

## Why and When Do NCREIF Member Sell Properties?

### A Probit Analysis of Asset Disposition Characteristics & Determinants in the Institutional Commercial Real Estate Investment Industry

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#### **EXECUTIVE SUMMARY**

Significant increases or decreases in the level of prices and number of property sales (transaction frequency) are monitored closely by private investors, analysts, advisors, and public sector participants. Understanding the factors affecting real estate price levels and their movements has been the focus of much research; however, relatively little attention has been given to examining transaction frequency. Transaction frequency is related to price movements and, thus, a key indicator of current real estate market conditions. In addition, it is widely viewed as an important “leading” indicator of the expected general conditions of local, regional, and national economies. In this study, we examine the significance of the primary factors that are expected to “explain” variations in the transaction frequency of institution-grade commercial real estate.

We begin by discussing the relationship between transaction frequency, market liquidity, and buyer / seller reservations prices. We show that the *relative* change in the distribution of the reservation prices of sellers and buyers is fundamental to changes in both market liquidity and transaction frequency. Using data from the underlying database of the NCREIF index (NPI), on sold and unsold properties from 1985 to 2001, we estimate alternative probit models and test the significance of the underlying factors expected to be correlated with the likelihood of a transaction. The probability of an investment-grade commercial property sale occurring is significantly related to three basic factors: (1) market conditions, (2) property characteristics, and (3) ownership characteristics. Interestingly, the three factors appear to play significant, independent, and approximately equivalent roles in determining transaction frequency.

Transaction frequency is correlated with changes in the market conditions. Economic expansion of the general market, as measured by the average annual percentage change in MSA

employment (*dEMP*), significantly increases the probability of a property sale. Similarly, a perceived strength in the real estate market, as measured by positive changes in the NPI (*dNPI*), is accompanied by increased transaction frequency. In addition, we report statistical evidence of a significant capital markets "flow of funds" effect on the institutional-grade commercial real estate market. An increase in the annual returns of the stock market (*dSTK*) is correlated with a decrease in property transaction frequency. The "flow of funds" effect is found after controlling for any "cost of debt" (mortgage funds) effect, where the probability of sale is negatively correlated with increases in the yield rates on mortgage funds. Finally, the Tax Reform Act of 1986 is found to have reduced the probability of property sales in the two years immediately following the Act by about 6 percent.

Ownership factors, such as if the property is held in an open-end or closed-end fund; if it is held in a joint venture; or if it is not leveraged; are all correlated with diminished transaction frequency. Property factors, such as the age and square footage of the property, while statistically significant, are relatively small in magnitude. Older properties are more likely to transact than younger, otherwise comparable, properties. Larger properties in the NCREIF database are found to be less likely to transact.

Finally, the test hypothesis that the primary sectors in the NCREIF database (e.g., office, industrial, retail, and apartment) respond equally cannot be rejected for changes in the NPI. Equality among sector coefficients is rejected for changes in employment and the stock market. However, it should be noted that the magnitude of the difference is small, and the statistical significance should not be overstated. Additional study of the response of each sector to changes in the market conditions, as well as property and ownership factors is required.

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#### **Abstract**

This study examines the correlation of national, regional, local variables, including property- and owner-specific variables, and investment-grade property sale frequency. More specifically, the study identifies the primary factors that “explain” intertemporal changes in transaction frequency in the underlying properties used to develop the NCREIF index. Understanding these factors yields important information that can be used by firms when forming market expectations and developing investment strategies.

#### **Introduction**

Real estate market transaction activity is monitored closely by private investors, analysts, advisors, as well as public sector participants. Significant increases or decreases in the level of prices, or the frequency of transactions, are often reported with some fanfare in the popular press. Understanding the factors affecting real estate price levels and their movements has been the focus of much research and analysis; however, relatively little attention has been given to examining transaction frequencies. In private real estate markets, changes in the frequency of transactions, as measured by changes in the number of properties sold from a stock of properties comparing one period to another (e.g., month-to-month, year-to-year), have been shown to be related to asset price movements.<sup>1</sup> Thus, transaction frequency is a key indicator of current conditions of the real estate market. In addition, it is widely viewed as an important “leading” indicator of the expected general conditions of local, regional, and national economies. By monitoring transaction activity levels, market participants are better able to form market expectations, evaluate prices, and develop investment strategies. This study examines the underlying factors that affect the probability of property sales occurring from period to period,

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<sup>1</sup> For example, recent work by Fisher, Gatzlaff, Geltner, and Haurin (2003) models the relationship between movements in property values (i.e., the capital appreciation component of the NPI) and transaction volume (i.e., the percent of properties in the NCREIF portfolio sold).

and therefore the transaction frequency. Identifying and evaluating the relative effects of these factors is fundamental to the analysis of the real estate market and its submarkets.

To date, research on the frequency of real estate transactions has focused primarily on the sale of existing residential properties and the demand for new residential construction (e.g., important works include Thom (1985) and Jaffee and Rosen (1979)).<sup>2</sup> We know surprisingly little about the private market “transaction cycles” of investment-grade commercial property, despite its importance to the institutional investment community. Even less is known about the factors underlying these sales cycles, and whether the relationship of “concurrent” or “leading indicators” of sales activity can be properly characterized.

This study identifies the relative correlation of national, regional, and local variables, including property- and owner-specific variables, with the likelihood of investment-grade property sales activity. Specifically, we examine factors that “explain” intertemporal changes in sales volume in the underlying properties used to develop the National Council of Real Estate Investment Fiduciaries property index (NPI). In addition, the study explores whether the relative importance of these factors varies across property types. Our primary focus is on intertemporal sales variation, but the research question is also relevant to cross-sectional studies.

The study is organized as follows. In the next section, Section 2, we discuss the interaction of buyer and seller reservation prices resulting in intertemporal changes in liquidity and the conditions leading to pro-cyclic behavior in the transaction cycle. A model describing the primary factors affecting transaction probability is presented in Section 3. The data are described and empirical results reported in Sections 4 and 5.

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<sup>2</sup> There is a substantial research on the issue of liquidity and trading volume in the financial economics literature. However, that literature applies directly to publicly traded assets. Our focus is on the private investment-grade real estate market activity.

## Transaction Frequency, Market Liquidity, and the Interaction of Reservation Prices

Though related, it is important to distinguish between the concepts of transaction frequency and market liquidity. Transaction frequency refers to the *number* of transactions that occur in a particular market during a particular period of time (e.g., 120 properties per year). The number of transactions is generally affected by market conditions (including the size of the market), property conditions, and other factors influencing buyer and seller decisions. Transaction frequency is easily observed and represents a key indicator of the liquidity in the market.

Market liquidity refers to the ease, or speed, at which properties transact, or expected to transact. One measure of the liquidity of a market is the reciprocal of the transaction frequency. For example, a market with an average transaction frequency of 120 properties per year constitutes a transaction “speed” of about 3.0 days per transaction ( $365 / 120$ ).<sup>3</sup> As with transaction frequency, comparison of this measure across markets requires an adjustment for the relative size of each market.

More commonly, market liquidity is viewed as the expected time required for a *particular* property to transact (e.g., 30 days). Using the example from the previous paragraph, if there are 10 sellers (properties) to each buyer, the expected market transaction rate on each (constant-quality) property extends to 30 days. Thus, market liquidity depends on the relative number of buyers and sellers “in” the market at a particular time—reflecting the conditions of the market, property, and other factors affecting their purchase/sale decision. It is important to note that the *relative* change in the number of sellers and buyers is fundamental to changes in both market liquidity and transaction frequency. If market size (i.e., the number of buyers and sellers) is held constant, transaction frequency and market liquidity are directly related, and movements in both reflect the changes in conditions affecting buyer and seller decisions.

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<sup>3</sup> This could be viewed as a market comprised of 6,000 constant-quality properties with a total turnover rate of 50 years ( $6,000 \text{ properties} / 50 \text{ years} = 120 \text{ properties} / \text{year}$ ).

Two stylized characteristics have been observed with respect to the transaction frequency (and liquidity) of private real estate markets. (1) Transaction frequency varies dramatically from period to period and market to market. Property owners can sell more assets, or sell any given asset quicker and easier (holding price constant), when the market is more “liquid.” Alternatively (and equivalently), greater liquidity implies that asset owners can sell the same number of assets (or any given asset in the same amount of time) at higher prices (other things being equal). (2) Transaction frequency (and liquidity) is positively correlated with the asset market “cycle.” Controlling for market size, transaction frequency is typically greater when the market is “up” (asset prices are relatively high and/or are rising), and vice versa, transaction frequency is lower when the market is “down” (prices relatively low or falling). Relative to the general economic conditions, changes in the frequency of transactions are typically found to be pro-cyclical and persistent. During “up” markets, capital flows into the real estate sector, there is a greater volume of trading, and it is “easier” to sell assets. Just the opposite typically occurs in “down” markets.

The relationship between transaction frequency and property appreciation is shown in Figure 1 below. The annual appreciation rate of the capital component of the National Council of Real Estate Investment Fiduciaries index (NPI) is denoted by the solid line for the period 1984 to 2001. The annual appreciation rate is charted along with the percentage of properties in the NCREIF portfolio (denoted as grey bars) that transacted each year. A strong positive correlation between periodic movements in the annual transaction frequency and the rate of appreciation can easily be noted. During the economic downturn of the early 1990s, both the percentage of transactions and the annual rates of appreciation experienced persistent declines from 1990 to 1992. Transaction frequency and appreciation rates then rose consistently through until peaking in 1997 and 1998, respectively.<sup>4</sup>

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<sup>4</sup> Annual rates of change in the NPI are generally suggested to lag and smooth actual changes due to the nature of the appraisal-based estimation process.

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—Insert Figure 1 about Here—  
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Asset prices are affected by changes in liquidity. In markets of equal size, higher transaction frequency indicates greater market liquidity.<sup>5</sup> Thus, by monitoring transaction activity levels, market participants are able to assess current liquidity levels and form better market expectations with which to evaluate prices.

Changes in transaction frequency can be described by examining the relationship of the relative movements in the distributions of potential buyer and seller reservation prices. To describe this, we consider the search model presented in Fisher, Gatzlaff, Geltner, and Haurin (FGGH, 2002). Their diagram of the stylized distribution of the potential buyers and sellers is show in Figure 2.

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In time  $t$  of Figure 1 (top panel), the vertical axis measures the number of potential buyers and sellers, while the horizontal axis indicates the relative reservation prices, assuming constant-quality assets and heterogeneous agents (buyers and sellers). Reservation prices are defined as the prices at which potential buyers and sellers will stop negotiating or searching for a better deal and complete a transaction. The left-hand side distribution represents the potential number of buyers and the right-hand side distribution the number of sellers.

Our interest is in the overlap region where some buyers are willing to pay more than sellers are willing to accept. The number of buyers willing to transact at some price,  $P_x$ , on the horizontal axis is represented by the area underneath the buyer reservation price frequency distribution to the right of  $P_x$ . Thus, the number of potential transactions in the asset market

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<sup>5</sup> This assumes a single, unsegmented, market having constant-quality assets.

during the period  $t$  is indicated by the size of the region of overlap between the buyer and seller reservation price distributions.<sup>6</sup>

The relative movements of the price distributions affect transaction frequency in the market. As economic activity increases, both distributions move to the right; however, it is the relative movement of the price distributions that affect transaction volume. As FGGH note, in order for the market process to conform to the observation that transaction frequency increases during an “up” market and decreases during a down market period, the overlap of the region must increase in time  $t+1$  and decrease in  $t+2$ , in comparison to the base period. For the overlap region to evolve in this manner, it is necessary for the buyer reservation price distribution to be more responsive than the seller reservation price distribution to economic conditions, although both distributions may move in the same direction.

Changes in the likelihood of the size (match) of the overlap region are influenced by both macro- and micro- level considerations. For example, transaction motivation may be affected by general market conditions and explain some of the variation over time in the flow of financial capital into and out of asset market segments. Alternatively the motivation may be affected by a strategic decision to hold property of a particular age, quality, or class. Thus, changes in the market, property, and ownership characteristics affecting the relative movements of the buyer and seller reservation distributions determine the transaction frequency in the market.

Ultimately, this type of pro-cyclical variable liquidity substantially affects the values and the measured movements in values within private markets. Understanding the effect of individual determinants on liquidity will allow for improved comparison between the capital risk and return

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<sup>6</sup> FGGH, 2002, note that the mean price of transactions will be roughly near the middle of the overlap region.

characteristics of the private market (or investment “asset class”) and public exchange-traded securities.<sup>7</sup>

## Model

To model transaction frequency, the likelihood of an investment-grade commercial property sale occurring is assumed to be a function of the condition of the market, the characteristics of the property, and the characteristics of the owner. This can be expressed as

$$\Pr(SALE_{j,t}) = f(MARKET_{j,t}, PROPERTY_{j,t}, OWNER_{j,t}), \quad (1)$$

where  $\Pr(SALE_{j,t})$  represents the probability that property  $j$  will transact in period  $t$ .  $MARKET_{j,t}$  denotes a vector of variables that represent the economic, demographic, and regulatory conditions of the market affecting property  $j$  in period  $t$ .  $PROPERTY_{j,t}$  is a set of variables used to describe the specific structural and locational characteristics of property  $j$  in period  $t$ .  $OWNER$  denotes a set of strategic operating characteristics of the owner (i.e., seller) that affect the likelihood of a transaction.

To estimate the model requires estimation of the probability that a property is sold or remains unsold in any given period. The probability of sale can be estimated as a probit model. This can be specified

$$\Pr(S_{jt} \neq 0 | Z_{jt}) = \Phi(\beta_j Z_{jt}) + e_{jt}, \quad (2)$$

where  $S_{jt} = 1$  if property  $j$  is sold in period  $t$ , 0 otherwise and  $Z$  is a vector of market, property, and ownership variables that are used to “explain” the likelihood of the property sale.  $\Phi$  is the standard cumulative normal distribution,  $\beta$  the estimated coefficient, and  $e_{jt}$  the estimation error.  $(\beta_j Z_{jt})$  results in producing a probit score, or index, that is used to evaluate the marginal effect and

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<sup>7</sup> Adjusting for the possible biases resulting from liquidity changes was addressed in our previous research conducted for the Real Estate Research Institute; “Variable Liquidity and Selection Bias in Transaction Indices of Institutional Commercial Property,” Fisher, Geltner, Gatzlaff, and Haurin, January, 2002.

statistical significance of each variable on the likelihood of sale. The variables considered to measure these factors are discussed below.

### ***Market Conditions***

The variables used to describe market conditions include economic, demographic, financial, and taxation measures. Transaction frequency has been characterized as pro-cyclical above; thus, it is anticipated that changes in economic condition of the market will be positively correlated with the likelihood of sale. During periods of market expansion and contraction, the probability of sale is expected to increase and decrease, respectively. In addition, the real estate market is characterized by serially correlated returns. Substantial appreciation in the real estate market represents a direct indicator of growth in the market resulting in an increased likelihood of transaction frequency.

Real estate market activity is likely affected by both the “flow of funds” and the “cost of funds.” Competition among the stock, bond, and real estate assets for equity capital results in a flow of funds to the highest-risk adjusted return. It is anticipated that increased returns in the stock and bond markets result in decreased transaction activity in the real estate market. An alternative argument is that increased stock and bond market returns result in a “portfolio effect.” In this scenario, substantial returns in the stock or bond market necessitate the investor’s portfolios to be rebalanced, resulting in additional investment (and transaction activity) in the real estate sector. Decreases in the cost of debt (mortgage loan funds), are expected to increase transaction frequency.

Finally, government intervention at the federal, state, and local levels plays a significant role in affecting transaction frequency. For example, it is anticipated that the federal Tax Reform Act of 1986 had a dampening effect on the transaction frequency of the investment property in the period immediately following the enactment of the Act. Although NCREIF members represent tax exempt institutions, the reduction of tax benefits by the Act makes it less desirable for taxable investors to purchase properties from NCREIF members. In addition, local market

growth management and economic development initiatives may affect transaction activity in specific markets.

### ***Ownership Characteristics***

The organizational, operational, and strategic characteristics of the property owners are expected to affect the likelihood of their property selling. Organizational characteristics include alternative forms of equity ownership, such as joint ventures. It is expected that the properties held by joint ventures are less likely to be sold than properties held under single ownership because of the additional administrative complexities associated with negotiating the sale. The sale of joint ventures requires the approval of all partners in the venture, including some who may be taxable entities or would otherwise have different perceptions of investment value than the NCREIF member. Properties held in open end funds are less likely to be sold during the period examined in this study than properties in closed end funds. This is because closed end funds have a finite life and the properties must be sold before termination of the fund. Open end funds do not have a finite life. Liquidity is provided by allowing investors to buy or sell shares of the fund. As long as the capital inflows to the fund are roughly in balance with the capital outflow, there is no pressure on the fund manager of the open end fund to sell individual properties to provide liquidity.

Operational characteristics include, for example, the decision to use of mortgage debt to finance the acquisition and ownership of the property. It is expected that the use of mortgage debt may be coupled with a strategy of seeking higher returns over a shortened holding period. This suggests an increase in the likelihood of properties transacting that have debt. In addition, buyers may be better able to negotiate acquisition of a property when current debt is in place that may be assumed. Finally, properties that have been held longer are more likely to transact. They have reached their useful holding period and strategic improvements to the property have been completed.

### ***Property Characteristics***

The characteristics of the property itself affect its likelihood of sale. Property characteristics include such items as the condition and age of the structure, its location, the viability of its tenants, and the property type. As properties age they are more likely to be sold by the NCREIF members. Because of their low risk preference, the institutional members of NCREIF are expected to prefer holding newer, so-called “institutional-grade,” property. Consistent with this is the notion that the smaller properties are more likely to be sold. In addition, sales of the largest properties in the NCREIF portfolio may be more complex and difficult to negotiate with a smaller population of potential qualified buyers.

The probability of sale is expected to be positively correlated with increased property occupancy. It is easier to market and negotiate the transaction of properties that are leased, because buyers do not incur the added risks associated with the leasing and absorption of space. However, it is possible that high occupancy rates serve as a proxy for higher-quality properties suggesting a greater likelihood to hold, rather than sell, the property.

In considering the role that such factors as employment, the flow of capital funds, and alternative asset class returns will play, we expect that these underlying determinants may vary across property types. In Section 5, we explore the use of alternative econometric specifications for examining the disposition behavior among the property types held by members of the NCREIF.

### **The Data**

To estimate the probit model, data on sold and unsold property must be available. In most analyses this creates a substantial barrier. However, the data available in the historical NCREIF database provide a unique opportunity to examine the underlying “explanatory” factors.

The NPI database is used in this study. This database includes property-level information on over 8,500 properties that have been held for the tax-exempt members of the NCREIF. These

data have been used to construct the NPI since the fourth quarter of 1977. The NCREIF portfolio of properties consisted of 3,311 properties as of 2001:4, with an aggregate appraised value of just over \$100 billion. Properties included in this database are generally well distributed across the four major regions of the nation. For example, properties located in the East, Midwest, West, and South represent 22%, 16%, 33%, and 29% of the number of properties in the database, respectively.<sup>8</sup> The data include primarily four property types: office (29%), industrial (29%), apartment (24%), and retail (18%).<sup>9</sup> The NCREIF database provides information on both sold and unsold properties. Over 3,000 of these properties have been sold during this time period, providing transaction information.

Because property- and owner-specific information is required, the data set we examine includes information on properties in the historical NCREIF database held during any period between 1985:1 and 2001:4. During this period we identify 1,556 properties that sold that having complete property information. In addition to the transaction observations, the number of unsold properties totals 16,876 observations. This yields a total of 18,432 observations in the data set that we employ.<sup>10</sup>

The numbers of sold and unsold observations are reported by year in Table 1. As shown, the proportion sold (Column 4) decreased from 1985 to 1986, then increased from 1986 through 1989, and then declined through 1992. Following 1992, the percentage of properties sold consistently increased again until they peaked in 1997 and then declined through the remainder of the period studied. The square footage of the properties sold and unsold is compared in Columns 5 and 9. Two characteristics are evident from casual inspection: (1) the mean square footage of the unsold properties consistently increased from 1985 to 2001, and (2) the mean square footage

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<sup>8</sup> Properties located in the East and West tend to be of higher values than those located in the South; hence, the value of the properties in the East, Midwest, West, and South represent approximately 27, 16, 36, and 21 percent of the aggregate value of the database, respectively.

<sup>9</sup> In addition, hotel properties represent less than 2 percent of the total properties.

<sup>10</sup> The number of observations exceeds the number of properties in the database because most properties are held more than one year, and we identify the observations of sold and unsold properties for each year.

of the properties sold varied considerably from year to year. The mean value per square foot of the sold and unsold samples (Columns 6 and 10) show a similar characteristic. With an average size of over 300,000 square feet and average values of almost \$35 million, the properties in the NCREIF portfolio generally represent the larger, high valued, segment of the overall property market.

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To estimate the probability of sale we estimate the probit model indicated by equation (2). The probit equation includes independent variables measuring the primary characteristics of market, ownership, and the property. Summary statistics for the variables applied are reported in Table 2. The dependent variable (SOLD) is a dummy variable equal to 1 if the property sold in period t, otherwise it is 0. On average 8.4 percent of the sample sold each year.

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The next five variables listed in Table 2 (variables 2 through 6) represent the market condition variables and include the following: dNPI, the percentage change in the NPI in the quarter sold of period t; dSTK, the percentage change in the S&P500 in period t; dEMP, the average annual percentage change in the employment in the MSA of property j over the previous two years; TAX86, a dummy variable equal to 1 if year 1986 and 1987 or 0 otherwise, to capture the effects of the Tax Reform Act of 1986 on the probability of sale; and MRATE, the average effective yield rate on 30-year conventional mortgages. The mean, standard deviation, minimum and maximum values of each variable over the study period are reported in Columns 2 through 5 of Table 2.

The ownership characteristic variables (variables 7 through 10) include three dummy variables equal to 1, otherwise 0, if the property is held in an open-end fund (FUND); if the property is held by a joint venture (JVEN); and if the property is held without debt (UNLEV). A

fourth ownership variable, HPER, indicates the number of years the property has been held as of period  $t$ . HPER is included to capture the effect of a property's holding period on the likelihood of sale. Table 2 lists that over the period studied an average of 28.5 percent of the properties were held in open-end funds, 23.3 were held in joint ventures, and 73.9 percent were owned without the use of mortgage debt.

The property-specific variables are the last five variables listed in Table 2 (variables 11 through 15). The property variables include: LEASED, the percent of the property leased in period  $t$ ; SQFT, the square footage of the property; SQFT2, the SQFT variable squared to model the likely diminishing effect of SQFT on the likelihood of sale; AGE, the age of the property in period  $t$ ; and AGE2, the AGE variable squared to model the likely diminishing effect of AGE as it increases. On average, properties in the sample are approximately 290,000 square feet, 13.79 year old, and 81.7 percent leased.

A correlation coefficient matrix that includes the dependent variable, SOLD, and each of the 15 independent variables is shown in Table 3. With a few exceptions, very little correlation found among the variable pairs. The moderate level of correlation that is found is between only a few variables. For example, the following variable pairs have correlation coefficients of over 0.40: JVEN is negatively correlated (-0.87) with UNLEV; dNPI is positively correlated (0.51) with dEMP; the SQFT and AGE variables are correlated with their squared components at 0.64 and 0.88, respectively. The effect of the correlated variables is considered when we evaluate the estimated coefficients of the probit model.

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## Results

The results of the probit estimation are presented in Tables 4, 5, and 6. To consider the relative strength of the model factors, the estimation of the likelihood of sale using only the market condition variables is first presented in Table 4. Table 5 then reports the results of

estimating the likelihood of sale considering only the ownership and property variables. To evaluate the stability of the coefficient estimates, Table 6 includes (combines) the two sets of variables into a single full-model estimate.

The probit estimation using the market condition variables is reported in Table 4. The model estimate is statistically significant and has a pseudo-R2 of 0.059. Individually (and jointly) the coefficient estimates are reported to be different from zero at the 99 percent significance level. The signs on the estimated coefficients are consistent with expectations. Economic expansion in the general market (dEMP) and in the real estate market (dNPI) increases the probability of a sale. In contrast, increased returns in the stock market (dSTK) decrease the probability of a property transaction; thus, this provides statistical evidence of a capital markets “flow of funds” effect on the real estate market. In addition, the mortgage interest rate (highly correlated with 10-year treasury rates) is negatively correlated with the probability of sale and, as anticipated, the Tax Reform Act of 1986 negatively affects the likelihood of property sale. The marginal effect of TAX86 on the probability of sale is estimated to be -6.8 percent. The marginal effect of each variable is discussed in conjunction with the full model.

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Table 5 reports the probit estimate using ownership and property-specific factors. Again, the model estimate is statistically significant. Interesting the pseudo-R2 of 0.057 and the model’s LR chi-square test are nearly identical to the model using only market condition factors. Interestingly, this suggests that the ownership/property-specific factors and the market condition factors are equally important in determining the likelihood of sale. Neither is dominant. The signs on estimated coefficients are again consistent with expectations. With the exception of the estimated coefficient on JVEN and SQFT2, all coefficient estimates are highly significant. The coefficient estimate on JVEN is moderately significant (Prob.-level = 0.118). It is important to note that the coefficient estimate on JVEN is likely affected by its correlation with UNLEV.

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—Insert Table 5 about Here—  
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The results of the combined model probit estimation are reported in Table 6. As expected, the combined model estimate is statistically significant. The pseudo-R2 of .1149 is almost double that of the partial models reported in Tables 4 and 5, strengthening the argument that market conditions and the characteristics of owners and properties play significant, independent, and approximately equivalent roles in determining transaction frequency. With the exception of LEASED, the estimated coefficients on each of the variables in Table 6 are found to be generally consistent with those reported in Tables 4 and 5. In Table 6, the estimated coefficient on LEASED is not found to be statistically significant. It is useful to note that this is possibly due to the moderate correlation of LEASED with the TAX86 variable.

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We report the marginal effects of the independent variables in the tables and use them to evaluate the variable's relative importance. The interpretation of the estimated coefficient in the probit model is that a one-unit increase in the respective independent variable increases the probit index by the size of the coefficient. The marginal effects ( $dF/dz$ ) indicate the change in the probability of sale associated with one-unit change in independent variable. Thus, we can say that a change of one-percent (one-unit) in the NPI, employment, and interest rates have a significant and sizable effect on the probability of sale. In addition, the size and direction of the effects of FUND, TAX86, and UNLEV are similar. Finally, the effects of AGE and SQFT, while statistically significant, are relatively small in magnitude.

As an initial test of the consistency in the probability of sale response of each of the primary real estate market sectors (i.e., apartment, retail, office, and industrial) to changes in market conditions we interact market sector dummies with  $dNPI$ ,  $dSTK$ , and  $dEMP$ . The omitted sector consists of hotels. The general expectation is that market sectors with more risk (higher

price volatility) likely experience a greater probability of sale response to market change. The results are reported in Table 7. The results indicate that very similar responses to changes in market conditions occur in each sector. Formal tests of equality among the coefficients of the respective sectors are reported at the bottom of Table 7. The hypothesis that all sector coefficients are equal cannot be rejected for changes in the NPI. Equality among sector coefficients is rejected for changes in employment and the stock market. However, it should be noted that the magnitude of the difference is small, and the statistical significance should not be overstated. Additional study of the response of each sector to changes in the market conditions, as well as property and ownership factors is an area requiring further study.

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## **Conclusion**

This study examines the primary factors that “explain” observed intertemporal variation in transaction frequency of institution-grade commercial real estate. Using data on sold and unsold properties from the underlying database of the NCREIF index (NPI), we estimate alternative probit models and test the statistical significance of factors expected to be correlated with the likelihood of a transaction occurring. The probability of an investment-grade commercial property sale occurring is significantly related to at least three basic factors: (1) market conditions, (2) property characteristics, and (3) ownership characteristics. Interestingly, the three factors appear to play significant, independent, and approximately equivalent roles in determining transaction frequency.

Transaction frequency, often characterized as pro-cyclical, is positively correlated with changes in the economic conditions of the market. Economic expansion of the general market, as measured by the average annual percentage change in MSA employment (*dEMP*), significantly increases the probability of a property sale. Similarly, a perceived strength in the real estate market, as measured by positive changes in the NPI (*dNPI*), is accompanied by increased

transaction frequency. In addition, we report statistical evidence of an important capital markets "flow of funds" effect on the institutional-grade commercial real estate market. An increase in the annual returns of the stock market (*dSTK*) is correlated with decreases in property transaction frequency. The "flow of funds" effect is found after controlling for any "cost of debt" (mortgage funds) effect, where the probability of sale is negatively correlated with increases in the yield rates on mortgage funds. Finally, the Tax Reform Act of 1986 is found to have reduced the probability of property sales in the two years immediately following the Act by about 6 percent.

Ownership factors, such as if the property is held in an open-end or closed-end fund; if it is held in a joint venture; or if it is not leveraged; are all correlated with diminished transaction frequency. Property factors, such as the age and square footage of the property, while statistically significant, are relatively small in magnitude. Older properties are more likely to transact than younger, otherwise comparable, properties. The larger properties in the NCREIF database are found to be less likely to transact.

Finally, the test hypothesis that all sectors (e.g., office, industrial, retail, and apartment) respond equally cannot be rejected for changes in the NPI. Equality among sector coefficients is rejected for changes in employment and the stock market. However, it should be noted that the magnitude of the difference is small, and the statistical significance should not be overstated. Additional study of the response of each sector to changes in the market conditions, as well as property and ownership factors is required.

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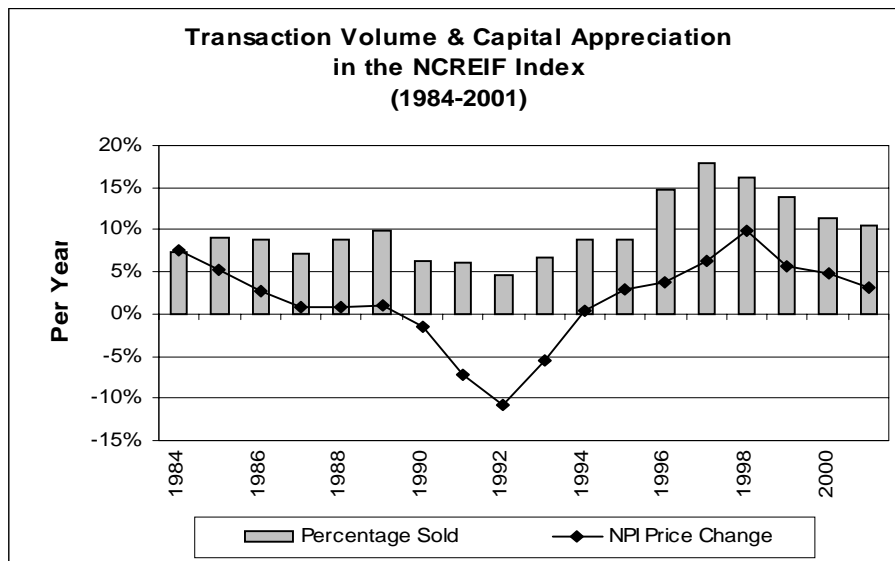
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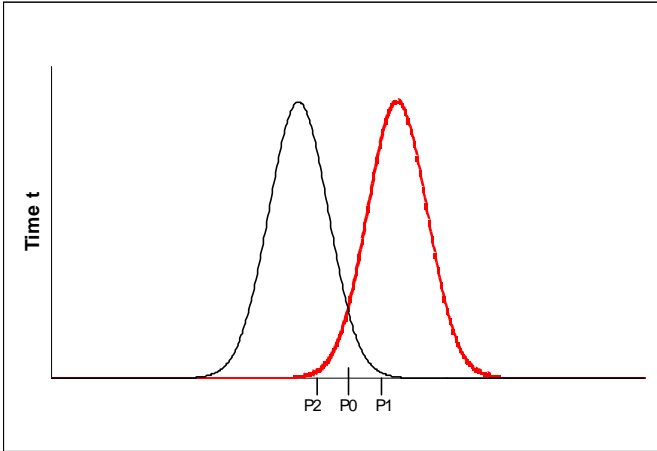
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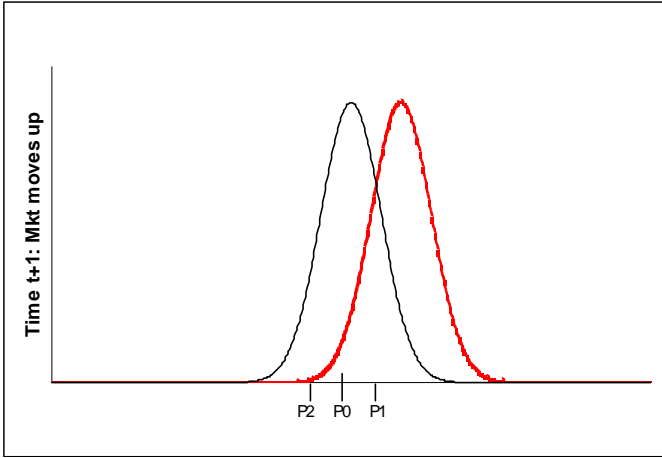
**Figure 1: Transaction Volume and Price Change**



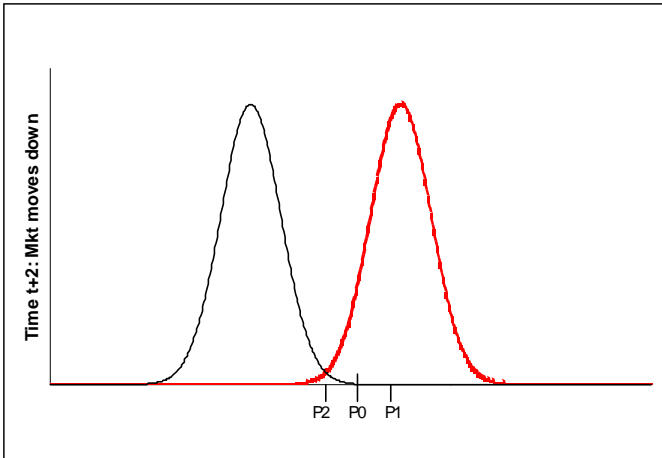
**Figure 2: Buyer / Seller Reservation Prices and Changes in Transaction Frequencies**



**A. Base Condition (Period t)**



**B. "Up" Market Condition (Period t+1)**



**C. "Down" Market Condition (Period t+2)**

**Table 1**  
**Summary Statistics: Sold and Unsold Properties**  
**(Listed by Year, 1985-2001)**

Year	Total		Sold Properties			Unsold Properties			
	Obs.	Obs.	% of Total	Mean SF	Mean \$/SF	Obs.	% of Total	Mean SF	Mean \$/SF
1985	112	3	2.68	562,087	13.46	109	97.32	170,085	56.42
1986	224	4	1.79	346,320	78.23	220	98.21	258,294	65.98
1987	354	7	1.98	234,789	54.50	347	98.02	251,590	72.05
1988	459	12	2.61	552,493	41.95	447	97.39	259,710	78.10
1989	552	26	4.71	221,375	73.21	526	95.29	274,358	84.34
1990	690	27	3.91	189,926	57.62	663	96.09	271,249	84.79
1991	837	21	2.51	185,717	50.66	816	97.49	273,296	77.57
1992	906	11	1.21	218,458	35.20	895	98.79	271,204	70.23
1993	1,079	24	2.22	166,840	50.18	1,055	97.78	272,905	66.66
1994	1,112	30	2.70	315,475	56.05	1,082	97.30	280,061	66.83
1995	1,250	27	2.16	302,283	76.06	1,223	97.84	283,545	67.04
1996	1,628	143	8.78	230,059	67.68	1,485	91.22	293,489	72.74
1997	1,804	317	17.57	241,379	72.23	1,487	82.43	300,153	77.58
1998	1,818	285	15.68	268,510	88.10	1,533	84.32	301,310	88.77
1999	1,920	225	11.72	258,446	85.11	1,695	88.28	306,068	95.40
2000	2,111	237	11.23	267,974	98.86	1,874	88.77	323,067	100.27
2001	1,576	157	9.96	252,007	88.49	1,419	90.04	334,176	104.06
<b>Totals</b>	<b>18,432</b>	<b>1,556</b>	<b>8.44</b>			<b>16,876</b>	<b>91.56</b>		

Note: Unsold properties are identified as unsold and in the database in the second quarter of each year

**Table 2**  
**Summary Statistics: Dependent and Independent Variables**  
**(1985-2001)**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
SOLD	0.084	0.278	0	1
dNPI	0.019	0.024	-0.053	0.047
dSTK	0.053	0.087	-0.227	0.213
dEMP	0.025	0.020	-0.050	0.115
TAX86	0.031	0.174	0	1
MRATE	0.079	0.011	0.067	0.122
FUND	0.285	0.451	0	1
JVEN	0.233	0.423	0	1
UNLEV	0.739	0.439	0	1
HPER	4.463	3.641	1	23
LEASED	0.817	0.322	0.00	1.11
SQFT	290,048	352,221	3,079	15,600,000
SQFT2	208.000	2650.000	0.009	243000.000
AGE	13.790	9.560	0	109.000
AGE2	281.575	549.434	0	11881.000

Notes:

SOLD, if property sold in period t then 1, otherwise 0

dNPI denotes the percentage quarterly return in period t

dSTK denotes the percentage annual return in period t

dEMP denotes the ave. annual pct. change in MSA's employment in the previous two years.

TAX86 is a dummy variable equal to 1 if the year is 1986 or 1987, otherwise 0

MRATE is the average effective yield rate on 30-year mortgages

FUND is a dummy variable equal to 1 if property is held in an open-end fund, otherwise 0

JVEN is a dummy variable equal to 1 if property is held by joint venture, otherwise 0

UNLEV is a dummy variable equal to 1 if property is held without debt, otherwise 0

HPER is the number of years property has been held in period t

LEASED is the percent of property leased in period t

SQFT is the square footage of the property; SQFT2 is SQFT squared (billions).

AGE is the age of the property in period t; AGE2 is AGE squared.

**Table 3**  
**Correlation Coefficient Matrix**  
**(1985 - 2001)**

	<b>SOLD</b>	<b>dNPI</b>	<b>dSTK</b>	<b>dEMP</b>	<b>TAX86</b>	<b>MRATE</b>	<b>FUND</b>	<b>JVEN</b>	<b>UNLEV</b>	<b>HPER</b>	<b>LEASED</b>	<b>SQFT</b>	<b>SQFT2</b>	<b>AGE</b>	<b>AGE2</b>
<b>SOLD</b>	1.00														
<b>dNPI</b>	0.11	1.00													
<b>dSTK</b>	-0.09	-0.03	1.00												
<b>dEMP</b>	0.07	0.51	0.08	1.00											
<b>TAX86</b>	-0.04	0.06	-0.35	0.01	1.00										
<b>MRATE</b>	-0.07	-0.29	-0.24	-0.11	0.38	1.00									
<b>FUND</b>	-0.07	0.02	0.01	0.04	0.01	0.01	1.00								
<b>JVEN</b>	0.03	-0.05	-0.06	-0.03	0.05	0.13	-0.19	1.00							
<b>UNLEV</b>	-0.04	0.04	0.05	0.03	-0.08	-0.14	0.21	-0.87	1.00						
<b>HPER</b>	0.12	-0.01	-0.01	-0.07	-0.03	-0.03	0.22	-0.13	0.14	1.00					
<b>LEASED</b>	0.06	0.20	0.10	0.10	-0.33	-0.44	-0.21	0.03	-0.04	-0.06	1.00				
<b>SQFT</b>	-0.03	0.03	0.00	0.00	-0.02	-0.04	-0.07	0.17	-0.20	-0.08	0.06	1.00			
<b>SQFT2</b>	-0.01	0.01	-0.01	-0.01	0.00	-0.01	-0.02	0.05	-0.05	-0.02	0.01	0.64	1.00		
<b>AGE</b>	0.08	0.10	0.02	-0.03	-0.05	-0.13	-0.03	0.03	-0.05	0.20	0.04	0.12	0.04	1.00	
<b>AGE2</b>	0.05	0.06	0.00	-0.04	-0.04	-0.08	-0.03	0.04	-0.04	0.07	0.04	0.09	0.03	0.88	1.00

Notes:

SOLD, if property sold in period t then 1, otherwise 0

dNPI denotes the percentage quarterly return in period t

dSTK denotes the percentage annual return in period t

dEMP denotes the ave. annual pct. change in MSA's employment in the previous two years.

TAX86 is a dummy variable equal to 1 if the year is 1986 or 1987, otherwise 0

MRATE is the average effective yield rate on 30-year mortgages

FUND is a dummy variable equal to 1 if property is held in an open-end fund, otherwise 0

JVEN is a dummy variable equal to 1 if property is held by joint venture, otherwise 0

UNLEV is a dummy variable equal to 1 if property is held without debt, otherwise 0

HPER is the number of years property has been held in period t

LEASED is the percent of property leased in period t

SQFT is the square footage of the property; SQFT2 is SQFT squared (billions).

AGE is the age of the property in period t; AGE2 is AGE squared.

**Table 4**  
**Probit Model: Estimated using Economic Factors**  
**(dependent variable =1 if property sells, 0 otherwise)**

<b>Panel A: Coefficient Estimates</b>				
<b>Ind. Var.</b>	<b><math>\beta</math> Est.</b>	<b>Std. Error</b>	<b>t-stat</b>	<b>Prob.&gt; t </b>
<b>dNPI</b>	10.621	0.959	11.08	0.000
<b>dSTK</b>	-2.473	0.162	-15.22	0.000
<b>dEMP</b>	3.656	0.869	4.20	0.000
<b>TAX86</b>	-1.004	0.128	-7.86	0.000
<b>MRATE</b>	-5.358	1.591	-3.37	0.001
<b>CONST</b>	-1.176	0.133	-8.84	0.000

Number of obs. = 18,432

LR chi2 (5) = 24.91 Prob.>chi2 = 0.000

Log likelihood = -5022.32

Pseudo R2 = 0.059

<b>Panel B: Marginal Effect Estimates</b>				
<b>Ind. Var.</b>	<b>dF/dz</b>	<b>t-stat</b>	<b>95% Conf. Interval</b>	
<b>dNPI</b>	1.441	11.08	1.198	1.684
<b>dSTK</b>	-0.336	-15.22	-0.379	-0.292
<b>dEMP</b>	0.496	4.20	0.265	0.727
<b>TAX86*</b>	-0.068	-7.86	-0.075	-0.061
<b>MRATE</b>	-0.727	-3.37	-1.151	-0.303

Note: (\*) dF/dz is for discrete change of dummy variable from 0 to 1

**Table 5**  
**Probit Model: Estimated using Property/Ownership Factors**  
 (dependent variable =1 if property sells, 0 otherwise)

<b>Panel A: Coefficient Estimates</b>				
<b>Ind. Var.</b>	<b><math>\beta</math> Est.</b>	<b>Std.Error</b>	<b>t-stat</b>	<b>Prob.&gt; t </b>
<b>FUND</b>	-0.377	0.036	-10.58	0.000
<b>JVEN</b>	-0.097	0.062	-1.56	0.118
<b>UNLEV</b>	-0.287	0.060	-4.77	0.000
<b>HPER</b>	0.056	0.004	14.93	0.000
<b>LEASED</b>	0.383	0.050	7.65	0.000
<b>SQFT</b>	-3.60E-07	1.15E-07	-3.12	0.002
<b>SQFT2</b>	-1.76E-16	7.62E-14	0.00	0.998
<b>AGE</b>	0.020617	0.003122	6.60	0.000
<b>AGE2</b>	-0.000174	0.000049	-3.59	0.000
<b>CONST</b>	-1.806	0.083	-21.73	0.000

Number of obs. = 18,432

LR chi2 (9) = 07.42 Prob.>chi2 = 0.000

Log likelihood = -5031.07

Pseudo R2 = 0.057

<b>Panel B: Marginal Effect Estimates</b>				
<b>Ind. Var.</b>	<b>dF/dz</b>	<b>t-stat</b>	<b>95% Conf. Interval</b>	
<b>FUND*</b>	-0.047	-10.58	-0.054	-0.039
<b>JVEN*</b>	-0.013	-1.56	-0.029	0.003
<b>UNLEV*</b>	-0.044	-4.77	-0.064	-0.024
<b>HPER</b>	0.008	14.93	0.007	0.009
<b>LEASED</b>	0.053	7.65	0.039	0.066
<b>SQFT</b>	-4.97E-08	-3.12	-8.10E-08	-1.80E-08
<b>SQFT2</b>	-2.43E-17	0.00	-2.10E-14	2.10E-14
<b>AGE</b>	0.002848	6.60	0.002009	0.003687
<b>AGE2</b>	-0.000024	-3.59	-0.000037	-0.000011

Note: (\*) dF/dz is for discrete change of dummy variable from 0 to 1

**Table 6**  
**Probit Model: Economic, Property, & Ownership Factors**  
 (dependent variable =1 if property sells, 0 otherwise)

<b>Panel A: Coefficient Estimates</b>				
<b>Ind. Var.</b>	<b><math>\beta</math> Est.</b>	<b>Std. Error</b>	<b>t-stat</b>	<b>Prob.&gt; t </b>
<b>dNPI</b>	10.686	1.024	10.43	0.000
<b>dSTK</b>	-2.644	0.170	-15.53	0.000
<b>dEMP</b>	5.983	0.910	6.58	0.000
<b>TAX86</b>	-0.995	0.134	-7.44	0.000
<b>MRATE</b>	-6.232	1.771	-3.52	0.000
<b>FUND</b>	-0.451	0.037	-12.17	0.000
<b>JVEN</b>	-0.108	0.063	-1.70	0.089
<b>UNLEV</b>	-0.383	0.062	-6.20	0.000
<b>HPER</b>	0.063	0.004	16.30	0.000
<b>LEASED</b>	0.062	0.060	1.05	0.296
<b>SQFT</b>	-4.21E-07	6.38E-08	-6.60	0.000
<b>SQFT2</b>	1.95E-14	1.68E-14	1.16	0.246
<b>AGE</b>	0.017001	0.003235	5.26	0.000
<b>AGE2</b>	-0.000141	0.000049	-2.84	0.004
<b>CONST</b>	-1.221	0.188	-6.49	0.000

Number of obs. = 18,432

LR chi2 (14) = 221.50 Prob.>chi2 = 0.000

Log likelihood = -4724.03

Pseudo R2 = 0.1145

<b>Panel B: Marginal Effect Estimates</b>				
<b>Ind. Var.</b>	<b>dF/dz</b>	<b>t-stat</b>	<b>95% Conf. Interval</b>	
<b>dNPI</b>	1.260	10.43	1.034	1.486
<b>dSTK</b>	-0.312	-15.53	-0.352	-0.272
<b>dEMP</b>	0.706	6.58	0.496	0.915
<b>TAX86*</b>	-0.057	-7.44	-0.063	-0.051
<b>MRATE</b>	-0.735	-3.52	-1.146	-0.324
<b>FUND*</b>	-0.046	-12.17	-0.053	-0.040
<b>JVEN*</b>	-0.012	-1.70	-0.026	0.001
<b>UNLEV*</b>	-0.052	-6.20	-0.071	-0.033
<b>HPER</b>	0.007	16.30	0.007	0.008
<b>LEASED</b>	0.007	1.05	-0.006	0.021
<b>SQFT</b>	-4.97E-08	-6.60	-6.40E-08	-3.50E-08
<b>SQFT2</b>	2.30E-15	1.16	-1.60E-15	6.20E-15
<b>AGE</b>	0.002005	5.26	0.001261	0.002749
<b>AGE2</b>	-0.000017	-2.84	-0.000028	-0.000005

Note: (\*) dF/dz is for discrete change of dummy variable from 0 to 1

**Table 7**  
**Probit Model: with Interaction Terms**  
 (dependent variable =1 if property sells, 0 otherwise)

Coefficient Estimates				
Ind. Var.	$\beta$ Est.	Std. Error	t-stat	Prob.> t
<b>dNPI</b>	-12.476	23.839	-0.52	0.601
<b>dSTK</b>	1.871	4.204	0.45	0.656
<b>dEMP</b>	44.955	32.285	1.39	0.164
<b>TAX86</b>	-0.986	0.136	-7.25	0.000
<b>MRATE</b>	-5.971	1.791	-3.33	0.001
<b>FUND</b>	-0.462	0.037	-12.34	0.000
<b>JVEN</b>	-0.111	0.064	-1.75	0.081
<b>UNLEV</b>	-0.384	0.062	-6.17	0.000
<b>HPER</b>	0.064	0.004	16.44	0.000
<b>LEASED</b>	0.058	0.061	0.96	0.335
<b>SQFT</b>	-4.13E-07	6.34E-08	-6.51	0.000
<b>SQFT2</b>	1.99E-14	1.38E-14	1.44	0.149
<b>AGE</b>	0.018434	0.003301	5.59	0.000
<b>AGE2</b>	-0.000156	0.000050	-3.12	0.002
<b>CONST</b>	-2.635	1.299	-2.03	0.043
<b>APT_D</b>	1.677	1.290	1.30	0.194
<b>RET_D</b>	1.178	1.289	0.91	0.361
<b>OFF_D</b>	1.438	1.288	1.12	0.264
<b>IND_D</b>	1.310	1.288	1.02	0.309
<b>NPI_OFF</b>	23.528	23.907	0.98	0.325
<b>NPI_IND</b>	22.575	23.890	0.94	0.345
<b>NPI_APT</b>	20.707	23.947	0.86	0.387
<b>NPI_RET</b>	25.170	23.949	1.05	0.293
<b>STK_OFF</b>	-4.216	4.215	-1.00	0.317
<b>STK_IND</b>	-4.950	4.214	-1.17	0.240
<b>STK_APT</b>	-5.053	4.222	-1.20	0.231
<b>STK_RET</b>	-3.690	4.222	-0.87	0.382
<b>EMP_OFF</b>	-40.865	32.336	-1.26	0.206
<b>EMP_IND</b>	-35.821	32.317	-1.11	0.268
<b>EMP_APT</b>	-43.812	32.349	-1.35	0.176
<b>EMP_RET</b>	-38.121	32.351	-1.18	0.239

Number of obs. = 18,432

LR chi2 (30) = 262.28                      Prob.>chi2 = 0.000

Log likelihood = -4703.64                  Pseudo R2 = 0.1183

Test  $\beta_{(NPI\_APT)} = \beta_{(NPI\_RET)} = \beta_{(NPI\_OFF)} = \beta_{(NPI\_IND)}$   
 chi2( 3) = 2.04                                  Prob > chi2 = 0.5632

Test  $\beta_{(STK\_APT)} = \beta_{(STK\_RET)} = \beta_{(STK\_OFF)} = \beta_{(STK\_IND)}$   
 chi2( 3) = 9.79                                  Prob > chi2 = 0.0204

Test  $\beta_{(EMP\_APT)} = \beta_{(EMP\_RET)} = \beta_{(EMP\_OFF)} = \beta_{(EMP\_IND)}$   
 chi2( 3) = 11.09                                Prob > chi2 = 0.0112