of deals where *only* seller financing is present (i.e., no bank debt). These are the deals where, presumably, information problems are most grave. As Panel A indicates, COD has a significantly positive effect on the presence of vendor only financing, consistent with an information story. Both buyer distance and property age, however, have coefficients of opposite sign to those predicted by theory. In Panel B neither COD nor buyer distance has an effect on the size of vendor only financing, but the broker coefficient is mildly consistent with mitigating information concerns. Thus, the financing results are a bit stronger when examining seller only financing, but the general evidence for financial structure mitigating information asymmetries is ambiguous at best.

C. Do Financial Decisions Influence the Price?

Finally, since both adverse selection models (Model A: VTB and bank debt substitution and Model B: Separating signaling) make similar predictions with regard to financial structure, to distinguish between them and to examine an additional implication of information theory, we assess whether the choice of financing influences the sale price. Model A assumes that the price is taken as given and then the form of financing is chosen. Model B assumes that the price and financial decision are determined simultaneously, and predicts that the price will be positively related to the seller's retained stake when the buyer faces an information disadvantage (Prediction B4).[24] To test this prediction, we regress the capitalization rate of the property, defined as net income on the property divided by the sale price, on the presence of a seller's retained stake in the property (a dummy variable equal to one if seller financing is present) and the previous controls. Since price is in the denominator, Prediction B4 predicts a negative relation between capitalization rate and the presence of a seller claim. Table 5 reports results from this OLS regression, where standard errors are White-corrected and assume group-wise clustering at the level of COD. There is no significant relation between VTB financing and capitalization rates.

Since the relation between VTB financing and price should be more evident when information asymmetries are high, we interact the seller's stake with COD, but similarly find no significant relation. Moreover, we repeat this regression for the most distant half of buyers and for the youngest (less than 5 years of income history) properties, since these are the properties with the most severe information issues. As the last two columns of Table 5 attest, however, there is no significant relation between the seller's stake and price, even among properties with the largest a

priori information problems.

Table 6 summarizes the theoretical predictions of information theory for financial structure and their verification in the data. Accumulating the results, we find mixed and fairly weak evidence of information asymmetries affecting financial structure in this market. Given the documented severity of information problems in the real estate market (evidenced by our results on limited participation, selective offering, and market segmentation) and the extensive theoretical literature devoted to resolving information problems through financial structure, it is interesting that asymmetric information does not play a larger role in real estate firm financial decisions.

The finance literature has generally found little support either for static pecking order theories (Helwege and Liang (1996), Graham and Harvey (2001), and Fama and French (2002)) or for signaling theories (Barclay and Smith (1995) and Graham and Harvey (2001)), which is consistent with our results. The timing of financing decisions and the evolution of capital structure, however, may be more affected by information considerations than the static choices we can analyze with our data. The relevance of asymmetric information to dynamic capital structure in this market remains an open question.

5. Conclusion

This paper examines the importance of asymmetric information in commercial real estate markets in the U.S. Using indirect information variables and exogenous variation in the quality of property tax assessments to characterize high- and low-asymmetric-information environments, we find strong evidence that asymmetric information is significant in the commercial property market. Not all the mechanisms suggested by theory, however, are used to resolve these information issues. We observe striking and clear evidence of limited participation, selective offering, and market segmentation. We find weak evidence that financial structure is used to allay information concerns. In effect, we find that in equilibrium, informed agents trade with each other, avoid trade with identifiable experts, and avoid selling properties that are particularly difficult to evaluate. In this context, signaling using financial structure is superfluous and is typically not employed. Our approach differs from that of earlier empirical work in that we conduct direct tests of some of the fundamental implications of information theory using a novel and exogenous information measure based on the quality of property tax assessments.

This paper shows that in responding to information disparities, economic agents first take direct action by not purchasing assets about which they are uninformed, focusing on assets that are easier to evaluate, and avoiding trades with the identifiably informed. The optimal choice of securities is used rather sparingly, though our data cannot test whether information considerations may have a more important effect on the timing and dynamic evolution of financial structure. Extending these results suggests that one might be cautious about regarding static financial structure choices as a device for minimizing information asymmetries, as this seems second order to limited participation, selective offering, and market segmentation.

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Footnotes

[1]Models of real estate pricing quite typically make reference to the severe information problems in this market (e.g., Downs and Guner (1999) and Ling and Ryngaert (1997)).

[2]Nonrecourse loans are guaranteed only against the property and not against other personal assets of the borrower. Stein (1997) discusses the pervasiveness of nonrecourse loans in commercial real estate.

[3]The indirect evidence (using information proxies) on the importance of information considerations for capital structure choice is generally more supportive. See, for example, Titman and Wessels (1988), Rajan and Zingales (1995), and Korajczyk, Lucas, and McDonald (1991).

[4]Baker and Wurgler (2000) also provide evidence that managers time equity and debt issuance, though they interpret their results as favoring a theory of market inefficiency.

[5]Many appraisals are performed simply to satisfy legal or regulatory requirements and they are not particularly informative. Similarly, property inspections are also fairly superficial and inexpensive. They may provide some information about the idiosyncratic state of the property, but are unlikely to give an indication of whether the property's price reflects local market values.

[6]In addition, COMPS contains 10,745 real estate sales from California over the period January 1, 1992 to March 30, 1999. At the suggestion of a referee, we have dropped these data from our sample because California does not conduct the assessment ratio studies that we use to measure information asymmetries in each market. In a previous version of the paper, we conducted tests specifically on this longer sample of California transactions for some of our hypotheses. There are few differences in our results, so we drop all California transactions for brevity.

[7]The city centers for each state are defined as follows: NV–Las Vegas; MA–Boston; MD–Baltimore and DC area; VA–DC area; TX–Austin and Dallas; IL–Chicago; CO–Denver. Houston, TX was not covered by COMPS over the sample period.

[8]COMPS provides the location (city and state) of the buyer and seller, as well as eight digit latitude and longitude coordinates of each property. We match the city locations of buyers and sellers with latitude and longitude coordinates provided by the *Geographic Names Digital Gazetteer*, published by the U.S. Geological Survey. Using these coordinate values, we compute the actual distance (in km) between each buyer and the property and each seller and the property using the arclength formula given by Coval and Moskowitz (1999). For details on this distance calculation, see Coval and Moskowitz (1999).

[9]Planned unit development is a zoning designation which waives standard zoning requirements and permits the adoption of a set of site-specific development standards.

[10]The low occurrence of VTB financing in Illinois and Virginia is notable. The average across the other states is over 20%. The unusual pattern of financing in Illinois and Virginia is due, however, to these states' recognition of land trusts. In a land trust, the owner of real property conveys it to a trust administered by a bank. The owner owns the beneficial interest in the trust and instructs the bank to act on his behalf. Hence, in our data set, when the seller of a land trust provides financing, it is recorded as bank financing, since the bank technically owns the property. Consequently, VTB loans will be understated in states where land trusts are recognized. Land trusts are used in Florida, Illinois, Indiana, North Dakota, and Virginia. Since we cannot identify land trusts in our data, we exclude Illinois and Virginia from our sample for some of our tests.

[11]Foreclosures exhibit this pattern, but our data set does not include foreclosures. In any case, banks do not typically expect to take an equity stake in a property when providing a mortgage.

[12]VTB financing is not typically short-term "bridge" financing used to expedite the deal. The maturities of VTB loans are often as long as (or longer than) the maturities of bank loans. The role of VTB finance in the residential market is discussed by Haurin and Hendershott (1986).

[13]In some cases, market value is estimated by an independent appraisal if insufficient recent sales took place in the region, or if certain types of properties are underrepresented in the data. The only state where estimates of market value were used in conjunction with actual sale prices was Texas. Appraised values comprise 24 to 60 percent of the comparison data used in Texas ratio studies. In addition, Nevada employs appraised values exclusively in its ratio studies. We verified, however, that the results in this paper are robust to the exclusion of Nevada properties.

[14]The earliest ratio study used for our sample is the 1996 Illinois study.

[15]Since neither a commercial index or age of commercial stock is available, we employ the housing index whose growth rate and age should be highly correlated with the commercial market in the same area.

[16]We exclude the MSA growth variable from this regression due to perfect multicollinearity.

[17]For brevity, we only report results using the continuous COD variable for the remainder of the paper. (Results are stronger using the High COD dummy specification.)

[18]We note that the constant term is not identified in the binary response model since it is subsumed into the estimated kernel. See Klein and Spady (1993) for more details about this model.

[19]All binary response regression results in the paper have been confirmed under the more robust Klein and Spady (1993) model. A previous draft of this paper contained those results, which are available upon request.

[20]Goldberger (1983) and Arabmazar and Schmidt (1982) show that maximum likelihood estimators of this form are typically inconsistent when the presumed error distribution is not equal to the true error distribution.

[21]For the truncated new mortgage regression, we must again throw out land trust states (Illinois and Virginia) as some of the bank mortgages are actually vendor loans erroneously recorded.

[22]One piece of evidence seemingly consistent with adverse selection is the increase in new bank debt and decrease in VTB financing for deals that use brokers. Garmaise and Moskowitz (2003), however, show that the negative broker effect on VTB financing is due to the endogenous selection of brokers by liquidity-constrained sellers, having little to do with information asymmetry.

[23]Binary response results for assumed/existing mortgages are omitted from Panel A because data on the previous mortgage of the property are only reported when the mortgage is assumed. Therefore, we cannot determine if a property has no assumed mortgage because it did not have a previous mortgage, or because the seller paid off the mortgage upon sale. The truncated regression in Panel B is immune to this potential problem because it only examines cases where an assumed mortgage exists. This also makes it immune to the recognition of land trusts, hence Illinois and Virginia are included in the regression.

[24]Due to the possible endogeneity of price, we excluded it from the financing regressions in the previous table.

Table 1:
Descriptive Statistics on the COMPS (U.S.) Database

	Panel A: Summary Information and Coefficients of Dispersion (COD)								
		Distance (km) from					Comm.	COD	
	# Sales	Buyer	Seller	Develop	Apt.	Land	& Ind.	Mean	σ
Overall	10,351	231.92	264.38	6.8%	23.3%	26.1%	50.6%	29.36	28.31
City-Center	5,297	225.09	254.93	7.3%	27.7%	23.7%	48.7%	34.91	33.15
Non-City	5,054	239.08	274.28	6.3%	18.8%	28.6%	52.6%	23.54	20.59
Small Deals	5,179	113.66	188.10	5.3%	25.6%	26.2%	48.2%	33.41	29.07
Large Deals	5,172	350.35	340.76	8.3%	21.0%	26.0%	53.0%	25.30	26.93
NV	1,603	360.06	312.74	7.5%	12.7%	54.0%	33.4%	5.82	1.11
MA	348	213.89	149.64	4.6%	72.1%	27.9%	0.0%	7.69	3.55
MD	854	267.50	304.50	3.0%	20.0%	3.3%	76.7%	9.62	5.17
VA	1,372	229.92	273.09	4.1%	6.5%	52.6%	41.0%	13.79	4.70
TX	1,311	370.90	463.99	16.5%	25.6%	21.7%	52.6%	7.43	1.24
IL	4,219	128.62	174.64	6.0%	32.3%	13.4%	54.3%	58.32	22.81
CO	644	273.58	315.82	2.3%	0.0%	21.6%	78.4%	13.92	0.90
High COD	5,155	149.88	200.06	5.3%	27.6%	13.5%	58.9%	50.84	26.10
Low COD	5,196	313.31	328.19	8.3%	19.0%	38.6%	42.3%	8.04	2.90
	Panel B: Pricing and Financing Information								
	Sale Price ($,000)		Vendor-to-Buyer		New Mortgage		Assumed Mortgage		Loan/
	mean	median	freq(%)	%Price	freq(%)	%Price	freq(%)	%Price	Value
Overall	$2,759	$656	13.0%	62.1%	54.7%	76.0%	2.0%	71.6%	75.2%
City	$2,831	$613	14.8%	62.9%	58.5%	75.0%	2.4%	77.6%	75.1%
Non-City	$2,683	$713	11.1%	60.6%	50.8%	77.3%	1.7%	57.4%	75.3%
Small Deals	$407	$390	14.9%	67.6%	56.9%	77.6%	0.6%	59.0%	77.4%
Large Deals	$5,114	$1,520	11.1%	60.9%	52.5%	75.8%	3.5%	71.7%	75.0%
NV	$2,224	$790	32.4%	65.6%	43.4%	71.5%	4.2%	64.4%	71.2%
MA	$2,687	$658	18.4%	52.4%	58.0%	74.4%	4.3%	67.3%	73.5%
MD	$2,735	$700	20.1%	68.1%	48.7%	75.3%	1.1%	64.2%	74.8%
VA	$4,140	$894	8.7%	59.2%	36.3%	81.9%	0.7%	30.0%	77.6%
TX	$3,512	$970	13.9%	53.2%	60.4%	76.9%	4.6%	67.7%	75.2%
IL	$2,382	$530	4.1%	58.7%	66.5%	75.6%	0.8%	80.8%	76.7%
CO	$2,150	$625	18.2%	67.6%	39.6%	69.6%	2.5%	59.7%	71.2%
High COD	$2,436	$550	6.7%	60.8%	62.3%	75.7%	1.0%	78.9%	76.6%
Low COD	$3,078	$820	19.2%	62.4%	47.2%	76.2%	3.0%	62.0%	74.2%

Descriptive statistics on the COMPS commercial real estate transactions from the U.S. over the period January 1, 1996 to March 30, 1999 are reported above. Panel A reports general statistics on the number of sales, average distance buyers and sellers are from the property, and the percentage of property sales that are planned development (Develop), apartments (Apt.), vacant land (Land), and commercial and industrial buildings (Comm. & Ind.). The last two columns report the mean and standard deviation (σ) of the coefficient of dispersion (COD), which is the dispersion around the median sale price-to-assessment value ratio within a region and for a particular property type. These figures are obtained from state property assessment ratio studies. COD measures are provided for each assessing jurisdiction and property type (Apartment, Land, and Commercial and Industrial buildings) and are assigned to each property within that jurisdiction and type. Summary statistics on COD weight each jurisdiction-property type group by the number of properties in each group, within each subsample. Panel B contains pricing and financing information on the real estate transactions. The three types of financing are vendor-to-buyer (VTB), assumed mortgage, and new mortgage. The mean and median sale price ($U.S.), frequency of each type of financing (freq(%)), and percentage of the sale price each type of financing comprises when it is used, as well as the total loan-to-value ratio are reported. Statistics are reported for the whole sample, for transactions within and outside of the largest metropolitan areas (City)—defined as the largest city or cities in each state, for the smallest and largest half of deals, for each state separately, and for transactions occurring in municipalities with the highest and lowest half of COD measures.

Table 2:
Limited Participation and Selective Offering

	Dependent Variable = Buyer Distance from Property (km)								
	All	Exclude IL	IL Only	All	Exclude IL	IL Only	All	Exclude IL	IL Only
# Obs.	*9,805*	*5,776*	*4,029*	*9,805*	*5,776*	*4,029*	*6,647*	*3,304*	*3,343*
3235.60	2600.15	2562.56	2269.87	2658.09					
(2.64)	(1.67)	(2.20)							
City	47.60*	70.34**	-38.75**	30.93	71.52**	-72.77**	31.93	58.70**	-26.80**
	(1.89)	(2.62)	(-2.42)	(1.40)	(2.88)	(-3.50)	(1.26)	(2.06)	(-2.67)
Age	-2.00**	-2.26**	-0.49**	-1.75**	-2.25**	-0.37**	-3.51**	-3.46**	-5.45**
	(-4.30)	(-4.12)	(-2.62)	(-4.26)	(-4.10)	(-2.27)	(-5.46)	(-2.56)	(-3.29)
Land	-62.99**	-101.89**	108.48**	-80.72**	-99.66**	33.12			
	(-2.61)	(-5.93)	(3.00)	(-3.74)	(-6.53)	(1.08)			
Apartment	40.62	95.87*	-28.80**	34.56	95.12*	-21.80	55.49	122.91**	-17.54**
	(0.88)	(1.72)	(-2.98)	(0.85)	(1.73)	(-1.38)	(1.46)	(2.47)	(-2.20)
Develop	-42.97	-36.03	-52.38*	-52.62*	-35.52	-53.07*	-26.29	-18.54	-11.35
	(-1.34)	(-0.77)	(-1.75)	(-1.70)	(-0.75)	(-1.79)	(-0.70)	(-0.33)	(-0.35)
σ_{local}	-6.68	21.06	29.12	-23.75	8.74	20.61	-20.65	-26.69	9.07
	(-0.20)	(0.67)	(0.97)	(-0.84)	(0.26)	(0.78)	(-0.60)	(-0.74)	(0.40)
log(Price)	-484.6**	-547.4**	-404.7**	-489.6**	-548.4**	-407.0**	-420.9**	-398.7**	-401.8**
	(-3.44)	(-3.04)	(-3.01)	(-3.47)	(-3.05)	(-3.02)	(-3.12)	(-2.07)	(-2.61)
$(\log(\text{Price}))^2$	21.51**	24.43**	16.97**	21.65**	24.46**	17.04**	19.51**	19.77**	17.06**
	(4.20)	(3.82)	(3.83)	(4.22)	(3.83)	(3.84)	(4.10)	(2.97)	(3.37)
CT Age	-0.40	-1.60*		-0.76	-1.81**		0.06	-1.45	0.85**
	(-0.67)	(-1.92)		(-1.31)	(-2.13)		(0.09)	(-1.46)	(4.94)
MSA Growth	194.49	34.14	0.52	264.89	60.48	0.41	-276.56	-316.53	
	(0.50)	(0.09)	(1.42)	(0.78)	(0.19)	(1.08)	(-0.65)	(-0.71)	
COD	-1.48**	-6.13**	-1.67**				-5.13**	-11.48**	-4.67**
	(-3.08)	(-2.83)	(-2.96)				(-5.16)	(-2.10)	(-4.64)
COD×Age							0.05**	0.13	0.09**
							(4.07)	(1.17)	(2.90)
High COD				-92.96**	-63.01**	-118.00**			
				(-4.29)	(-4.02)	(-8.50)			

Results from the regression of buyer distance from the property (in km) on a set of control variables and two direct measures of exogenous information, COD and HighCOD, are reported over the period January 1, 1996 to March 30, 1999. COD is the coefficient of dispersion measure and HighCOD is a dummy variable equal to one for all properties with associated COD measures above the median measure (13.31). The control variables include city, land, apartment, and planned development dummies, the age of the property, the log and squared log of the sale price, a measure of local price variability, which is the standard deviation of commercial property capitalization rates within a 10 mile radius, excluding the property itself, σ_{local}, the average growth rate on the index of all housing sales within each Municipal Statistical Area (MSA) over the 1996 to 1999 period, provided by Fannie Mae and Freddie Mac, and the median age of primary housing stock in each census tract, provided by the U.S. Census Bureau. Each property is identified with its MSA and census tract via its latitude and longitude coordinates. An interaction term between COD and age is also employed. Regressions are run for the whole sample, excluding properties from the state of Illinois, and for all properties within the state of Illinois only. The regressions are estimated via ordinary least squares (OLS), with t-statistics reported in parentheses using White (1982)-corrected standard errors that account for group-wise clustering at the level in which the COD is measured (assessing jurisdiction and property type). The coefficient on the constant term is not reported for brevity.

*,** Indicates significance at the 10% and 5% levels, respectively.

Table 3:
Selective Offering and Market Segmentation

Dependent Variable =	**Panel A: Property Age**			**Panel B: Buyer is a Broker**			
		Exclude	IL			Exclude	IL
	All	IL	Only	All	All	IL	Only
# Obs.	*6,557*	*3,225*	*3,332*	*7,468*	*7,468*	*4,459*	*4,013*
Regression Model:	OLS	OLS	OLS	Logit	Klein-Spady	Logit	Logit
3.719	-0.524						
(0.46)	(-0.06)						
City	10.061**	-1.828	26.947**	0.829**	0.128	0.873**	0.322
	(2.63)	(-0.72)	(12.81)	(6.34)	(0.20)	(5.31)	(1.07)
Age				0.002	-0.003	0.002	0.010**
				(0.75)	(-0.26)	(0.42)	(2.55)
Land				0.389**	-0.232	0.458**	0.610
				(2.40)	(-0.29)	(2.24)	(1.24)
Apartment	7.671**	8.551**	6.398**	-0.329**	-0.141	0.343	0.555**
	(2.22)	(2.19)	(9.92)	(-2.11)	(-0.18)	(1.61)	(2.76)
Develop	-1.442	-1.763	-1.688	-0.130	-0.015	-0.014	-0.136
	(-1.19)	(-0.96)	(-1.08)	(-0.57)	(-0.03)	(-0.05)	(-0.35)
σ_{local}	1.857	1.205	0.546	0.073	-0.018	0.003	-0.469
	(0.61)	(0.47)	(0.74)	(0.38)	(-0.02)	(0.01)	(-1.18)
Seller is a Broker				1.324**	2.416**	-0.060	4.067**
				(6.57)	(3.52)	(-0.69)	(6.24)
(Seller is a Broker)×COD				0.022**	0.147**	1.424**	-0.012
				(4.20)	(2.24)	(2.42)	(-1.16)
log(Price)	-11.464	-23.255**	9.116	-0.051	-1.000	-0.846	-0.342
	(-1.18)	(-3.83)	(0.81)	(-0.06)		(-0.74)	(-0.27)
$(\log(\text{Price}))^2$	0.254	0.632**	-0.449	0.001	-0.023**	0.026	0.013
	(0.77)	(3.27)	(-1.15)	(0.01)	(-2.48)	(0.67)	(0.30)
Buyer Distance				-0.001	0.002	-0.004**	0.001
				(-0.76)	(0.39)	(-2.81)	(0.05)
CT Age	0.466**	0.484**	0.272	0.007	0.001	0.003	-0.013*
	(3.15)	(3.80)	(1.33)	(1.41)	(0.03)	(0.45)	(-1.82)
MSA Growth	103.182**	132.658**		-6.776**	-0.353	-1.876	
	(1.98)	(3.71)		(-2.78)	(-0.03)	(-0.63)	
COD	0.335**	0.758**	0.171**	-0.007**	0.003	-0.103**	0.004
	(2.42)	(2.32)	(2.56)	(-2.14)	(0.13)	(-3.68)	(0.44)

Panel A reports results from the regression of property age (excluding properties with recorded ages of zero, which include all vacant land sales) on the direct information measure COD over the period January 1, 1996 to March 30, 1999. The control variables include city, apartment, and planned development dummies, the log and squared log of the sale price, a measure of local price variability, which is the standard deviation of commercial property capitalization rates within a 10 mile radius, excluding the property itself, σ_{local}, the average growth rate on the index of all housing sales within each Municipal Statistical Area (MSA) over the 1996 to 1999 period, provided by Fannie Mae and Freddie Mac, and the median age of primary housing stock in each census tract, provided by the U.S. Census Bureau. The regressions are estimated via ordinary least squares (OLS), with t-statistics reported in parentheses using White (1982)-corrected standard errors that account for group-wise clustering at the level in which COD is measured (assessing jurisdiction and property type). Panel B reports binary response regression results where the dependent variable is whether the buyer is a broker trading on his own account, estimated via logit and the Klein and Spady (1993) semiparametric model with t-statistics reported in parentheses computed from the outer-product matrix. The regressors include those of Panel A plus the age of the property, a land dummy, a dummy for whether the seller is a broker, an interaction between the seller-is-a-broker dummy and COD, and the buyer distance from the property. The constant term is non-existent for the Klein and Spady model and is not reported for the other regression models for brevity. Regressions are run for the whole sample, excluding properties from Illinois, and for all properties within the state of Illinois only.

*,** Indicates significance at the 10% and 5% levels, respectively.

Table 4:
Is Financial Structure Affected by Information Asymmetry?

	Panel A: Binary Response (Logit)					**Panel B: Truncated Regression (Powell (1986))**				
Dependent Variable =	VTB	New Mortgage	VTB*	VTB 2nd Trust	Vendor Only	VTB	New Mortgage	Assumed Mortgage	VTB 2nd Trust	Vendor Only
# Obs.	*2,260*	*2,260*	*121*	*755*	*2,260*	*898*	*1,523*	*156*	*297*	*615*
City	0.1542	-0.3355**	-0.3016	-0.1483	0.2511**	-0.0131	-0.0381**	-0.0533*	0.0790	-0.0460**
	(1.45)	(-3.24)	(-0.36)	(-0.33)	(2.24)	(-0.44)	(-3.32)	(-1.73)	(0.03)	(-2.47)
Age	0.0159**	-0.0065**	0.0179	0.0261**	0.0137**	-0.0015	-0.0001	-0.0002	-0.0208	0.0006
	(6.00)	(-2.44)	(0.73)	(2.44)	(4.86)	(-1.49)	(-0.01)	(-0.19)	(-0.55)	(0.98)
Land	1.5353**	-1.1399**	1.9061*	0.0108	1.5572**	-0.1571	-0.0985**	-0.1324**	-6.3572	-0.0756**
	(10.19)	(-7.77)	(1.68)	(0.02)	(10.02)	(-1.46)	(-6.64)	(-2.35)	(-1.62)	(-2.65)
Apartment	-0.0231	-0.0253	-0.2174	0.1257	-0.1592	-0.0894	0.0267**	0.0696**	-0.3297	0.0130
	(-0.17)	(-0.19)	(-0.24)	(0.22)	(-1.07)	(-1.11)	(2.45)	(2.71)	(-0.22)	(0.54)
Develop	-0.2123	-0.0169	-1.4493	-0.4456	-0.0366	0.0140	-0.0048	-0.0119	1.0848	0.0413
	(-1.20)	(-0.10)	(-0.47)	(-0.49)	(-0.20)	(0.22)	(-0.30)	(-0.18)	(0.65)	(1.12)
σ_{local}	0.0199	0.1086	-0.1140	-0.2150	0.0871	-0.0207	0.0394**	0.0161	0.1351	0.0124
	(0.13)	(0.75)	(-0.11)	(-0.39)	(0.55)	(-0.45)	(3.21)	(0.33)	(0.09)	(0.41)
Broker	-0.5709**	0.5343**	-1.0206	-0.7104*	-0.5779**	-0.0617**	-0.0191	0.0426	0.9847	-0.0524**
	(-5.56)	(5.29)	(-1.28)	(-1.69)	(-5.42)	(-2.11)	(-1.45)	(1.13)	(0.37)	(-3.16)
Seller is a Broker	0.0202	0.1350	-4.4502	-1.3361	-0.1330	-0.1120**	-0.0176	-0.0225	-6.5476*	-0.1002**
	(0.11)	(0.72)	(-0.75)	(-0.90)	(-0.67)	(-2.47)	(-0.82)	(-0.39)	(-1.84)	(-2.60)
Buyer Distance	-0.0003**	0.0001	-0.0002	0.0004*	-0.0004**	-0.0001	-0.0001	-0.0001	0.0022	-0.0001
	(-3.63)	(0.42)	(-0.44)	(1.87)	(-3.70)	(-0.59)	(-0.91)	(-1.29)	(0.95)	(-0.64)
CT Age	0.0003	0.0001	0.0267	-0.0006	-0.0034	-0.0014	-0.0002	0.0010	0.0168	-0.0002
	(0.07)	(0.02)	(0.71)	(-0.03)	(-0.70)	(-0.72)	(-0.41)	(0.60)	(0.35)	(-0.23)
MSA Growth	-10.7492**	7.5166**	1.8195	1.1812	-11.4205**	0.6475	0.0594	-0.2425	8.6431**	0.0466
	(-5.47)	(3.90)	(0.11)(0.14)	(-5.46)		(0.65)	(0.33)	(-0.54)	(2.24)	(0.10)
COD	0.0355*	-0.0067	-0.0438	-0.0958	0.0440**	-0.0008	0.0042**	0.0005	0.0125	0.0033
	(1.69)	(-0.32)	(-0.20)	(-0.84)	(2.01)	(-0.63)	(2.05)	(0.30)	(0.10)	(0.65)
Assumed			-3.0678							
			(-0.85)							

Results from the regression of various financing types on direct and indirect information variables plus property, buyer, seller, and location characteristics are reported above over the period January 1, 1996 to March 30, 1999. Six sets of dependent variables are used: vendor-to-buyer financing (VTB) scaled by sale price, new mortgage scaled by sale price, assumed mortgage scaled by sale price, VTB scaled by sale price in excess of the amount of assumed mortgage (VTB*), VTB financing conditional on a second trust deed being used, and vendor only financing (e.g., financed solely by the seller). Panel A reports coefficient estimates under logit, where the dependent variable is one if the financing type is used, and zero otherwise. Panel B reports coefficient estimates under the truncated regression model of Powell (1986), where the data is truncated to only those observations where the dependent variable (financing type) is positive. T-statistics are reported in parentheses, with standard errors calculated via the outer-product matrix for the binary response model, and via bootstrapping (250 simulations) for the truncated regression model. Binary response regressions of VTB and new mortgages as well as the truncated regression of new mortgages, exclude states that recognize land trusts to control for distorted reporting effects arising from land trust deals. The regressors include COD, city, land, apartment, and planned development dummies, the age of the property, a measure of local price variability, which is the standard deviation of commercial property capitalization rates within a 10 mile radius, excluding the property itself, σ_{local}, dummy variables for the presence of a broker and whether the seller is a broker, buyer distance from the property, the average growth rate on the index of all housing sales within each Municipal Statistical Area (MSA) over the 1996 to 1999 period, provided by Fannie Mae and Freddie Mac, and the median age of primary housing stock in each census tract, provided by the U.S. Census Bureau. The constant term is not reported for brevity.

*,** Indicates significance at the 10% and 5% levels, respectively.

Table 5:
Do Financial Decisions Influence the Price?

	Dependent Variable: Capitalization Rate = Income/Price			
	All Properties		Most Distant	Youngest
# Obs.	*744*	*744*	*407*	*163*
City	-0.4230**	-0.4210**	-0.5776**	-0.1759
	(-2.02)	(-2.02)	(-1.96)	(-0.89)
Age	0.0171**	0.0169**	0.0194**	0.0808**
	(2.29)	(2.34)	(2.16)	(2.80)
Land	0.5190	0.4942	0.5310	0.8448**
	(1.19)	(1.16)	(1.10)	(1.91)
Apartment	0.1094	0.0965	0.2472	-0.6683**
	(0.43)	(0.39)	(0.87)	(-3.08)
Develop	-0.0416	-0.0430	-0.3681**	-0.1644
	(-0.23)	(-0.24)	(-4.77)	(-1.24)
σ_{local}	0.9315**	0.9378**	1.3739**	0.1034
	(2.63)	(2.70)	(3.07)	(0.36)
Broker	0.3252	0.3227	0.1142	0.5013
	(1.02)	(1.00)	(0.40)	(1.20)
Seller is a Broker	-0.4071	-0.4401	-0.1195	-0.0425
	(-0.78)	(-0.84)	(-0.45)	(-0.17)
Buyer Distance	-0.0001	-0.0001*	0.0001	-0.0001**
	(-1.50)	(-1.80)	(1.51)	(-2.37)
CT Age	0.0172**	0.0170**	0.0233*	0.0158
	(1.99)	(1.98)	(1.81)	(1.27)
MSA Growth	-7.0595	-7.1565*	-7.5520	-2.1928
	(-1.61)	(-1.73)	(-1.28)	(-0.37)
COD	0.0060	-0.0249	-0.0074	0.0659
	(0.11)	(-0.47)	(-0.11)	(1.65)
VTB>0	-0.0826	-0.9597	0.5332	-0.1194
	(-0.22)	(-1.07)	(1.29)	(-0.23)
(VTB>0)$\times$COD		0.1067		
		(1.20)		

Results from the regression of property capitalization rates (net income on the property divided by the sale price) on the presence of the seller's retained stake in the property (a dummy variable equal to one if seller financing is present) plus a set of controls for broker usage, buyer, seller, and property characteristics, including city, land, apartment, and planned development dummies, the age of the property, a measure of local price variability, which is the standard deviation of commercial property capitalization rates within a 10 mile radius, excluding the property itself, σ_{local}, dummy variables for the presence of a broker and whether the seller is a broker, buyer distance from the property, the average growth rate on the index of all housing sales within each Municipal Statistical Area (MSA) over the 1996 to 1999 period, provided by Fannie Mae and Freddie Mac, and the median age of primary housing stock in each census tract, provided by the U.S. Census Bureau are reported above over the period January 1, 1996 to March 30, 1999. Also included as regressors are COD and an interaction between the seller's retained stake and COD. Regressions are run over all properties for which cap rates are available, for properties with the most distant half of buyers, and for the youngest properties (less than 5 years of income history). Coefficient estimates are calculated via ordinary least squares (OLS), with t-statistics reported in parentheses, where standard errors are White-corrected and account for group-wise clustering at the level in which COD is measured (assessing jurisdiction and property type). The constant term is not reported for brevity.
*,** Indicates significance at the 10% and 5% levels, respectively.

Table 6:
Summary of Theoretical Predictions and Their Verification in the Data

Prediction		Table, Column	Verified?
Limited Participation, Selective Offering, and Market Segmentation			
1.	*Buyers are local.*	1	Yes
2.	*Buyer distance is smaller when information asymmetry is high (e.g., when COD is high).*	2, 1-6	Yes
3.	*Buyer distance is smallest when information asymmetry is high and the property is young.*	2, 7-9	Yes
4.	*Young properties are less likely to be sold when information asymmetry is high.*	3, 1-3	Yes
5.	*Brokers are more likely to sell to other brokers, particularly when information asymmetry is high.*	3, 4-7	Yes
Financial Structure			
	Adverse Selection Model A: Seller and Bank Debt Substitution		
A1.	*More seller financing (VTB) when information asymmetry is high.*		
	Frequency (%)	4, 1	Weak
	Magnitude ($)	4, 6	No
	2nd Trust only (%)	4, 4	No
	2nd Trust only ($)	4, 9	No
	Vendor only (%)	4, 5	Yes
	Vendor only ($)	4, 10	No
A2.	*Less bank financing when information asymmetry is high.*		
	Frequency (%)	4, 2	No
	Magnitude ($)	4, 7	No
A.3	*More VTB when existing (assumed) mortgage is large.*	4, 3	No
	Adverse Selection Model B: Separating Signaling		
B.1	*More VTB when information asymmetry is high. (same as A.1)*	see above	see above
B.2	*Less assumed mortgage when information asymmetry is high.*	4, 8	No
B.3	*More VTB when existing mortgage is large. (same as A.3)*	see above	see above
B.4	*Sale price positively related to seller's retained stake (VTB), particularly when information asymmetry is high.*	5, 1-2	No
	Most distant buyers only	5, 3	No
	Youngest properties only	5, 4	No