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SUSTAINABILITY AND OCCUPANT RETENTION IN MULTIFAMILY APARTMENTS

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ABSTRACT

Advocates of sustainability argue that ESG investments in real estate reduce tenant turnover and improve tenant recruitment. Previous research has been limited by long commercial lease terms, making it difficult to observe these outcomes directly. This study overcomes that by analysing the multifamily sector's annual lease cycle. Using a database of U.S. lease contracts from January 2019 to March 2020, a logistic regression finds tenants are approximately 4% more likely to renew leases in certified buildings. This increased probability is driven by eco-labels associated with audited cost savings, like Energy Star, and property management. However, a Poisson regression investigating vacancy duration found no clear relationship between ESG certification and the time required to attract new tenants. In conclusion, ESG investments slightly increase retention rates for existing tenants but do not provide a notable competitive advantage in recruiting new ones.

Keywords: ESG, Leasing, Residential, Resilience, Sustainability

INTRODUCTION

The business case for Environmental, Social, and Governance (ESG) investment has shifted from value-add to proactive market transition risk management. Discourse in Europe and the U.S. now concerns capital market and regulatory risks of inaction (Vrensen et al. 2020; Cloutier et al. 2021; Robinson & McIntosh 2022). This risk is best seen in decarbonisation and climate resilience, but also includes post-pandemic wellness and social equity pressures.

Building certification is the most common strategy to manage these risks and communicate with the market (Gabe and Christensen, 2019), identifying properties that exceed standards to reduce future obsolescence, vacancy, and capital costs. Environmental sustainability labels, or "eco-labels", are the most popular strategy due to the global nature of climate change, while social concerns tend to be local to specific markets or time periods. Popular eco-labels used in the United States include LEED, Energy Star, IREM Certified Sustainable Property, and Green Globes.

In signalling reduced environmental risks, advocates claim eco-labels offer immediate competitive advantages. The US Green Building Council (2023) lists ten reasons for its LEED label, including energy efficiency, higher resale value, lower operational costs, increased occupant retention, tax benefits, and market dominance. Of these claims, only higher resale value addresses future risk; the other nine are immediate balance sheet advantages.

Widespread research confirms eco-labeled properties achieve higher resale prices (e.g. Eichholtz et al. 2010 for office markets). Evidence on income returns is mixed, with some finding higher rents (e.g. Bond & Devine 2016) but not lower total occupancy costs (e.g. Gabe & Rehm 2014). More recent research links ESG premiums to capital, not income, returns (Devine et al. 2022), suggesting price premiums reflect investor perceptions of reduced future risk.

Little empirical research confirms if perceived risk reduction from eco-labels matches real outcomes of risky events. Most studies use capitalization (cap) rates to measure risk (e.g. Pivo and Fisher, 2010; McGrath, 2013; Gabe et al. 2021a), but cap rates reflect expectations, not actual results. This project's contribution is observing a tangible risk outcome—tenant attraction and retention—and associating it with the presence of eco-labeling. Existing evidence of favourable outcomes to future risk events is indirect, typically using occupant satisfaction as a proxy measurement of the outcome. Surveys show office tenants prefer eco-labeled buildings (e.g. Kok et al. 2023; Robinson et al. 2016), leaving logical inference to conclude that satisfied tenants are more likely to renew.

Using 2019-2020 U.S. multifamily portfolio data, this paper observes tenant retention and attraction. It asks if building tenants are more likely to renew and if eco-labels reduce time-to-lease for vacancies. Logistic (retention) and Poisson (attraction) regressions are used, controlling for size, age, amenities, and location. Results show ESG investment marginally improves retention but has no clear effect on attraction.

LITERATURE

This study contributes to the literature on sustainability market transformation effects. While existing studies cover asset prices, rents, costs, and satisfaction, this paper fills an empirical gap regarding observation of tenant attraction and retention outcomes. For a more thorough literature review, consult Robinson & McIntosh (2022).

Rental and Asset Premiums

Eco-labelling studies typically concentrate on commercial office asset pricing leasing. Wiley et al. (2010) found large sales ($29.71-$129/sf) and rental (7.3%-17.3%) premiums for Class A offices. Eichholtz et al. (2010) and Fuerst and McAllister (2011) also found significant sales (16-25%) and rental (3.3-5%) premiums. These early results likely include a first-mover advantage and reflect construction-only LEED certifications with no performance liability. Later, examining the operational LEED-EBOM certification, Kok et al. (2012) found a smaller $2/sf rental premium.

As eco-labels are less popular in the institutional residential market, the price literature is thin. Examining 136 properties, Couch, Carswell & Zahirovic-Herbert (2015) found LEED was not a significant predictor of asset prices. Conversely, Bond & Devine (2016) investigated a sample of 97 LEED-certified properties against 193 comparables and found a 9% rent premium. Their model included detailed building attributes and a Walk Score, building on Pivo & Fisher (2010) to control for urban form. Recently, Gabe et al. (2023) replicated Bond & Devine (2016) with a much larger sample size. Using asking rents, they found nearly identical price premiums of 7% to 10%, demonstrating the persistence of these market incentives over time.

Challenges of Attribution

Another important research question is attributing premiums to eco-labels, which correlate with age, amenities, and occupant satisfaction (Robinson & Sanderford, 2016). Eco-labels also associate with governance quality (Costa et al., 2018; Sedlacek & Meier, 2012). However, the link between certification and actual performance is poor, especially for design-stage assessments common in pricing studies (Gabe & Christensen, 2019).

With better statistical controls, ESG pricing effects remain but shrink. Gabe et al. (2021a) found multifamily rent premiums fell from 7% to 4% after adding spatial controls, because eco-labeled buildings are often in newer, “hot” submarkets. Similarly, unrealistic early office premiums (Eichholtz et al. 2010; Fuerst and McAllister 2011; Wiley et al. 2010) for design-stage certifications reduce to low single digits for operational ones (Kok et al. 2012), showing a “hype effect.”

Occupancy and Satisfaction

Eco-label advocates market improved occupancy rates. Early office sector studies support this: Fuerst & McAllister (2009) found occupancy rates 8% higher in LEED and 3% higher in Energy Star buildings. Kok et al. (2012) noted properties with lower occupancy rates closed that gap after eco-label guided renovation, though results also depended on market timing. Wiley, et al. (2010) found even higher occupancy premiums (10.2% to 17.9%) in a sample limited to only Class A office buildings.

Early occupancy studies are criticized for the above described attribution challenge to isolate novelty from ESG investment effects. However, newer research associates office occupant satisfaction to renewal intentions. Kok et al. (2023) found satisfaction scores drove an 8% increase in stated renewal probability and 11% in recommendations (a proxy for recruitment). However, their argument was complicated because eco-labels do not directly affect renewal intent but do correlate with higher overall satisfaction, which then produced their headline retention and recruitment effects.

Most research stops at the correlation between satisfaction and eco-labeling (Guo et al. 2021), creating an opportunity to measure retention rates directly. Long office lease terms limit observation of actual decisions, forcing studies like Kok et al. (2023) to rely on stated renewal intent.

This paper is among the first to investigate retention and attraction in the multifamily sector, leveraging its annual lease renewal cycle. The closest existing study, by Devine and Kok (2015) in the office market, found LEED had no effect on lease renewal, while BOMABest certification had a marginal 3.4% increased likelihood. Their results, however, were statistically weak with few certified buildings and inconsistent robustness tests. To improve on Devine and Kok (2015), the multifamily market is a better laboratory due to higher leasing activity. This study also introduces a novel model to test if eco-labels reduce vacancy costs by enhancing tenant attraction.

DATA

Data comes from a top U.S. multifamily owner/operator, covering approximately 2,000 complexes in 41 states and 124 unique census geographies from January 2019 through March 2020. Data after this period is excluded due to expected COVID-19 pandemic influences on rent and lease renewals, making this study a pre-COVID benchmark.

Four datasets from the owner are used. At the individual unit scale are the "lease transaction" and "rent roll" datasets. At the apartment complex scale are the "property information" and "sustainability" datasets. Models generally combine one unit-level dataset with both complex-level datasets.

Multifamily Apartment Data

The lease transaction dataset contains 406,035 transactions over 15 months in 2,048 complexes. Each record identifies if the lease is a renewal or new contract, the lease term, and whether rent is below submarket average. About 2.6% of leases have discounted rents, observed across 76% of complexes. Just under half (48%) of all transactions are renewals.

The rent roll dataset includes 14,471,914 monthly observations for 1,112,251 unique units. Each observation contains unit characteristics (bedrooms, bathrooms, square feet), submarket rent estimates, occupancy status, and monthly effective rent, which is the contracted rent minus concessions.

The property information dataset provides descriptive complex-level data: address, use type (e.g., student housing), quality grade, size, and monthly occupancy rates. With the exception of monthly occupancy, this information is considered fixed throughout the observation period.

The sustainability dataset contains results from a 2022 internal survey of 1,333 property managers on hundreds of sustainability activities and policies (e.g., LED lighting, Walk Score category). This research uses self-reported data on the presence of eco-labels: LEED, Energy Star, IREM Certified Sustainable Property, Green Globes, and NGBS. The owner also calculates an internal "form score" (0 to 328), a weighted sum of positive survey answers that serves as a crude proxy for the depth of ESG investment.

Additional Data

To supplement the above owner-supplied data, properties were geocoded using Google Maps API to obtain latitude and longitude. Less precise matches were manually geocoded. These coordinates were then used to identify U.S. Census geographies, including the CBSA metropolitan market.

The sustainability dataset was audited and enhanced. Eco-labels were independently verified with certifying agencies, revealing many discrepancies and leading to two identifications: self-reported and independently verified. Additionally, a precise 1-100 Walk Score was obtained from Walkscore.com, replacing the less precise self-reported categories and used in all models.

Since research shows school quality affects tenant decisions (Gabe et al. 2021b), data from Greatschools.com was used to find assigned public schools and their quality metrics for each complex. The property's location

was associated with specific school catchment zones that have enrollment priority.[1] Each matched school is rated on multiple factors. Since complexes are often matched with multiple schools, an overall school quality rating was calculated for each property. Individual school ratings from Greatschools.com are weighted by the inverse of the size of the school's catchment area. This method emphasizes smaller, more exclusive catchments and gives higher weight to primary schools, which research shows are most important to renters (Gabe et al. 2021b).

While Walk Score controls for some micro-location value, further control for urban form was obtained from the first two principal components of the EPA Smart Location Database (Ramsey and Bell, 2014). Per Gabe et al. (2021a), these represent urban economic activity (Factor 1) and exurban low-density form (Factor 2). Each complex's Census Block Group was matched to these national-scale spatial structure scores.[2]

Data Preparation & Descriptive Statistics

To prepare the data, complex-level information was merged into the unit-level datasets. Observations with missing data were omitted. The sample was limited to leases of 11 months or more, and student housing complexes were removed. For statistical confidence, only CBSAs with at least seven complexes, including two or more eco-labeled properties, were included. These steps narrowed the sample to 1,101 apartment complexes across 34 CBSAs.

Table 1 compares unit configurations between the full dataset and the selected sample. Because the data is from a single owner, the distribution is very similar: one- and two-bedroom apartments comprise about 85% of units in both. The main difference is a lower share of units with 0 or 0.5 bathrooms in the selected sample, likely due to the exclusion of student housing.

Table 2 details key variables and reveals a gap between self-reported and verified eco-labels, especially for LEED and Energy Star. We note self-reported, but not verified, LEED properties could be "Registered" but not formally certified, while self-reported, but not verified, Energy Star certifications may have expired, as renewal is annual. For this study, verified Energy Star properties were certified in 2019 or 2020. Other labels (IREM, Green Globes, NGBS) are less common and show smaller reporting gaps; notably, IREM certification was underreported by managers.

As the data is from an institutional owner, the portfolio quality is high: 57% of complexes are rated "A" or "A+," while only 7% are rated "B-" or lower. For the dependent variables, rent shows an expected log-normal distribution (median $1485, mean $1707). The average vacancy turnover period is 1.56 months. As shown in Figure 1, vacancy duration follows a declining Poisson distribution, with over half of vacancies lasting just one month.

Figure 2 cross-tabulates quality grades and eco-labels, confirming a strong correlation between certification and premium buildings, per the literature (Robinson and Sanderford, 2016). Eco-labels are a minority within each quality grade, allowing for statistical differentiation. Reporting discrepancies occur across the quality spectrum. When using verified data, the correlation weakens at the highest quality grades, as "A+" and "A" managers tend to overreport certification while "A-" managers underreport it.

IDENTIFICATION STRATEGIES

Our study tests two hypotheses:

[1] School choice policies vary, but most districts use spatial catchment zones to factor location into student allocation. Research shows school choice diminishes, but does not eliminate, the location value of school quality, so priority catchments remain relevant (Gabe et al. 2021b).

[2] Gabe et al. (2021) also published factor scores for each Metropolitan Statistical Area. However, this study includes some Micropolitan Statistical Areas, so national-scale factors are used. Robustness tests using the MSA-scale scores on a reduced sample did not alter the results reported here.

H1: Sustainability investment increases lease renewal probability (tenant retention).

H2: Sustainability investment shortens vacancy periods (tenant attraction).

The theory is that these competitive advantages reduce collection losses, thereby increasing net operating income (NOI). In addition, a lower probability of future collection losses may also lead to a lower exit capitalisation rate.

Rent Premium Model (Data Validation)

Before testing these hypotheses, the dataset is validated by attempting to replicate the 7% - 9% rental rate premiums for ESG investment found by Bond and Devine (2016) and Gabe et al. (2023). The rent roll dataset is used to validate prior findings. Because our market data is from a single owner, this replication helps identify any sample bias. The model specification equation below is similar to Bond and Devine (2016) and Gabe et al. (2023). To avoid overfitting from monthly observations, the model uses each unit's average monthly rent over the 15-month observation period. The logarithm of a unit's (*i)* average monthly rent is a linear combination of exogenous building, location, and unit-specific variables, plus the ESG variable of interest. Six specifications are tested for robustness using different sustainability (*ESG*) variables: 1) baseline (omitted), 2) self-identified eco-label, 3) verified eco-label, 4) self-identified specific label, 5) verified specific label, and 6) the internal survey "form score."

$$LN(Avg\_Month\_Rent)_i = \beta_0 + \beta_1 \overrightarrow{Complex_i} + \beta_2 \overrightarrow{Location_i} + \beta_3 \overrightarrow{Unit_i} + \beta_4 \overrightarrow{ESG_i} + \epsilon_i$$

This specification differs slightly from prior literature. We lack specific amenity data, using an aggregated quality grade instead. We also add two EPA Smart Location Database components for enhanced spatial control. Since better controls for endogenous correlates can reduce the observed premium, we expect our results to be on the lower end of the previously observed 7 to 9% rental rate premiums.

Tenant Retention Model

To evaluate **H1**, a logistic model uses the lease transaction database to relate lease renewal probability to sustainability observations. The dependent variable *Renewal* is 1 for renewals (about half the data) and 0 otherwise. Independent variables are specified similarly to the rent model above, testing the same five sustainability definitions.

$$Renewal_i = \beta_0 + \beta_1 \overrightarrow{Complex_i} + \beta_2 \overrightarrow{Location_i} + \beta_3 \overrightarrow{Unit_i} + \beta_4 Discount_i + \beta_5 \overrightarrow{ESG_i} + \epsilon_i$$

A key independent variable unique to this model is *Discount*, a binary variable equal to 1 if rent is below the submarket average. This price advantage is expected to be strongly related to renewal probability, similar to the incentive for longer tenure in rent-controlled apartments (Ault et al. 1994). The model is estimated using Maximum Likelihood Estimation. A positive parameter for the ESG variable indicates retention is more likely in eco-labeled properties. The effect is expressed later as an "odds ratio," interpreted as the probability of renewing in a certified building relative to an identical uncertified one.

Vacancy Duration (Tenant Recruitment) Model

To test **H2**, a Poisson regression using the rent roll database models the duration of vacancy in months. This model is estimated only for units experiencing at least one month of vacancy. Independent variables are identical to the rent premium model, with vacancy timing expected to influence duration due to seasonality.

$$Duration\ of\ Vacancy_i = \beta_0 + \beta_1 \overrightarrow{Complex_i} + \beta_2 \overrightarrow{Location_i} + \beta_3 \overrightarrow{Unit_i} + \beta_4 \overrightarrow{ESG_i} + \epsilon_i$$

Observations of zero-month vacancies are excluded because these would include lease renewals, biasing the results. By focusing only on units with one month or more of vacancy (114,987 units, or 47% of the sample), the model naturally excludes renewals and isolates the duration effect. This is justified as 48% of lease transactions are renewals, making it likely most zero-month vacancies correspond to renewal events. Poisson regression is a common technique for modeling repeat events, in this case the probability that the event (vacancy) extends for one more period. The model, which is also estimated using Maximum Likelihood Estimation, is similar to how Cheung et al. (2004) investigated the drivers of home transaction frequency.

RESULTS AND DISCUSSION

As expected, empirical estimations find slightly smaller rent premiums in our data than is reported in the literature. Regarding **H1**, logistic regression finds a 4.7% higher probability of tenant renewal in buildings with independently verified eco-labels. Regarding **H2**, models of vacancy duration cannot reject the null hypothesis, finding no effect from eco-labeling.

Rent Premium Model Results

In the rent premium model (Table 3), control parameters are consistent and rational. Higher rents are associated with higher building occupancy, larger unit size, high Walk Scores, dense urban forms, and better schools. Rents are lower for older and more suburban units. The owner's quality grade is highly predictive: A+ units rent for 7% more than A- units, while C-grade units rent for over 20% less.

A positive correlation exists between monthly rents and eco-labels. This pricing effect is stronger for independently verified labels, enhancing the argument that rent premium can be attributed to third-party sustainability verification. The self-certified group includes unverified "poseur" properties that add noise and reduce the pricing effect. Interestingly, the internal “form score” (a crude proxy for the quantity of sustainability features) shows no economically relevant relationship to rental prices.

The observed eco-labeling premiums are lower than the 7% to 9% found by Bond & Devine (2016) and Gabe et al. (2023); here, the LEED premium is just under 4%. This could be due to several factors: our better urban spatial controls may reduce endogeneity (Gabe et al., 2021a); there could be temporal decay as market penetration of eco-labels increases; or it may signal sampling bias from using a single owner whose labeled and non-labeled products are less differentiated than the market average.

Tenant Retention Results

Table 4 reports logistic regression results from the tenant retention model as odds ratios, where values above 1.0 indicate a higher probability of lease renewal. The headline result is sensitivity to pricing: a rent discount below the submarket average massively increases renewal probability by 53%. This suggests tenants are aware of market rents and, given high relocation costs, even a small discount strongly discourages mobility.

Other controls have marginal effects. For every one-point increase in school quality on Greatschools.com’s 10-point scale, tenants are 1% more likely to renew. The relationship between quality and renewal is nuanced. Compared to A-grade buildings, tenants in A+ buildings are 7% less likely to renew, while the highest renewal probability is in the moderate A-/B+ category. This suggests an optimization effect where tenants balance amenities and cost.

For the sustainability variables, the independently verified specifications are most reliable. Specification 3 reveals that a verified eco-label associates with a 4% more renewal probability. Specification 5 shows this renewal signal is strongly driven by Energy Star buildings. This is logical, as Energy Star is a performance-based label that likely reduces tenants’ utility bills. IREM certification, reflecting the presence of professional management, also increases retention. Like the rent premium model, the internal “form score” is essentially noise.

Vacancy Duration (Turnover) Results

Table 5 shows the Poisson regression results for vacancy duration. Seasonality has the strongest effect: a winter vacancy lasts about 24% longer than a summer one. Age and quality also matter; vacancies in C-quality buildings last 4-6% longer than in A-grade buildings, and for every year a building ages, its vacancies last 5.5% longer.

For eco-labeled properties, the model fails to reject the null hypothesis: a verified eco-label is unrelated to vacancy duration. There is no empirical support for the claim that eco-labels help attract tenants. Only the National Green Building Standard (NGBS) shows a significant relationship, and it is negative, increasing vacancy duration by about 6%. This may be because it is a relatively unknown construction standard of less importance to tenants.

CONCLUSIONS

The findings for the tenant retention hypothesis (**H1**) are nuanced. While a general aggregated eco-label identification shows a 4% increase in renewal probability, this is most likely driven by financial benefits to tenants. Energy Star, a performance-based label demonstrating energy savings, is associated with a nearly 7% increase in renewal probability, while design-based LEED is not significant. This price sensitivity aligns with the greater than 50% renewal likelihood increase for below-market rents.

The tenant recruitment model rejects **H2**, finding no relationship between vacancy duration and eco-labeling; instead, vacancy responds to traditional signals like seasonality and asset depreciation.

Beyond sustainability, the models also reveal interesting tenant behaviours that can be explored in future research. High-amenity A+ space is easier to fill (shorter vacancy duration) but harder to retain tenants in (lower renewal probability), suggesting tenants may not value the luxury amenities associated with such A+ properties at their higher price. The A- quality class appears to be a "sweet spot" with lower prices and high retention.

From a sustainability perspective, cost-saving investments, like energy efficiency, are most likely to retain tenants. While tenants realize these savings, the owner benefits from reduced vacancy and higher net income, showing that the “split incentive” problem demotivating owner investment in energy efficiency is likely overstated. In contrast, design-based certifications with weaker links to operational performance (Gabe and Christensen, 2019) do not appear to influence tenant decisions.

As an academic contribution, this study adds scope to the exploratory work of Devine & Kok (2015). Their smaller study found no office lease renewal effect for LEED but a slight increase for a management-focused certification. With much larger data, this study confirms that eco-labels providing direct tenant value—through cost savings (Energy Star) or better management (IREM)—are rewarded with increased renewal probabilities. Certifications weighted on design and construction do not appear to influence tenant renewal or attraction. This suggests tenants must experience these benefits to be aware of them.

Table 1. Configuration and size comparison between the raw data in the rent roll dataset and the selected units following data preparation.

	Entire Dataset	Selected Units
Studio	67,941	**15,934**
1 bedroom	498,089	**116,367**
2 bedroom	454,322	**97,221**
3 bedroom	75,781	**140,26**
4+ bedroom	16,118	**311**
0/0.5 bath	131,878	**5,772**
1/1.5 bath	562,715	**142,399**
2/2.5 bath	397,406	**94,127**
3+ bath	19,745	**1,078**
Median size (sq. ft.)	870	**868**
Mean size (sq. ft.)	907	**911**
Total number of units	**1,112,251**	**243,859**

Table 2. Descriptive statistics of dependent and independent variables used in the rental rate and vacancy duration models. N = 243,859 selected units from the rent roll dataset.

	Median	Mean	Low	High	SD
Effective rent ($/month)	$1485	$1,707	$402	$23,550	818
Vacancy duration (months)	0	1.56	0	14	2.58
Self-reported eco-certification (1=yes)	0	26.3%	0	1	-
Verified eco-certification (1=yes)	0	21.3%	0	1	-
Self-reported LEED (1=yes)	0	11.6%	0	1	-
Verified LEED (1=yes)	0	8.3%	0	1	-
Self-reported Energy Star (1=yes)	0	13.7%	0	1	-
Verified Energy Star (1=yes)	0	7.1%	0	1	-
Self-reported Green Globes (1=yes)	0	1.4%	0	1	-
Verified Green Globes (1=yes)	0	1.2%	0	1	-
Self-reported IREM (1=yes)	0	4.4%	0	1	-
Verified IREM (1=yes)	0	6.0%	0	1	-
Self-reported NGBS (1=yes)	0	1.9%	0	1	-
Verified NGBS (1=yes)	0	1.7%	0	1	-
Internal ESG “form score”	136.5	140.6	0	328.2	64.7
Quality grade A+ (1=yes)	0	18.2%	0	1	-
Quality grade A (1=yes)	0	38.8%	0	1	-
Quality grade A- (1=yes)	0	7.8%	0	1	-
Quality grade B+ (1=yes)	0	10.2%	0	1	-
Quality grade B (1=yes)	0	17.4%	0	1	-
Quality grade B- (1=yes)	0	3.5%	0	1	-
Quality grade C+ (1=yes)	0	1.8%	0	1	-
Quality grade C or lower (1=yes)	0	2.4%	0	1	-
Building age (years)	11	16.5	1	143	15.6
Urban spatial structure factor	2.66	5.39	-3.14	85.98	10.2
Exurban spatial structure factor	1.71	1.89	-15.83	40.21	4.7
Building vacancy rate	6.69%	10.48%	0%	83.10%	11.23%
School quality rating (1-10)	5.156	5.247	1	9.84	1.68
Walk score (0-100)	58	58.15	0	100	26.44

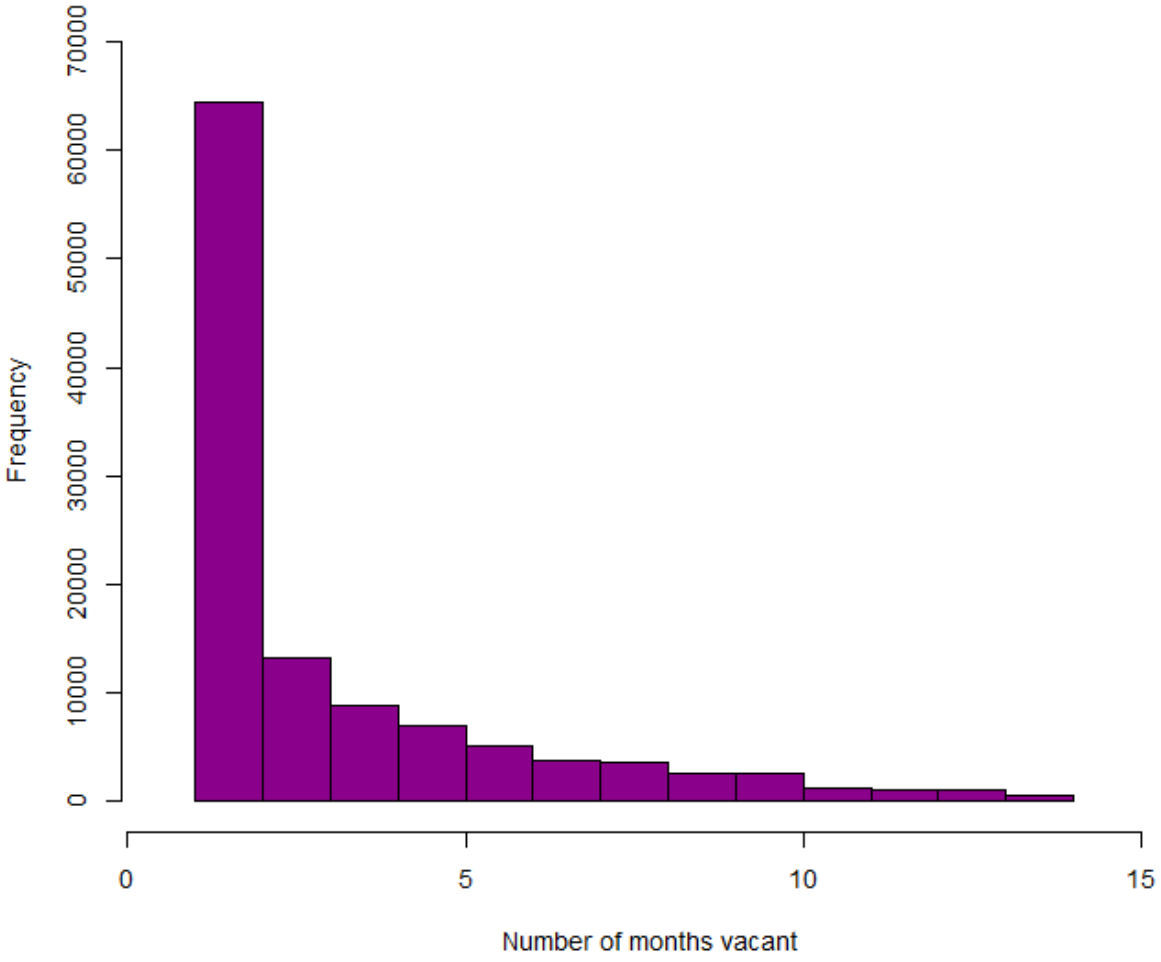

Figure 1. Distribution of vacancy duration for all selected units where vacancy is observed. (N = 114,987 selected units)

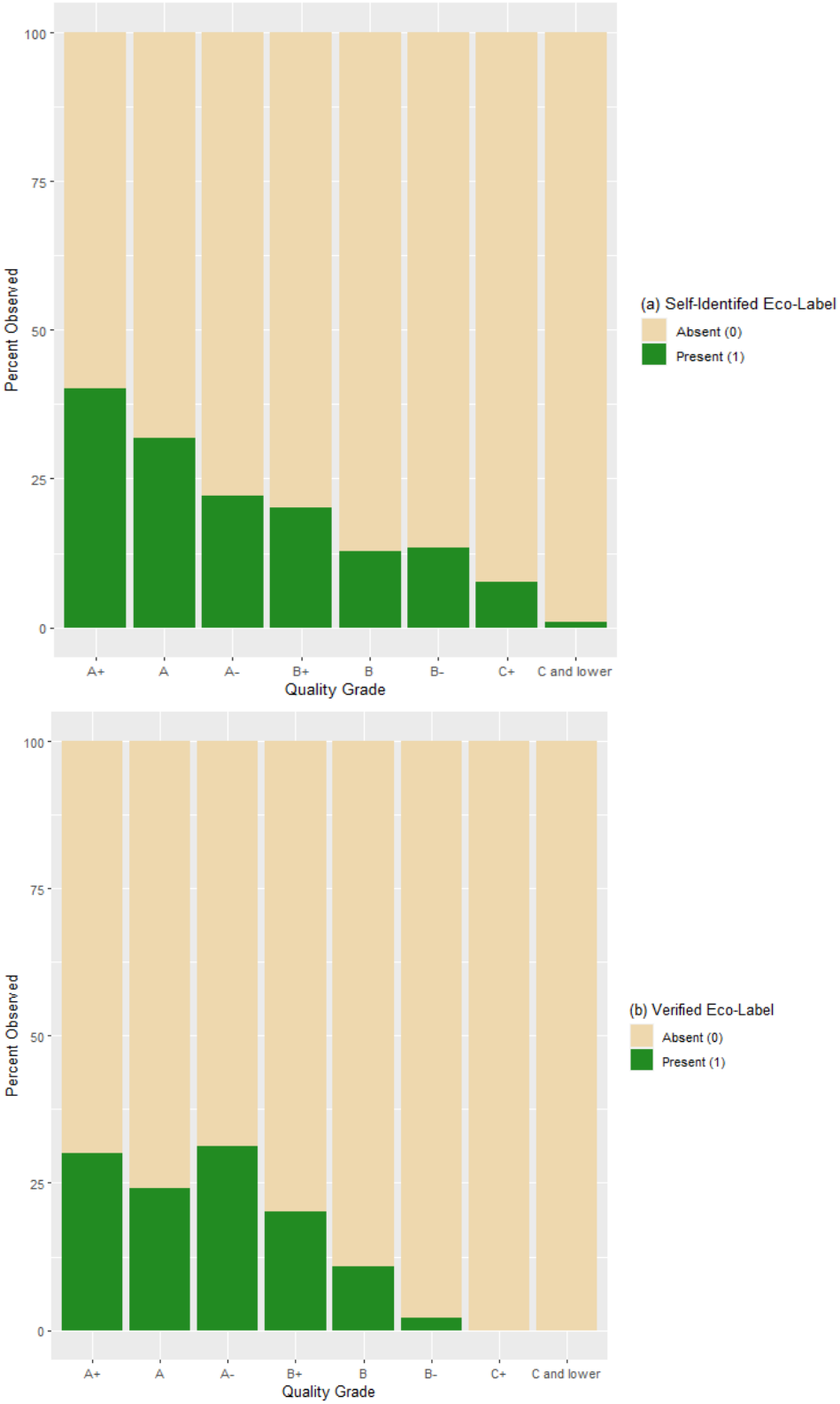

Figure 2. Cross-tabular selected unit incidence of eco-labels by quality grade for (a) self-identified eco-labels from the sustainability dataset, and (b) independently verified eco-labels.

Table 3. Results of the rent premium model used to replicate existing research with the rent roll dataset. The dependent variable is the natural log of monthly average rent for each unit. Specification 1 is a baseline omitting ESG factors. Specifications 2 and 4 define eco-labels as self-reported. Specifications 3 and 5 define eco-labels as independently verified by the certifying agencies. Specification 6 defines ESG as the "form score" on the internal sustainability survey. *, **, and * identify significant differences from an odds ratio of 1.00 at the 10%, 5%, and 1% level.**

	1	2	3	4	5	6
ESG identification	None	Self	Verified	Self	Verified	Survey
Any eco-label		0.0289***	0.0471***			
LEED				0.0228***	0.0388***	
Energy Star				0.0069***	0.0212***	
NGBS				0.0164***	0.0228***	
Green Globes				0.0104***	0.0618***	
IREM				0.0200***	0.0476***	
Internal ESG score						0.0004***
Bldg. Occupancy	0.1013***	0.1059***	0.1145***	0.1061***	0.1153***	0.1236***
Unit size (sq. Ft.)	0.0007***	0.0007***	0.0007***	0.0007***	0.0007***	0.0007***
Size squared	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***
Age (in 2019)	-0.0049***	-0.0047***	-0.0046***	-0.0048***	-0.0047***	-0.0038***
Age squared	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
Walk Score	0.0031***	0.0030***	0.0029***	0.0030***	0.0029***	0.0029***
EPA: urban form	0.0051***	0.0051***	0.0051***	0.0050***	0.0051***	0.0051***
EPA: exurban form	-0.0104***	-0.0104***	-0.0103***	-0.0105***	-0.0104***	-0.0106***
School rating	0.0085***	0.0086***	0.0081***	0.0086***	0.0081***	0.0080***
Bedroom count	0.0319***	0.0307***	0.0313***	0.0309***	0.0317***	0.0305***
Bathroom count	-0.0196***	-0.0188***	-0.0181***	-0.0187***	-0.0185***	-0.0155***
A+ quality	0.0737***	0.0731***	0.0708***	0.0725***	0.0709***	0.0687***
A quality	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
A- quality	-0.0682***	-0.0634***	-0.0703***	-0.0654***	-0.0685***	-0.0588***
B+ quality	-0.0586***	-0.0563***	-0.0598***	-0.0565***	-0.0583***	-0.0551***
B quality	-0.1462***	-0.1431***	-0.1414***	-0.1443***	-0.1403***	-0.1388***
B- quality	-0.1813***	-0.1812***	-0.1778***	-0.1820***	-0.1766***	-0.1781***
C+ quality	-0.2299***	-0.2242***	-0.2214***	-0.2259***	-0.2224***	-0.2152***
C quality or lower	-0.2004***	-0.1960***	-0.1939***	-0.1972***	-0.1939***	-0.1990***
Residential use	-0.1383***	-0.1408***	-0.1414***	-0.1401***	-0.1403***	-0.1308***
Active adult use	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
Mixed use	-0.1172***	-0.1173***	-0.1145***	-0.1168***	-0.1115***	-0.1092***
Constant	6.5454***	6.5373***	6.5451***	6.5434***	6.5485***	6.4766***
CBSA fixed effects	Included	Included	Included	Included	Included	Included
Month of Vacancy	Included	Included	Included	Included	Included	Included
Observations	179,364	179,364	179,364	179,364	179,364	179,364
R-squared	0.8028	0.8037	0.8047	0.8034	0.8045	0.8061
Adjusted R-squared	0.8027	0.8036	0.8046	0.8033	0.8044	0.8061

Table 4. Results of the lease renewal probability model expressed as an odds ratio. The dependent variable is equal to 1 if the lease transaction is a renewal to the existing tenant, zero otherwise. ESG identifications across six specifications are identical to Table 3. *, **, and * identify significant differences from an odds ratio of 1.00 at the 10%, 5%, and 1% level.**

	1	2	3	4	5	6
ESG identification	None	Self	Verified	Self	Verified	Survey
Any eco-label		1.0688***	1.0399***			
LEED				1.0797***	1.0298	
Energy star				0.9934	1.0675***	
NGBS				0.7898***	0.7462***	
Green globes				0.8796***	1.001	
IREM				1.1537***	1.1058***	
Internal ESG score						0.9997***
Rent discount	1.5257***	1.5274***	1.5235***	1.5304***	1.5293***	1.5244***
Unit size (sq. Ft.)	1.0010***	1.0010***	1.0010***	1.0010***	1.0010***	1.0010***
Size squared	1.0000***	1.0000***	1.0000***	1.0000***	1.0000***	1.0000***
Age (in 2019)	1.0379***	1.0384***	1.0381***	1.0374***	1.0374***	1.0372***
Age squared	0.9996***	0.9996***	0.9996***	0.9996***	0.9996***	0.9996***
Walk score	1.0008***	1.0008***	1.0008***	1.0006**	1.0006***	1.0010***
EPA: urban form	1.0030***	1.0030***	1.0029***	1.0030***	1.0029***	1.0030***
EPA: exurban form	1.0073***	1.0073***	1.0073***	1.0070***	1.0071***	1.0073***
School rating	1.0097***	1.0101***	1.0096***	1.0096***	1.0090***	1.0099***
Bedroom count	1.0412***	1.0398***	1.0415***	1.0432***	1.0440***	1.0420***
Bathroom count	0.8515***	0.8526***	0.8515***	0.8517***	0.8507***	0.8497***
A+ quality	0.9373***	0.9331***	0.9352***	0.9433***	0.9435***	0.9402***
A quality	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
A- quality	1.0680***	1.0735***	1.0647***	1.0677***	1.0599***	1.0636***
B+ quality	1.0553***	1.0589***	1.0539**	1.0529**	1.0484**	1.0533**
B quality	0.9022***	0.9084***	0.9058***	0.9071***	0.9122***	0.8976***
B- quality	0.9619	0.9643	0.9659	0.9617	0.9718	0.9566
C+ quality	0.9111**	0.9183**	0.9175**	0.9209**	0.9297*	0.9062**
C quality or lower	0.8335***	0.8422***	0.8402***	0.8425***	0.8499***	0.8313***
Residential use	0.8018***	0.7958***	0.7968***	0.8022***	0.7979***	0.7987***
Active adult use	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
Mixed use	0.4672***	0.4654***	0.4671***	0.4625***	0.4724***	0.4656***
Constant	0.5255***	0.5140***	0.5255***	0.5268***	0.5377***	0.5489***
CBSA fixed effects	Included	Included	Included	Included	Included	Included
Observations	186,055	186,055	186,055	186,055	186,055	186,055
Log likelihood	-126,075.9	-126,059.1	-126,071.2	-126,022.4	-126,028.8	-126,071.4
Akaike inf. Crit.	252,257.80	252,226.10	252,250.30	252,160.80	252,173.60	252,250.80

Table 5. Results of the duration of vacancy model. Coefficients are expressed as an odds ratio with a probability of 1.0 equalling the average vacancy duration. ESG identifications across six specifications are identical to Table 3. *, **, and * identify significant differences from an odds ratio of 1.00 at the 10%, 5%, and 1% level.**

	1	2	3	4	5	6
ESG identification	None	Self	Verified	Self	Verified	Survey
Any eco-label		1.0062	1.0042			
LEED				1.005	1.0054	
Energy star				0.9906	0.9866	
NGBS				1.0418***	1.0593***	
Green globes				1.0458**	1.0145	
IREM				0.9868	0.9869	
Internal ESG score						1.0001*
Unit size (sq. Ft.)	1.0001	1.0001	1.0001	1.0001	1.0001*	1.0001
Size squared	1	1	1	1	1	1
Age (in 2019)	1.0555***	1.0541***	1.0544***	1.0571***	1.0581***	1.0548***
Age squared	0.9990***	0.9990**	0.9990**	0.9991**	0.9991**	0.9991**
Walk score	1.0000***	1.0000***	1.0000***	1.0000***	1.0000***	1.0000***
EPA: urban form	0.9990***	0.9990***	0.9990***	0.9989***	0.9990***	0.9990***
EPA: exurban form	1.0019***	1.0019***	1.0019***	1.0020***	1.0021***	1.0019***
School rating	1.0032***	1.0031**	1.0031**	1.0033***	1.0032***	1.0032***
Bedroom count	0.9924	0.9923	0.9925	0.9924	0.992	0.9924
Bathroom count	1.0112***	1.0114***	1.0114***	1.0117***	1.0117***	1.0118***
A+ quality	0.9883**	0.9882**	0.9880**	0.9880**	0.9878**	0.9879**
A quality	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
A- quality	0.9987	0.9991	0.9982	0.9981	0.9997	1.0004
B+ quality	1.0326***	1.0329***	1.0324***	1.0338***	1.0333***	1.0334***
B quality	1.0264***	1.0263***	1.0265***	1.0260***	1.0245***	1.0272***
B- quality	1.0037	1.0033	1.0038	1.0019	1.0023	1.0046
C+ quality	1.0641***	1.0639***	1.0643***	1.0635***	1.0594***	1.0656***
C quality or lower	1.0339**	1.0344**	1.0342**	1.0324**	1.0316**	1.0340**
Vacant in January	1.3960***	1.3960***	1.3961***	1.3956***	1.3947***	1.3963***
Vacant in February	1.4180***	1.4179***	1.4180***	1.4181***	1.4172***	1.4180***
Vacant in March	1.3536***	1.3538***	1.3537***	1.3532***	1.3535***	1.3539***
Vacant in April	1.3096***	1.3095***	1.3096***	1.3082***	1.3077***	1.3096***
Vacant in May	1.2363***	1.2359***	1.2363***	1.2361***	1.2352***	1.2360***
Vacant in June	1.1607***	1.1606***	1.1609***	1.1617***	1.1616***	1.1610***
Vacant in July	1.1625***	1.1630***	1.1626***	1.1623***	1.1624***	1.1629***
Vacant in August	1.1604***	1.1602***	1.1601***	1.1612***	1.1599***	1.1603***
Vacant in Sept.	1.1859***	1.1861***	1.1861***	1.1853***	1.1864***	1.1861***
Vacant in October	1.1960***	1.1962***	1.1962***	1.1957***	1.1955***	1.1959***
Vacant in Nov.	1.2392***	1.2389***	1.2390***	1.2398***	1.2400***	1.2395***
Vacant in Dec.	1.2588***	1.2589***	1.2588***	1.2590***	1.2594***	1.2592***
Constant	0.8965***	0.8978***	0.8985***	0.8957***	0.8969***	0.8880***
Property use	Included	Included	Included	Included	Included	Included
CBSA fixed effects	Included	Included	Included	Included	Included	Included
Observations	89,782	89,782	89,782	89,782	89,782	89,782
Log likelihood	-133,455.2	-133,454.3	-133,454.9	-133,445.5	-133,444.8	-133,453.4
Akaike inf. Crit.	267,040.40	267,040.60	267,041.80	267,031.10	267,029.50	267,038.90

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