New Evidence on the Green Building Rent and Price Premium

by

Franz Fuerst and Patrick McAllister*

Paper presented at the Annual Meeting of the American Real Estate Society, Monterey, CA, April 3, 2009.

Acknowledgement

The authors wish to thank the CoStar Group for providing the large dataset needed to perform this analysis. All errors remain our own.

*The University of Reading, Henley Business School, School of Real Estate and Planning, PO Box 219, Whiteknights, Reading, RG6 6AW, UK, Tel : + 44 (0) 118 931 6657, Fax : + 44 (0) 118 931 8172 e.mail: p.m.mcallister@rdg.ac.uk or f.fuerst@rdg.ac.uk

Abstract

This paper investigates the effect of voluntary eco-certification on the rental and sale prices of US commercial office properties. Hedonic and logistic regressions are used to test whether there are rental and sale price premiums for LEED and Energy Star certified buildings. The results of the hedonic analysis suggest that there is a rental premium of approximately 6% for LEED and Energy Star certification. A sale price premium of approximately 35% was found for 127 price observations involving LEED rated buildings and 31% for 662 buildings involving Energy Star rated buildings. When compared to samples of similar buildings identified by a binomial logistic regression for LEED-certified buildings, the existence of a rent and sales price premium is confirmed albeit with differences regarding the magnitude of the premium. Overall, the results of this study confirm that LEED and Energy Star buildings exhibit higher rental rates and sales prices per square foot controlling for a large number of location- and property-specific factors.

Introduction

The supply of environmentally responsible goods and services has experienced considerable growth rates in recent years for a diverse range of products including agricultural produce, clothing, consumer electronics and real estate. What the markets for these products have in common is an increasing willingness of customers to pay a premium which is potentially based on a heightened awareness of the environmental impact of production and consumption patterns. This trend has been assisted by independent third party (albeit often government sponsored) certification and labeling programs and codes. Indeed, in the real estate sector, eco-labeling has been a central element of a blend of governmental policies and voluntary market change that is attempting to produce reductions in carbon emissions from the commercial real estate sector. While government intervention can be in the form of new regulations and standards, financial incentives, leadership or example and education and information, this paper focuses on the potential role of the voluntary eco-labelling of commercial offices to affect market prices and, consequently, to produce favourable environmental outcomes. In essence, this study attempts to measure the revealed preferences of market participants who lease and invest in eco-labeled commercial offices.

The framework for this research is that occupier and investor preferences towards existing stock may change in the light of growing awareness of environmental sustainability and this change in behaviour should manifest itself in the form of price signals (rental and capital values). A key expectation is that price signals will emerge through the operation of markets and result in changes in the relative allocation of resources within the commercial real estate sector. Higher relative risk-adjusted returns from environmentally responsible buildings should provide an incentive to market participants to allocate capital investment to their production.

Building on previous empirical work, this paper provides an empirical investigation of the rental and sale price differentials between LEED and Energy Star certified buildings and non-certified commercial buildings in the US. In the analysis, certified buildings are compared to a sample of non-certified buildings which were selected to include properties in the same submarket areas as the certified sample. Two techniques are used to test whether there are significant price differentials. Firstly, rents and prices are related to a set of hedonic characteristics of the buildings such as age, location, number of stories *inter alia*. Essentially, our hedonic model measures price differences between certified buildings and randomly selected non-certified buildings in the same submarkets area controlling for differences in lease contract, age, height, quality, sub-market etc. We first estimate rental regressions for a sample of approximately 200 LEED and 800 Energy Star (the precise number varies slightly with model specification) as well as approximately 10,000 buildings in the control group. The results of hedonic regression suggest that there is a rental premium of approximately 6% for LEED and Energy certification. In terms of LEED level, although the coefficients have the expected signs, only the Certified and Platinum level have a significant premium. Based on a sample of transaction prices for 662 Energy Star and 127 LEED-certified buildings, we find price premiums of 31% and 35% respectively.

In trying to mitigate a potential omitted variable bias in the hedonic framework, we also apply a probabilistic logistic regression approach. This provides a method of selecting buildings in the control sample that are sufficiently similar to the eco-certified group. Based on the individual probability scores obtained from the logistic regression, we then define buildings for inclusion in a peer group sample. When compared to samples of similar buildings identified by a binomial logistic regression for LEED-certified buildings, the existence of a rent and sales price premium is confirmed albeit with differences regarding the magnitude of the premium.

This paper is organized as follows. The first section provides background discussion to the topic focusing on the growth in environmental certification, the nature of eco-labeled buildings and previous research on their costs and benefits. The main empirical section outlines the data and methods applied in the study followed by a discussion of the results and considerations of the validity of the results as well as possible paths for future research.

Background and Context

Eco-labeling in Commercial Real Estate Markets

Many certification and labeling codes are viewed as contributing to a price-based solution to promote increased provision of environmental public goods (Kotchen, 2006). A commonly accepted advantage of voluntary eco-labels is that the prices of sustainable attributes can be revealed through the operation of markets and potential inefficiencies associated with government intervention and compulsory standards are avoided. In common with many eco-certification schemes, the major objective is to provide information to market participants about the environmental effects of the production and consumption of products and/or services. The aims are broadly twofold. The first is, by providing information, to encourage a shift towards more environmentally responsible consumption. The second is to stimulate producers and other market participants to improve the environmental standards of products and services. In particular, as a form of eco-label, Energy Star allows comparison of the energy efficiency of buildings. This allows prospective buyers and occupiers to see information on the energy efficiency so they can consider these issues as part of their decision on investment or occupation.

It can be inferred that policy makers expect market participants to respond to the greater transparency provided by certification. Envisaged (interlinked) outcomes may involve changes in the supply and demand curves for environmentally responsible buildings that alter investment decisions by owners and occupiers and lead to differential rental pricing and rental growth (or depreciation) of new and existing buildings linked to the level of their carbon emissions. Hence, it is expected that the interaction of improved information, market transparency and the price mechanism will produce positive environmental outcomes.

Although arguably still in nascent form, in many real estate markets a blend of voluntary and mandatory eco-labels have emerged in a number of commercial real estate markets. Voluntary environmental certification systems for buildings include schemes such as Green Star (Australia), LEED (USA), Energy Star (USA), Green Globes (USA), and BREEAM (UK). These schemes supplement mandatory approaches that can specify minimum environmental standards and the provision of information on environmental effects. Compulsory certification of energy efficiency was introduced in the European Union in 2008 following the EU Energy Performance of Buildings Directive and takes the form of Energy Performance Certificates and Display Energy Certificates.

As noted above, this paper focuses on LEED and Energy Star certification. The LEED Green Building Rating System, developed by the U.S. Green Building Council, consists of set of standards for the assessment of environmentally sustainable construction. The rates of growth in numbers of 'green' buildings have been rapid with numbers doubling nearly every two years. As of April 1, 2009 the CoStar database indicates that there are 402 LEED rated office buildings and 1925 Energy Star rated office buildings. In common with the major regional certification such as Green Star and BREEAM, the rating system focuses on six broad categories related to: sustainability of location, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality and innovation and design process.

There are different levels of LEED accreditation based upon a scoring founded upon the six major categories listed above. In LEED v2.2 for new construction and major renovations for commercial premises, buildings may qualify for four levels of certification.

- Certified: 26-32 points
- Silver: 33-38 points
- Gold: 39-51 points
- Platinum: 52-69 points

For existing buildings, the Energy Star scheme provides a more widespread scheme for eco-certification as Energy Star-certified buildings greatly outnumber those certified under the USGBC's LEED-EB program for existing buildings. The Energy Star scheme involves an assessment of buildings' energy performance. Buildings are awarded a score out of 100. Only buildings that are in the top quartile are eligible for Energy Star accreditation. Office properties tend to dominate both the LEED and Energy Star in terms of space and numbers (Nelson, 2007). Based on anecdotal evidence, LEED certification may be more prestigious than Energy Star as it provides a more comprehensive evaluation of a building's environmental impact. It is notable that there have been reports of some real estate developers making fraudulent claims about having obtained LEED certification in the early stages of construction (see Burr, 2009). This underlines the perceived attractiveness of the LEED certification scheme. Furthermore, LEED certification is more costly to obtain in terms of fees, encompasses a broader range of sustainable attributes and is comparable to other real estate eco-certification schemes in the UK, Germany and Australia. There is an expectation that premiums should vary between Energy Star and LEED certified buildings and also within the different levels of LEED buildings.

A common mistake made in the discussion of "green" buildings is that the costs and benefits of eco-labeling and the costs and benefits of incorporating environmentally responsible features and practices in buildings are lumped together, although they should be considered separately. Regardless of the source (label or actual performance), there are a range of benefits for owners and occupiers that have been reported in the majority of empirical studies. Moreover, these buildings may be eligible for the growing array of subsidies and tax benefits[1] that have appeared for eco-labeled buildings. Occupiers can have reduced costs of operating buildings (mainly associated with energy and other utility savings), improved productivity (due to reduced staff turnover, absenteeism *inter alia*) and other competitive advantages linked to marketing and image benefits.

As well as potential rental uplifts, investors may benefit from reduced holding costs (due to lower vacancy rates and higher tenant retention), reduced operational costs (due to energy and

[1] A number of US states have introduced different types of incentives to encourage greater supply of certified buildings.

other utility savings), reduced depreciation (linked to the use of latest technologies) and reduced regulatory risks. In turn, surveys of willingness-to-pay have found that occupiers have stated that they are prepared to compensate owners for the additional costs of eco-certified buildings through higher rents (see GVA Grimley, 2007 and McGraw Hill Construction, 2006 for examples). However, it is important to distinguish between what occupiers and investors state that they are ready to pay from what they really pay.

Price formation in commercial real estate markets

A potentially significant factor influencing the existence and/or the level of a premium for environmentally responsible buildings is the price setting process. In the marketing literature, there are three broad strategies to price setting,

- Estimation of reservation prices of occupiers through market research techniques.
- Link to competitors' pricing levels
- Cost-plus pricing (based on average cost)

While it may be the case that "for many companies, average cost is the initial, paramount, or only determinant in price setting" (Shipley and Jobber, 2001, 307), this is unlikely to be the case in the commercial real estate rental market. It is more difficult to link pricing to cost and anecdotal evidence suggests that competition-linked pricing dominates. In the absence of suitable certified comparables and clear pricing signals, owners may anchor on the prices of non-certified buildings. Pricing strategy may also be influenced by whether developers tend to adopt price skimming or penetration strategies.

Apart from a small number of studies on the empirics of search theory and the microfoundations of the natural vacancy rate theory, research on the price setting strategies in commercial real estate markets is relatively scant. Conventionally, marketing of commercial real estate assets for occupation is based upon the 'posting' of asking rents that are then subject to negotiation about the detailed terms of the lease contract and rent. Although developers of certified buildings may be confident that potential occupiers will obtain an additional consumer surplus relative to non-certified buildings, information about potential occupiers' willingness-to-pay may be costly to obtain. In contrast, in many consumer markets, buyers' reservation prices for environmentally responsible products can be estimated from actual trading prices. Since the heterogeneity of commercial real estate premises reduces the availability of clear market pricing signals, owners of certified buildings are faced with difficulty in assessing the reservation prices of occupiers for a relatively novel product.

Sales prices tend to be determined by a similar process. Typically, the vendor lists the property with brokers and sets an asking price. This asking price may be linked to pricing levels observed in recent transactions. Prospective buyers can then send Letters of Intent (LOIs) that describe the general terms (including sale price) under which they would buy the property.

A Cost Premium?

Depending on the relationship between price and production cost, the existence and size of a cost premium to construct certified buildings may be relevant to price premiums. There have been a number of studies of the construction cost premium associated with achieving certification (see, for example, Kats, 2003; Berry, 2007; Morrison Hershfield, 2005). These studies suggest small construction cost premiums of around 2% on average. To investigate the cost premium in more depth, Matthiesen and Morris (2007) analyzed 83 building projects with a primary goal of LEED certification and 138 similar building projects without the goal of sustainable design. Confirming the findings of earlier studies, they found no significant difference in average costs for building projects with a primary goal of LEED certification as compared to non-certified buildings.

It is worth noting that the methodological difficulties in measuring the cost premium raise similar issues to measuring the price premium. In particular, there are difficulties in identifying an appropriate benchmark for comparison between the two types of building (conventional and environmentally responsible). In addition, there is expected to be substantial cross-sectional variation between building projects. However, the conclusion from this evidence of a largely insignificant cost premium is that, if rental asking prices are formed on a 'cost plus' basis, owners may not be driven to demand rental premiums due to cost pressures.

Lease Contracts

The type of lease contract may also be a factor in the rent determination process. It is well-established the allocation of cost liability for property taxes, insurance, maintenance, repairs and utility costs will have an impact on the rental level. In research on the pricing of variations in lease terms, the standard assumption of lease pricing models is that real estate investors will extract the same value from the property regardless of leases structure (see Grenadier, 1995, Booth and Walsh, 2001, Ambrose, Hendershott and Klosek, 2002). In short, investors are assumed to be fully compensated by rental adjustments for the costs of providing ‘benefits’ to tenants. However, in practice, institutional features of the rent determination process may prevent the transmission of expected price effects to actual prices. For instance, researchers have been unable to identify empirically an expected term structure of rents (see Bond, Loizou and McAllister, 2008, Englund, Gunnelin, Hoesli and Söderberg, 2003).

In this context, there is an important distinction between lease structures in which the tenant is responsible for the costs of energy and lease structures where the owner is liable. For the latter, it is expected that tenants will pay a higher rent for a leasing on a gross or full service basis. However, since an owner of energy efficient buildings will incur relatively lower energy costs, *ceteris paribus*, assuming price competition they may be prepared to accept a discounted (relative to full service or gross rental contracts on poor energy efficient buildings) rental level if leasing on gross or full service terms. In addition, owners may also prefer to lease on gross or full service lease terms in order to capture the savings generated by the lower energy costs. In turn, for tenants on gross or full service leases, there is no reduced operating cost incentive to offer a higher rent for energy efficient buildings. However, since there may be image benefits associated with eco-certification or perceived business benefits associated with the use of less ‘artificial’ heating and cooling technologies, a rental premium may still be identified gross and full service leases in eco-certified buildings.

In contrast, for tenants on net leases, since they are directly liable for energy costs, there are clear operational savings associated with an energy efficient building. As a result, it is expected that tenants will be prepared to make an increased rental bid relative to comparable poor energy efficient buildings. Assuming that the rent determination process is affected by prospective energy costs, for eco-certified buildings with net lease structures, there should be a higher rental premium than for eco-certified buildings with full service or gross leases. As a result, while we expect to confirm that net leases have a lower rent than gross full service leases, we expect this differential to narrow in eco-certified buildings.

Measuring the Price Differential

When attempting to measure a price differential between a certified and non-certified product, there are two key methodological and data issues. The first problem is to identify appropriate benchmarks to compare certified and non-certified products. The second is to identify sufficient market price information from transaction activity to measure price differentials. With regard to the first issue, commercial real estate markets present some problems. In some product markets, apart from the certification label, eco-friendly goods may be indistinguishable from conventional goods e.g. some timber or food commodities. As a result, it is often straightforward to identify a suitable benchmark against which to measure a price differential. Additionally, assuming active trading, it is also likely that there will be adequate price information.

In contrast, in markets where products are bespoke (such as commercial real estate), the construction and design requirements of obtaining certification may add to inherent product heterogeneity. Further, thin trading and low market transparency may reduce the amount and quality of available price information. The result is that measuring the price differential for eco-certified buildings is hindered by the combination of the lack of an appropriate benchmark and limited price information due to thin market effects.

Since markets are dynamic, it is also expected that levels of price differential will tend to change over time. In a static equilibrium framework, the price differential *at a given point in time* can be analysed as the product of different demand and supply curves for certified and non-certified buildings. However, since supply and demand curves tend to be dynamic (e.g. due to the effects of changes in market penetration and production costs) prices adjust. Even in the short term, supply and demand elasticities will not be static for certified and non-certified buildings and, as a result, price differentials should vary over time. Furthermore, linked to the nomination problem inherent to real estate development, developer responses to a price differential will themselves shift the supply curve and affect the level of price differential.

There are also strong grounds to expect levels of price differential to vary cross-sectionally. Certified buildings are obviously not homogenous. For instance, as noted above, there are different levels of certification. As a result, there are likely to be variations between certified buildings in the levels of the potential benefits (reduced costs of occupancy, image and business performance) that may be obtained by occupiers. In turn, there may be variations between buildings in the price effects of certification.

A further aspect of the pricing issue is that certification standards themselves tend to be dynamic usually (albeit not exclusively) in an upwardly direction. For instance, it is commonly suggested that voluntary government sponsored eco-labelling standards provide a signal to market participants of the policy direction for future mandatory standards. In addition, where a certificate is awarded for relative environmental performance compared to the existing building stock e.g. Energy Star, over time this performance may deteriorate in relative terms as standards improve as existing stock is upgraded and new stock is developed. In simple terms, a building that was in the top 25% by energy performance in 1999 may not be eligible for an Energy Star rating in 2009. We are not aware that there is any process for withdrawing certification as the building population changes.

Related empirical studies

There have been few studies have attempted to measure the price effects of green building rating. Studies that have identified higher rents and improved returns based on the views and experiences of expert professions still require empirical verification. While recognizing the centrality of pricing to adoption, recent reviews of the literature have found little convincing research that identified a certification premium (see Berry, 2007). Nelson (2007) examined the performance differences between certified and non-certified buildings using a number of criteria. Drawing upon the CoStar database, the study compared LEED rated buildings and Energy Star buildings with a vastly larger sample of non-certified buildings in the CoStar database. While acknowledging the significant differences between the sample and the wider population, it found that certified buildings tended to be newer, owner-occupied or single tenanted, concentrated geographically and sectorally (in the office sector). Recognizing that it did not control for these differences, the study identified lower vacancy rates and higher rents in LEED-rated buildings.

There have been a group of studies that draw upon the CoStar database of US properties to identify the effect of environmental certification on sale prices and rents respectively. The most widely quoted among these was conducted by Miller *et al* (2008). To control for differences between their sample of certified buildings (927 buildings) and a much larger sample of non-certified buildings, the authors include a number of control variables such as size, location and age in their hedonic regression framework. They find that dummy variables for Energy Star and LEED ratings show rent premia of 6% and 10% respectively but these results are not significant at the 5 percent level.

Wiley, Benefield and Johnson (2008) focused on the effect on rent, occupancy rate and sale price of eco-certification for Class A buildings in 46 office markets across the USA[2]. Using an hedonic pricing approach, they found rental premiums ranging from approximately 15-18% for LEED certified buildings and 7-9% for Energy Star certified buildings depending on the model specification. In terms of sales transactions, they estimated premiums of $130 per sq ft for LEED certified buildings and $30 for Energy Star. However, although plausible, these results need to be treated with some caution. A limitation of their hedonic model is that it lacks controls for micro-locational effects. In essence, they identify rental and sale premiums for certified buildings relative to non-certified buildings *in the same metropolitan area*. However, if certified buildings tend to be more likely to be found in better quality locations within a metropolitan area, observed premiums may include a location as well as a certification premium.

In a recent working paper, Eichholtz, Kok and Quigley (2009) also used an hedonic framework to test for the effect of certification on the contract rents of 694 office buildings. Using GIS techniques, they control for location effects by identifying other office buildings in the CoStar database within a radius of 0.25 miles of each certified building. They identify a statistically significant rent premium on rents per square foot of 3.3% for Energy Star certified buildings. Surprisingly, they find no significant rent premium for LEED-certified buildings. However, when they used "effective" rents to reflect different vacancy rates in certified buildings, the premium increased to around 10% for Energy Star certified buildings and 9% for LEED-certified buildings[3]. Similar results were found for transaction prices. Although not discussed in the paper, they found a substantial 19% sale price premium for Energy Star certified buildings but no statistically significant premium for LEED-certified buildings. If they are confirmed, these findings have substantial implications for developers who are considering LEED certification and it is important that they are corroborated by other studies. In this paper, we apply a similar hedonic methodology to Eichholtz *et al* to a similar data set. However, instead of using the asking rent multiplied by the occupancy rate (termed 'effective rent' by the authors), we use the rental rates reported by CoStar to isolate the effect of certification on rent only. A further advantage of doing so is that we do not have to address the endogeneity and complex interaction of rents and vacancy rates in a building. More substantively, we control for location effects using actual submarkets (as defined by CoStar) rather than possibly arbitrary submarkets.

[2] Sales data were available for 26 office markets.

[3] Eichholtz *et al* also find that there is a higher relative premium for cheaper locations. However, this is likely to be due to the fact that similar absolute premiums due, for example, to lower energy costs will invariably result in higher relative premiums in less expensive locations.

While there are clearly plausible *a priori* reasons to expect price differences between certified and non-certified buildings, this is not necessarily certain. As noted below, previous research has shown that not all variations in asset attributes are necessarily reflected in asset prices (see, for example, Wheaton, 1984). Conversely, the lack of a significant premium would not necessarily preclude the existence of considerable benefits of certified buildings as described in the previous section.

Models and data

In the empirical test of rent and sales price premia of certified buildings, we apply a two-stage approach. Firstly, we adopt a standard hedonic framework. In the second stage, we select a matched peer group based on logistic regression and compare the results obtained from both types of estimates.

Hedonic analysis

Hedonic regression modeling is the standard methodology for examining price determinants in real estate research. This method is used here primarily to measure the price effect of LEED and Energy Star certification. Rosen (1974) first generalized that the hedonic price function covering any good or service consisted of a variety of utility-bearing characteristics. In office rent determination literature, hedonic modeling typically specifies that a range of physical, locational and lease characteristics be used as the independent variables determining price.

As described in the literature review section of this paper, a critical issue in measuring the price effect of eco-certification is to control for the fact that certified buildings may be newer, higher or located in more attractive locations or markets. The standard log-linear hedonic rent model takes the following form:

$$\ln R_i = \alpha_i + \beta x_i + \phi Z_i + \varepsilon_i \tag{1}$$

where R_i is the natural log of average rent per square foot in a given building, x_i is a vector of the natural log of several explanatory locational and physical characteristics, β and φ are the respective vectors of parameters to be estimated. Z_i is a vector of time-related variables and ε is a random error and stochastic disturbance term that is expected to take the form of a normal distribution with a mean of zero and a variance of σ^2. The hedonic weights assigned to each variable are equivalent to this characteristic's overall contribution to the rental price (Rosen 1974).

For the purpose of this study, we specify two types of hedonic models. The first type explains rents and the second explains price per square foot in sales transactions.

Hedonic Rent Model

$$\ln R_i = \beta_0 + \beta_1 \ln A_i + \beta_2 \ln S_i + \beta_3 \ln L_i + \beta_4 \ln T_i + \beta_5 \ln G_i + \beta_6 N_i + \beta_7 BC_i + \beta_8 SU_i + \beta_9 GR_i + \varepsilon_i \quad (2)$$

In this model, A_i represents the age of the property, measured from the year of construction or the year of a major refurbishment (whichever occurred more recently), S_i is the number of stories of the property, L_i represents the lot size, T_i and G_i are the latitude and longitude geographic coordinates of the property which capture any large-scale effects of the spatial distribution of properties across the country, N_i is a dummy variable indicating a net lease (taking the value of zero for a gross or full-service lease), BC_i are controls for building class (standard categories A,B,C and F) and SU_i are controls for submarkets (853 in total) and ε_i is the error term which is assumed to be independent across observations and normally distributed with constant variance and a mean of zero. A rent premium for LEED and/or Energy Star rated buildings is captured by the GR_i term, a dichotomous variable that takes the value of 1 for certified buildings and a value of 0 otherwise. In alternative model specifications, the GR_i dummy variable is replaced by separate terms for LEED and Energy Star certification (Model 2) and level of LEED certification (Model 3).

Hedonic Sales Transaction Price Model:

Similarly, the regression for estimating price per square foot in sales transactions is estimated in the following way:

$$\ln R_i = \beta_0 + \beta_1 \ln A_i + \beta_2 \ln S_i + \beta_3 \ln L_i + \beta_4 \ln T_i + \beta_5 \ln G_i + \beta_6 E_i + \beta_6 MC_i + \beta_7 BC_i + \beta_8 SU_i + \beta_9 GR_i + \varepsilon_i \quad (3)$$

where E_i is a time trend variable which accounts for general price inflation and other unobserved trends over time. This variable increases in semi-annual increments. Beyond this control for the overall trend, we also included E_i, which indicates market conditions at the time of sale proxied by the average quarterly return of the NAREIT index. All other variables are the same as in the rent model.

The type of specification used in the rent and transaction price models allows us to detect differences in the weight of parameter estimates across submarkets, building class categories and market conditions by estimating separate intercepts. This Least Squares Dummy Variable (LSDV) approach has the advantage of controlling for a number of omitted variables, for example small-scale spatial effects at the submarket level that we could not model explicitly as the data necessary to do this were not available to us. The LSDV approach allows intercepts of the regression to differ across markets while assuming constant variable coefficients. This is important not only because of the difference in price levels across markets but also because it controls for tax and other incentives that several states and cities grant for buildings that are certified including tax credits, reduced permitting fees and property tax abatements (Roberts, 2007).

Binomial logistic regression

While the hedonic regression approach is the principal method for determining rent and price premium since it enables the researcher to control for a host of relevant building characteristics, it is subject to a potentially serious methodological problem. If buildings in the treatment group (eco-certified buildings in our case) and the control group (non-eco-certified buildings) differ systematically with respect to characteristics that are significant factors in rent formation, the hedonic model will not attribute the price effect of individual factors accurately and the model as such is subject to omitted variable bias. This problem may arise because of unmeasured common features of eco-certified buildings, for example certain micro-locational characteristics that are not entered as independent variables in the hedonic model. Therefore, we complement the hedonic analysis with a logistic regression framework which serves as a basis for selecting buildings in the control sample that are sufficiently similar to the eco-certified group. Based on the individual probability scores obtained from the logistic regression, we can then define a cutoff point for inclusion in the peer group sample.

Our logistic model assumes a dichotomous dependent variable which measures the probability π_i of being an eco-certified building as

$$\pi_i = \frac{\exp(\eta_i)}{1+\exp(\eta_i)} \quad (4)$$

Thus, we can determine a likelihood function *lf* for n observations $y_1,...,y_n$, with probabilities $\pi_1,..., \pi_n$ and case weights $w_1,...,w_n$, can be expressed as

$$lf = \prod_{i=1}^{n} \pi_i^{w_i y_i} (1 - \pi_i)^{(1-y_i)} \quad (5)$$

In the logarithmic form used in our paper, the full model L is thus:

$$\mathrm{L} = \ln(\mathrm{lf}) = \sum_{i=1}^{n} w_i \mathrm{y_i} \ln(\pi_i) + \mathrm{w_i}(1 - \mathrm{y_i})\ln(1 - \pi_i) \quad (6)$$

Having obtained probability values for each observation in our database, we can then proceed to re-define our sample of comparable buildings by including only those non-certified buildings that sufficiently resemble certified buildings based on the features included in the logistic regression model.

Data

The tagging of LEED and Energy Star buildings by CoStar enables researchers to identify numbers and types of eco-certified buildings in the database. Given the discussion above, a key issue is the benchmark against which the sample of certified buildings can be compared. Our benchmark sample consists of approximately 24,479 office buildings in 853 submarkets in 81 metropolitan areas spread throughout the United States. This means that our hedonic model is measuring price differences between certified buildings and randomly selected non-certified buildings in the same metropolitan area controlling for differences in age, size, height, location, lease type, building class and submarket.

In the first step, we drew details of approximately 1,900 eco-certified buildings of which 626 were LEED certified and 1,282 were Energy Star. In the second step, buildings were selected in the same metropolitan areas and submarket as the certified sample. Sample selection was based on the criteria a) same submarket or market as certified buildings and b) at least 10 comparable observations for each certified building in the database. Although the market weightings may be different between the benchmark and the certified samples, our regression model controls for market-specific effects. Of the LEED buildings, 31% (n=192) are certification-level, 29% (n=180) are Silver, 32% (n=201) are Gold and 7% (n=45) are Platinum level. In total, we have used 9,806 observations of transaction prices and 18,519 (asking) rent observations.

Results

Descriptive Statistics

The descriptive statistics are displayed in Exhibit 1. There are clearly some differences between eco-certified and non-certified buildings. The former tend to be newer. In particular, the median age of LEED certified buildings is five years. The comparable figure for the benchmark sample is 23. While there is relatively little difference between buildings with Energy Star certification and the benchmark sample in terms of age, the former tend to be dominated by tall buildings suggesting that they are mainly located in CBD locations. This is supported by the fact that Energy Star buildings tend to be on average nearly 20 times larger than non-certified buildings. Without controlling for the differences between the samples, certified buildings have higher asking rents and lower vacancy rates than non-certified buildings. Median asking rents are approximately 35% higher in LEED and Energy Star certified buildings. There are also some notable differences in terms of the proportions of each sample that are on triple let leases compared to gross or full service leases. Energy Star buildings have 12% and LEED buildings have 10% on net leases. The comparable figures for the control sample is 22%. More thorough investigation is required, however, to infer a general prevalence of gross leases in certified buildings as the higher share may simply be reflective of differences in property types (particularly mono- vs. multi-tenanted properties) between the certified and the non-certified samples.

Exhibit 1: Descriptive statistics of overall sample with LEED and Energy Star sample

Overall	RENT $ psf	PRICE $ psf	% LEASED	SIZE (sq ft)	STORIES	AGE
Mean	19.50	141.19	63.82	52,771	3.32	28.37
Median	18.00	113.81	79.80	10,800	2.00	23.00
Std. Dev.	9.16	112.50	38.87	145,147	5.75	27.48
Skewness	2.40	1.77	-0.69	7.57	5.92	1.97
Kurtosis	14.47	8.77	1.88	92,807	50.21	8.42
Observations	16,488	9,120	24,951	16,488	24,479	21,147
LEED	**RENT $ psf**	**PRICE $ psf**	**% LEASED**	**SIZE (sq ft)**	**STORIES**	**AGE**
Mean	26.74	251.12	91.06	179,290	6.45	11.77
Median	24.50	247.41	100.00	95,000	4.00	5.00
Std. Dev.	11.00	136.33	22.46	262,071	8.50	19..06
Skewness	1.79	0.37	-2.91	4.68	3.13	3.30
Kurtosis	7.21	3.32	10.78	43.49	13.76	14.89
Observations	210	127	667	667	622	504
Energy Star	**RENT $ psf**	**PRICE $ psf**	**% LEASED**	**SIZE (sq ft)**	**STORIES**	**AGE**
Mean	27.76	254.93	91.43	315,052	13.40	19.43
Median	25.04	230.88	95.76	217,082	9.00	20.00
Std. Dev.	11.37	138.20	12.44	301,264	12.89	12.77
Skewness	1.66	1.47	-3.06	1.99	1.62	2.31
Kurtosis	7.21	6.57	17.78	7.59	5.55	13.66
Observations	990	662	1,480	1,480	1,453	1,474

Hedonic regression results and the rent premium

To further investigate the hypothesis of a rent and price premium for certified buildings, we estimate hedonic regressions as outlined above. Two separate regressions are estimated to model rent and transaction price separately. All continuous numeric variables were transformed to log values to (1) reduce non-normality found in initial examinations of the dataset, (2) to reduce heteroskedasticity and (3) to be able to interpret the results as elasticities. The results are summarized in Exhibits 2 and 3.

When controlling for the most important rent determinants such as age, height, size and sub-market location, we find a statistically significant rent premium of 6% in eco-certified buildings compared to non-certified buildings in the same sub-market area. The control variables used in the regression show the expected signs. This regression explains approximately 60% of the cross-sectional variation in rents in the entire sample.

Model 2 shows the results of the regression with separate dichotomous variables for LEED and Energy Star certification. Both types of certification are found to exert a positive and significant impact on rents. While the premium for LEED is higher as expected, there is very little difference between the premiums for LEED and Energy Star buildings. A further common assumption that we set out to test is that the rent premium of LEED buildings is increasing with the level of certification. Model 3 in Exhibit 2 reports the estimation results with a LEED level variable. In this specification, the dichotomous LEED variable is modified to reflect the certification standard, i.e. Certified, Silver, Gold and Platinum. While the coefficients have the expected signs, only the Gold level is significant.

Exhibit 2

Results from hedonic model estimation of rental rates			
	Model 1	**Model 2**	**Model 3**
Dependent variable	Rent psf (log)	Rent psf (log)	Rent psf (log)
Constant	**3.61*** **	**3.81*** **	**3.80*** **
Eco-certified	**0.06*** **		
LEED		**0.06** **	
Certified			**0.09** **
Silver			0.04
Gold			0.04
Platinum			**0.16*** **
Energy Star		**0.06*** **	**0.06*** **
Net Lease	**-0.11*** **	**-0.11*** **	**-0.11*** **
No. of stories (log)	**0.06*** **	**0.06*** **	**0.06*** **
Size square feet (log)	**0.02*** **	**-0.01*** **	**-0.01*** **
Site area (log)	**0.01* **	0.00	0.00
Age (log)			
3-6 years	**-0.06*** **	**-0.06*** **	**-0.06*** **
7-10 years	**-0.12*** **	**-0.12*** **	**-0.12*** **
11-19 years	**-0.14*** **	**-0.14*** **	**-0.14*** **
20-23 years	**-0.16*** **	**-0.16*** **	**-0.16*** **
23-26 years	**-0.18*** **	**-0.18*** **	**-0.18*** **
27-31 years	**-0.19*** **	**-0.19*** **	**-0.19*** **
32-42 years	**-0.20*** **	**-0.20*** **	**-0.20*** **
43-62 years	**-0.23*** **	**-0.24*** **	**-0.24*** **
>62 years	**-0.23*** **	**-0.23*** **	**-0.23*** **
Longitude (log)	**-0.01*** **	**-0.01*** **	**-0.01*** **
Latitude (log)	**-0.43*** **	**0.45** **	**0.45** **
Class A	**0.20*** **	**0.20*** **	**0.20*** **
Class B	**0.09*** **	**0.09*** **	**0.09*** **
Adjusted R-squared	0.61	0.61	0.61
F test	26.44***	26.40***	26.28***
Included observations	10,970	10,970	10,969

*** - significant at 1% level
** - significant at 5% level
* - significant at 10% level

Although it is not a central part of the study, it is interesting to compare the results of the control factors with the findings of other studies of office rent determinants. Given a variation in data sources and model specifications, previous studies do not always provide consistent findings on the relationship between variables such as age, size and height *inter alia* and office rents/prices. As expected, we find that the coefficient for the age variable is negative. In addition, consistent with previous research (for example, see Bollinger, Ihlanfeldt and Bowes, 1998; Shilton and Zaccaria, 1994), we find that there is a significantly positive relationship between height and rent. We also find a negative relationship between size and rent. In common with Laverne and Winson-Geideman (2004), we find a negative relationship between triple net leases and rental level.

Hedonic regression results and the price premium

Exhibit 3 reports the results of the hedonic regressions with sales price per square foot as the dependent variable. Three separate models were estimated with the similar independent variables. All models display similar results and have similar explanatory power. The explanatory power is lower relative to the regressions for the sample of rents. For most of the independent variables, the coefficients have the expected signs. Of the additional four variables to control for rising and falling market conditions, dropping the variable for strong positive growth all exhibit the expected sign and are significant (confirming the link between direct and indirect real estate returns). Model 1 suggests a sales premium of 36% for eco-certified buildings. In Model 2, we distinguish between LEED and Energy Star and find premiums of 35% and 31% respectively[4]. When we break down the LEED sample into its various categories, premiums are significant for each individual category. Whilst the premium for platinum-rated buildings may seem unrealistic, it is based on the sales of eight buildings.

The results suggest a much higher relative sales price premium compared to rental price premiums. There are a number of potential explanations. A possible explanation may lie in the combined effects of investors' expectations of higher rental income, lower operating costs, higher occupancy rates, image benefits to investors and a lower risk premium.

[4] The larger average premium of 30% for eco-certified buildings compared to LEED and Energy Star premia is due to the existence of a number of buildings that hold both types of certification. For these buildings, the rental premium will effectively be split between the LEED and Energy Star coefficients resulting in a lower premium compared to the overall eco-certified variable.

Exhibit 3

Results from hedonic model estimation of sales prices			
	Model 1	**Model 2**	**Model 3**
Dependent variable	**Sale price psf (log)**	**Sale price psf (log)**	**Sale price psf (log)**
Constant	-0.02	0.09	0.08
Eco-certified	0.36***		
LEED		0.35***	
Certified			0.20***
Silver			0.38***
Gold			0.36***
Platinum			1.00***
Energy Star		0.31***	0.31***
No. of stories (log)	0.15***	0.15***	0.15***
Size square feet (log)	-0.23***	-0.23***	-0.23***
Site area (log)	0.09***	0.09***	0.09***
Age (log)			
3-6 years	0.15***	0.15***	0.16***
7-10 years	0.50***	0.51***	0.51***
11-19 years	0.45***	0.50***	0.46***
20-23 years	0.40***	0.45***	0.41***
23-26 years	0.38***	0.40***	0.38***
27-31 years	0.37***	0.37***	0.38***
32-42 years	0.27***	0.37***	0.28***
43-62 years	0.27***	0.27***	0.28***
>62 years	0.28***	0.27***	0.30***
Longitude (log)	-0.02***	-0.02***	-0.02***
Latitude (log)	1.03**	1.06**	1.04**
Class A	0.42***	0.43***	0.43***
Class B	0.06***	0.06***	0.06***
Time trend variable	0.03***	0.03***	0.03***
Moderate positive market	-0.08***	-0.08***	-0.08***
Moderate negative market	-0.10***	-0.11***	-0.11***
Strong negative market	-0.10***	-0.10***	-0.10***
SUBMARKET CONTROLS			
Adjusted R-squared	0.42	0.42	0.42
F test	8.96***	8.92***	8.89***
Included observations	6,158	6,158	6,157

*** - significant at 1% level
** - significant at 5% level
* - significant at 10% level

Logistic regression results

Our binomial logistic regression model includes as covariates the continuous variables building age, land area, rentable building area, stories, occupancy rate as well as the categorical variables building class and market (see appendix for model estimates).

Having obtained probability values for each building in our sample of approximately 15,700 office buildings with valid observations, we select a smaller peer sample of matched buildings with a calculated probability value of at least 18 percent of belonging in the eco-certified group (without actually being an eco-certified). The cut-off value was defined to match the peer sample closely to the certified building sample regarding their main features. While a probability value of 18 percent may appear low in overall terms, it is important to keep in mind that the vast majority of buildings in our sample exhibit very low or zero probabilities. Put differently, a building with a 18 percent probability value is within the top 6% of all buildings in terms of probability (including 'true' eco-certified buildings). It appears thus justified to set a relatively low probability value. Exhibit 4 reports the mean and median for key values for both the eco-certified and the matched peer sample. Compared to the large differences between eco-certified and the overall control sample shown in Exhibit 4, these two groups show a much greater degree of similarity of building attributes. More importantly, average rental rates are $27.04/sq.ft (median value of $24.00/sq.ft) in the matched peer sample and $27.76/sq.ft. (median of $25.04/sq.ft.) for the Energy Star sample. This corresponds to a 2.7% average rental premium (4.3% for median values). Similarly, sales prices for the matched peer sample are $191/sq.ft (median value of $155/sq.ft) and $255/sq.ft (median value of $231/sq.ft) for Energy Star buildings. This translates into a 33.8% sales premium for Energy Star certified buildings (49.4% based on median values). The results for the LEED sample are inconclusive, however, probably due to the fact that only a small sample of peer group buildings could be derived from the logistic model with sufficiently large probability values.

Overall, the results of the logistic regression appear to corroborate the existence of a rent and sales price premium detected by the hedonic regression, a caveat is in order regarding the interpretation of these results. Summary measures such as the arithmetic mean and the median are very basic indicators of the differences of two distributions. More sophisticated tests and measures are required to confirm the existence of a premium.

Exhibit 4: Comparison of key variables based on binomial logistic regression

Overall	RENT $ psf	PRICE $ psf	% LEASED	SIZE (sq ft)	STORIES	AGE
Mean	**19.50**	**141.19**	**63.82**	**52,771**	**3.32**	**28.37**
Median	**18.00**	**113.81**	**79.80**	**10,800**	**2.00**	**23.00**
Std. Dev.	9.16	112.50	38.87	145,147	5.75	27.48
Observations	16,488	9,120	24,951	16,488	24,479	21,147
Energy Star Peer sample	**RENT $ psf**	**PRICE $ psf**	**% LEASED**	**SIZE (sq ft)**	**STORIES**	**AGE**
Mean	**27.04**	**190.55**	**82.47**	**329,116**	**13.11**	**18.69**
Median	**24.00**	**154.57**	**92.02**	**208,861**	**9.00**	**19.00**
Std. Dev.	12.43	143.74	15.34	362,432	13.00	10.61
Observations	697	533	838	838	838	836
Energy Star	**RENT $ psf**	**PRICE $ psf**	**% LEASED**	**SIZE (sq ft)**	**STORIES**	**AGE**
Mean	**27.76**	**254.93**	**91.43**	**315,051**	**13.40**	**19.44**
Median	**25.04**	**230.88**	**95.76**	**217,082**	**9.00**	**20.00**
Std. Dev.	11.37	138.21	12.44	301,264	12.89	12.77
Observations	990	662	1,480	1,480	1,453	1,474
LEED Peer sample	**RENT $ psf**	**PRICE $ psf**	**% LEASED**	**SIZE (sq ft)**	**STORIES**	**AGE**
Mean	**28.17**	**226.51**	**94.35**	**781,016**	**23.44**	**16.84**
Median	**24.75**	**154.25**	**98.20**	**623,899**	**20.00**	**13.00**
Std. Dev.	15.31	185.00	7.95	588516	20.24	11.73
Observations	30	32	57	57	57	57
LEED	**RENT $ psf**	**PRICE $ psf**	**% LEASED**	**SIZE (sq ft)**	**STORIES**	**AGE**
Mean	**26.74**	**251.12**	**91.07**	**179,290**	**6.45**	**11.78**
Median	**24.50**	**247.42**	**100.00**	**95,000**	**4.00**	**5.00**
Std. Dev.	10.99856	136.34	22.46	262071	8.50	19.06
Observations	210	139	667	667	622	504

Conclusions

In many product markets eco-labeling is a common method of signaling superior environmental performance. The growth in compulsory and voluntary eco-labeling of commercial real estate assets is part of a number of regulatory and voluntary initiatives to reduce carbon emissions from the commercial building stock. The central aim of eco-labeling is to alter the behavior of market participants through the provision of improved information about the environmental effects of their real estate decisions. It is anticipated that better informed capital providers and occupiers will shift towards more environmentally responsible production, investment and use. A key expectation is that the price mechanism will create price differentials linked to environmental performance and result in the allocation of more capital to environmentally beneficial investment.

There are strong *a priori* grounds to expect price differentials between eco-labeled and non-eco-labeled offices. It is generally accepted that there are benefits associated with environmentally responsible buildings. For occupiers, there will often be reductions in operational costs associated with occupying the buildings, improvements in productivity of the occupier's business and image benefits for the occupier. For investors, there may be higher Net Operating Incomes due increased demand from occupiers, lower void rates, lower costs of ownership and an element of protection from future regulatory changes.

The results of the empirical analysis confirm these expectations. The hedonic regressions suggest that there is a rental premium of approximately 6% for LEED certification and 5% for Energy Star. The type of lease contract may be a very important issue here. It has been argued that, for properties on gross or full service leases, occupiers have less incentive to pay a rental premium since they do not benefit from reduced operating costs. It is notable that a much larger proportion of Energy Star certified buildings have gross or full service leases. For sales prices, we find price premiums of 31% for Energy Star and 35% for LEED certified buildings. In order to control for the possibility of an omitted variable bias in the hedonic model, we also applied a logistic regression framework. The results appear to be confirm the existence of a premium for Energy Star certified buildings whereas no valid results could be obtained for LEED certified buildings due to small sample size.

There are a number of important issues that suggest that empirical studies of *typical* price differentials need to be interpreted with care. Firstly, as we have seen there are significant methodological and data issues in controlling for the inherent heterogeneity between certified and non-certified buildings. Secondly, all empirical studies provide a historic snapshot of price differentials for specific sample in a specific time period. It is expected that price differentials for certified buildings should vary over time and between buildings. Attempts to profit from any current or historic price premiums are faced with the standard ‘developer’s dilemma’ – that their supply response to *current* price differentials between certified and non-certified buildings is likely to affect the *future* price differential. Finally, there is also a potential problem of sample or omitted variable bias. It is possible that the eco-certification process is only one element of additional investment to create a market leading product.

Given the topicality of this area of research, the dynamic nature of real estate markets and the potential limitations of hedonic analyses, there is clearly scope for further research. This study has focussed on office properties only. Empirical studies of the retail, industrial and residential markets may arrive at different results that reflect the variations in market structure and drivers, in the passing through of operating costs and in the bargaining power of market agents. Further, there is little understanding of the relative contribution of the potential sources of price differentials – fiscal benefits and subsidies, improved business performance, image benefits or reduced operating costs. In particular, it is also clear that lease type may be a major determinant of the allocation of the costs and benefits of eco-certification costs and benefits and, in turn, influence the price determination process.

References

Ambrose, B., P. Hendershott and M. Klosek. 2002. Pricing Upward-Only Adjusting Leases. *Journal of Real Estate Finance and Economics* 25**:** 33-49.

Berry, T. 2007. *Towards a green building and infrastructure investment fund: A review of challenges and opportunities.* Compass Resource Management.

Bond, S., P. Loizou and McAllister, P. 2008 Lease Maturity and Initial Rent: Is There a Term Structure for UK Commercial Property Leases?, *Journal of Real Estate Finance and Economics,* **36:** 451-469.

Bollinger, C.R., K.R. Ihlanfeldt and Bowes, D.R. 1998. Spatial Variations in Office Rents in the Atlanta Region. *Urban Studies* 35: 1097-1118.

Booth, P. and D. Walsh. 2001. An option pricing approach to valuing upward only rent review properties with multiple reviews. *Insurance: Mathematics and Economics.* 28: 151-171.

Burr, A. 2009. Greenwashing Hits LEED, Green LEDE: Green Building News from CoStar, 5 February 2009.

Eichholtz, P., N. Kok, and J. Quigley, Doing Well By Doing Good? Green Office Buildings, Working paper, *Fisher Center for Real Estate and Urban Economics,* UC Berkeley, January, 2009.

Englund, P., A. Gunnelin, M. Hoesli, and B. Söderberg. 2004. Implicit Forward Rents As Predictors of Future Rents. *Real Estate Economics* 32: 183-215.

Grenadier, S.R. (1995). The valuation of leasing contracts: a real options approach. *Journal of Financial Economics* 38: 297-331.

GVA Grimley. 2007. *Towards Sustainable Offices.* Research Bulletin, Spring, 2007.

Kats, G. 2003. *The Costs and Financial Benefits of Green Buildings – A Report to California's Sustainable Building Task Force.* Capital E, October 2003.

Kotchen, M. 2006. Green Markets and Private Provision of Public Goods. *Journal of Political Economy* 114: 816-834.

Laverne, R. J. and K. Winson-Geideman. 2003. The influence of trees and landscaping on rental rates at office buildings. *Journal of Arboriculture* **29**: 281–290.

Matthiessen L. F. ,& Morris P. 2007. Cost of green revisited: Re-examining the feasibility and cost impact of sustainable design in the light of increased market adoption. Davis Langdon.

McGraw Hill Construction. 2006. *Green Building Smart Report.*

Miller, N., Spivey, J. Florance, A. (2008): *Does Green Pay Off?* University of San Diego Working Paper, final draft version: July 12, 2008.

Morrison Hershfield. 2005. *A Business Case for Green Buildings.* Internal Morrison Hershfield Report.

Nelson, A. 2007. *The Greening of U.S. Investment Real Estate – Market Fundamentals, Prospects and Opportunities.* RREEF Research Report No. 57.

Roberts, T. 2007. Green Buildings Get Tax Relief. *Green Source*, April 2007, 22-23.

Rosen, S. 1974. Hedonic prices and explicit markets: production differentiation in pure competition. *Journal of Political Economy* 82: 34–55.

Rosen, K. T. 1984. Toward a Model of the Office Building Sector. *Journal of the American Real Estate and Urban Economics Association* 12: 261-269.

Shilton, L. and A. Zaccaria. 1994. The Avenue Effect, Landmark Externalities, and Cubic Transformation: Manhattan Office Valuation. *Journal of Real Estate Finance and Economic* 8: 151-65.

Shipley, D.D., Jobber, D. 2001, Integrative pricing via the pricing wheel, *Industrial Marketing Management* 30: 301-14.

Wheaton, W. 1984. The incidence of inter-jurisdictional differences in commercial property taxes. *National Taxation Journal* 37: 515–527.

Wiley, J., Benefield, J. and Johnson, K. Green Design and the Market for Commercial Office Space, *Journal of Real Estate Finance and Economics*, forthcoming.

Appendix

1) Binary logit regression results, Dependent Variable: Energy Star

Variable	Coefficient	Std. Error	z-Statistic	Prob.
NET_LEASE	0.057922	0.130460	0.443980	0.6571
CLASS_A	2.454620	0.309649	7.927114	0.0000
CLASS_B	1.293093	0.299050	4.324007	0.0000
LOG(PERC_LEASED)	0.046252	0.012304	3.759209	0.0002
LOG(RBA)	1.190321	0.086390	13.77852	0.0000
LOG(STORIES)	0.098473	0.098076	1.004048	0.3154
LOG(LAND_AREA)	0.125521	0.047578	2.638211	0.0083
LOG(LATITUDE)	0.179184	0.537102	0.333613	0.7387
LONGITUDE	-0.025654	0.003886	-6.601324	0.0000
AGE_2	1.528032	0.381441	4.005950	0.0001
AGE_3	2.398577	0.359381	6.674183	0.0000
AGE_4	2.556344	0.353591	7.229671	0.0000
AGE_5	2.485484	0.359858	6.906841	0.0000
AGE_6	2.424259	0.358497	6.762295	0.0000
AGE_7	2.239303	0.362735	6.173395	0.0000
AGE_8	1.840518	0.389193	4.729057	0.0000
AGE_9	2.137577	0.438057	4.879682	0.0000
AGE_10	2.281619	0.478008	4.773184	0.0000
MARKET=ATL	-21.69732	2.204238	-9.843455	0.0000
MARKET=BOS	-22.19250	2.277677	-9.743482	0.0000
MARKET=CHI	-23.06455	2.300868	-10.02428	0.0000
MARKET=DAL	-24.16595	2.184192	-11.06402	0.0000
MARKET=DEN	-23.21927	2.282163	-10.17424	0.0000
MARKET=DET	-24.85842	2.329238	-10.67234	0.0000
MARKET=HOU	-23.16278	2.136798	-10.83995	0.0000
MARKET=LA	-23.94290	2.231082	-10.73152	0.0000
MARKET=NYC	-24.86169	2.284635	-10.88213	0.0000
MARKET=ORA	-21.83048	2.220420	-9.831690	0.0000
MARKET=PHI	-23.14557	2.268911	-10.20118	0.0000
MARKET=PHX	-22.47323	2.230609	-10.07493	0.0000
MARKET=PIT	-24.07889	2.516710	-9.567604	0.0000
MARKET=POR	-23.71122	2.409520	-9.840641	0.0000
MARKET=SEA	-23.16753	2.419400	-9.575733	0.0000
MARKET=SFO	-22.50109	2.298123	-9.791074	0.0000
MARKET=WAS	-22.74027	2.242741	-10.13950	0.0000

Mean dependent var	0.070620	S.D. dependent var	0.256198
S.E. of regression	0.189605	Akaike info criterion	0.241609
Sum squared resid	564.2710	Schwarz criterion	0.259145
Log likelihood	-1864.493	Hannan-Quinn criter.	0.247413
Avg. log likelihood	-0.118516		

2) Binary logit regression results, Dependent Variable: LEED

Variable	Coefficient	Std. Error	z-Statistic	Prob.
NET_LEASE	-0.523901	0.163320	-3.207822	0.0013
CLASS_A	1.818274	0.351601	5.171416	0.0000
CLASS_B	1.358862	0.321351	4.228589	0.0000
LOG(PERC_LEASED)	0.028231	0.006830	4.133295	0.0000
LOG(RBA)	1.062952	0.097500	10.90202	0.0000
LOG(STORIES)	-0.558342	0.125989	-4.431677	0.0000
LOG(LAND_AREA)	-0.040078	0.059265	-0.676251	0.4989
LOG(LATITUDE)	3.057911	0.804235	3.802261	0.0001
LONGITUDE	-0.010714	0.005135	-2.086612	0.0369
AGE_2	-0.540259	0.175331	-3.081374	0.0021
AGE_3	-1.689854	0.196912	-8.581780	0.0000
AGE_4	-2.759682	0.231232	-11.93468	0.0000
AGE_5	-3.138020	0.292188	-10.73972	0.0000
AGE_6	-3.432982	0.330028	-10.40210	0.0000
AGE_7	-3.010015	0.288372	-10.43797	0.0000
AGE_8	-3.363648	0.397222	-8.467928	0.0000
AGE_9	-1.861662	0.343047	-5.426839	0.0000
AGE_10	-1.466282	0.326795	-4.486854	0.0000
MARKET=ATL	-25.14796	3.064053	-8.207418	0.0000
MARKET=BOS	-25.02741	3.200923	-7.818810	0.0000
MARKET=CHI	-26.46994	3.225419	-8.206669	0.0000
MARKET=DAL	-27.23677	3.060725	-8.898799	0.0000
MARKET=DEN	-26.26472	3.195883	-8.218297	0.0000
MARKET=DET	-26.74465	3.234441	-8.268708	0.0000
MARKET=HOU	-26.07173	2.975933	-8.760858	0.0000
MARKET=LA	-27.32365	3.112786	-8.777876	0.0000
MARKET=NYC	-27.44926	3.212389	-8.544809	0.0000
MARKET=ORA	-26.01336	3.118306	-8.342145	0.0000
MARKET=PHI	-25.06092	3.162012	-7.925624	0.0000
MARKET=PHX	-26.36706	3.119580	-8.452117	0.0000
MARKET=PIT	-24.20722	3.195638	-7.575082	0.0000
MARKET=POR	-24.98468	3.319866	-7.525811	0.0000
MARKET=SEA	-25.22267	3.362574	-7.501002	0.0000
MARKET=SFO	-25.49138	3.195472	-7.977342	0.0000
MARKET=WAS	-25.56573	3.147622	-8.122234	0.0000

Mean dependent var	0.023965	S.D. dependent var	0.152946
S.E. of regression	0.136579	Akaike info criterion	0.150623
Sum squared resid	292.7730	Schwarz criterion	0.168160
Log likelihood	-1148.722	Hannan-Quinn criter.	0.156428
Avg. log likelihood	-0.073023		