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An Analysis of U.S. Multi-Family Housing, Eco-Certifications, & Walkability

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ABSTRACT

This paper examines the persistence of differentiated pricing in the multi-family housing related to eco-certification. In examining a sample of market rents for non-specialty, multi-family properties both across the U.S., as well as those areas that enjoy the highest concentrations of LEED certified apartments, we find rental premiums of 10.2% and 14.7%, respectively for those properties with LEED certification. The addition of the continuous Walk Score, to control for variations in urban form, results in premiums of 7.4% and 9.6%, respectively. These findings are directionally consistent with those found in earlier studies, and demonstrate a persistence in rental premiums for certified properties over time, and with increased LEED adoption.

KEYWORDS

Eco-certification; multi-family; rent premium; sustainability; urban form; walkability

Introduction

The early 1990s were an innovative time regarding sustainability and urban form. Indeed, 1993 saw the U.S. Green Building Council (USGBC) and the Congress for New Urbanism (CNU) formed. Amidst a growing awareness surrounding buildings, neighborhoods, and their impact on people and the environment, the USGBC sought to establish a framework to encourage sustainable building practices in the real estate and construction industry while the CNU's principles focused on walkability, among other urban design features that are positively associated with quality of life. While 1998 marked the official launch of the USGBC's Leadership in Energy and Environmental Design (LEED) certification scheme, it also marked a turning point in energy usage, with it being the first year that commercial and residential buildings surpassed the industrial sector as the single largest consumer of energy in the United States. WalkScore followed later in 2007 and its broad adoption since connects the increased importance and measurement of urban spatial structure alongside green building features.

Since its launch, LEED has become the most widely used property rating system in the world, and easily associated with green building to a general public that has grown increasingly aware of the risks associated with climate change. Indeed, an estimated two-thirds of all U.S. consumers, and 90% of Gen-Z, have indicated that they are willing to pay a premium for sustainable products, with the primary stated consideration being a desire to help the environment (Petro, 2022). Shareholder proposals related to environmental and climate not only reached an all-time high in 2021, but saw increased support for those proposals among voters (Trevino et al., 2021). Given the fact that the commercial and residential sectors have accounted for as much as 57.9% of the total energy consumed, and over 35% of total CO_2 emissions per year in the United States it is clear that the greening of the built environment is a vital part of the solution regarding global sustainability efforts (EIA, 2021). However, the predominance of academic literature is focused on differentiated pricing and economic performance of commercial office buildings. This, despite the fact that individuals have much more control over the amenities they are willing to pay for regarding housing than office, shorter lease periods more readily reflect current willingness to pay, and that with property values of nearly $3 Trillion, multi-family housing represents the largest U.S. commercial real estate sector, and accounts for as many as 14% of all U.S. LEED certifications (NAREIT, 2019). Though there has been some work specific to purchase price

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premiums relative to LEED or WalkScore, there is a notable dearth of literature relating to multi-family housing.

This paper is motivated by the opportunity to help remedy that disparity. Similar to commercial office, which encompasses a multitude of studies over time, reflecting changes to the available data that reinforced and expanded upon the results of seminal works, this paper examines the persistence of differentiated pricing in multi-family housing. Utilizing a sample of asking rents obtained from the CoStar Group's Apartments.com multi-family rental data for the years 2016– 2017, it builds on work by Bond and Devine (2016a) and Gabe et al. (2021) in demonstrating the impact of LEED certification and Walk Score on a building's average rental rate per square foot. Given the environmental importance of this sector, the increased public awareness surrounding sustainability, and the general deficit of academic work in this area, the paper makes two important contributions to the literature. First, we observe differentiated pricing in sample—congruent with the extant literature in office and smaller sample work in multi-housing. Second, the magnitude, direction, and different timing/source data suggests that the pricing differences are persistent across time, akin to the findings in office—predicated on the comparison to the findings from Bond and Devine (2016a) where data gathered represented the early part of the economic recovery out of the Great Financial Crisis. While the second finding is comparative, it both validates prior work and cleaves the multi-housing research to the broader conversation about differentiated financial economic performance of eco-certified buildings and those with greater locationally efficiency. To wit, it provides accretive results that help frame our evolving understanding of the market for sustainable buildings and locations.

Below, the paper provides a summary of eco-certifications for commercial buildings and their market penetration over time, a brief discussion on Walk Score and its validity in controlling for urban form, a review of the extant sustainable real estate literature, a description of the data and methodology, and discussion of empirical model results.

Background

Sustainable Building Certifications & Adoption Trends

In the United States, there are two predominant eco-certification schemes that cover both commercial and residential properties: Energy Star and LEED. Energy Star focuses solely on energy performance, with commercial properties achieving certification by operating within the top quartile of peer buildings, and residential properties though the verification of energy efficient features. Though there are additional certification or eco-labeling schemes such as the National Association of Home Builders National Green Building Standard (NGBS), LEED is the most prominent certification scheme in the U.S. multi-family housing market. Since its launch, the LEED certification has evolved in order to best reflect the demands of an increasingly sustainability conscious public. As opposed to specific amenities such as an ensuite laundry or pool, the LEED certification represents green building strategies that address the planning, design, construction, and operations of a property as a means to reduce the negative environmental impacts of buildings and their inhabitants. Projects are certified under different classification systems, such as Building Design and Construction (BD + C), Interior Design and Construction (ID + C), Homes, and Neighborhood Development (ND). Once a project has met the prerequisite requirements for Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental, and if for Homes: Innovation, it then earns additional points within each of these areas, as well as Regional Priority and Location and Transport. Buildings qualify to be Certified at 40 points. Up to 110 points can be earned, with properties able to achieve Silver, Gold, and Platinum status. Each project decides which of the up to 140 established point credit options it will seek to earn; thus, each building achieves certification in a unique manner. As with previous research that has looked at willingness to pay for eco-labels that represent a bundle of attributes, such as LEED, while concurrently examining the willingness to pay for underlying individual attributes, there are points available under some systems that hold similarities to Walk Score or building amenities. For instance, some projects may earn a point for being located within ½ mile of a service, or a point may be given for fitness room that is open to all residents, and provides a stated amount of equipment for both adults and children. Depending on the system, these two opportunities can yield between 0 and a total of 3 points towards certification.

The aforementioned certification pathways represent static certifications, and do not lapse once earned. However, given the increasing desire for performance-based metrics LEED introduced a dynamic certification, Operations and Management (O + M), in

2009. This dynamic certification requires collecting and reporting property performance data relative to baseline requirements and additional points. Projects are required to re-qualify within 5 years of their previous O + M certification in order to retain their designation. Shortly after launching O + M, LEED also initiated what it calls a "recertification" plan which, given that the original, static designation does not lapse, allows a project to add an additional certification under the O + M designation in order to demonstrate that the building is functioning as envisioned. It should be noted that as of the end of 2017, only 11 multi-family properties had obtained certification under O + M, and no O + M certifications had lapsed.

Though the number of properties with sustainable building certifications is still relatively small in comparison to the overall amount of total building stock available, that number has been continually increasing. Approximately 14% of all non-government, investment based commercial office buildings and 3.3% of investment-grade multi-family units within the 30 largest U.S. markets having some form of eco-certification (CBRE, 2019). Some of this growth has been a result of inclusion of such schemes into city, county, state and federal policies, with LEED principles being included in 151 individual pieces of legislation between 2000 and 2008 (USGBC, 2021). As evidenced by Figure 1 below, which highlights the number of properties that achieve new[1] LEED certification each year, although the majority of the legislation has been focused on government or government funded projects rather than mandating private building requirements, the private for-profit commercial sector has always been the primary user of the certification.

As more properties achieved LEED certification each year, as shown in Table 1 below, and with the 1999 launch of the Energy Star rating for commercial properties, researchers had access to uniform systems of certification that allowed for a relatively consistent sample of properties in the U.S. Peaking in 2010 for commercial office, and in 2012 for multi-family property, the number of new yearly certifications has remained relatively stable, reflecting trends in new construction and renovation, in addition to offering an established and diversified distribution of properties.

Walkability & Walk Score

The study of the impact of urban form on property prices is not a new one. However, the advent of new urbanism reflects the changing consumer demands related to walkable blocks and streets, with housing in close proximity to other amenities such as shopping (CNU, 2022). While seminal research in this area, most notably the work of Song and Knaap (2003), was reliant on the outputs of geographic information system (GIS) mapping, the advent of the Walk Score allows for a common metric with which to measure walkability and control for urban form. Launched in 2007, the Walk Score uses a proprietary algorithm to identify the number, and range, of amenities such as banks, grocery stores, restaurants, and schools in a given area. It then awards points based on the distance to these amenities from any known address. Amenities that are within a 5-minute walk receive maximum points, after which values decrease to 0 beyond a 30-minute walk. The score itself is apportioned into ranges, with 90–100 being a "walker's paradise" (daily errands do not require a car), 50–69 being "somewhat walkable" (some errands can be accomplished on foot), and 0–24 as "car-dependent" (almost all errands require a car) (Walk Score, 2022). There have been some stated criticisms associated with the Walk Score, namely that it does not address

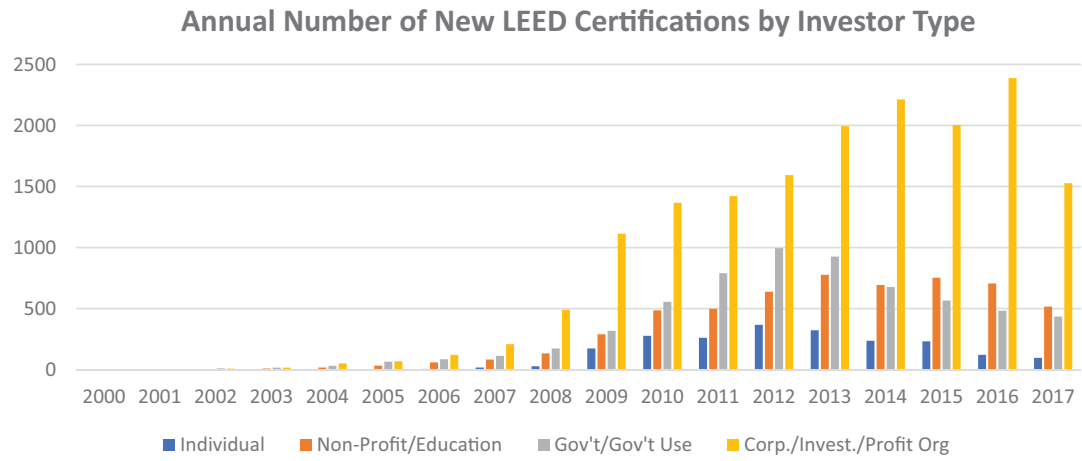

Figure 1. Annual number of new LEED certifications by investor type. *Source*. USGBC and Author's own work.

Table 1. Annual number of new LEED certified projects by project type.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Office	2	4	6	17	41	68	121	209	425	1204	1515	1419	1316	1357	1123	1118	1114	1092	**12151**
Retail					3	7	12	39	143	244	241	415	544	611	781	699	945	326	**5010**
Multi-family		1		1	8	7	14	37	61	164	326	493	624	539	595	523	489	513	**4395**
Industrial/warehouse		1	3	4	8	8	9	14	22	63	70	88	91	117	151	144	145	118	**1056**

Source. USGBC and Author's own work.

topography or weather, which may influence how much people choose to walk in a given location. However, the Walk Score has been validated by researchers in the U.S. and abroad as a sound metric for measuring how much residents of a neighborhood actually do walk to destinations (Carr et al., 2011; Duncan et al., 2011; Koohsari et al., 2018). As such, Walk Score is increasingly used in residential housing literature as a means to control for variations in urban form.

Literature Review

Sustainable Real Estate Literature: Commercial

Tracking the diffusion of sustainability-labeled buildings into the property markets, the sustainable real estate literature has evolved to describe differentiated financial performance among certified buildings in all asset classes. The preponderance of the extant research focuses on buildings, with a smaller tilt towards firms (e.g., REITs). Further, the majority of the literature focuses on office, a table of relevant works of which can be found in the Appendix. Given the limited research related to multi-family housing, this paper focuses there. In the sub-sections below, we provide a summary of the sustainable real estate literature, acknowledging the comprehensive review contained in Holtermans and Kok (2019).

The sustainable real estate literature has matured significantly in the last 20 years along with the diffusion of certified assets. It is now clear that sustainability certified assets create differentiated economic returns as compared to their non-certified counterparts (Eichholtz et al., 2010). This outperformance exists across asset classes including office (Fuerst & McAllister, 2011b; Wiley et al., 2010), industrial (Harrison & Seiler, 2011), hotels (Robinson et al., 2016), apartments (Bond & Devine, 2016a), retail (Chang & Devine, 2019), housing (Kahn & Kok, 2014), and across both public and private firms (Coën et al., 2018; Devine et al., 2022; Devine & Yönder, 2021; Eichholtz et al., 2012; Sah et al., 2013). International studies further demonstrate that green buildings earn market premium. In Asia, Addae-Dapaah and Chieh (2011) find an 11.69% price premium for eco-certified owned apartments in Singapore whereas in Tokyo, Fuerst and Shimizu (2016) indicate that the premium for eco-certified condominiums is 5%. In Indonesia, Njo et al. (2021) found results that more closely reflected those in Singapore with 15% purchase premiums for green apartments. In Europe research by Fuerst et al. (2015) in the UK and by Olaussen et al. (2017) in Norway both reveal that energy efficiency demonstrated through European Energy Performance Certificates (EPC) earn housing premiums. Indeed, a meta-analysis of EPC ratings conducted by Cespedes-Lopez et al. (2019) illustrated that they add a housing price premium of 4.2% globally.

There are also additional threads that connect to the economic differentiation research. For example, there is a thread examining tenant preferences for sustainable attributes of commercial buildings and homes (Aroul & Hansz, 2012; Aroul & Rodriguez, 2017; Bruegge et al., 2016; Cadena & Thomson, 2021; Christensen et al., 2022; Clayton et al., 2021; Dastrup et al., 2012; Goodwin, 2011; Robinson et al., 2016; Walls et al., 2017; Zhang et al., 2018). There are also threads exploring green leases (Gabe et al., 2019), the diffusion patterns of sustainably certified real estate (Devine & McCollum, 2019; Kok et al., 2011; Sanderford et al., 2018), and the role of policy in increasing the adoption of sustainable certifications, materials, and building practices (Bond & Devine, 2016b; Koebel et al., 2015). Though we focus on walkability or Walk Score to account for differences in urban form per Bond and Devine (2016) and Gabe et al. (2021), there have been works that looks specifically at its effects on property prices (Bartholomew & Ewing, 2011; Boyle et al., 2014; Pivo & Fisher, 2011; Yin et al., 2020) or as a locational robustness check (Wittowsky et al., 2020).

There are a number of individual papers that help to shape our efforts here. Below, we provide a bit more detailed summary several that inform our empirical work.

Holtermans and Kok (2019) highlights the value differentiation persistence over time. It also reevaluated some of the key questions originally posed by researchers in order to determine whether the initial

financial advantages attributed to eco-certification in commercial office properties have held both over time, and with the increased adoption of such schemes. The authors were able to employ a more robust sample, utilizing panel data to construct rental indices in order to determine rental growth, as well as a cross-sectional sample in order to further establish whether the earlier findings relative to occupancy, rent and price premiums held. Though they found no significant difference in rental growth between certified properties and their non-certified counterparts, the results regarding other premiums have held over time. Indeed, there are average rental premiums of 2.2% and effective rental premiums of 4.6% for eco-certified properties, with LEED and Energy Star properties commanding 1.9– 1.5% and 1.3– 4.1%, respectively. Pricing premiums for LEED or Energy Star exhibit a 10.1% increase in transaction price over non-certified properties, with LEED certified buildings commanding premiums of 14.8%, while the Energy Star certified properties transact for 6.6% more. In examining whether certain eco-certifications become less valuable over time, the paper finds that the value of the Energy Star label does decrease the further from certification timing the difference is measured.

In the extant literature, the majority of LEED certified commercial office properties are newer, larger, taller, are more likely to be located in prime geographic areas such as CBDs, and are more likely to be Class A than their non-certified counterparts. Additionally, the authors observe that it is the norm rather than the exception for Class A commercial office properties to obtain a LEED and/or Energy Star certification, so that the price premium might instead be reflective of the higher quality of the asset rather than the certification. Fuerst et al. (2017) examined a sample of 2,734 Class A office transactions between 2007 and 2012. They found that though there is a market share premium for these high-quality assets overall, this premium is actually 5% higher for assets that are eco-certified. However, the authors also note that, contrary to previous research, when looking at the certification effects, LEED, Energy Star or Dual certified (holding both eco-certifications) individually, the price effects were more suggestive of price premiums that are related to the creation of a 'clientele effect' whereby the greater the investors' market share of eco-certified properties, the greater the price said investors will have paid.

Given the tilt towards differentiated performance, there also been interest in identifying the specific building elements that of the most value to tenants as consumers, including labels or certifications themselves. Simons et al. (2014) conducted focus groups of office users in the Chicago, Denver, Washington, D.C. and San Francisco Bay Areas to rank various 'green' attributes frequently associated with office properties to determine those deemed most important by the respondents. Users assigned the greatest weight too access to natural light in work spaces, convenient public transportation, indoor air quality, temperature control/comfort, efficient lighting, and heating and cooling. Respondents were also asked to assign the benefits of sustainable building features to people, planet, or profit. While the preponderance of research to date has been primarily focused on the economic benefits of green building, Simons et al. (2014) found that the benefits of a green building were perceived to accrue to people, or employees.

Building on the tenant preference work, Robinson et al. (2016) worked to determine the green features for which tenants would be willing to pay. Utilizing a web-based survey, the paper explored reactions to existing building features as well as tenants' perceptions of the relative importance of various building attributes (i.e., attribute ranking). Both LEED and Energy Star designations ranked in the middle in terms of importance and frequency of selection, with indoor air quality and access to natural light being most valuable. The authors do note, however, that certain attributes, such as the Energy Star designation, are less observable or easily available. Insofar as tenant's willingness to pay for an attribute in terms of percentage above their existing lease, access to natural light within individual workspaces and indoor air quality were, again, seen as the most valuable features. Consistent with the ranked results, LEED designation was ranked in the middle, with Energy Star designation coming in slightly lower. The authors then utilized probit models to determine willingness to pay for eco-certified buildings, the attributes for which a respondent is willing to pay a more than 2% premium, and the attributes by rank. The results determined that energy companies, public companies, and companies that utilized sustainable suppliers or who had green commercial interiors were most likely to pay more for eco-certified properties. Additionally, only those in the real estate, energy and IT industries showed a propensity to specifically value the LEED designation.

Most recently, Robinson et al. (2017) used lease-level analysis to investigate many of the individual attributes found within the LEED designation in order to determine which of these features are most

valuable. The authors found that the LEED certification commands a 13.6% premium. Energy Star, as compared to non-LEED properties, commands a 6.5% premium, but when individual green attributes are considered, the Energy Star designation becomes just one within the bundle of green attributes that command a premium, while the LEED designation exhibits its value-add regardless of other sustainable building controls.

Sustainable Real Estate Literature: Multi-Family Housing

Despite the relative focus by academics on the effects of eco-certifications on commercial and single-family residential properties, there is a paucity of literature related to sustainable multi-family housing. Two pieces inform our empirical work below and frame the research opportunity.

Couch et al. (2015) examined the relationship between LEED and sales prices for multi-family properties in the Chicago, New York, Portland, and Seattle markets. These markets were chosen based on the fact that they were identified as having the highest concentration of LEED multi-family properties relative to other markets. Their resultant sample of 136 properties consisted of 25 LEED certified, and 111 non-certified control properties, with property-level data obtained through CoStar and CoreLogic. Controlling for location, building attributes, and demography, the results indicated that LEED certification was not a significant predictor of variation in property prices. Stepwise model selection identified rentable building area, land area, and population per square mile as the significant drivers of value.

Most germane to this study is the work of Bond and Devine (2016a). In this work the authors examined the effects of green multi-family housing on rental rates at year end 2012. From an initial sample of LEED certified, privately constructed multi-family properties with no less than 10 units, and further excluding specialty properties such as student and senior housing as well as those who had more than 25% of their units allocated to affordable housing, they arrived at a final sample of 97 LEED certified properties and 193 comparable properties encompassed a total of 26,774 and 57,115 units respectively. The sample included a substantial volume of building attributes beyond basic characteristics and introduced a Walk Score to the model— building on work by Pivo and Fisher (2011) to account for urban form. It also used advanced econometric techniques such as coarsened exact matching to shape the sample.

The results of the initial regression showed an increase in the rent per square foot for LEED certified buildings to be 7%. Models that utilize CEM weights also showed a rental premium for both LEED certified, and green marketed properties. LEED certified properties presented with an 8.9% premium, with the premium for all green properties at 7.6%. The premium related to properties that marketed themselves as green, without possessing LEED certification, dropped to 1.76%, indicating that the non-LEED green properties reduced the overall green premium, though this specific sample was greatly diminished and the result was not statistically significant. Indeed, controlling for both treatment groups, LEED certified and green non-certified, results in a LEED premium of 9.1% versus 4.74% for green, non-certified properties. In relation to the treatment group subsamples, the LEED certification premium also held, with less walkable properties valuing the certification more highly with a 5.77% rental premium as compared to the most walkable group at 4.9%, indicating the LEED certification is viewed as more valuable by suburban renters. Finally, it is clear here that the LEED premium isn't just about the novelty of a new, and certified property. Indeed, for properties greater than 2 years old, the rental premium was the highest of any of the models at 9.5%, significant at the 10% level, indicating that the premium may be more reflective of the certification rather than the fact that newer properties typically command higher rents.

Since these two papers were published, the penetration of LEED certification into this asset class has increased significantly, with 736 LEED certified multi--family rental properties across 36 Core Based Statistical Areas (CBSAs). Given this growth in the number of certified properties, the rise the percentage of households that rent versus own, and the ever-increasing attention being paid to environmental concerns by individuals and regulators alike, it is important to explore whether the initially observed premiums are evident in a different time period and in a broader array of geographies. It is this question that motivates the paper.

Data & Methods

Using CoStar Group's Apartments.com, institutional grade, non-specialty properties with 50 or more units across the most populous 50 CBSAs in the U.S. were identified. Those markets without comparable LEED

properties were removed, resulting in a sample of 82,094 unique market-rate multifamily properties across 36 CBSAs, with 736 of those properties being LEED certified. Though there is a general dispersion of LEED multi-family properties throughout the U.S., there are certain markets that reflect high adoption areas similar to those used in Couch et al. (2015). These high-adoption CBSAs, each of which contain more than 50 LEED certified multi-family properties, are Chicago, Portland, Seattle, and Washington, D.C. These four markets account for 12,996 unique properties, of which 316 possess LEED certification.

In addition to property and unit controls consistent with previous research, such as age, renovation status, configuration and grade, walk score was included as a summary measure of urban location, reflecting the findings of Gabe et al. (2021). Apartments.com[2] collected daily asking rent observations for each of the properties. Utilizing proprietary analytics to account for potential data validity issues, such as pending vacancies and multiple observations of the same unit, these daily asking rent observations were then converted into estimated monthly average asking rents, per configuration, as described in Gabe et al. (2021). Further, seasonal variance was controlled for through the generation of annual rental observations per building, and consolidated into monthly averages. These monthly averages were then combined into separate annual observations per building, resulting in a full year asking rents for 2016, and a full year asking rents for 2017 for the sample. Average rent per square foot for each individual multi-family building being calculated as the weighted average per configuration type using Equation 1 below:

$$AverageRent_{it} = \frac{\Sigma_{i=1}^{n}\ UnitCount_{it} * \ UnitRent_{it}}{\Sigma_{i=1}^{n}\ UnitCount_{it} * \ UnitSF_{it}}$$

For building i at time t. (1)

As expected, the average asking rents for LEED properties across all 36 CBSAs was greater than for non-LEED properties, at $2.77 PSF versus $1.58 PSF, respectively. This also holds for the four CBSAs with high LEED adoption as well, though the differential is marginally less with LEED properties down slightly on average to $2.74 PSF and the average rent of non-certified properties increasing to $1.67 PSF. All other results are in-line with expectations, and reflect characteristics consistent with LEED certified properties generally being newer, and located in desirable areas that have high pedestrian access to amenities, such as urban centers (Table 2).

We incorporate this data into a relatively traditional hedonic modeling framework. The generic model we use resembles the guidance found in Malpezzi (2003) and more recently in Seiler (2014) and is specified as:

$$LnAvgRent_{ijt} = \beta_{0jt} + \beta_{1jt}LD_i + \beta_{2jt}WS_i + \beta_{3jt}\overrightarrow{MF}_i + \epsilon_{ijt} \quad (2)$$

Where LD_i is the dichotomous indicator variable with 1 signifying that the property is LEED certified, and 0 for those properties without certification, WS_i represents the continuous Walk Score of the property, and $\overrightarrow{MF}_i$ is a vector of multi-family apartment building characteristics consistent with previous research, including property type, configuration, renovation status, age, age squared to account for historical value, and amenities such as pool, gym, private outdoor space, and ensuite laundry, for property i at time t in market j.

Models 1–4 look at all markets that contain LEED certified multi-family properties. Model 1 examines the full sample of properties and control variables, relating the natural log of average rent per square foot to a set of hedonic and other building characteristics, thus providing a baseline for analysis. Models 2 and 3 denote the relationship between average rent and either LEED certification or continuous Walk Score, respectively, for the full sample. Indeed, though the multi-family housing market exhibits greater spatial heterogeneity than commercial office, the characteristics of both property types are not dissimilar in that properties achieving LEED certification are more likely to be newer, Class A, and high-rise, indicating a

Table 2. Descriptive statistics.

	Avg. Mo. Asking Rent/SF	% Garden (%)	% High-rise (%)	% Studio (%)	% 1BR (%)	% 2BR (%)	% 3BR (%)	Renovated (%)	Age	Walk score	# Buildings in complex
All Markets: LEED Cert. Properties	$2.77	4.90	45.90	16.50	49.90	29.00	4.50	2.40	8.2	82.83	1.86
All markets: Non-Cert. Properties	$1.58	74.70	6.50	6.50	40.10	43.90	9.50	3.70	36.86	53.33	11.07
High LEED Conc. Mkts: LEED Cert. Properties	$2.74	1.90	54.40	17.60	54.60	24.50	3.30	3.50	7.82	88.69	1.39
High LEED Conc. Mkts: Non-Cert. Properties	$1.67	61.60	10.40	10.50	38.80	42.20	8.60	4.00	39.16	60.12	9.09

bias towards urban locations as suggested by a higher Walk Score. Thus, Model 4 comprises controls for both walkability as well as green building certification. In all models, we control for market and geography (to hone the identification relative to walkability) with fixed effects for each of the CBSAs in the sample.

Accounting for the possibility that, given the relatively low number of LEED certified multi-family properties, any possible rental premium might be a reflection of product scarcity, Models 5–8 mimic the structure of Models 1–4, but utilize the sample consisting of the four CBSAs, identified as high LEED adoption markets. In this, the authors seek to determine whether LEED properties retain rental premiums in markets where the LEED product is more common and available, and therefore no longer a niche good, consistent with the work of Fuerst et al. (2017).

In addition to being evaluated in situ, the results from the models are also qualitatively compared against prior work from Bond and Devine (2016a) which examined a different set of buildings and geographies to make determinations about the durability of the green and walkability premiums in multi-housing— to the extent they are evident. This descriptive and comparative step is not intended to replace a time series analysis. Instead, it is included to contextualize our empirical results and to help take stock of ways that similar models applied to different data at different times can contribute to accretive understanding to financial economic phenomena.

Results & Discussion

The models point to two contributions to the literature: (1) there are premium rents among eco-certified multifamily buildings and those buildings with greater walkability (2) given the differences in sample, time period, and geography examined from the prior literature, it would appear that initial financial advantages attributed to LEED certification and walkability for multi-family properties have held both over time, and with the increased adoption of the scheme in both previously identified markets as well as new ones. These findings area consistent with Bond and Devine (2016a) and Holtermans and Kok (2019). Further, these differentiated outcomes are even greater in those markets that reflect the highest levels of adoptions of LEED properties, suggesting that the data can accommodate an alternative explanation to a scarcity premium.

Rental Premiums

Model 1 serves as a baseline model and provides context for the additional model specifications. Consistent with prior theory and extant evidence, all measures in Model 1 present with the expected signs and are statistically significant. Per Bond and Devine (2016), those property attributes that correspond more closely with newer properties in urban locations, such as high-rise and those with a high percentage of studios, provide evidence of rental premiums, as do property amenities.

Model 2 estimates the value of LEED certification across all properties. Relative to non-certified properties, and all else equal, LEED certified properties command a rental premium of ∼10% and all other variables remain largely unchanged. Here, fixed-effects control for differences between markets accounting for findings from prior research that have questioned the degree to which these premiums are associated with consumers' willingness to pay for amenities found in urban locations frequently associated with LEED certified properties. Following Bond and Devine (2016) and Gabe et al. (2021), Model 3 adds Walk Score to the baseline model in order to capture variations in urban form more specific than market fixed effects—much in the spirit of Pivo and Fisher (2011) and their study of the office market. The results are congruent with the prior papers and demonstrate a small positive relationship between rents and relative location. For every additional 10 points in walk score translates into a 2% additional rent per square foot. Renters are willing to pay more for more locationally efficient—or sustainably located apartments.

Model 4 is consistent and congruent with the prior research, accounting for both LEED certification and walk score. Utilizing the full sample, whereby LEED certified properties account for more than three times the number previously examined, and accounting for greater geographical absorption diversity with seven additional CBSAs, the resultant rental premium of 7.4% significant. In their most quotidian state, Models 1–4 provide sample and construct validation. They also add to the literature detailing the role eco-certifications and walkability as drivers of differentiated economic performance. Earlier studies and demonstrate that overall, LEED certified properties command significant rental premiums as compared to their standard comparable buildings in commercial real estate and multi-housing contexts. The results here expand the geography and scale of analysis from some prior work and help build out more of the story about differences for sustainability (Table 3).

Table 3. Determinants of multi-family property rents models 1– 4 include all markets with observed LEED-certified apartments.

	LnAvgRent			
	All markets with LEED buildings			
	(1)	(2)	(3)	(4)
LEED		0.102***		0.074***
		−0.009		−0.009
Walk score			0.002***	0.002***
			0.00	0.00
Garden	−0.140***	−0.139***	−0.091***	−0.090***
	−0.003	−0.003	−0.003	−0.003
High-rise	0.173***	0.169***	0.146***	0.143***
	−0.004	−0.004	−0.004	−0.004
% Studio	0.713***	0.710***	0.669***	0.667***
	−0.008	−0.008	−0.008	−0.008
% 1 BR	0.499***	0.498***	0.474***	0.473***
	−0.006	−0.006	−0.006	−0.006
% 2 BR	0.255***	0.255***	0.254***	0.253***
	−0.006	−0.006	−0.006	−0.006
Reno < 10 years	0.034***	0.034***	0.037***	0.037***
	−0.005	−0.005	−0.005	−0.005
LnAge	−0.164***	−0.163***	−0.148***	−0.147***
	−0.004	−0.004	−0.004	−0.004
LnAge2	0.025***	0.025***	0.020***	0.020***
	−0.001	−0.001	−0.001	−0.001
Gym	0.107***	0.107***	0.107***	0.107***
	−0.002	−0.002	−0.002	−0.002
Pool	0.041***	0.041***	0.053***	0.053***
	−0.002	−0.002	−0.002	−0.002
Priv. Outdoor space	0.012***	0.012***	0.013***	0.013***
	−0.002	−0.002	−0.002	−0.002
Ensuite laundry	0.046***	0.046***	0.046***	0.046***
	−0.002	−0.002	−0.002	−0.002
# Complex buildings	−0.000***	−0.000***	0	0
	0	0	0	0
Year	0.032***	0.032***	0.032***	0.032***
	−0.002	−0.002	−0.002	−0.002
Constant	−64.902***	−64.909***	−65.026***	−65.030***
	−3.487	−3.485	−3.431	−3.43
Mkt fixed effects	Yes	Yes	Yes	Yes
Observations	82,094	82,094	82,094	82,094
R^2	0.723	0.724	0.732	0.732
Adjusted R^2	0.723	0.723	0.732	0.732

Notes.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

High Adoption Markets

Acknowledging the low numbers of LEED properties in many markets, the prior work categorized markets by adoption level. Findings using these distinctions suggested that LEED certified buildings themselves might be considered a scarce commodity, and any rental premium reflective of that uniqueness might represent the eco-certification itself (Fuerst et al., 2017).

In this context, Model 5 serves as a baseline model for the four markets identified from the full sample containing no less than 50 LEED certified properties. Similar to Model 1, column 5 shows the results for property characteristics and provides a robustness check for our model and sample. Again, all values exhibit the expected signs and statistical significance relative to the extant literature.

When accounting for the impact of LEED certification in column 6, there is a pronounced increase—one that is greater than was associated with the properties that have achieved certification in the full sample. The rental premium identified at 14.7% would seem to be counterintuitive given that as LEED certification becomes more of a standard feature, the willingness to pay a premium for scarcity should decrease. Accounting for WalkScore in Model 8, as expected the LEED premium decreases somewhat to 9.6%, though is still greater than the 7.4% obtained from the full sample.

This result, while on its face a bit unexpected, is not incongruous with prior work. Fuerst et al. (2017) demonstrate that even in markets where the majority of properties were LEED certified, LEED certification still commanded a premium, though the relationship was with price and reflective too of a potential clientele effect. It also should be noted that the level of absorption of LEED multi-family properties does not yet reflect levels seen in Class A office properties. Thus, it is also possible that the rental premiums associated with LEED properties have influenced the number of properties achieving LEED certification, and would be a topic of future research.

Finally, column 8 explores the relationship between rents and LEED certification, controlling for urban form through walk score. Results indicate that the rent premium for LEED is even greater in markets where LEED is more common than in the overall sample. This is consistent and congruent with Bond and Devine (2016a). It is also consistent with Pivo and Fisher (2011) who observed valuation premiums relative to higher walkability in the office market.

The results above contribute to the broader conversation about the potential to address social and environmental issues while achieving appropriate risk adjusted financial returns which in turn connects to the important, evolving, and passionate debate about the theory of the firm (Coase, 1937; Pivo & UN, 2008). Real estate firms of all types continue to develop their understanding of what it means to be a fiduciary and how investments related to ESG and climate adaptation/mitigation contribute to the generation of economic value in excess of the cost of capital.

The results add to the literature which demonstrates across real estate asset classes (Chang & Devine, 2019; Eichholtz et al., 2010; Harrison & Seiler, 2011; Robinson et al., 2016) and regions of the globe (Devine et al., 2017; Devine & McCollum, 2019) that

there are differentiated economic performance patterns between eco-certified and well-located buildings and their traditional counterparts. Here, our contribution is to illustrate differentiated rent patterns attendant to the sustainability and relative location of apartment buildings across a large sample of data. These results should contribute to increased price discovery efficiency given their consistency and expansion.

These findings and continued debate are timely as the U.S. Securities and Exchange Commission (SEC) proposed rule, S7-10-22, will require that all public firms disclosure of material climate risks. The European Union, Japan, Australia, India and other countries already have legal frameworks requiring climate risk disclosures for similar types of firms. Where eco-certified and walkability are components of a broader conversation about climate, it is clear that there is a meaningful and material role for the built environment in contributing to and creating solutions to climate change (Glaeser & Kahn, 2010) (Table 4).

Table 4. Determinants of multi-family property rents models 5–8 only include markets with >50 LEED-certified apartments.

	LnAvgRent			
	All markets with LEED buildings			
	(5)	(6)	(7)	(8)
LEED		0.147***		0.096***
		−0.02		−0.02
Walk score			0.004***	0.004***
			0.00	0.00
Garden	−0.174***	−0.172***	−0.102***	−0.102***
	−0.01	−0.01	−0.01	−0.01
High-rise	0.160***	0.148***	0.118***	0.111***
	−0.01	−0.01	−0.01	−0.01
% Studio	0.826***	0.822***	0.716***	0.715***
	−0.02	−0.02	−0.02	−0.02
% 1BR	0.532***	0.527***	0.461***	0.459***
	−0.02	−0.02	−0.02	−0.02
% 2BR	0.248***	0.248***	0.248***	0.248***
	−0.02	−0.02	−0.02	−0.02
Reno < 10 years	0.065***	0.063***	0.069***	0.068***
	−0.01	−0.01	−0.01	−0.01
LnAge	−0.223***	−0.219***	−0.184***	−0.182***
	−0.01	−0.01	−0.01	−0.01
LnAge2	0.036***	0.036***	0.026***	0.027***
	0.00	0.00	0.00	0.00
Gym	0.089***	0.090***	0.084***	0.085***
	−0.01	−0.01	−0.01	−0.01
Pool	0.012**	0.012**	0.038***	0.038***
	−0.01	−0.01	−0.01	−0.01
Priv. Outdoor space	0.025***	0.024***	0.030***	0.030***
	−0.01	−0.01	−0.01	−0.01
Ensuite laundry	0.065***	0.066***	0.058***	0.058***
	−0.01	−0.01	−0.01	−0.01
# Complex buildings	0.00	0.00	0.001***	0.001***
	0.00	0.00	0.00	0.00
Year	0.035***	0.035***	0.035***	0.035***
	−0.01	−0.01	0.00	0.00
Constant	−69.529***	−69.554***	−69.794***	−69.806***
	−9.24	−9.21	−8.84	−8.83
Mkt fixed effects	Yes	Yes	Yes	Yes
Observations	12996.00	12996.00	12996.00	12996.00
R^2	0.55	0.56	0.59	0.59
Adjusted R^2	0.55	0.56	0.59	0.59

Notes.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

Comparison to Prior Findings

Considering that LEED properties tend to be newer and located in more desirable urban locations, consistent with prior work when the Walk Score is included in order to account for variations in urban form, the results are consistent with the 7% premium identified by Bond and Devine (2016a) at 7.4%. This slight increase might reflect the apparent increase for the consumption of sustainable goods overall, but also with Gen Z renters beginning to come of age. When we look at the four markets with the greatest levels of adoption, we find an even greater premium associated with LEED certification. Similar to the findings of Fuerst et al. (2017), increased absorption of certified properties does not result in a decrease in premium. Indeed, the rental premium found in these markets exceeded the general premiums at 14.7% overall, and 9.6% when accounting for the Walk Score. Though these results are contrary to Couch, et al. (2015), they also represent a much larger sample.

It should also be noted that the high concentration cities were included in the overall sample, thereby affecting the results of the overall sample and potentially making the overall results closer to the 4.9–9.45% range found by Bond and Devine (2016a). However, the results are consistent with the finding about persistence in differentiated financial outcomes between certified and non-certified space over time. As we draw on an expanded sample of locations, certified, and non-certified properties, derived from a source widely utilized by the consumers of multi-family property, we observe a rental premium and would suggest that this premium persists. Naturally, as the work is cross-sectional, the second point estimate of differentiated outcomes is not definitive time series evidence. Qualitatively, what we observe is that the differentiation or premium persists across two very different samples and at different points in the market cycle.

Conclusion

The aim of this paper was to measure the extent to which LEED certification was a material predictor of the variation in multi-family rents. In the 4– 5 years

between the end of 2012 and the beginning of our sample period, the U.S. has seen a 24% increase in market adoption for LEED certified multi-family housing, with property certifications increasing more than sevenfold in this short period. Earlier studies noted a price premium of between 4.9% and 9.1% for certified properties. However, as the LEED badge becomes more ubiquitous, certain markets experience high adoption rates, and properties aggressively compete with their non-certified counterparts who have the same desirable amenities, are renters still willing to pay more for a property certified under LEED or a more walkable one? Data was drawn from a sample of asking rents provided by CoStar's Apartments.com, a leading source of data in the multi-family housing markets, consisting of over 81,000 properties, 736 of which are LEED certified. Controlling for markets and key amenities shown to be valued by renters, and utilizing a semi-log hedonic regression model, it was found results similar to extant literature. Analysis of the full sample indicates a 10% price premium for LEED properties as compared to their conventional counterparts. This is similar to the apartment purchase premium found in Asia in addition to those found for eco-certified multi-family housing. Analysis of the concentrated sample, focusing on high adoption cities, reveals a similar premium when using Walk Score to control for variations in urban form. These results are, again, in line with findings previously identified either with the multi-family market, or pursuant with commercial office properties. It is a time of intense public interest relating to sustainability and the environment, and informed discussions require evidence from a variety of sectors when examining whether the public assigns financial value to an eco--certification such as LEED. This study provides an additional point of validation regarding the premium that consumers are willing to pay for a good whose certification conveys a contribution to a more sustainable environment.

Notes

1. Recertification under LEED O&M account for <1% of all LEED certifications.
2. Apartments.com is owned by CoStar, Inc. and per their website "The Apartments.com Network represents the nation's most comprehensive online rental marketplace. Our extensive network of 12 leading sites including Apartments.com, ForRent.com, ApartmentFinder.com and 9 others are visited over 100 million times each month by renters looking for their next apartment." (CoStar Group, 2022).

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Appendix. Table of relevant works: commercial office properties.

Year	Author(s)	Focus	Sample	Sample year(s)	Method	Location controls
2008	Miller, Spivey & Florance	Sales Price	Class A Office LEED & Energy Star	2004–2008	Hedonic Regression	City
2009	Fuerst & McAllister	Occupancy	Commercial Office LEED & Energy Star	N/A	Hedonic Regression/Quantile Regression	Submarkets
2009	Dermisi	Assessed and Market Values	Class A & B Office LEED	2009	Robust Hedonic Regression	None
2010	Wiley et al.	Rent, Occupancy, and Sales Price	Class A Office LEED & Energy Star	1999–2007	Hedonic Regression, Two-Stage Least Squares	Unspecified Vector of Locational Attributes
2010	Pivo & Fisher	Cap Rates and Sales Price	Commercial Office Energy Star	1999–2008	Hedonic Regression	State
2010	Eichholtz, Kok & Quigley	Rent and Sales Price	Commercial Office LEED & Energy Star	1999–2007	Hedonic Regression	Quarter Mile Radius Location Clusters
2011	Fuerst & McAllister	Rent and Sales Price	Commercial Office LEED & Energy Star	1999–2008	Hedonic Regression	Submarket
2012	Kok et al.	Rent and Occupancy	Class A & B Office LEED: EBOM	2011	Hedonic Regression	14 Markets
2012	Reichardt et al.	Rent	Commercial Office LEED & Energy Star	2000–2009	Difference-in-Differences/ Hedonic Regression	MSA
2013	McGrath	Cap Rates	Commercial Office Investment-Only LEED & Energy Star	2002–2010	Robust Hedonic Regression	Submarket
2019	Holtermans & Kok	Rent, Occupancy, and Sales Price	Commercial Office LEED & Energy Star	2004–2013	Repeated Measure Regression/ Hedonic Regression	MSA/Quarter Mile Radius Location Clusters