# Certification Matters: Green Talk is Cheap Talk

Shaun A. Bond[1]

Avis Devine[2]

**March 2014**

**Abstract:**

There is an active and growing literature examining the rental rate, sales price, and occupancy premiums associated with sustainable or energy efficient certified real estate. To date, the focus has rested largely on office properties and for sale single family residential properties. We examine the rental rates achieved by green multifamily properties, providing the first look at the population of LEED market-rate apartments in the United States. We find an approximate 8.9 percent rental rate premium associated with LEED apartments. Moreover, this research provides the first indication that LEED certification garners an additional premium over non-certified space that identifies as green, identifying the strength of the certification signal and contributing to the longstanding discussion on the merits of certification.

Key words: Energy Efficiency, Sustainability, Rent Premium, Occupancy Rates, Residential

JEL Codes: R11, R52, R58

[1]University of Cincinnati, Department of Finance and Real Estate, Cincinnati, OH 45221
[2]University of Guelph, College of Management and Economics, Guelph, ON N1L 0G1 CANADA; devinea@uoguelph.ca; Phone: 519-212-0653; Fax: 519-823-1964

The majority of research on sustainable buildings has focused on commercial buildings and residential single-family property sales, providing evidence of rental and sale price premiums (Miller, Spivey, and Florance, 2008; Wiley, Benefield, and Johnson, 2010; Eichholtz, Kok, and Quigley 2010; Kok and Jennen, 2011; Kok, McGraw, and Quigley 2011; Ciochetti and McGowan 2010; Fuerst and McAllister 2009, 2011; Aroul and Hansz, 2011; Kok and Kahn, 2012; Costa and Kahn, 2009). Missing from this body of work is an examination of an important third category of properties: green multifamily. To date there has been little to no analysis of this property group, most likely due to the unavailability of data. To amend this, we collect the first dataset of multifamily green properties, examining all LEED-certified multifamily properties in the United States. We find a rental rate premium for LEED certified multifamily properties (approximately 8.9 percent). The results are statistically very strong and robust across a wide array of subsample analyses.

One of the most popular debates in greening commercial real estate is over the added value of certification of energy efficient and sustainable properties. Certification is often a costly endeavor (particularly in the case of LEED), begging the question: does certification matter, or is being green enough? Several of the comparable properties in our sample promote their greenness while possessing no green certifications (LEED or otherwise). This allowed us to evaluate the role of the certification signal versus that of puffery, or using positive terms to obtain higher prices for real estate. Much work has been done on the role of puffery in single family sales prices, with results indicating that use of positive, subjective language does result in sales price premiums (Haag, Rutherford, and Thompson, 2000; Goodwin, Waller, and Weeks, forthcoming). Our analysis supports similar findings, indicating that properties which say they are green without certification to support such a claim are able to command a rent premium. While this indicates that green cheap talk is effective, when both certification and puffery are controlled for, we find LEED certified properties command almost double the rental rate premium of that experienced by the green, non-certified properties. This indicates that the LEED signal is strong, which is logical, as it is not a cheap signal to obtain.

We believe that the investigation of the environmental certification of multifamily properties is important for two reasons. First, by definition, multifamily properties are more sustainable than single-family properties. In construction terms, apartment-style housing is more densely designed than single-family housing, decreasing land used as well as construction materials used per unit. Operationally, tenants benefit from the natural pooling of their heating and cooling resources, minimizing waste. Additionally, investing in a sustainable single-family home is still moderately complicated. Due to the limited sustainable housing stock (approximately 6,100 market-rate LEED-certified single family homes as of year-end 2013, versus over 26,000 market-rate LEED-certified apartment units), there are few green homes available for resale. This problem is exacerbated by the fact that most green single-family homes have been custom built over the past 10 years, and home owners predominantly undertake a custom homebuilding project with the intention to remain in that home for many years, thereby withholding the green house from the market. On the contrary, rental units are occupied on shorter horizons (with most leases governing a one-year period), allowing turnover and greater accessibility to prospective tenants. Therefore, if a person wants a sustainable single-family home, they must either choose to build a green home or renovate their existing home with sustainable features. Sustainable multifamily provides an "easy green" option, where households can invest in sustainability by simply signing a lease.

The second reason to investigate multifamily housing is because it forms a large part of the investable real estate market in the U.S. In the NCREIF database, which tracks the investment performance of institutionally owned real estate, multifamily housing accounts for over 25 percent of the total value of all assets tracked.[1] In the REIT market, over 13 percent of assets, by market value, are accounted for by multifamily properties.[2] In addition, the National Multi Housing Council estimates that the multifamily housing sector provides accommodation for approximately one-third of U.S. households.[3] Therefore, the demonstration of economic benefit associated with energy efficient certification has important implications for both the investment community and society more broadly.

In investigating the users of multifamily accommodation in more detail, it is found that the majority of the United States' current and near-future renter base consists of those born between the late 1970s through the early 2000s (commonly known as Generation Y). Marshall et al (2011) finds that individuals in this group are remaining renters longer than previous generations due to postponed family creation. Torres (2010) indicates that this generational group is defined by their demand for a high quality of life, including an interest in job stability, a desire for socialization, and a concern for environmental well-being. People of this generation are characteristically highly sensitive to occupancy and transportation cost savings. Therefore, among this important group of possible multifamily housing consumers there is evidence to suggest a preference for environmentally efficient housing situated in close proximity to work and public transportation, and within walking distance of amenities and commercial areas (Hansen 2011). This "clientele

[1] https://www.ncreif.org
[2] http://www.reit.com/DataAndResearch/Property-Sector-Performance.aspx
[3] http://www.nmhc.org/Content/LandingPage.cfm?NavID=2

effect" may provide one possible explanation for a rental premium associated with green certified rental apartments.

There are also other economic arguments for premiums to be associated with certified properties, beyond the clientele effect. Such arguments include signaling and the financial benefit of possible reductions in operating costs from energy savings. From the literature on sustainable office space analysis, we know that firms are willing to pay a premium for green office space for a variety of reasons. There is the utility cost savings associated with sustainably-constructed buildings, as well as theories of happier, healthier, and more productive workers (Kats 2003, Ecofys 2003). However, often the more important aspect is that of reputation. A firm may feel it strengthens their public image (and, therefore their firm value) if they are associated with sustainability. Therefore, the rent premium is offset by the added firm value. For instance, the Crude Petroleum and Gas industry leases over 60 percent of its rental space in green buildings, a decision most likely made to bolster their public image (Eichholtz, Kok and Quigley, working paper 2012). While the former benefit (utility cost savings) easily applies to consumer housing, the later benefit (strengthened public image) may be less obvious. Even if we set aside social status benefits from signaling a personal conviction to "do good" for the earth, the willingness of a renter to pay a premium for sustainable housing over traditional housing may be justified by their expected utility cost savings.

We build off this early demand analysis and utility cost savings story by identifying if there is a rent premium associated with sustainable multifamily rental properties and to whom that benefit accrues. Additionally, our data collection provides the first glimpse at what the U.S. LEED multifamily rental housing stock looks like. Our empirical analysis demonstrates that there is not only a rental rate premium associated with any green posturing for apartment, but also an additional premium associated with LEED certification. Importantly, to our knowledge this is the first time that it has been shown that there is no benefit associated with simply posturing as a green property. Therefore, green talk really is cheap talk. This result has important implications for the construction and real estate development industries by addressing the long-standing discussion regarding the merits of certification.

## Literature Review

To date sustainable real estate research has focused on commercial buildings, specifically office space. This body of literature provides evidence of rental and sale price premiums and superior occupancy rates associated with green commercial buildings, basing the green definition on the Energy Star, LEED, or other national equivalent labeling systems (Wiley, Benefield, and Johnson, 2010; Kok and Jennen, 2011; Kok, McGraw, and Quigley 2011; Ciochetti and McGowan 2010; Fuerst and McAllister 2009). Nelson (2007) uses CoStar office building data to compare LEED rated and Energy Star buildings to a large sample of non-certified commercial properties. He identifies a variety of descriptive differences in the two subsamples (with green buildings more frequently being newer, owner- or single tenant-occupied, and concentrated geographically in certain markets), and controlling for such differences finds LEED buildings to have higher occupancy and rental rates. Miller, Spivey, and Florance (2008) completes a similar analysis, finding statistically insignificant loadings on the LEED and Energy Star treatment variables when explaining rental rates, but that LEED and Energy Star certified buildings experience sales price premiums of 6 and 11 percent, respectively. Eichholtz, Kok, and Quigley (2010) also completes a similar analysis to examine actual and effective rental rates. The authors find 3.3 and 10 percent statistically significant rent and effective rent premiums for Energy Star buildings. Additionally, the authors find a nineteen percent Energy Star sales price premium, but are unable to find statistically significant LEED-related rent and sales premiums. These authors also have a recent extension to this research, verifying that these premiums still exist, even years after the introduction of green space to the office market (Eichholtz, Kok and Quigley, 2013). Lastly, Fuerst and McAllister (2011) also completes an analysis of CoStar office buildings in the U.S., selecting their comparable properties based on submarket definitions as opposed to distance radii. Their hedonic regressions find 5 and 4 percent rental premiums for LEED and Energy Star certified properties, and 25 and 26 percent sales price premiums for buildings with those certification programs, respectively.

A comparatively limited amount of research examines sustainability and residential properties. Aroul and Hansz (2011) examines Frisco, Texas, the nation's first municipality to mandate a sustainable green building program, Costa and Kahn (2009) focuses on Sacramento, California, and Kok and Kahn (2012) examines California. All studies examine single-family transaction prices and find premiums for green construction. Brounen and Kok (2011) examines Dutch residences and finds that energy labels create transparency in the energy efficiency of dwellings. Lastly, Bond and Devine (2013, working paper) examines the effect government policies incentivizing private, market-rate LEED construction have on single family LEED construction. The authors find that policies issued by the municipalities and states prove to be more effective than those issued by counties, and that incentives tied to definite financial benefit (tax credits, grants) are the most effective incentive types.

Additionally, it is important to consider the role consumers play in this analysis, as housing is not only a consumption good, but the largest consumption good for most households. The marketing literature has examined in-depth the growth in demand for environmentally friendly products (Chen 2001, Crane 2001) and how green consumption (Anderson and Cunningham 1972, Kinnear, Taylor and Ahmed, 1974) reflects not only opinions related to prices and quality preferences, but also to personal values and beliefs (Caruana 2007, Irwin and Baron, 2001). Through this literature stream, researchers have sought to identify the green consumer through economic, demographic, and personal value measures related to environmental consciousness (Schlegelmilch, Bohlen and Diamantopoulos 1996, Shrum, McCarty and Lowrey 1995, Mazar and Zhong 2010).

Pricing premiums have been verified in both commercial and for-sale single family residential sustainable construction in a variety of locations, both within the United States and internationally. Additionally, consumers appear interested in sustainable options in their housing and are willing to pay a reasonable premium (i.e. – a premium which would be offset by the long-term utility savings associated with the investment) for such improvements. Having verified that pricing premiums may be achieved on sustainable construction, the natural extension to this field of research is to examine if similar results occur in residential rental properties. The only research uncovered to-date in green multifamily properties is a rent study by the Property and Portfolio Research arm of CoStar, indicating that LEED is the second most important feature to renters (following a downtown location), with 24 percent of polled renters willing to pay a rent premium for LEED certification.[4]

---

[4] Heschmeyer, M. (2013, June 24). "Real Estate Is Local; So Are Price, Amenities." *CoStar*. http://www.costar.com/News/Article/Real-Estate-Is-Local;-So-Are-Price-Amenities/149659

## Data

Through the end of November 2012, there were 14,932 and 10,106 buildings certified under the LEED and LEED for Homes programs, respectively. Beginning with that population, we selected all U.S. privately-constructed, predominantly market-rate multifamily properties with at least ten units. This list excludes special use properties such as assisted living facilities, student housing, and military barracks and only includes properties with income-restrictions if those restrictions are on less than 25 percent of the units (and the non-market rate units are excluded from the sample). There are 223 multifamily LEED projects, of which 97 are for-rent properties (the balance being for-sale condominium-type properties). These rental properties have a total of 26,744 units.

While there is a heavy concentration of LEED multifamily properties in the coastal areas, the property type has permeated the country: there are LEED multifamily rental projects across the country, including the South, Midwest, and Mountain areas as well as the two coasts. These LEED multifamily properties are predominantly situated within the urban centers, meeting some of the lifestyle goals of the targeted sustainable renters discussed previously, such as socialization, walkability, and concerns about occupancy and transportation costs. Figure 1 highlights the for-rent multifamily property markets, with the light, mid-toned, and dark markers indicating cities with one, two through five, and seven through eleven LEED rental properties, respectively. Of the 29 markets with LEED rental properties, 41 percent have one LEED apartment property and 28 percent have two LEED apartment properties. San Francisco, Boston, and Washington DC have four, five, and seven LEED rental properties, respectively. The balance of the markets have eight or nine properties each, with the exception of New York City which has eleven LEED properties. These high-penetration markets (Los Angeles, Chicago, Dallas, Seattle, Portland, and New York) largely represent the investment-grade markets of the U.S. and are generally situated in coastal areas.

*(Insert Figure 1 here)*

LEED

Developed by the U.S. Green Building Council (USGBC) in 1998, Leadership in Energy and Environmental Design (LEED) provides building owners and operators with a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions. Pursuing LEED certification can often result in an increased cost of initial design and construction, but these costs can be mitigated by the lower operational costs. Additionally, recent findings indicate that if green strategies are instituted from the beginning of the planning process, those added costs may be avoided. Additionally, this construction cost premium is shrinking as green construction methods and materials become less the exception and more the norm.[5]

To pursue any type of LEED certification, each project must begin by meeting the Energy Star requirements and then improve its sustainability substantially over that level. This provides a concise relative comparison of the two certification products. To meet LEED requirements, a

---

[5] World Green Building Council, "The Business Case for Green Building: A Review of the Costs and Benefits for Developers, Investors and Occupants," 2013. http://www.worldgbc.org/files/8313/6324/2676/Business_Case_For_Green_Building_Report_WEB_2013-03-13.pdf

home can meet sustainability requirements in the categories of energy use, water use, indoor air quality, material use (including the minimization of waste), land use, and education of the homebuilder and end user. [6]

Complaints of the LEED programs include its high certification costs, the fact that it is a design tool and not a performance measurement tool, and that is it not yet climate-specific (although the newest version hopes to address this weakness). LEED is developed and continuously modified by workers in the sustainable building industry, especially in the ten largest metro areas in the U.S. However, LEED certified buildings have been slower to penetrate small and mid-sized markets.

Analysis

In order to analyze the differences between LEED multifamily rental properties and their traditionally-constructed counterparts, comparable properties are identified. The method through which comparable properties are selected can be approached a variety of ways. Eichholtz, Kok, and Quigley (2009) uses a standard distance radius surrounding the subject property in order to identify comparable properties. Fuerst and McAllister (2011) instead uses CoStar-delineated submarkets from which to source comparables. The authors note that two properties could be situated quite close together but, because of geographic features, may have different locational appeal (quite literally "on the wrong side of the tracks"). Additionally, they note that a standard radius may not be applicable to all properties. In more disparate markets (some in Texas, for example), a building could be situated several miles away and still be in a comparable location. That said, submarket delineations are themselves subjective.

[6] www.usgbc.org.

Our approach to comparable property selection blends the two methods, in a technique similar to that approved by The Appraisal Foundation.[7] By using Appraisal Institute guidelines, we identify the typical elements of comparison appropriate for this product type including property size, quality and amenities (Appraisal Institute, 2001) Then, we identify properties that are both characteristically and locationally most comparable. Using an online map search tool, all the apartments near the subject property are identified. Working from the nearest neighbor outward, the properties are examined to determine if they are characteristically comparable. Nearly all apartment properties of this caliber have webpages, and there are several well-established agglomerating websites for apartment properties which also identify similar-quality properties in the nearby area and offer reviews of the properties. Lastly, many of the properties of this quality level are owned by a few of the largest high-end apartment operators in the country such as UDR, Avalon, AMLI, and Gables. As many of the subject properties are owned and operated by these groups, using their sister properties as comparables provides a natural match. Oftentimes, comparable properties are directly adjacent to the subject property, nearly guaranteeing locational equivalence. When this is not the case, the comparable property options are examined within the context of their geographical proximity to the subject, taking both distance and geographic barriers into consideration. In the vast majority of cases, all selected comparable properties are situated within one mile of the subject. The exception to this occurs in more sprawling, suburban areas. In these instances, the individual apartment complexes can spread across acres of land, as do their comparables, making the distance between the properties greater by nature. In no case is a comparable property selected that is situated more than three miles from the subject. We strive

---

[7] The Appraisal Foundation-approved methodology is considered to be the real estate industry's best practice.

for three comparable properties per subject property, but elect to use fewer comparable properties rather than weaker comparables if presented with that situation.[8] In a few cases, no properties are deemed acceptable comparables and those properties are removed from the subsequent analysis.[9] The sample includes 97 LEED and 193 traditionally-constructed apartment properties. Due to the close proximity of several LEED properties in some markets, certain comparable properties are used as controls for more than one subject property, resulting in a smaller total number of comparable properties. There are 57,115 total units in the comparable properties.

Having identified the group of LEED and comparable traditionally-constructed apartments, property-level data is hand-collected on the properties. This data is factual (not subjective), so it was predominantly taken from each property's website or leasing agents. Information collected on each property includes: the total number of units in the property; if the property includes a gym, a pool, outdoor common area, on-site retail; if there is surface and/or covered parking available, and if parking has an additional cost; and, if the tenants have gross or net leases. Additionally, the year the property was constructed or has a major renovation was identified, to control for property age or effective age.

The lease format is of particular interest with respect to our research question because it controls who garners the benefits of reduced energy costs. In a gross lease, the landlord captures the energy

---

[8] *The Appraisal of Real Estate – 12th Edition* indicates that a single sale may sufficiently explain the market, but that the most important aspect of comparable selection is that the value of including each comparable in the selection be understood (pg. 420).

[9] There are eight cases in which this occurs. These eight properties are situated in: Seattle, WA (2 of 8 properties in MSA); Portland, OR (1 of 9 properties in MSA); Washington, DC (1 of 8 properties in MSA); Bayonne, NJ (1 of 11 properties in NYC MSA); Anaheim, CA (1 of 8 properties in LA MSA); Cincinnati, OH (1 of 2 properties in MSA); and, Augusta, GA (only property).

cost savings, while in a net scenario (which generally requires the tenant to pay for the energy costs associated with heating, cooling, and electrical usage, but not trash or water), the benefits of decreased energy costs accrue to the tenant. In the latter scenario, the tenant would be incentivized to select a LEED apartment over a traditionally-constructed one, holding all else equal. Or, a tenant would be incentivized to pay a higher rental rate for a LEED building if the energy savings offset the increased rental cost.

In addition to these property-specific features collected from the source, we also determined the Walk Score for all of the properties in our sample. Walk Score is a private company that measures walkability of properties based on the surrounding amenities. The scores scale from zero to 100, and can change frequently, as the amenities surrounding properties open and close their doors. To control for this, Walk Scores were collected for every property on the same day.

Lastly, one of the great benefits of this real estate type is that it is marketed openly to the public. With other commercial real estate product types such as office, retail, and industrial, the market for space is conducted in a slightly less transparent environment. Often, intermediaries are used to disseminate information about available space, and that information is often not widely available. However, apartment properties market themselves to the general public. As green has become a more popular concept, many apartment properties are aligning themselves with the idea. Obviously, the subject properties are clearly stating their green nature through advertisement of their LEED certification, but several of the traditionally-constructed properties also tout green features. In fact, many of the non-certified properties promote themselves as green, prominently displaying their sustainable and environmentally friendly features on their website. These features can range from offering recycling programs or having on-site ZipCars, all the way up to equipping their units with Energy Star appliances or offering community rooftop gardens. In all cases, these features are not only promoted, but clearly identified as green or sustainable features of the property. Therefore, it is not that the collector of the data determined that features of the property to be an indication that the property is presenting itself as green. Instead, the property's marketing clearly states that it is green, and provides these features as proof. In each case, it is carefully verified that the comparable properties are neither LEED certified nor Energy Star certified. Given this open-information market, we are able to divide our sample into three categories: LEED certified properties, green non-certified properties, and non-green properties.

*(Insert Table 1 here)*

Table 1 summarizes the different subsamples of properties grouped by their construction or major renovation year. Panels A, B, C, and D provide descriptive data on the LEED properties, all the comparable properties, the non-certified but green comparable properties, and the non-certified, non-green comparable properties, respectively, with Panels C and D being subgroups of Panel B. Panel A indicates that none of the LEED certified properties in our sample were constructed prior to 2001, and all but ten properties were constructed since 2006. It is possible that existing properties were subsequently certified, indicating that the year of construction is not necessarily the year of certification. The 97 LEED properties have a total of 26,744 units and include 472 unique unit configurations (our unit of comparison). The vast majority operates on net leases, and LEED properties have stabilized their average size in the mid-200 unit range, which is slightly higher than the comparable properties.

Turning to the full sample of comparable properties see in Panel B, over half of the properties selected as competitors for the LEED properties have also been constructed or significantly renovated since 2006. The 50 properties listed in the Year 2000 group represent all existing properties which maintain their high-end status through on-going renovation, including some long-existing buildings (100+ years). Throughout the analysis, buildings are defined as New if they were constructed or had major renovation completed since 2010 and as Existing if they were constructed prior to 2001 and have not experienced a major renovation since that time. The 193 comparable buildings have a total of 57,115 units and 936 unique unit configurations. While their number of units is in the mid-200 units, that size has been trending downward over the last six years.

Of those 57,115 units, nearly 30 percent are situated in green, non-certified buildings. By far, these buildings have become much more popular since 2006, with three-fourths constructed or substantially renovated in the second half of the sample period. On the contrary, the non-green subsample (which makes up the other 70 percent of comparable properties) experienced their boom in the mid- to late-2000s, tailing off over the last three years. This may be an indication that green apartments – be they certified or not – are becoming the norm and non-green apartments are falling out of favor.

Having collected building information on all of the LEED and comparable properties, we turn to the unit of interest, the individual apartment type. In lieu of each unit being an observation, we consolidate units at the property level based on five features. By averaging all units in a property which share these features, we control for the within category variation caused by outliers without losing the between category variation. Within a constrained period of three weeks (as rental rates are time-sensitive), we collected data on each type of unit in the properties. Unit types are defined based on: number of bedrooms and bathrooms; the presences of a bonus room such as a den or loft; the inclusion of private outdoor space such as a balcony or patio; and, the inclusion of en-suite laundry facilities. For each of these unique combinations, we collected each property's average square footage and average monthly asking rental rate, allowing us to also calculate rental rates on a per square foot basis. For example, there will be an observation representing the average rental rate per square foot for all of a property's one bedroom, one bathroom units with a patio and en-suite laundry facilities. Within the same property there will be a different observation representing the average rent per square foot for similar units which also include a den. Not all combinations exist, as many are illogical (example: a one-bedroom apartment with four bathrooms). Of the 320 possible combinations, approximately 100 different combinations are observed. Additionally each property varies in the number of combinations observed, with some offering a wide array of feature combinations and other buildings offering only one unit configuration. What results is a dataset of 1,591 observations (representing 83,859 individual units), of which 472 unit types (26,744 units) are situated in LEED certified properties, 183 unit types (16,515 units) in green non-certified properties, and 936 unit types (40,600 units) in non-green properties.

When collecting the rental rates, we adjusted each to reflect the actual rate if there was a notable leasing special offered (example: one month free rent). However, this occurred in less than ten cases, which is to be expected given (and provides evidence supporting) the current tight apartment market. We take asking rental rates as the contract rates, which is a reasonable assumption as apartment renters are usually price takers. In the multifamily market, individual households generally don't have enough importance to negotiate rental rates, especially when demand for rental units is high. While we were unable to collect definite vacancy rates on the properties, many properties' websites indicate which units are available either now or in the near future. While collecting the data, the majority of properties had a very small number of available units listed. Therefore, while we will not attempt to determine effective rental rate, the nature of the multifamily rental market in general and the specific current conditions of the multifamily rental market allow us to accept asking rents as a reasonable representation of actual rents. Table 2 provides a side-by-side comparison of the four sample categories, including both average property data and average unit data.

*(Insert Table 2 here)*

Revisiting the property-level data first (Panel A), we see that in many ways these four subsamples are quite similar. The average number of units per building falls within a scale of 34 units, and the average Walk Score for each subsample is 82. Additionally, only a token few properties in each subsample operate gross leases. The vast majority of properties offer an on-site gym and outdoor common area, while pools and on-site retail space is less common. Few properties offer surface parking, while most offer covered parking at a cost. LEED properties have a stronger tendency to charge extra for parking, but that is consistent with a green mentality. The added fee serves to deter people from owning one (or more than one) car, which would lower the amount of emissions.

While there are some fine differences in the property-level data, the unit type-level data is remarkably similar (Panel B). The average unit type size range is only 38 square feet, and the average monthly rent range is $38, or less than two percent of the median rent for the LEED properties. While that is already indicative of well-matched unit types based on size and price, when the per square foot rent for each unit type is averaged (capturing both size and rent in a weighted analysis), all four subsamples return the same rate: $2.67 per square foot. The median results in all of these categories return similar results, with a tighter range in unit type size and a slightly less exact match on rent and rent per square foot.

In Panel C we examine three common "families" of unit types: the studio apartment with one bathroom (fourteen percent of the observations); the one bedroom / one bathroom unit (26 percent of the observations); and, the two bedroom / two bathroom unit (23 percent of the observations).[10] While all observed unit types are included in the analysis, these three common unit formats are highlighted because of their mainstream appeal. These three "families" of unit types comprise over 60 percent of the observations, so the strength of their comparability is of particular importance. In each case, the subsample once again return quite similar results. Focusing on the rent per square foot measure, the range for the studio unit types is $0.25 (eight percent of the LEED rate), the range for the one bedroom unit types is $0.20 (seven percent of the LEED rate), and the range for the two bedroom unit types is $0.12 (five percent of the LEED rate). The tightness of

[10] The "family" refers to all unit types that share bedroom/bathroom configurations, despite the presence or lack of a den, en-suite laundry, and/or private outdoor space.

these ranges for size and both rent measures as well as the consistency of those tight ranges across the types of analysis indicate that these comparables are indeed just that.

Methodology

We use a standard real estate valuation framework to determine if LEED energy efficiency certification creates a rental rate premium. The sample of buildings used includes the full population of LEED certified residential rental commercial properties (apartments) in the United States from the program's inception through the end of November 2012 and a control sample consisting of one or more nearby nonrated residential rental commercial property. Characteristics of these properties are evaluated in a semilog equation relating rental rates per unit to hedonic characteristics (unit characteristics, building characteristics, amenities provided). The regression equation to be modeled is:

$$logR_i = \alpha + \beta_i X_i + \delta g_i + \varepsilon_i \qquad \text{(Equation 1)}$$

In Equation 1, the dependent variables is the natural logarithm of the rent in cents per unit per square foot ($R_i$) in residential rental property i. $X_i$ is a vector of hedonic characteristics of each unit type observation i. Lastly, the variable of interest, $g_i$, is a dummy variable with a value of 1 if property i is LEED certified and zero otherwise. Similar versions of the equation are estimated using different versions of the treatment variable as well. A, β, and δ are estimated coefficients and $\varepsilon_{in}$ is an error term. A complete list of variable names and definitions is included in Table 3.

*(Insert Table 3 here)*

In order to effectively cluster the properties and their comparables, a matching procedure is utilized and the resulting weights are applied to the regression models. The matching methodology used is Coarsened Exact Matching (CEM), a monotonic imbalance reducing matching method (Iacus, King, and Porro, 2008). CEM and common propensity score matching differ in that this method allows for the balance between the control and treatment groups to be selected ex ante rather than discovered through trial and error of model estimations. CEM is a three-step process: first, the data is coarsened by discretizing the variables to build a multi-dimensional histogram; second, if a cell does not contain at least one control and treatment observation each, all observations in that cell are discarded; and third, weights are created, with each treatment observation receiving a weight of one, and each control observation receiving a weight of $Treatment_i/Control_i$ (a weighted weight). There are several benefits to CEM. The adjustment of one variable's imbalance does not affect the maximum imbalance on other variables. Also, the process guarantees common empirical support without requiring specific data restrictions. Lastly, the results are robust to measurement error and the process is more transparent than propensity score matching. CEM has outperformed other matching methods in Monte Carlo tests (Iacus, King and Porro, 2008).

**Results**

We estimate Equation 1 using our full sample and the control variables described in the data section. Table 4 Equation 1 provides the results in which the dummy treatment variable captures the pricing effect of LEED certification. We control for cluster fixed effects, with each cluster representing the treatment and weighted comparable properties.[11] The loading on this treatment variable is approximately 0.0700 and has a p-value of 0.000, indicating that if a rental unit is LEED certified the rent per square foot is seven percent higher. Equation 2 represents the same equation with the addition of CEM weights. In this estimation, the treatment variable loading increases in magnitude to 8.9 percent while maintaining high statistical significance, a similar R-squared value, and generally consistent loadings on the control variables in terms of sign, magnitude, and statistical significance. Using the average rent per square foot of $2.67 (which is the same for all subsamples, LEED and comparable properties), that indicates an approximate per square foot per month premium range of $0.18 to $0.23.

*(Insert Table 4 here)*

To estimate the economic impact of this difference, we examine this treatment's effect on a theoretical property created from the average and median values of our full sample of properties. We use a conservative premium estimate of $0.20 per square foot (approximately 7.5 percent). Assuming a 250-unit property comprised of 1,000 square foot units, certifying LEED results in $600,000 added annual income (assuming it is fully leased), and therefore $10 million in added value (based on a 6 percent capitalization rate[12]).[13] This is based on the assumption of no added operating expense. There has been no evidence of added cost to operate a LEED building over a

---

[11] In addition to cluster fixed effects, all equations were also estimated using MSA fixed effects. There was little change in the results, with the exception of a lower R^2 due to the decrease in variables.
[12] Integra Realty Resources estimates 2012 multifamily capitalization rates were 5.91% and 6.09% for urban and suburban properties, respectively. Viewpoint 2013: Integra Realty Resources Real Estate Value Trends. Available at: http://irr.com/_FileLibrary/Publication/13/viewpoint2013.pdf
[13] To put this value in context, using that average rental rate per square foot of $2.67 for the example building with a 40% expense ratio and the 6% capitalization rate would indicate a base building value of approximately $80 million.

traditionally constructed building. This analysis disregards additional energy efficiency savings the LEED property owner may experience from operating the common areas, and any increase in occupancy rates (already determined in the literature for office properties: Nelson, 2007; Eichholtz, Kok, and Quigley, 2010 and 2013). Therefore, the added gross income should fall directly to net operating income and be entirely convertible into added value. While LEED certification is often touted as an expensive process, it is unlikely the cost would outstrip the added income described above.

Table 4 Equation 3 presents the same estimation as in Equation 2, except the treatment variable is now Green. The Green treatment variable has a value of one for every property that markets itself as being green. In addition to including all of the LEED properties, this treatment group also includes all of the properties which market themselves as having green features but are not certified under any sustainability or energy efficiency program. While a premium is expected here (since we have already identified that the LEED subgroup within the green group garners a premium), what is notable is that the premium is lower than the LEED premium (7.6 percent for all Green properties versus 8.9 percent for LEED certified properties). This indicates that the non-certified properties garner a lower premium than the certified properties, dragging the average premium down.

To further test these results, we estimate the equation again, this time examining the impact on rental rates for properties claiming to be green but not being LEED certified (Green, Non-LEED). Table 4 Equation 4 shows a small, positive loading on the green, non-LEED treatment variable. However, the sample size is substantially smaller for this treatment group (as there are only 183 treated observations and 472 matched comparable observations), and the result is statistically insignificant.

To understand the relationship between the two green property subsamples (those that are LEED certified and those that are not but claim to be green), we control for both treatment groups in the same estimation (Table 4 Equation 5). Here, the results on clear: all properties which claim to be green experience a rental rate premium. However, LEED certified properties' premium is nearly double that of the non-certified properties (9.10 percent versus 4.74 percent). Of note is the strong statistical significance of both the treatment variables and the strength and consistency of the balance of the model as compared to the other estimations shown in Table 4. This finding clearly supports the "cheap talk" nature of green language. While stating a property is green will result in increased rental rates, the signal is weak. The stronger signal of LEED certification matters, and results in a substantially larger rental rate premium.

Sensitivity Analysis

To test for robustness, we examined the impact of a variety of other controls on our results. At the property level, additional variable data collected and tested which did not prove significant includes: Transit Scores; Bike Scores; on-site retail; outdoor common area; surface parking; covered parking; and, if a fee is associated with parking. Variables controlling for political ideology, heating and cooling degree days, and propensity to prefer green were considered to see if an area which is predisposed to green concepts would experience different rental rate responses. To test the roll of regional demographics, population and income controls were tested. Additionally, all models were tested using MSA-level fixed effects in lieu of cluster fixed effects, and the results were largely the same. Lastly, controls were tested to identify properties situated in the top six investment markets and the largest 100 MSAs, neither of which proved significant.

*(Insert Table 5 here)*

As additional sensitivity analysis, Table 5 reports results from re-estimating Equation 2 from Table 4 using three different subsamples. Table 5 Equations 1 and 2 examine two subsamples of properties with different Walk Score scales. Walk Score quantifies how walkable a lifestyle a resident can have, with a scores of 70-89 deemed Very Walkable (most errands accomplishable on foot), and scores of 90-100 deemed Walker's Paradise (daily errands not requiring a car). First, we examine units with Walk Scores of 90 and higher (Table 5, Equation 1), representing the most urban and walkable properties. In the second estimation (Table 5, Equation2), we examine units with Walk Scores less than 80. While this subgroup is cut mid-way through the Very Walkable designation, cutting it off at 70 instead of 80 results in a very small subsample. Therefore, we decided to evaluate all properties with Walk Scores up through 80 as an evaluation of the less-walkable, suburban properties. Both equations show LEED certified premiums (4.9 and 5.8 percent, respectively) that are highly statistically significant. It is interesting to note that the premium for LEED certification is greater in the suburban, less walkable properties.

Lastly, we complete a similar analysis focusing on the existing unit stock. In this subsample, only properties more than two years old are examined to determine if the shine of LEED wears off after its initial popularity. Table 5 Equation 3 again mirrors the modeling of Table 4 Equation 2, with the exception of the sample. The results here too are consistent with those found throughout this analysis, with a statistically significant LEED premium of 9.5 percent. This indicates that even after the new product excitement wears off, the LEED premium endures. Therefore, that the added income we estimated earlier ($600,000 annually on the sample building) will not be a one-year bonus, but will be a persistent source of added income.

**Conclusion**

We collected unit-level data on every market-rate, privately-constructed LEED multifamily property certified in the United States through the end of November 2012, and did the same for comparable uncertified properties. The resulting bank of over 1,500 rental units allowed us to examine the characteristics of LEED-certified multifamily rental properties, and how they compare to their traditionally-constructed counterparts. The summary statistics indicate that these two subsamples of properties are well matched for quality characteristics and other control variables (indicating the strength of the comparables), which helps facilitate a careful analysis of the certification effect.

Using a hedonic semi-log model with the natural log of average rent per square foot (in cents) as the dependent variable, we are able to explore the effects both LEED certification and any green posturing have on rental rates. Our estimated equations are quite strong and robust, with control variables proving highly significant (economically and statistically) and carrying the expected sign in most cases. Focusing on the treatment variable loadings, the results are highly consistent. Across the models, the loadings on the LEED treatment variable carry the expected sign and are statistically significant at the one percent level of analysis in most cases. The LEED premium estimates range from 7.0 to 9.1 percent for the full sample, and from 4.9 to 9.5 percent for the subsample analyses. This alone indicates the strong likelihood that there is a rental premium associated with LEED-certified properties.

However, the result of particular interest is that the LEED-certified loading is greater than that on all green units (8.8 versus 7.6 percent) and, specifically, greater than that of the green, non-certified units. By controlling for both LEED ceritified properties and non-certified properties which are advertised as being green, we see that the premium associated with the green, non-certified properties is substantially less than the LEED premium (4.7 versus 9.1 percent). Lastly, sensitivity analysis shows that the LEED premium exists both in high and low walkability properties (urban and suburban markets) and in the existing stock of apartment units, indicating that it is not simply the newness of green that is garnering the higher rents.

Our results indicate that in addition to a rental premium associated with green multifamily units, there is an additional premium assigned to LEED certification. Therefore, while the cheap talk of green works - with green, non-certified properties garnering a rental rate premium - it does not nullify the value added through LEED certification. The strength of the certification signal remains, and provides an added 4 percent premium over that earned through green cheap talk.

Whether one views the rental rate difference between energy efficient, sustainable properties and traditionally-constructed properties as a green premium or as a brown discount, it is clear that there is an economically and statistically significant difference. Additionally, we also now know that there is a definite price differentiation between properties which say they are green and those which certify they are green.  LEED certified properties consistently rent for higher rates than their non-certified competitors, both green and non-green.

## References


Anderson, W. and Cunningham, W., 1972. The socially conscious consumer. *The Journal of Marketing*, 36 (3): 23-31.

Appraisal Institute, 2001. *The Appraisal of Real Estate - 12th Edition*. Chicago, IL: The Appraisal Institute.

Aroul, R. and Hansz, J., 2012. The Value of "Green:" Evidence from the First Mandatory Residential Green Building Program. *Journal of Real Estate Research*, 34 (1): 27-49.

Banfi, S., Farsi, M., Filippini, M., and Jakob, M., 2008. Willingness to pay for energy-saving measures in residential buildings. *Energy Economics*, 30: 503-516.

Bond, S. and Devine, A., 2013. Do Policy Incentives Promote Green Building? Working paper.

Brounen, D. and Kok, N., 2011. On the economics of energy labels in the housing market. *Journal of Environmental Economics and Management*, 62:166-179.

Brounen, D., Kok, N., and Quigley, J., 2011. Residential Energy Use and Conservation: Economics and Demographics. Working paper.

Brounen, D., Kok, N., and Quigley, J., 2011. Residential Energy Literacy and Capitalization. Working paper.

Caruana, R., 2007. A sociological perspective of consumption morality. *Journal of Consumer Behavior*, 6: 287-304.

Chen, C., 2001. Design for the environment: A quality-based model for green product development. *Management Science*, 47: 250-263.

Ciochetti B. and McGowan, M., 2010. Energy Efficiency Improvements: Do they Pay? *Journal of Sustainable Real Estate*, 2 (1):305-333.

Costa, D. and Kahn, M., 2009. Towards a Greener California: An Analysis of Household Variation in Residential Electricity Purchases. Working Paper.

Crane, A., 2001. Unpacking the ethical product. *Journal of Business Ethics*, 30: 361-373.

Ecofys, 2003. Cost Effective Climate Protection in the EI Building Stock. Report for EURIMA. Ecofys: The Netherlands.

Eichholtz, P., Kok, N., and Quigley, J., 2010. Doing Well by Doing Good: Green Office Buildings. *American Economic Review*, 100:2494-2511.

Eichholtz, P., Kok, N., and Quigley, J., 2013. The Economics of Green Building. *The Review of Economics and Statistics*, 95(1): 50-63.

Eichholtz, P., Kok, N., and Quigley, J., 2012. Who Rents Green? Ecological Responsiveness and Corporate Real Estate. Working paper.

Fuerst, F. and McAllister, P., 2009. An Investigation of the Effect of Eco-Labeling on Office Occupancy Rates, *Journal of Sustainable Real Estate*, 1 (1):49-64.

Fuerst, F. and McAllister, P., 2011. Green Noise or Green Value? Measuring the Effects of Environmental Certification on Office Values, *Real Estate Economics*, 39 (1): 45-69.

Goodwin, K., Waller, B., and Weeks, H., forthcoming. The Impact of Broker Vernacular in Residential Real Estate, *Journal of Housing Research*.

Haag, J., Rutherford, R., and Thomson, T., 2000. Real Estate Agent Remarks: Help or Hype? *Journal of Real Estate Research*, 20: 205-215.

Hansen, K., 2011. What Does Gen Y Want? *REALTOR Mag*, May 2011.

Iacus, S., King, G., and Porro, G., 2009. Causal Inference Without Balance Checking: Coarsened Exact Matching, Working Paper. Available at: http://gking.harvard.edu/files/cem-plus.pdf

Irwin, J. and Baron, H., 2001. Response mode effects and moral values. *Organizational Behavior and Human Decision Processes*, 84: 177-197.

Kats, G., 2003. The costs and Financial Benefits of Green Buildings: A report to California's sustainable Building Task Force. U.S. Green Building Council: Washington, D.C.

Kinnear, T., Taylor, J. and Ahmed, S., 1974. Ecologically concerned consumers: Who are they? *The Journal of Marketing*, 38 (2): 20-24.

Kok, N., McGraw, M., and Quigley, J., 2011. The Diffusion of Energy Efficiency in Building. *American Economic Review*, 101 (3):77-82.

Kok, N. and Jennen, M., 2011. The Value of Energy Labels in the European Office Market. Working paper.

Kok, N. and Kahn, M., 2012. The Value of Green Labels in the California Housing Market: An Economic Analysis of the Impact of Green Labeling on the Sales Price of a Home, July 2012. http://issuu.com/nilskok/docs/kk_green_homes_071912/3

Kwak, S., Yoo, S., and Kwak, S., 2010. Valuing energy saving measures in residential buildings: A choice experiment study. *Energy Policy*, 38:673-677.

Marshall, K., 2011. Generational change in paid and unpaid work. *Canadian Social Trends*, 92, catalogue no. 11-008-X.

Mazar, N. and Zhong, C., 2010. Do Green Products Make Up Better People? *Psychological Science*, 21 (4): 494-498.

Miller, N., Spivey, J., and Florance, A., 2008. Does Green Pay Off? *Journal of Real Estate Portfolio Management*, 14 (4): 385-400.

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

Sadler, M., 2003. Home energy preferences and policy: applying stated choice modeling to a hybrid energy economic model. Report to National Resources Canada, Simon Fraser University, September 2003.

Schlegelmilch, B., Bohlen, G. and Diamantopoulos, A., 1996. The link between green purchasing decisions and measures of environmental consciousness. *European Journal of Marketing*, 30 (5): 35-55.

Shrum, L., McCarty, J. and Lowrey, T., 1995. Buyer characteristics of the green consumer and their implications for advertising. *Journal of Advertising*, 24 (2): 71-82.

Torres, B., 2010. Why Gen Y delays homebuying, *San Francisco Business Times*. Retreived from http://www.bizjournals.com/sanfrancisco/blog/2010/06/why_gen_y_delays_homebuying.html?page=all.

Wiley, J., Benefield, J., and Johnson, K., 2010. Green Design and the Market for Commercial Office Space. *Journal of Real eState Finance and Economics*, 41 (2): 228-243.

**Table 1: Summary Statistics of Year-by-Year Property-Level Data**

These tables describe the average (unless otherwise noted) values of categorical variables broken down by year constructed or renovated for each subsample: the LEED properties (Panel A), the full sample of comparable properties (Panel B), the green non-certified properties (Panel C), and the non-green non-certified properties (Panel D).

**Panel A: LEED**

| | | | | - | Percent of **Properties** with: | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year Built/ Renovated | # Properties | Total Units | Avg Units/ Property | Avg Walk Score | Gross Lease | Gym | Pool | Outdoor Common Area | On-site Retail | Surface Parking | Covered Parking | Parking Cost |
| 2001 | 1 | 298 | 298 | 98 | - | 100% | - | 100% | 100% | - | 100% | 100% |
| 2002 | 1 | 293 | 293 | 97 | - | 100% | - | 100% | - | - | 100% | 100% |
| 2003 | 3 | 570 | 190 | 89 | - | 67% | 67% | 100% | 67% | - | 100% | 67% |
| 2004 | 2 | 1,582 | 791 | 89 | - | 100% | - | 100% | 100% | - | 100% | 100% |
| 2005 | 3 | 1,247 | 416 | 84 | - | 100% | 67% | 100% | 33% | 33% | 100% | 100% |
| 2006 | 6 | 2,258 | 376 | 90 | - | 100% | 33% | 100% | 67% | - | 100% | 100% |
| 2007 | 3 | 933 | 311 | 90 | - | 67% | 33% | 100% | 33% | - | 100% | 67% |
| 2008 | 10 | 2,225 | 223 | 85 | - | 90% | 40% | 100% | 50% | 10% | 90% | 90% |
| 2009 | 24 | 6,317 | 263 | 77 | - | 92% | 50% | 96% | 54% | 13% | 100% | 88% |
| 2010 | 26 | 7,065 | 272 | 83 | 4% | 92% | 65% | 96% | 58% | 31% | 88% | 81% |
| 2011 | 13 | 2,839 | 218 | 76 | 8% | 77% | 46% | 92% | 62% | 23% | 85% | 69% |
| 2012* | 5 | 1,117 | 223 | 78 | - | 60% | 40% | 100% | 40% | 40% | 100% | 100% |
| **Total** | **97** | **26,744** | **276** | **82** | **2%** | **88%** | **49%** | **97%** | **56%** | **19%** | **94%** | **85%** |

** Through November 30, 2012*

**Panel B: All Comparables**

| | | | | - | Percent of **Properties** with: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year Built/ Renovated | # Properties | Total Units | Avg Units/ Property | Avg Walk Score | Gross Lease | Gym | Pool | Outdoor Common Area | On-site Retail | Surface Parking | Covered Parking | Parking Cost | Green |
| 2000* | 50 | 14,978 | 300 | 83 | 2% | 90% | 72% | 94% | 60% | 26% | 88% | 76% | 10% |
| 2001 | 5 | 1,292 | 258 | 96 | - | 100% | 40% | 100% | 40% | - | 80% | 80% | - |
| 2002 | 8 | 2,078 | 260 | 83 | - | 100% | 63% | 100% | 25% | 13% | 100% | 100% | 13% |
| 2003 | 9 | 1,701 | 189 | 89 | - | 89% | 89% | 89% | 56% | 11% | 100% | 67% | 11% |
| 2004 | 9 | 1,994 | 222 | 88 | - | 100% | 67% | 100% | 67% | 11% | 89% | 78% | 22% |
| 2005 | 11 | 2,836 | 258 | 72 | - | 100% | 100% | 100% | 36% | 45% | 91% | 82% | - |
| 2006 | 10 | 3,192 | 319 | 74 | - | 80% | 80% | 90% | 60% | 30% | 90% | 60% | - |
| 2007 | 13 | 3,062 | 236 | 78 | - | 85% | 54% | 77% | 46% | 31% | 69% | 69% | 15% |
| 2008 | 19 | 4,004 | 211 | 84 | - | 100% | 68% | 100% | 58% | 11% | 95% | 89% | 32% |
| 2009** | 26 | 14,717 | 229 | 82 | - | 92% | 54% | 92% | 50% | 19% | 96% | 77% | 27% |
| 2010 | 10 | 2,602 | 260 | 79 | - | 90% | 60% | 100% | 60% | 10% | 100% | 70% | 30% |
| 2011 | 12 | 2,371 | 198 | 84 | 8% | 67% | 50% | 83% | 67% | 8% | 75% | 58% | 33% |
| 2012*** | 11 | 2,288 | 206 | 83 | - | 91% | 64% | 100% | 73% | - | 100% | 100% | 18% |
| **Total** | **193** | **57,115** | **251** | **82** | **1%** | **91%** | **67%** | **94%** | **55%** | **19%** | **90%** | **77%** | **17%** |

**Includes existing properties with significant ongoing renovation, maintaining the a comparable condition (many historic)*
***Includes one property with 9,000 units in a planned community. This is suppressed from Average Unit calculations.*
**** Through November 30, 2012*

**Table 1: Summary Statistics of Year-by-Year Property-Level Data (continued)**

**Panel C: Non-LEED, Green Comparables**

| | | | | - | Percent of **Properties** with: | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year Built/ Renovated | # Properties | Total Units | Avg Units/ Property | Avg Walk Score | Gross Lease | Gym | Pool | Outdoor Common Area | On-site Retail | Surface Parking | Covered Parking | Parking Cost |
| 2000* | 5 | 1,256 | 251 | 93 | - | 100% | 100% | 100% | 80% | - | 100% | 100% |
| 2001 | 0 | | | | | | | | | | | |
| 2002 | 1 | 491 | 491 | 60 | - | 100% | 100% | 100% | - | 100% | 100% | 100% |
| 2003 | 1 | 178 | 178 | 97 | - | 100% | 100% | 100% | 100% | - | 100% | 100% |
| 2004 | 2 | 275 | 138 | 90 | - | 100% | 50% | 100% | - | - | 100% | 50% |
| 2005 | 0 | | | | | | | | | | | |
| 2006 | 0 | | | | | | | | | | | |
| 2007 | 2 | 582 | 291 | 73 | - | 100% | 100% | 100% | 50% | 50% | 50% | 50% |
| 2008 | 6 | 1,022 | 170 | 70 | - | 100% | 83% | 100% | 67% | 33% | 83% | 67% |
| 2009** | 7 | 10,838 | 306 | 81 | - | 100% | 57% | 86% | 43% | 14% | 100% | 71% |
| 2010 | 3 | 632 | 211 | 82 | - | 67% | - | 100% | 100% | - | 100% | 100% |
| 2011 | 4 | 735 | 184 | 88 | 25% | 25% | 25% | 50% | 50% | - | 50% | 25% |
| 2012*** | 2 | 506 | 253 | 93 | - | 100% | 50% | 100% | 100% | - | 100% | 100% |
| **Total** | **33** | **16,515** | **235** | **82** | **3%** | **88%** | **64%** | **91%** | **61%** | **15%** | **88%** | **73%** |

**Includes existing properties with significant ongoing renovation, maintaining the a comparable condition (many historic)*
***Includes one property with 9,000 units in a planned community. This is suppressed from Average Unit calculations.*
**** Through November 30, 2012*

**Panel D: Non-LEED, Non-Green Comparables**

| | | | | - | Percent of **Properties** with: | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year Built/ Renovated | # Properties | Total Units | Avg Units/ Property | Avg Walk Score | Gross Lease | Gym | Pool | Outdoor Common Area | On-site Retail | Surface Parking | Covered Parking | Parking Cost |
| 2000* | 33 | 9,883 | 299 | 77 | 3% | 85% | 70% | 91% | 52% | 33% | 85% | 70% |
| 2001 | 5 | 1,292 | 258 | 96 | - | 100% | 40% | 100% | 40% | - | 80% | 80% |
| 2002 | 7 | 1,587 | 227 | 86 | - | 100% | 57% | 100% | 29% | - | 100% | 100% |
| 2003 | 8 | 1,523 | 190 | 88 | - | 88% | 88% | 88% | 50% | 13% | 100% | 63% |
| 2004 | 7 | 1,719 | 246 | 87 | - | 100% | 71% | 100% | 86% | 14% | 86% | 86% |
| 2005 | 11 | 2,836 | 258 | 72 | - | 100% | 100% | 100% | 36% | 45% | 91% | 82% |
| 2006 | 10 | 3,192 | 319 | 74 | - | 80% | 80% | 100% | 60% | 30% | 90% | 60% |
| 2007 | 11 | 2,480 | 225 | 79 | - | 82% | 45% | 73% | 45% | 27% | 73% | 73% |
| 2008 | 13 | 2,982 | 229 | 90 | - | 100% | 62% | 100% | 54% | - | 100% | 100% |
| 2009 | 19 | 3,879 | 204 | 82 | - | 89% | 53% | 95% | 53% | 21% | 95% | 79% |
| 2010 | 7 | 1,970 | 281 | 78 | - | 100% | 86% | 100% | 43% | 14% | 100% | 57% |
| 2011 | 8 | 1,636 | 204 | 82 | - | 88% | 63% | 100% | 75% | 13% | 88% | 75% |
| 2012** | 9 | 1,782 | 198 | 81 | - | 89% | 67% | 100% | 67% | - | 100% | 100% |
| **Total** | **160** | **40,600** | **254** | **82** | **1%** | **91%** | **68%** | **94%** | **54%** | **20%** | **91%** | **78%** |

**Includes existing properties with significant ongoing renovation, maintaining the a comparable condition (many historic)*
*** Through November 30, 2012*

**Table 2: Comparison of Property and Unit Level Data**

This table highlights the average (unless otherwise noted) values of a categorical variables for the LEED sample, the full sample of comparable properties, and the two subsamples of comparable properties, green non-certified and non-green non-certified. The 9,000-unit comparable property is suppressed from the Average Units/Property calculations.

| | **LEED** | **All Comparables** | Green Comparables | Non-Green Comparables |
|---|---|---|---|---|
| **Panel A: Property-Level Data** | | | | |
| Number of Properties | **97** | **193** | 33 | 160 |
| Total Unit Type Observations | **472** | **1119** | 183 | 936 |
| Total Units | **26,744** | **57,115** | 16,515 | 40,600 |
| Average Units/Property | **276** | **251** | 235 | 254 |
| Average Walk Score | **82** | **82** | 82 | 82 |
| Green Property | **100%** | **17%** | 100% | 0% |
| Gross Lease | **2%** | **1%** | 3% | 1% |
| Gym | **88%** | **91%** | 88% | 91% |
| Pool | **49%** | **67%** | 64% | 68% |
| Outdoor Common Area | **97%** | **94%** | 91% | 94% |
| On-Site Retail | **56%** | **55%** | 61% | 54% |
| Surface Parking | **19%** | **19%** | 15% | 20% |
| Covered Parking | **94%** | **90%** | 88% | 91% |
| Parking Fee | **85%** | **77%** | 73% | 78% |
| **Panel B: Unit Type-Level Data** | | | | |
| Average Size | **1,031** | **1,042** | 1,068 | 1,037 |
| Median Size | **968** | **979** | 979 | 978 |
| Average Rent | **$2,695** | **$2,732** | $2,726 | $2,733 |
| Median Rent | **$2,275** | **$2,319** | $2,440 | $2,263 |
| Average Rent PSF | **$2.67** | **$2.67** | $2.67 | $2.67 |
| Median Rent PSF | **$2.47** | **$2.38** | $2.64 | $1.73 |
| **Panel C: Common Unit Type Data** | | | | |
| ***Studio / 1 Bath*** | | | | |
| Observations | **66** | **163** | 25 | 138 |
| Average Size | **596** | **570** | 564 | 571 |
| Average Rent | **$1,802** | **$1,701** | $1,767 | $1,689 |
| Average Rent PSF | **$3.10** | **$3.05** | $3.27 | $3.02 |
| ***1 Bedroom / 1 Bath*** | | | | |
| Observations | **123** | **288** | 54 | 309 |
| Average Size | **769** | **777** | 792 | 824 |
| Average Rent | **$2,062** | **$2,028** | $2,184 | $2,101 |
| Average Rent PSF | **$2.71** | **$2.63** | $2.78 | $2.58 |
| ***2 Bedroom / 2 Bath*** | | | | |
| Observations | **112** | **253** | 57 | 242 |
| Average Size | **1,211** | **1,166** | 1,229 | 1,202 |
| Average Rent | **$3,108** | **$2,960** | $3,051 | $3,045 |
| Average Rent PSF | **$2.59** | **$2.56** | $2.47 | $2.54 |

## Table 3: Variable Names and Definitions

Following is a list of all variables used in the analysis and a brief definition. For further information on variables, see the Data section.

| Name | Definition |
|---|---|
| *Total Units* | The number of rental apartment units in a property. |
| *Unit Type* | A unit category describing rental apartment units based on *# Bedrooms, # Bathrooms, Den/Loft, Private Outdoor Area,* and *Ensuite Laundry*. |
| *Total Unit Type Observations* | The number of unique *Unit Type* observations which exist in a sample or subsample. |
| *Size* | The average size of a rental apartment unit, measured in square feet. |
| *Rent* | The average monthly rental rate for a rental apartment unit, adjusted for any notable rental rate special offers (example: one month's free rent). |
| *Rent PSF* | *Size / Rent.* |
| *Ln(Rent PSF in Cents)* | The natural log of *Rent PSF* measured in cents. |
| *LEED* | Dummy variable: 1 if the rental apartment unit is situated in a LEED certified property; 0 otherwise. |
| *Green* | Dummy variable: 1 if the rental apartment unit is situated in a property that markets itself as green (including all LEED certified units); 0 otherwise. |
| *Green, Non-LEED* | Dummy variable: 1 if the rental apartment unit is situated in a property that markets itself as green but is NOT LEED certified; 0 otherwise. |
| *New Building* | Dummy variable: 1 if the property in which the rental apartment unit is situated was constructed or underwent major renovation since 2010; 0 otherwise. |
| *Existing Building* | Dummy variable: 1 if the property in which the rental apartment unit is situated was constructed prior to 2001 and has not undergone a major renovation since then; 0 otherwise. |
| *Walk Score* | A third party-provided score rating the walkability of a property based on surrounding amenities. Score scales from 0 to 100. |
| *Gym* | Dummy variable: 1 if the property provides a gym for the tenants; 0 otherwise. |
| *Pool* | Dummy variable: 1 if the property provides a pool (or pools) for the tenants; 0 otherwise. |
| *On-Site Retail* | Dummy variable: 1 if the property incorporates retail uses on-site; 0 otherwise. |
| *Outdoor Common Area* | Dummy variable: 1 if the property provides private outdoor green space for the tenants; 0 otherwise. |
| *Gross Lease* | Dummy variable: 1 if the lease structure for the rental apartment unit is such that the landlord pays all utilities (not considering telecommunication/cable/internet); 0 otherwise. |
| *Surface Parking* | Dummy variable: 1 if the property offers surface parking (uncovered) for the tenants; 0 otherwise. Not mutually exclusive of *Covered Parking*. |
| *Covered Parking* | Dummy variable: 1 if the property offers covered parking (surface or structure) for the tenants; 0 otherwise. Not mutually exclusive of *Surface Parking*. |
| *Parking Fee* | Dummy variable: 1 if the parking available to the tenants comes at an additional cost (either *Surface Parking* and/or *Covered Parking*); 0 otherwise. |
| *# Bedrooms* | Categorical variable: 0 = studio unit; 1 = 1 bedroom unit; 2 = 2 bedroom unit; 3 = 3 bedroom unit; 4 = any unit with 4 or more bedrooms. |
| *# Bathrooms* | Categorical variable: 1 = 1 full bathroom; 1.5 = 1 full and 1 half bathroom; 2 = 2 full bathrooms; 2.5 = 2 full and 1 half bathroom… |
| *Den/Loft* | Dummy variable: 1 if the rental apartment unit includes a bonus room, such as a den or loft, that cannot be considered a bedroom; 0 otherwise. |
| *Private Outdoor Area* | Dummy variable: 1 if the rental apartment unit includes private outdoor area, such as a patio or deck; 0 otherwise. |
| *Ensuite Laundry* | Dummy variable: 1 if private laundry facilities are provided within the rental apartment unit; 0 otherwise. |

## Table 4: Regression Results, Full Sample

Following are full sample regression estimations with three different treatment variables: LEED certified properties, any property that markets itself as green (including all LEED properties), and the properties that market themselves as green but are not LEED certified. Equation 1 is unweighted and Equations 2-5 include CEM-calculated weights. All equations include cluster fixed effects and categorical controls for the number of bedrooms and bathrooms. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent level of analysis.

| *Ln(Rent PSF in Cents)* | (1) | | (2) | | (3) | | (4) | | (5) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| LEED | 0.0700 | *** | 0.0887 | *** | | | | | 0.0910 | *** |
| | (.0110) | | (.0118) | | | | | | (.0123) | |
| Green | | | | | 0.0760 | *** | | | | |
| | | | | | (.0116) | | | | | |
| Green, Non-LEED | | | | | | | 0.0176 | | 0.0474 | *** |
| | | | | | | | (.0132) | | (.0162) | |
| New Building | 0.0493 | *** | 0.0243 | | 0.0159 | | 0.0344 | | 0.0150 | |
| | (.0185) | | (.0188) | | (.0200) | | (.0242) | | (.0200) | |
| Existing Building | -0.1062 | *** | -0.0828 | *** | -0.0851 | *** | -0.1388 | *** | -0.0804 | *** |
| | (.0139) | | (.0162) | | (.0162) | | (.0216) | | (.0161) | |
| Walk Score | 0.0021 | *** | 0.0019 | ** | 0.0017 | ** | -0.0009 | | 0.0017 | ** |
| | (.0008) | | (.0009) | | (.0009) | | (.0011) | | (.0008) | |
| Gym | 0.1130 | *** | 0.1246 | *** | 0.0946 | *** | 0.0533 | | 0.0956 | *** |
| | (.0328) | | (.0387) | | (.0336) | | (.0409) | | (.0333) | |
| Pool | 0.0491 | *** | 0.0480 | *** | 0.0377 | *** | -0.0268 | | 0.0398 | *** |
| | (.0126) | | (.0136) | | (.0130) | | (.0179) | | (.0132) | |
| Gross Lease | 0.1211 | *** | 0.1365 | *** | 0.0350 | | 0.0002 | | 0.0381 | |
| | (.0464) | | (.0497) | | (.0442) | | (.0497) | | (.0461) | |
| Ln (Size) | -0.2036 | *** | -0.2686 | *** | -0.2963 | *** | -0.3525 | *** | -0.2933 | *** |
| | (.0352) | | (.0391) | | (.0394) | | (.0704) | | (.0395) | |
| Private Outdoor Area | 0.0209 | ** | 0.0169 | | 0.0169 | | 0.0319 | ** | 0.0156 | |
| | (.0092) | | (.0111) | | (.0107) | | (.0146) | | (.0107) | |
| Ensuite Laundry | 0.0444 | *** | 0.0310 | * | 0.0503 | *** | 0.0715 | *** | 0.0449 | *** |
| | (.0142) | | (.0160) | | (.0141) | | (.0203) | | (.0143) | |
| Constant | 6.9366 | *** | 7.3696 | *** | 7.5527 | *** | 8.1863 | *** | 7.5431 | ** |
| | (.2399) | | (.2675) | | (.2636) | | (.4623) | | (.2638) | |
| | | | | | | | | | | |
| Observations | 1589 | | 1544 | | 1544 | | 655 | | 1544 | |
| R^2 | 0.87 | | 0.87 | | 0.85 | | 0.82 | | 0.85 | |
| F Test P-value | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | |
| | | | | | | | | | | |
| Cluster Fixed Effects | Yes | | Yes | | Yes | | Yes | | Yes | |
| # Bedroom Controls | Yes | | Yes | | Yes | | Yes | | Yes | |
| # Bathroom Controls | Yes | | Yes | | Yes | | Yes | | Yes | |
| CEM Weights | No | | Yes | | Yes | | Yes | | Yes | |

## Table 5: Selected Results from Other Regressions

The samples for Equations 1 and 2 are comprised of the units with Walk Scores of 90 and higher, and units with Walk Scores of less than 80, respectively, capturing the impact in urban and suburban areas. The sample for Equation 3 is comprised of the units in buildings constructed before 2011, capturing the lasting impact of LEED certification. All equations include cluster fixed effects, categorical controls for the number of bedrooms and bathrooms, and CEM weights determined with respect to the treatment variable. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent level of analysis.

| *Ln(Rent PSF in Cents)* | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| Sample | Walk Score 90 - 100 | | Walk Score 0 - 80 | | Property >2 Years Old | |
| | | | | | | |
| LEED | 0.0490 | *** | 0.0577 | *** | 0.0945 | * |
| | (.0158) | | (.0184) | | (.0134) | |
| New Building | 0.0265 | | 0.1065 | *** | | |
| | (.0270) | | (.0255) | | | |
| Existing Building | -0.0388 | ** | -0.2506 | *** | -0.0736 | *** |
| | (.0177) | | (.0.21) | | (.0183) | |
| Walk Score | -0.0019 | | -0.0243 | | 0.0011 | |
| | (.0035) | | (.0445) | | (.0009) | |
| Gym | -0.0101 | | -0.0243 | | 0.1455 | *** |
| | (.0476) | | (.0447) | | (.0555) | |
| Pool | 0.0585 | *** | -0.0244 | | 0.0388 | *** |
| | (.0193) | | (.0381) | | (.0144) | |
| Gross Lease | -0.0971 | | | | -0.0457 | |
| | (.0753) | | | | (.0475) | |
| Ln (Size) | -0.3599 | *** | -0.2030 | *** | -0.2107 | *** |
| | (.0615) | | (.0689) | | (.0434) | |
| Private Outdoor Area | 0.0367 | ** | 0.0016 | | -0.0076 | |
| | (.0147) | | (.0209) | | (.0118) | |
| Ensuite Laundry | 0.1036 | *** | -0.0241 | | 0.0247 | |
| | (.0190) | | (.0371) | | (.0178) | |
| Constant | 8.2547 | *** | 6.2924 | *** | 7.0560 | *** |
| | (.5320) | | (.4504) | | (.3039) | |
| | | | | | | |
| Observations | 670 | | 350 | | 1192 | |
| R^2 | 0.89 | | 0.91 | | 0.86 | |
| F Test P-value | 0.00 | | 0.00 | | 0.00 | |
| | | | | | | |
| Cluster Fixed Effects | Yes | | Yes | | Yes | |
| # Bedroom Controls | Yes | | Yes | | Yes | |
| # Bathroom Controls | Yes | | Yes | | Yes | |
| CEM Weights | Yes | | Yes | | Yes | |

**Figure 1: LEED For-Rent Multifamily Map**

The following map notes the locations of all market-rate multifamily privately-constructed rental properties in the U.S. Light, medium, and dark green markers indicate markets with one, two through five, and seven through eleven properties each, respectively.