DECOMPOSING THE VALUE EFFECTS OF SUSTAINABLE INVESTMENT

Research Paper Summary

1. Why is this an area of interest to EPRA members?

Survey evidence suggests that the primary concern of REIT managers in relation to sustainability efforts is the impact on financial outcomes of the firm – which we study in this paper.

2. What was the focus of your research?

We carried out a systematic decomposition of the effects of sustainable investments on a comprehensive set of measures of operational performance and market valuation for listed real estate firms in the US and the UK.

3. Describe key conclusions for market practitioners

a. Investing in sustainable properties improves the operational performance of listed real estate firms in the US and the UK: A higher share of sustainable investments is associated with higher levels of cash flow available for distribution to investors.

b. Sustainable investment improves market valuation outcomes for listed real estate firms in these markets, above and beyond effects of higher cash flows and lower risk: Firms with more sustainable properties in their portfolios achieve higher price-to-NAV ratios.

c. In the UK, where a baseline level of environmental reporting is mandatory, we find that the results are less nuanced than in the US, as the compulsory environmental disclosure for investment property may reveal environmental underperformance and thus gradually improve the average level of environmental sustainability of the local building stock, attenuating the effect from any additional voluntary sustainability labels.

Research summary

Survey evidence suggests that the primary concern of REIT managers in relation to sustainability efforts is the impact on financial outcomes of the firm. So, do environmentally sustainable properties offer benefits for the financial performance of the firms investing in them? If so, what are the underlying economic mechanisms driving these performance effects? In this study, we systematically decompose the effects of sustainability practices on the value and performance of listed real estate investment firms in the US and the UK. In the US, we find evidence of higher rental values for firms with a larger share of sustainable properties in their portfolio. We also find that they incur higher operating expenses, as sustainable properties tend to be high-tech, smart buildings.

On the corporate level, we find evidence of lower interest expenses associated with investment in more sustainable properties. Bottom line: We find that sustainable investment increases funds available for distribution to shareholders. In terms of valuation outcomes, we find that US REITs with a larger share of sustainable properties in their portfolio additionally benefit from lower systematic risk and higher market valuations relative to their net asset value. In the UK,

where a baseline level of environmental reporting is mandatory, we find that listed property companies benefit somewhat from investments in sustainability-certified properties through higher earnings and improved valuation outcomes. However, the results are less nuanced than in the US. The compulsory environmental disclosure for investment property in the UK may reveal environmental underperformance and thus gradually improve the average level of environmental sustainability of the local building stock, attenuating the effect from any additional voluntary sustainability labels in this country-market.

EPRA RESEARCH

European Public Real Estate Association

Decomposing the value effects of sustainable investment

Content table

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DECOMPOSING THE VALUE EFFECTS OF SUSTAINABLE INVESTMENT

Final report

Executive summary

Real estate investment firms around the globe increasingly commit to ever more ambitious sustainability practices.[1] Since 2010, the number of real estate investment firms agreeing to have their businesses scrutinized for the Global Real Estate Sustainability Benchmark (GRESB) has increased from 198 to 759, representing a gross asset value of US$2.8 trillion.[2] Research suggests that strong sustainability practices are associated with superior investment performance on the individual property level.[3] Pivo (2008) finds that real estate investment trusts (REITs) have taken notice of these property-level benefits, but that the primary concern of REIT managers in relation to sustainability efforts is the impact on financial outcomes of the firm. This begs the question: Do possible financial benefits to sustainable properties filter through to the corporate performance of the firms investing in them? If so, what are the underlying economic mechanisms driving these performance effects?

Two features of the literature on sustainable real estate investment to date motivate our analysis. First, there is ambiguity in the empirical evidence for the relationship between sustainable real estate investments and improved corporate financial performance of real estate investment firms. Focusing on accounting measures, Ho, Rengarajan, and Lum (2013) examine the effects of sustainable investments on operational firm performance in Singaporean REITs and find mixed results. Examining stock market performance, Fuerst (2015) finds that international REITs with a higher GRESB ranking fail to achieve higher stock returns than their lower-ranking peers. Similarly, Eichholtz, Kok, and Yönder (2012) find that US REITs with a larger proportion of sustainable properties in their portfolio do not earn positive abnormal stock returns. Second, where the literature documents a positive effect of sustainability practices on firm-level financial outcomes, the underlying mechanisms are insufficiently understood. Sah, Miller, and Ghosh (2013) find higher corporate valuations for US REITs that participate in the Energy Star program. Eichholtz, Kok, and Yönder (2012) find that accounting-based measures of operational performance improve for US REITs which hold more sustainable properties. Fuerst (2015) finds that REITs with a higher GRESB ranking achieve higher risk-adjusted returns. However, these studies stop short of identifying the fundamental economic mechanisms responsible for these improvements. As a result, research is unable to offer insights for managers into the amount of resources they should optimally allocate to generating "green value," or to provide guidance for investors on what might be the price of a "green conscience." In order to address this gap in the literature, we systematically decompose the effects of sustainability practices on the value and performance of listed real estate investment firms.

Listed real estate investment firms offer a useful opportunity to study these effects for two reasons. First, we observe value and performance on the individual asset as well as aggregate corporate level, namely property portfolio-level cash flows, driven by rents and operating costs, and corporate-level cash flows after the expenses for managing and financing the portfolio. Second, real estate assets are actively traded in a secondary market, allowing us to measure firm value above and beyond the market value of the underlying real estate assets. As a result, we are able to decompose any valuation effects into a component driven by cash flows available for distribution to investors, changes in the discount rate, or a "halo" effect of corporate reputation for sustainability. Our first contribution is to isolate these different empirical effects of sustainability practices.

[1] The pursuit of environmentally-sensitive buildings is driven by the observation that real estate is associated with more than 40% of energy consumption, and more than 80% of electricity use, the highest level of all use sectors (see http://www.eia.gov).
[2] See: https://www.gresb.com/2016/global.
[3] There is evidence of rental value, occupancy-rate, and asset value premiums for environmentally-certified office buildings (Eichholtz, Kok, and Quigley, 2013, 2010; Fuerst and McAllister, 2011; Miller, Spivey, and Florance, 2008; Wiley, Benefield, and Johnson, 2008), with similar findings for multifamily rental rates (Bond and Devine, 2016). Sustainable properties are also subject to lower rates of obsolescence (Kok and Jennen, 2012), and improve intangible outcomes such as tenant satisfaction and lease renewal rates (Devine and Kok, 2015). Furthermore, sustainable properties are less likely to be associated with residential mortgage delinquency (Kaza, Quercia, and Tian, 2014) and commercial mortgage default (An and Pivo, 2015).

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Efforts to achieve corporate environmental sustainability may be motivated by increased market demand in the real estate investment industry, or top-down through environmental regulation imposed by governments. These potential local idiosyncrasies may have significant implications for the empirical links between sustainability practices and firm value across international markets. However, existing research is often limited to a single country-market and lacks international comparisons. Our second contribution is to compare the empirical links between sustainability practices and firm value and performance across the US and the UK. These two countries are home to the leading global environmental certification programs. They also differ significantly in the institutional environment for sustainability reporting of investment property. While the UK requires a baseline level of environmental performance disclosure for investment property, no such requisite reporting exists in the US.

We begin our analysis by outlining a conceptual framework that systematically links sustainability practices to property performance and firm value to inform our testable hypotheses and empirical approach. We then compile a data set of listed equity REITs in the US and REITs as well as listed property companies in the UK. For the sample firms, we hand-collect and match information on ownership of properties with data on the environmental certification of those properties from the leading certification programs in the US and the UK (LEED, Energy Star, and BREEAM). This matching exercise allows us to calculate the share of each firm's portfolio that corresponds to environmentally sustainable buildings relative to conventional buildings, and to track the evolution of this metric through time. We then relate this panel of green share data to the panel of property portfolio-level and corporate-level performance and value outcomes.

We find evidence that rental value premiums of sustainable properties filter up to the rental revenue of US REITs, holding assets, liabilities and unobservable firm and time effects constant. On that basis, we also find that sustainable investment is associated with higher operating expenses for US firms, likely because green buildings tend to feature more sophisticated technology and utilize more electricity in exchange for greater ambient control. In sum, we find that the rental revenue premium fully compensates for any increase in operating expenses, resulting in stable net operating income for the US sample. On the corporate expense level, we find lower interest expenses associated with investment in more sustainable properties in the US, consistent with recent findings of lower spreads on debt collateralized against sustainable properties (Eichholtz, Holtermans, Kok, and Yönder, 2015). As a result, our findings suggest that higher property-level cash flows and lower corporate-level expenses increase funds available for distribution to shareholders. Further, we find that US REITs with a larger share of sustainable properties in their portfolio benefit from lower systematic risk and higher market valuations relative to their net asset value. Our findings imply that these valuation gains are above and beyond higher market values of the underlying properties, hence we interpret them as gains based on corporate reputation effects.

In the UK, where a baseline level of environmental reporting is mandatory, we find that listed property companies benefit somewhat from investments in sustainability-certified properties through higher cash flow and valuation outcomes. However, the results are less nuanced than in the US. The compulsory environmental disclosure for investment property may reveal environmental underperformance and thus gradually improve the average level of environmental sustainability of the local building stock, attenuating the effect from any additional voluntary sustainability labels in the UK. Our results suggest that while the primary effect of certification in the US, a market without requisite baseline reporting, is to improve transparency and thus reduce the amount of uninformed trading in the market, certifications against the benchmark of baseline environmental performance reporting in the UK may additionally provide a signal of particularly high environmental quality of the firm's portfolio. In combination, these two effects cancel each other out, leaving liquidity unaffected in the UK sample.

In summary, this study contributes to our understanding of the value and performance effects of corporate sustainability practices in three main ways. First, we clarify the relative value and performance effects of sustainability practices on the property-level, the operating and financing level of the firm, and the corporate level from the shareholder's point of view. Second, the existing literature mostly focuses on individual countries. However, real estate investment is a global industry and concerns around sustainability are global in nature, too. We contribute to filling this gap in the literature by comparing the value and performance effects of environmental certification practices in different international markets. Finally, we are able to clarify, for investors and managers alike, the economic channels through which sustainability practices contribute to firm value and performance.

Chapter 1 Background

Our empirical work is based on the fundamental dividend-discount relationship of corporate valuation. The study that is closest to ours in using this relationship to motivate empirical tests is Capozza and Seguin (1999). The dividend discount model defines firm value V at time t as the present value of future dividends D_t, discounted at a rate r:

$$V_t = \int_t^T D_t e^{-rt}\, dt$$

Table 1 shows a standard REIT income statement. According to this *pro forma*, the corporate cash flow available for distribution to shareholders, C_t, is the cash flow obtained from the properties owned and operated by the REIT, Y_t, minus any interest expense, I_t, and minus corporate level overheads, G_t:

$$C_t = Y_t - I_t - G_t$$

Pro forma REIT income statement and valuation schematic

PERFORMANCE LEVEL		ITEM
PROPERTY		Rental revenue
	-	Rental operating expense
	=	Property-level cash flow (NOI)
CORPORATE	-	Interest expense
	-	General & administrative expense
	=	Corporate cash flows (FFO)
MARKET		Valuation (P/NAV)
		Discount rate
		Liquidity

Table 1: The table presents a schematic of a typical *pro forma* income statement and basic corporate valuation principle for an equity REIT.

If REITs pay out 100% of cash flows available for distribution, then firm value becomes:

$$V_t = \int_t^T (Y_t - I_t - G_t) e^{-rt}\, dt$$

Assuming constant rates of growth in property cash flows, g^y, and corporate overheads, g^g, this equation may be simplified, in perpetuity, to the following expression:

$$V_t = \frac{Y_t}{r - g^y} - \frac{G_t}{r - g^g}$$

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The REIT regulation requires qualifying firms to pay out at least 90% of taxable earnings as dividends. REITs regularly pay out significantly more than that (Boudry, 2011; Hardin and Hill, 2008; Wang, Erickson, and Gau, 1993). This policy creates a close correlation between REIT dividends and cash flows for distribution; the valuation of REITs is then driven by the present value of future corporate cash flows (Capozza and Seguin, 1999).

If a corporate policy to invest in sustainable properties affects REIT firm value, then it must do so via one or more of the valuation components identified above. In this study, we trace the effects of sustainable property investment through the REIT valuation process and its constituent components.

Cash flow effects
A corporate policy of investing in sustainable properties may affect the numerator of the dividend (cash flow) discount valuation through a number of different economic channels. The following section outlines our hypotheses in relation to those channels. Several of our hypotheses are the first attempts to examine such questions. However, where possible, each hypothesis is rooted in the relevant existing literature.

Property-level cash flows: Property level cash flows are a function of rental revenues and operating expenses. Research on the individual building level suggests that properties with sustainability certifications achieve higher rental rates (Bond and Devine, 2016; Eichholtz, Kok, and Quigley, 2013, 2010; Fuerst and McAllister, 2011; Kahn and Kok, 2014; Miller, Spivey, and Florance, 2008; Wiley, Benefield, and Johnson, 2008). As a consequence, we expect that REITs with a larger proportion of sustainable properties in their portfolio realize higher rental revenues.

In terms of operating expenses, a major goal of sustainable building is to decrease resource usage, theoretically translating into lower energy-related operating costs (Kats, 2003; Newsham, Mancini, and Birt, 2009; Scofield, 2009, 2013). However, studies find a positive relationship between environmental certification and energy use, particularly in technologically sophisticated “smart buildings” (Fullbrook, Jackson, and Finlay, 2006; Kats, 2010). On the other hand, Devine and Kok (2015) find that sustainable buildings are linked to improved tenant satisfaction and a higher likelihood of renewing a lease, suggesting lower tenant incentives and re-leasing costs over time. At this juncture, the most consistent result from this nascent literature is the call for more research. To our knowledge, we are the first to test whether REITs with a larger share of sustainable properties realize higher or lower operating expenses.

Net operating income: As NOI, the bottom-line property level cash flow measure, is impacted by both, rental income and operating expenses, it is an empirical question as to which effect dominates on the portfolio level.

General and administrative (G&A) expenses: After net operating income, corporate level cash flows are driven by corporate level overheads. As noted, environmentally-certified properties are often technologically advanced “smart” buildings with higher tenant satisfaction, thus possibly requiring less intense asset management. REITs with a larger share of sustainable properties in their portfolio may therefore incur lower G&A or management expenses. To the best of our knowledge, we are the first to explore this possible effect of sustainable investment on corporate management expenses.

Interest expenses: Corporate-level cash flows are further affected by interest expenses. Eichholtz, Holtermans, Kok, and Yönder (2015) find lower spreads on corporate debt issuances collateralized against sustainable properties. Building on those results for interest rate spreads at issuance, and holding the level of corporate debt constant, we expect REITs with a larger share of sustainable investments to incur lower interest expenses.

Funds from operations: Funds from operations (a US REIT-specific measure of accounting earnings or cash flow available for distribution to shareholders) are the overall product of net operating income after G&A (management) expenses and corporate interest expenses. These funds represent a key cash-flow metric in the valuation of real estate firms. Having examined the different categories of firm-level income and expense items separately, it is an empirical question how these individual effects combine to influence the bottom line of funds from operations.

Discount rate and valuation effects
A corporate policy of investing in sustainable properties may, in addition to affecting the numerator of the dividend (cash flow) discount valuation, also have an impact on the denominator, the discount rate. The discount rate in the valuation reflects the required rate of return on the firm's equity.

Liquidity: The required rate of return is partly a function of liquidity (Yakov Amihud, 1988). Liquidity may be affected by investment policies if these policies affect informational asymmetries (Harris, Kriebel, and Raviv, 1982) or the cost of collecting value-relevant information (Ippolito, 1989). The valuation of real estate requires intricate knowledge of the assets, which is costly to acquire (Han, 2006). Environmental certification improves transparency by providing a considerable amount of information on the fundamentals of properties. Higher liquidity (stock turnover) may signal a higher proportion of uninformed traders in the market (Baker and Stein, 2004). To the extent that better information about the fundamentals of a REIT's portfolio, possibly through certifications, reduces uninformed trading, we expect that REITs with a larger share of sustainable properties in their portfolio experience lower ratios of stock turnover.

Systematic Risk: The required rate of return is also a function of the systematic risk of the equity, measured by the CAPM beta. Sustainable property investment is often associated with the goal of making a portfolio more resilient. This resiliency may manifest itself in higher and more stable occupancy rates and/or less variation in operating expenses (Devine and Kok, 2015). To the extent that sustainable properties are a more stable source of rental income and subject to less volatile expenses, a portfolio with a higher exposure to sustainable buildings may generate more stable performance that is less sensitive to variation in the economic environment. Thus we expect that REITs with a higher share of sustainable properties have lower systematic risk.

Valuation: On balance, the effects above may combine to produce higher market valuations for REITs with a larger share of sustainable properties in their portfolio. This comprehensive assessment allows us to evaluate the relative magnitude of the effects of sustainable investments on corporate performance, and establish the extent to which any positive value effects are driven by cash flow factors or discount rate factors, that is, systematic risk and liquidity.
In addition, the fact that real estate assets are actively traded in a secondary market affords us with an opportunity to measure the contribution of sustainable investments to the value of the firm above and beyond any contributions to the value of the underlying properties as determined by cash flow and discount rate factors, possibly reflecting a reputation or "halo" effect of sustainable investment.

Chapter 2 Empirical method

Basic regression set-up
In order to explore the effects of sustainable investment, we specify a set of regression models, similar to Capozza and Seguin (1999). First, we focus on the different components of cash flow effects. The dependent variables in our models correspond to the cash flow elements of REIT value and performance discussed above. They include: (i) rental revenue, (ii) rental operating expense, (iii) property-level cash flows (NOI), (iv) interest expense, (v) general and administrative expense, (vi) corporate level cash flows available for distribution (FFO in the US, earnings in the UK) For instance, consider the following baseline model for rental revenue, RR_{it}:

$$RR_{it} = \beta_1 L.AT_{it} + \beta_2 L.AT_{it}^2 + \beta_3 L.LT_{it} + \beta_4 L.LT_{it}^2 + f_i + d_t + u_{it}$$

where AT_{it} is the depreciated book value of total assets, and LT_{it} is the book value of total liabilities. In order to address potential endogeneity in the relationships of interest, we lag all right-hand side variables, where $L.$ denotes the lag operator. In this specification, the coefficient β_1 may be interpreted as a baseline property rental yield. In order to account for possible non-linearity, we include squared terms of total assets and liabilities. We include firm fixed effects, f_i, to control for time-invariant unobservable firm-specific characteristics. These controls allow us to isolate the effect of investments in environmentally sustainable properties after accounting for the general characteristics of the firm's asset base. We also include time fixed effects, d_t, to account for market-wide factors that vary through time but affect all firms such as investor sentiment or a preference for certain investment styles. Lastly, u_{it} is the residual.

Effect of sustainable investment

We assess the influence of sustainable property investment by allowing the baseline rental yield to vary with the degree of sustainable investment. Consistent with Eichholtz, Kok, and Yönder (2012), we define the degree to which a REIT follows a sustainable investment policy as the *GreenShare* of firm *i* at time *t*:

$$GreenShare_{it} = \frac{\sum_n^N Area_{it}^{Certified}}{\sum_m^M Area_{it}}$$

where the numerator sums the area (square footage) of all *N* certified properties held by firm *i* at time *t* and the denominator sums the area of all *M* properties held in total by firm *i* at time *t*, so that the *GreenShare* is a ratio in *[0,1]*. As a result, we estimate the following model:

$$RR_{it} = \beta_1 L.GreenShare \times L.AT_{it} + \beta_2 L.AT_{it} + \beta_3 L.AT_{it}^2 + \beta_4 L.LT_{it} + \beta_5 L.LT_{it}^2 + f_i + d_t + u_{it}$$

where the model contains the same observable covariates included in the baseline model, and firm as well as time fixed effects are included as before. In order to account for heteroskedasticity, we estimate this model using weighted least squares (WLS) with the inverse of the book value of total assets as weights. In subsequent variants of the model, we replace the dependent variable with the remaining components of REIT cash flow performance outlined above.

Extension to discount rate and valuation effects

Discount rate or required rate of return effects may be reflected in one or more of the following variables: (i) liquidity, (ii) systematic risk, and finally, (iii) overall valuation effects. Next, we examine the link between sustainability and stock liquidity. Consider the following specification:

$$VT_{it} = \beta_1 L.CSHO_{it} + \beta_2 L.CSHO_{it}^2 + \beta_3 L.LT_{it} + \beta_4 L.LT_{it}^2 + f_i + d_t + u_{it}$$

where variables are defined as in the first model, except VT_{it} is the total number of common shares traded for firm *i* over a period *t* and $CSHO_{it}$ is the number of common shares outstanding at the end of the period. In this specification, the coefficient β_1 may be interpreted as a baseline turnover ratio for the sample firms. Following the same logic as before, we augment this model as follows:

$$VT_{it} = \beta_1 L.GreenShare \times L.CSHO_{it} + \beta_2 L.CSHO_{it} + \beta_3 L.CSHO_{it}^2 + \beta_4 L.LT_{it} + \beta_5 L.LT_{it}^2 + f_i + d_t + u_{it}$$

where the model contains the same observable covariates included before, and firm as well as time fixed effects are included. This model is estimated using WLS with the inverse of the number of common shares outstanding as weights.

Sustainability practices may also make the portfolio of a REIT more resilient to market-wide shocks, reducing systematic risk. To explore this relationship, we estimate a regression analogous to the model above, only the dependent variable is the series of firms' CAPM β coefficients, obtained from annual regressions of monthly returns on stock market indexes (S&P500 in the US and FTSE 100 in the UK):

$$BETA_{it} = \beta_1 L.GreenShare \times L.AT_{it} + \beta_2 L.AT_{it} + \beta_3 L.AT_{it}^2 + \beta_4 L.LT_{it} + \beta_5 L.LT_{it}^2 + f_i + d_t + u_{it}$$

where all variables are defined as before. Note that for scaling purposes, we multiply the firm's β coefficient for a given year by the book value of its assets. We estimate the equation using WLS, with the inverse of the firm's book value of assets as weights.

Lastly, strong sustainability practices may improve corporate reputation and desirability of the stock for investors, thus inducing a corporate valuation premium. Common measures of corporate value rely on the ratio of the market value of the firm's assets relative to their depreciated book value, commonly referred to as *q*. However, to the extent the improvements in the operational performance of sustainable properties are reflected in the market value of those assets, and given that we would like to examine corporate valuation effects above and beyond those potentially higher market values of the underlying assets, we use the price to NAV ratio as our measure of value. The price to NAV ratio incorporates variation in the

market value of the underlying REIT properties, and thus the ratio of the firm's stock price to the net asset value of its properties can provide better insight into the pure valuation effects of sustainable investments.

Thus, as a final specification, we use market value of the firm's equity as the dependent variable, with the net asset value (NAV) on the right-hand side, so that the coefficient on the interaction between NAV and the variable *GreenShare* captures pure valuation effects reflected in the price/NAV ratio, as follows:

$$MCAP_{it} = \beta_1 L.NAV_{it} + \beta_2 L.NAV_{it}^2 + \beta_3 L.LT_{it} + \beta_4 L.LT_{it}^2 + f_i + d_t + u_{it}$$

where variables are defined as before, except $MCAP_{it}$ is the total market capitalization (share price multiplied by common shares outstanding) for firm *i* in period *t* and NAV_{it} is the net asset value at the end of the period. In this specification, the coefficient β_1 may be interpreted as a baseline price to NAV multiple. We then estimate the following augmented model:

$$MCAP_{it} = \beta_1 L.GreenShare \times L.NAV_{it} + \beta_2 L.NAV_{it} + \beta_3 L.NAV_{it}^2 + \beta_4 L.LT_{it} + \beta_5 L.LT_{it}^2 + f_i + d_t + u_{it}$$

where we include the same observable covariates and firm as well as time fixed effects as before. The equation is estimated using WLS with the inverse of the firm's net asset value as weights.

Chapter 3 Data

In order to estimate the models outlined above, we employ financial reporting and property portfolio data on listed US equity REITs as well as UK REITs and property companies from the SNL Financial database. For the calculation of the *GreenShare*, we first identify the addresses of the buildings owned by the sample firms at any given point in time from SNL. We then collect the addresses of all sustainability-certified properties in the US and the UK directly from the certification providers, including the certification date.

Lastly, we employ GIS techniques to match the addresses of the properties held by the sample firms with the addresses of all certified properties. This matching exercise produces a list of certified properties held by the sample firms through time.

There are two leading sustainability and energy efficiency building certification programs in the US (Energy Star and LEED), and one in the UK (BREEAM). Each of these programs originated in their respective countries, they dominate their local markets, and they have a strong presence in international markets, supporting our choice of these two countries for our analysis.[4]

The study period begins in 2000 for the US (when comprehensive certification data is first available), and in 2009 for the UK (when BREEAM data is first available), with the final sample covering 2001–2014 and 2010–2014, respectively, taking into account the lagged specifications and the most recent data available. Throughout these sample periods, we adopt an unbalanced panel approach to mitigate survivorship bias (Baum, 2006). Firms enter the sample when they first appear on SNL and meet the data requirements, and exit when they become inactive (acquired/defunct). Our final sample contains 956 and 297 firm-year observations in the US and UK, respectively.

Table 2 presents key ratios on the financial characteristics of the sample firms during the study period. In order to mitigate any undue influence of outliers, all variables are winsorized at the 1st and 99th percentiles. Table 3 presents pairwise correlation coefficients between the key financial ratios and the sustainability measures in our study. We find some significant but not excessive correlations between the financial ratios and sustainability measures, alleviating concerns surrounding multicollinearity.

[4] The majority of sample firms with a positive *GreenShare* hold a mix of different environmentally certified properties. Our *GreenShare* metric captures properties certified under any of the three certification programs.

Firm characteristics, US and UK firms

Variable	Mean	SD	P25	Median	P75	Min	Max
Panel (a) US firms							
Rental revenue	0.12	0.03	0.10	0.12	0.14	0.02	0.24
Rental operating expense	0.04	0.02	0.03	0.04	0.05	0.00	0.14
NOI	0.08	0.02	0.07	0.08	0.10	0.02	0.21
G&A expense	0.01	0.01	0.01	0.01	0.01	0.00	0.06
Interest expense	0.03	0.01	0.02	0.03	0.03	0.00	0.09
Funds from operations	0.05	0.02	0.04	0.05	0.06	-0.06	0.20
Market leverage	0.47	0.15	0.37	0.46	0.57	0.01	0.99
MB ratio	1.34	0.34	1.12	1.29	1.49	0.54	3.28
Market value to NAV	1.01	0.20	0.90	1.02	1.13	0.15	3.15
Turnover	0.11	0.08	0.06	0.09	0.13	0.00	0.78
Certified (by area)	0.02	0.06	0.00	0.00	0.02	0.00	0.29
Certified (by assets)	0.05	0.12	0.00	0.00	0.04	0.00	0.54
Panel (b) UK firms							
Rental revenue	0.06	0.02	0.04	0.06	0.07	0.00	0.13
Rental operating expense	0.01	0.01	0.01	0.01	0.02	0.00	0.05
NOI	0.03	0.06	0.02	0.04	0.05	-0.93	0.12
SG&A expense	0.02	0.05	0.01	0.01	0.02	0.00	0.88
Interest expense	0.02	0.01	0.01	0.01	0.02	0.00	0.08
Earnings	0.06	0.08	0.01	0.05	0.09	-0.44	0.70
Market leverage	0.46	0.19	0.32	0.45	0.60	0.04	0.94
MB ratio	0.95	0.13	0.89	0.96	1.04	0.54	1.31
Market value to NAV	0.91	0.23	0.78	0.91	1.06	0.26	1.48
Turnover	0.36	0.27	0.15	0.34	0.50	0.00	1.89
Certified (by area)	0.01	0.03	0.00	0.00	0.00	0.00	0.12

Table 2: The table presents the descriptive statistics of the sample firms on an annual basis. All firm-level accounting and portfolio information is obtained from SNL. Financial key ratios are scaled by book value of assets, unless otherwise indicated. Market leverage is the ratio of total liabilities plus mezzanine items to the market value of assets. Market value of assets is book value of assets minus book value of common equity plus market value of equity (number of common shares outstanding multiplied by the end of quarter share price). The market-to-book (MB) ratio is the market value of assets over the book value of assets. The market value-to-NAV ratio is the market capitalization of the firm (market value of equity) divided by the firm's NAV (net asset value (NAV) per share multiplied by the number of shares outstanding). Turnover is the total number of shares traded in a period over the total number of shares outstanding at the beginning of the period. Sustainability characteristics are scaled as indicated, by book value of assets or area (property square footage). In the UK, the equivalent expense to G&A expenses reported is Selling, General and Administrative (G&A) Expenses. Furthermore, we use earnings instead of FFO as listed property companies in the UK do not report FFO.

Correlation table

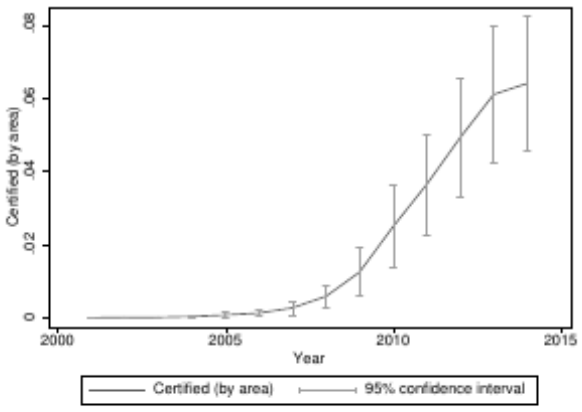
	Certified US		Certified UK
VARIABLE	**By assets**	**By area**	**By area**
Rental revenue	-0.0852*	-0.1169*	-0.1378
Rental operating expense	0.0491	0.0161	-0.1310
NOI	-0.1553*	-0.1909*	0.0224
G&A expense (SG&A expense)	-0.0308	-0.0439	-0.0698
Interest expense	-0.1723*	-0.1925*	-0.0180
Funds from operations (Earnings)	-0.0911*	-0.0995*	0.0698
Market leverage	-0.0210	-0.0273	-0.0731
MB ratio	-0.0563	-0.0902*	0.1594
Market value to NAV	0.0113	0.0297	0.1848*
Turnover	0.0254	0.0429	0.1387

Table 3: The table presents selected pairwise Pearson correlation coefficients for the financial and sustainability characteristics of the US equity REITs and UK equity REITs as well as listed property investment firms in the sample over the study period. All variables are defined as in Table 2. The asterisk denotes significance of the difference of correlation coefficients from zero at the 1% level.

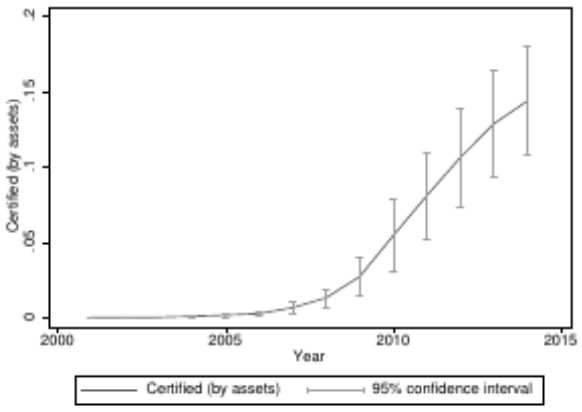
Figure 1 highlights the evolution of the sustainability measures in our sample. Since the start of the study period, green properties have developed into a significant proportion of US REIT portfolios. In 2014, the final year in our sample, green properties on average account for approximately 15% of US REIT assets and more than 6% of portfolio square footage. In the UK sample, the share of sustainable properties is lower, reaching an average of 2% by area in 2014, but shows an upward trend similar to the US sample.[5]

[5] In the UK, information on the net book value of the assets held by the sample firms is not available, so we focus the comparative analysis on the *GreenShare* based on the area (square footage) of the assets held by the sample firms.

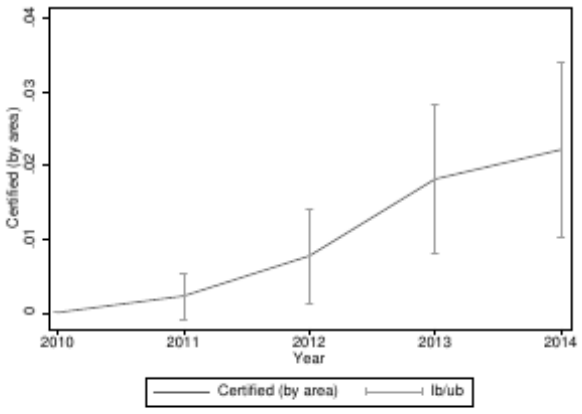
Evolution of sustainability measures



(a) Mean share of certified area to total area US



(b) Mean share of certified assets to book value US



(c) Mean share of certified area to total area UK

Figure 1: The figure shows the evolution of annual mean green shares in the US, by book value of assets (Panel (a)) and the total square footage (area) (Panel (b)), as well as in the UK, by area (Panel (c)) over the study period. The bars indicate a 95% confidence interval around the mean estimate.

Chapter 4 Results

Cash flow effects

Tables 4 and 5 show the regression results for the operational effects of sustainable investment in the US equity REITs and the UK listed property companies, respectively, in our sample. Note that all of our findings are established after controlling for firm and time fixed effects to account for unobservable firm-specific factors such as firm quality and market-wide influences such as sentiment.

Regression results for US operational effects, all certified sustainable area

VARIABLES	(1) Rental revenue	(2) Operating expense	(3) NOI	(4) G&A expense	(5) Interest expense	(6) FFO
(Assets) x (Certified area)	0.053**	0.029***	0.004	0.000	-0.016***	0.035**
	(2.55)	(2.77)	(0.32)	(-0.01)	(-3.50)	(2.01)
Total assets	0.133***	0.038***	0.101***	0.004***	0.006***	0.062***
	(15.00)	(8.36)	(17.02)	(3.50)	(2.83)	(8.36)
$(Assets)^2$	-0.002***	-0.000**	-0.002***	0.000	-0.000*	0.000
	(-4.56)	(-2.34)	(-6.50)	(0.75)	(-1.92)	(1.50)
Total liabilities	-0.049***	-0.003	-0.053***	0.002	0.036***	-0.037***
	(-3.38)	(-0.41)	(-5.50)	(0.89)	(11.28)	(-3.05)
$(Liabilities)^2$	0.002	0.000	0.002***	0.000	0.000	-0.003***
	(1.51)	(0.43)	(3.36)	(0.16)	(-1.57)	(-3.20)
Observations	956	956	956	956	956	956
R-squared	0.974	0.952	0.973	0.920	0.976	0.914
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: The table presents the regression results estimating the firm-year observations of the operational ratios for US equity REITs as a function of the share of all certified sustainable properties held by the firm, (Assets) x (Certified area), and firm characteristic control variables. Variables are defined as in Table 2. Columns (1) to (6) correspond to the results for the individual operational performance measures as indicated in the column headings. Assets squared and Liabilities squared are scaled by (10^{-6}). Firm and year fixed effects are included as indicated to control for time- and firm-invariant unobservables, respectively. Robust t-statistics, obtained via WLS with the inverse of the book value of the firm's assets used as weights, are shown in parentheses. Significance is indicated as follows: * p<0.1, ** p<0.05, *** p<0.01.

Regression results for UK operational effects, all certified sustainable area

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	**Rental revenue**	**Operating expense**	**NOI**	**SG&A expense**	**Interest expense**	**Earnings**
(Assets) x (Certified area)	0.009	-0.002	0.049**	-0.008	0.001	0.426***
	(0.47)	(-0.29)	(2.54)	(-0.91)	(0.15)	(3.27)
Total assets	0.024***	0.004*	0.009	0.014***	-0.001	0.197***
	(3.81)	(1.82)	(1.38)	(4.54)	(-0.55)	(4.54)
$(Assets)^2$	-0.001	0.000	-0.001	-0.000	-0.000	-0.013***
	(-1.46)	(0.12)	(-1.25)	(-1.55)	(-1.11)	(-3.18)
Total liabilities	0.046***	0.006	0.047***	-0.014**	0.038***	-0.283***
	(4.10)	(1.55)	(4.16)	(-2.59)	(8.50)	(-3.72)
$(Liabilities)^2$	-0.003	0.000	-0.003*	0.001	-0.001*	0.056***
	(-1.45)	(0.16)	(-1.71)	(0.77)	(-1.84)	(4.20)
Observations	297	297	297	297	297	297
R-squared	0.985	0.977	0.963	0.916	0.979	0.791
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: The table presents the regression results estimating the firm-year observations of the operational ratios for UK equity REITs and listed property companies as a function of the share of all certified sustainable properties held by the firm, (Assets) x (Certified area), and firm characteristic control variables. Variables are defined as in Table 2. Columns (1) to (6) correspond to the results for the individual operational performance measures as indicated in the column headings. Assets squared and Liabilities squared are scaled by (10^{-6}). Firm and year fixed effects are included as indicated to control for time- and firm-invariant unobservables, respectively. Robust t-statistics, obtained via WLS with the inverse of the book value of the firm's assets used as weights, are shown in parentheses. Significance is indicated as follows: * p<0.1, ** p<0.05, *** p<0.01.

Column (1) of Table 4 presents the effects of sustainable investment on rental revenue relative to total assets for US REITs. The estimated conditional average rental yield is 13.3%. The positive significant coefficient on the (Assets) × (Certified share) variable suggests that a larger share of certified sustainable properties is associated with a higher rental yield. Economically, a REIT with a share of sustainable assets equal to the sample mean of 2% (based on area) plus one standard deviation, resulting in a green share of 8%, has an expected rental yield of 13.7% [=0.133+(0.053×0.08)]. This positive effect of environmental certification on rental values is consistent with the existing literature on the building level, but further shows that these positive effects on rental levels carry through from the property level to the portfolio level.

Column (2) shows the effects of sustainability on rental operating expenses and reveals contrasting results for the two subgroups. We find that investment in sustainable properties unfavorably affects the operating costs of US REITs. While the overall conditional average ratio of operating expenses to total assets is 3.8%, this measure increases to 4% for a REIT with a share of sustainable assets equal to the sample mean plus one standard deviation. To our knowledge, we are the first to document this effect of sustainable investment on the operating cost of a REIT. Our finding is consistent with the notion that the technological sophistication of sustainable properties may increase operating costs as compared to conventional properties.

Next, we explore the net effect of sustainable investment on rental revenue and operating expense by considering property-level cash flows (NOI) in Column (3). In the US, we find that the NOI remains unaffected, suggesting that the balance of higher rental revenue and higher operating costs for sustainable buildings cancel each other out. Our finding implies that the increase in rental revenue fully compensates for the higher operating costs associated with the ownership of sustainable properties.

The second layer of possible operational effects relates to corporate-level costs. Column (4) presents the effect of sustainable investment on G&A expenses. We find that higher shares of sustainable investment are not associated with any significant changes in G&A expenses, suggesting that sustainable property portfolios require the same level of management expenses as conventional properties. Again, to our knowledge we are the first to explore this effect of sustainable investment on corporate-level (management) expenses, as distinct from property-level operating costs.

Column (5) shows that higher shares of sustainable investment are associated with lower interest expenses in our US sample, holding firm size as well as liabilities (i.e. the level of indebtedness of the firm) constant. Our finding is consistent with Eichholtz, Holtermans, Kok, and Yönder (2015) who document lower spreads on debt collateralized against sustainable properties. However, we add to this line of inquiry by quantifying the effect of sustainable investment on the overall level of corporate interest expenses in REITs, rather than the cost of individual debt issuances. In economic terms, a firm with an average share of sustainable assets of 2% has an expected conditional interest expense ratio of 0.57%, dropping to 0.47% for a REIT with a share of sustainable assets equal to the sample mean plus one standard deviation.

The net effect of property level and corporate level revenue and expenses can be summarized in corporate-level cash flow available for distribution to shareholders. For US REITs that is measured as funds from operations (FFO). As per Column (6) of Table 4, we find a statistically significant positive effect of sustainable investment for US REITs. In economic terms, while the average conditional FFO yield is 6.2%, this figure increases to 6.5% for a REIT with a green share of one standard deviation above the sample mean.

In Columns (1) and (2) of Table 5, we document insignificant findings for the UK firms in terms of rental revenue and operating expenses. Yet, we find a positive and significant effect of sustainable investment on NOI. We also find insignificant effects for sustainable investments on G&A and interest expenses. Still, the improved NOI levels seem to carry through to earnings, as we find significantly higher earnings yields for a UK firm with a higher share of sustainable investments relative to conventional property. In economic terms, we find that the expected NOI (earnings) yield improves by 15% (3.9%) for a UK firm with sustainable real estate holdings one standard deviation above the mean relative to an average firm.

We interpret the lack of significance of a number of the UK findings relative to the US findings as follows: In the UK, Energy Performance Certificates (EPCs) are required for any property being leased or sold, with fees in place for properties which fail to comply. It is already known that beginning on April 1, 2018, properties must additionally meet at least a grade E (scale: A to G; A being best) in order to be leased or sold to a private party.[6] This compulsory environmental disclosure may lay bare any significant environmental underperformance and thereby gradually improve the average level of environmental sustainability of the local building stock. This effect may in turn attenuate the nuanced differentiation from voluntary sustainability labels in the UK relative to a market without requisite reporting, such as the US.

[6] See: https://www.gov.uk/energy-performance-certificate-commercial-property/overview.

Discount rate and valuation effects

Tables 6 and 7 show the regression results for the discount rate and valuation effects in the US and the UK respectively, as a function of sustainable investment and the control variables.

Regression results for US valuation, liquidity and risk effects, all certified sustainable area

VARIABLES	(1) Liquidity	(2) Risk	(3) Valuation
(CSHO) x (Certified area)	-0.126***		
	(-2.63)		
Common shares outstanding	0.125***		
	(7.76)		
(Common shares outstanding)^2	-0.000**		
	(-2.21)		
(Assets) x (Certified area)		-2.598***	
		(-4.64)	
Total assets		1.009***	
		(3.00)	
(Assets)^2		-0.070***	
		(-4.85)	
(NAV) x (Certified area)			0.752***
			(2.82)
Net asset value			0.912***
			(15.32)
(Net asset value)^2			-0.001
			(-0.30)
Total liabilities	1.667***	0.926*	-0.016
	(4.63)	(1.71)	(-0.19)
(Liabilities)^2	-0.016	0.192***	-0.011
	(-0.62)	(4.99)	(-1.58)
Observations	956	956	956
R-squared	0.779	0.757	0.898
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Table 6: The table presents the regression results estimating the firm-year observations of the liquidity, risk, and firm value measures for US equity REITs as a function of the share of certified sustainable properties held by the firm and firm characteristic control variables. Column (1) considers the number of shares traded relative to the total number of shares outstanding (turnover) as a measure of liquidity. Column (2) considers systematic risk (CAPM beta, scaled by net book value of assets). Column (3)

considers the ratio of stock price to net asset value as a proxy for firm value. Variables are defined as in Table 2. Squared terms of control variables are scaled by $(10)^{-6}$. Firm and year fixed effects are included as indicated to control for time- and firm-invariant unobservables, respectively. Robust t-statistics, obtained via WLS, with the inverse of the total number of common shares outstanding, the net book value of assets, and the net asset value, respectively, used as weights, are shown in parentheses. Significance is indicated as follows: * p<0.1, ** p<0.05, *** p<0.01.

Regression results for UK valuation, liquidity and risk effects, all certified sustainable area

	(1)	(2)	(3)
VARIABLES	**Liquidity**	**Risk**	**Valuation**
(CSHO) x (Certified area)	0.316		
	(1.39)		
Common shares outstanding	0.331***		
	(3.78)		
(Common shares outstanding)^2	-0.000		
	(-1.09)		
(Assets) x (Certified area)		0.585	
		(0.53)	
Total assets		0.521	
		(1.42)	
(Assets)^2		-0.029	
		(-0.86)	
(NAV) x (Certified area)			1.400***
			(3.26)
Net asset value			1.497***
			(16.22)
(Net asset value)^2			-0.110***
			(-6.90)
Total liabilities	24.146	-0.096	-0.199**
	(0.90)	(-0.15)	(-2.34)
(Liabilities)^2	8.250*	0.091	0.014
	(1.88)	(0.81)	(0.73)
Observations	297	297	297
R-squared	0.954	0.848	0.975
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Table 7: The table presents the regression results estimating the firm-year observations of the liquidity, risk, and firm value measures for UK equity REITs and listed property companies as a function of the share of certified sustainable properties held by the firm and firm characteristic control variables. Column

(1) considers the number of shares traded relative to the total number of shares outstanding (turnover) as a measure of liquidity. Column (2) considers systematic risk (CAPM beta, scaled by net book value of assets). Column (3) considers the ratio of stock price to net asset value as a proxy for firm value. Variables are defined as in Table 2. Squared terms of control variables are scaled by $(10)^{-6}$. Firm and year fixed effects are included as indicated to control for time- and firm-invariant unobservables, respectively. Robust t-statistics, obtained via WLS, with the inverse of the total number of common shares outstanding, the net book value of assets, and the net asset value, respectively, used as weights, are shown in parentheses. Significance is indicated as follows: * p<0.1, ** p<0.05, *** p<0.01.

First, we explore the notion that sustainable investment improves transparency and thus reduces uninformed trading, lowering stock turnover. Column (1) of Table 6 shows that a higher share of certified sustainable properties in a US REIT's portfolio is associated with a lower turnover ratio for that firm's stock. According to our estimates, the expected conditional turnover ratio for an average REIT is 12.5%. Our results suggest that the turnover ratio drops to 11.5% for a REIT with a share of sustainable properties one standard deviation above the mean.

Column (2) of Table 6 shows that US REIT stock returns with a larger share of sustainable investments carry less systematic risk; in other words, they are less sensitive to variation in the returns on a broad stock market index (in our analysis, the S&P500). In economic terms, the risk-reducing effect of sustainable investment is also significant. An average REIT in our sample has an expected conditional beta of approximately 1. Our results suggest that a REIT with share of sustainable properties of 8% (one standard deviation above the sample mean) has an expected beta of 0.80, a reduction of 20 basis points.

We find that a higher share of sustainable investment is associated with a significant improvement in the price to NAV ratio for US REITs (Column 3). Our results suggest that a REIT with an average share of sustainable properties has an expected conditional P/NAV ratio of 0.912. If the share of sustainable investments increases by one standard deviation, we expect the P/NAV ratio to increase to 0.972, an improvement of 60 basis points. Our findings suggest that a higher share of sustainable investment is accretive to firm value above and beyond any improvement in the market value of the underlying assets of the firm. This result implies that, in addition to tangible improvements in cash flows from sustainable properties, and in addition to lower required rates of return, firm market value benefits from a larger share of sustainable investments. We interpret this finding as a reputation effect.

We find no statistically significant effect of sustainable investment in terms of liquidity for UK firms. We interpret the difference from the US findings as a result of no requisite environmental performance reporting in the US. Therefore, environmental certification programs such as LEED and Energy Star are the only source of information on the environmental performance of property available to US investors. When more information about the environmental performance of a firm's portfolio becomes available in the form of sustainability certifications, information asymmetries are reduced and the proportion of uninformed traders in the market declines, reducing stock turnover, consistent with Baker and Stein (2004).

In the UK on the other hand, environmental certifications are not the only source of information about the environmental performance of investment property, as environmental performance certificates are mandatory for any property being leased or sold. As a result, environmental certifications may not only inform investors about the environmental performance of the firm's portfolio, but also may include a benchmarking mechanism against other firms with no certified properties. Our findings are consistent with the notion that in the UK, certifications not only inform about environmental performance but are also a signal of high-quality environmental performance of the firm's portfolio, potentially increasing liquidity. In the UK, the information asymmetry effect and quality signaling effect appear to cancel each other out.

We find no effect of sustainable investment on systematic risk for UK firms either. However, the UK results are based on a considerably smaller sample. Consistent with the US results, we find a positive effect on the P/NAV ratios of the UK sample firms that is associated with a larger share of sustainable investments. In economic terms, our findings suggest an improvement in firm value relative to NAV of almost 4%.

Robustness tests

In the regressions exploring cash flow effects, we replace the book value of assets with the firm's gross asset value as a current market-based metric of the firm's asset value instead of historical cost which reflects stale information. Our findings are robust to using gross asset value: all statistically significant variables of interest retain their significance and sign for both the US and the UK samples.

SNL also provides net book value figures for assets held over time by US firms, but not for UK firms. For robustness, we estimate the US results with the *GreenShare* based on net book value instead of area. Our findings are robust to using net book value instead of square footage for calculating the *GreenShare*.

Lastly, we control for the quality of property portfolio of a REIT or a listed property company. The *GreenShare* may capture the impact of portfolio quality as green properties are of higher quality. We create two measures of portfolio quality, the weighted average age of the properties and a weighted count of those properties in the firms' portfolios that have been renovated. Our findings are robust to including these proxies for portfolio quality. The results of all of our robustness tests are available upon request.

Implications for investment

The impact of environmental certification on buildings is well researched, particularly on property-level rental and occupancy rate premiums, and associated value premiums. Due to data limitations, less research is completed on operating expenses, and that which is complete has yet to converge on a consensus. This creates a "black box" issue, where we can observe and analyze the effective income input and the value output, but know little about the other two factors involved in value (expenses and risk). Partially due to this black box issue, early research hypothesized that the increased asset value was a result of the increased effective income. Researchers concluded that energy-efficient buildings should use less energy, thereby decreasing operating costs, further increasing the NOI, and that there was no reason that environmentally-certified properties should experience higher capitalization rates (in some cases, noting that they may even be associated with lower capitalization rates). The impact of high-tech buildings on power usage was not anticipated.

Researchers are now beginning to gain insight into that black box. Devine and Kok (2015) identify that the variance in operating costs for environmentally-certified properties is lower, and Fuerst (2015) finds lower risk and volatility for green REITs. These findings of decreased risk substantiate an expectation of lower capitalization rates (and lower discount rates for REITs), however they make no steps toward evidence of decreased operating expenses. Our research provides some of the first evidence that not only may there be increased operating expenses, but that those increased expenses could counterbalance the increased effective rent, resulting in a constant NOI. Taken alone, this is a notable result. But when paired with the evidence of increased value, our research indicates that the value premium associated with environmentally-certified property investment may partly be driven by decreased risk. These findings are supported by our corporate-level results, indicating that sustainable portfolios may experience lower interest and overhead expenses. Such results are intuitive for lower-risk properties. Lower corporate level expenses are then combined with the non-elevated NOIs and firms experiencing lower market betas due to improved resilience to variation in market conditions, especially energy markets.

That the benefit from sustainable real estate investment may be rooted in decreased risk is good news, as that benefit may perpetuate more reliably than rental premiums. Industry research by CBRE[7] suggests that the adoption of green office buildings in the 30 largest US cities is beginning to level off. Holtermans and Kok (2016) finds that there is no premium in rental growth associated with environmentally-certified properties. As green buildings become the norm, the associated rent premiums may begin to dissipate. However, it is less obvious that sustainable buildings should become riskier. Therefore, since the financial benefits of environmentally-certified properties appear partly rooted in risk, these benefits may persist.

Our comparison between the UK and the US suggests a number of implications for investors. We choose to compare these two countries because they are home to leading global certification programs. In addition, they also take different approaches to sustainability. In the UK, a baseline environmental performance report (EPC) is mandatory for all properties being leased or sold. The US has no such requisite reporting. We find that the US results for the effects of investment in sustainability certified

[7] See http://www.cbre.com/about/corporate-responsibility/environmental-sustainability/real-green-research-challenge

properties are overall more nuanced. In terms of cash flow effects, our results suggest that mandatory environmental disclosure may reveal significant environmental underperformance and gradually improve the average level of environmental sustainability of local investment property. This effect may in turn attenuate the strength of differentiation from voluntary sustainability labels in the UK.

In terms of transparency effects, our results suggest that certifications in the US, where that is the only information available to investors about environmental performance, primarily reduce the amount of uninformed trading in the market. In the UK on the other hand, the availability of baseline environmental performance reports seems to add to the presence of an environmental certification on a property a signal of particularly high environmental quality, potentially increasing liquidity, and on balance cancelling out the effect on uninformed trading.

Conclusion

We provide the first systematic, international decomposition of possible financial benefits of sustainable real estate investment on corporate performance metrics across the two leading country-markets in terms of sustainable property certifications. This study provides novel insight inside the black box of sustainable property investments by REITs and listed property companies, and how possible associated costs and benefits accrue to different financial outcome measures.

Specifically, we explore distinct operating (cash flow) and valuation (discount rate) effects. We evaluate the operational impact on property level effective rents, operating expenses, and net operating income, as well as on firm level overhead costs, interest expense, and cash flows available for distribution. On the valuation side, we examine the price to NAV ratio, reflecting a unique measure of how investors value corporations in the stock market relative to their asset value, and explore additional components of valuation: the discount rate, based on systematic risk, and liquidity. To our knowledge, this is the most complete picture of the relationship between green property investments and operating as well as investment performance documented from the corporate perspective.

We find a number of significant results that differ systematically between the two country-markets we study. In the UK, where a baseline level of environmental reporting is mandatory in the form of environmental performance certificates, listed property companies benefit somewhat from investments in sustainability-certified properties through higher cash flow and valuation outcomes. In the US, which features no such requisite reporting and environmental certifications provide the only source of property environmental performance information available to investors, the benefits of sustainable investment are stronger and comprise distinct cash flow, risk, and corporate valuation effects. In summary, the international comparison in our study also suggests some benefits of improved transparency from environmental performance reporting.

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