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The Financial Rewards of Sustainability:

A Global Performance Study of Real Estate Investment Trusts

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Abstract

This study shows for the first time, that investing comprehensively in sustainability as measured by the GRESB rating) pays off for REITs by enhancing operational performance and lowering risk exposure and volatility. Analyzing a sample of REITs from North America, Asia and Europe for the 2011-14 time period, it also appears that there is untapped potential, particularly in the REIT community, to improve the sustainability performance of corporate real-estate portfolios.

Introduction

Despite a plethora of worldwide initiatives and regulations to curb greenhouse gas emissions, the predictions regarding future emission and global warming pathways are becoming increasingly dire. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2014) predicts in its baseline scenario a doubling or even tripling of global energy use and a 50-150% increase of total greenhouse gas emissions over the next decades, mainly brought on by economic and demographic growth. Similarly, Friedlingstein et al (2014) report that, instead of stagnating or declining, global emissions of CO_2 from fossil fuel combustion and cement production have continued to grow by 2.5% per year on average over the past decade, thereby rapidly approaching the total volume of allowable CO_2 emissions that is necessary to contain global warming to a 2 °C temperature rise. In light of these predictions, it becomes increasingly clear that our current efforts of greening the economy, particularly relating to buildings which account for around 32 percent of final energy use and for 33 percent of CO2 emissions (IPCC 2014) are insufficient. A continuation on the current path will necessitate ever more drastic emission reductions in the future.

The search for effective strategies to reduce building-related emissions took its natural starting point at the building level with a range of voluntary and compulsory measures such

as green building labelling (BREEAM, Energy Star, Green Star, LEED, to name just a few) and mandatory Energy Performance Certificates or building energy consumption reporting. In addition to these individual building-level measures, there is an increasing awareness that crucial decisions about the ownership and operation of buildings are frequently made at a higher level, for example in the context of managing a real estate investment portfolio. The corollary of this realization is that an effective strategy of reducing emissions in the building sector needs to simultaneously target the individual building as well as the portfolio, investment fund or company level.

It is in this context that GRESB, the Global Real Estate Sustainability Benchmark, was launched in 2009 by several large pension funds in an effort to achieve a more comprehensive understanding of their total exposure to environmental, social, governance and energy risks. GRESB provides a quantified and multi-dimensional sustainability benchmark which has become standard practice for the world's largest real estate investment and asset management companies. In 2014, GRESB benchmarked companies with assets worth USD 8.9 trillion. Each fund and property company receives a detailed sustainability rating based on a series of metrics and a placement in one of four possible performance quadrants whereby 'Green Star' represents the quadrant with the highest achievers (see Figure 3). Further details on the structure and processes of the GRESB rating system can be found in Appendix 1.

The present study investigates whether the sustainability benchmark rating provided by GRESB is significantly associated with higher financial performance using a large sample of Global REITs. There are a number of reasons to expect such a link *a priori*. Firstly, the value of the additional transparency provided by the GRESB assessment may increase the attractiveness of a listed real estate company which in turn should result in higher demand for its stock. Secondly, a lower environmental impact has been shown in previous studies to positively affect cash flows at the property level which should also affect the aggregate operational financial performance as measured by returns on assets (ROA), returns on equity (ROE) as well as the stock market performance of listed property companies. Higher cash flows are transmitted through a number of channels, ranging from rental premiums (Fuerst and McAllister, 2011a, Eichholtz, Kok and Quigley, 2012), to higher occupancy rates (Fuerst and McAllister, 2011) and lower cost of capital (Cajias, Fuerst and Bienert 2013) for real estate companies with 'greener' assets and management processes. Finally, both the increased level of transparency and the lower exposure to environmental, energy and regulatory risk should alter the risk-return profiles of participating companies. All else equal, we expect that companies with higher GRESB ratings achieve higher returns per unit of risk.

To test for these effects, we employ a unique database that combines detailed information on the GRESB sustainability ratings with REIT characteristics and performance metrics from a variety of sources into a global panel dataset covering the 2009-14 time period.

Current state of research

The link between the environmental and financial performance of a company is a well-researched area. For example, Derwall et al (2005) constructed equity portfolios based on an eco efficiency criterion, i.e. a value-added to waste ratio and find that the higher portfolio significantly outperformed the lower portfolio in the 1995-2003 period. In a follow-up, Guenster et al (2011) confirmed that eco-efficiency is strongly linked to operating performance and market value of a company.

In the real estate literature, an increasing number of studies investigates the economic value of sustainability primarily at the individual asset level, typically using eco-labels as a proxy for sustainability. One of the few studies conducted at the portfolio level are Eichholtz, Kok and Yonder (2012) and Sah, Miller and Ghosh (2013). Both studies use exposure of a real estate portfolio to LEED and Energy Star labels as a predictor for financial performance. Eco-labels are a useful proxy for the 'greenness' in these studies in the absence of other information. However, studies relying exclusively on eco-labels may miss the impact of a whole array of other sustainability measures and programs which companies may have developed or have committed themselves to on larger industry-wide platforms. If these alternative channels of sustainability commitments are substitutes for eco-labels or even non-perfectly correlated complements of eco-labels, then an exclusive focus on these labels may yield inaccurate or biased results in the econometric analysis. The GRESB ratings employed in the present study are a multi-dimensional measure of sustainability performance and are thus more likely to represent more fully a company's overall commitment to sustainability matters than simple aggregated asset-level metrics.

Research Design

The empirical study of the link between sustainability action and financial performance in the global REIT universe requires reliable, widely available and globally standardised performance metrics. Very few global REIT and real estate portfolio studies are published to date (e.g. Paul et al, 1991; Bond et al 2003, Serrano and Hoesli, 2009), perhaps due to data availability and compatibility constraints. While sustainability performance is measured by

GRESB, financial performance is considered in two different ways in the present study: firstly as operational performance which includes ROA and ROE and secondly as stock market performance represented by the annualised stock market return as well as alphas and betas. We then model each of these financial performance metrics ROA, ROE, stock returns, alphas and betas as a function of a number of REITs characteristics that are selected as control variables for the models and add the GRESB score as the sustainability metric of choice. The inclusion of REIT characteristics largely follows established specifications in related studies such as Eichholtz, Kok and Yonder (2012) and Sah, Miller and Ghosh (2013). Specifically, we set out to test the following three hypotheses.

1) if higher GRESB scores positively affect the operational (ROA and ROE) of REITs;
2) if higher GRESB scores positively affect the stock performance (total returns, alphas and betas) of REITs;
3) if GRESB sub-scores that are based on tangible outcomes such as 'Measurement & Performance' are more predictive of financial performance, both operational and stock market, than more intangible aspects as, for example, captured in the Management & Policy' subscore.

Estimation strategy

To test these hypotheses, we use a set of variations on the following basic model specification:

$$\mathrm{ROA_{it}}\,, \mathrm{ROE_{it}}, \mathrm{R_{it}} = \alpha + \beta_1\ \mathrm{GRESB_{it}} + \beta_2 \mathrm{REIT\ characteristics_{it}} + \beta_3 \mathrm{Market\ characteristics} + \varepsilon \ldots (1)$$

For the first two hypotheses tests, the $GRESB_{it}$ variable represents the overall score which each participating REIT obtains based on the scores it obtains in each of eight aspects that are covered by the annual GRESB survey. Details on these aspects are provided in Table 1. For the third hypothesis test, we substitute the $GRESB_{it}$ variable with two separate dimension scores Measurement & Performance and Management & Policy which make up the overall score with a weighting of 70% and 30% respectively. The vector of *REIT characteristics* includes age in years since IPO, market capitalisation, property type specialisation (if any), price to book ratio, debt to asset ratio and annual asset growth rate. *Market characteristics* include, among others, the value of the benchmark REIT index for the main country in which a REIT is invested and/or that country's risk free investment rate and

quarterly time fixed effects to account for any time-varying effects that are not captured by the benchmark market indices.

In addition to the financial return measures mentioned above, we test for two further common metrics of the finance literature: Sharpe ratios and alphas/betas. Sharpe ratios provide a basic adjustment for risk and are calculated by dividing the excess quarterly stock return of a REIT over its country's risk-free rate by the standard deviation of its daily stock prices. Sharpe ratios are also calculated for ROAs and ROEs. To retain a more realistic gauge for the underlying volatility of a REIT's prices, we use the volatility of daily stock prices as the denominator, rather than the volatility of the quarterly operational performance measures which may systematically underestimate the 'true' volatility of a REIT. Alphas and betas are then estimated using the standard three-factor Fama-French framework (1987):

$$(\mathrm{R}_i - \mathrm{R}_f) = \alpha + \beta_1(\mathrm{R}_m - \mathrm{R}_f) + \beta_2 \mathrm{SMB} + \beta_3 \mathrm{HML} \ldots (3)$$

Following Serrano and Hoesli's (2009) suggestion for analysing global real estate portfolio performance and investment strategies, we use the FTSE EPRA/NAREIT Global Real Estate Index as the market index R_m of choice for our set of global REITs. The two other factors, SMB (market cap) and HML (book-to-market) factors are calculated using general stock level data as, for example, supported by Peterson and Hsieh (1997) and Zietz, Sirmans and Friday (2003). Having obtained the Sharpe ratios and market alpha and beta values for each REIT and quarter, we then regress these relative measures on the GRESB ratings plus a vector of control variables as before to determine whether GRESB ratings have a measurable impact:

$$\mathrm{Sharpe}_{it}, \mathrm{Alphas}_{it}, \mathrm{Betas}_{it} = \alpha + \beta_1 \mathrm{GRESB}_{it} + \beta_2 \mathrm{REIT\ characteristics}_{it} + \beta_3 \mathrm{Market\ char.} + \varepsilon \ (3)$$

Again, we reject the null hypothesis of no differential performance if the coefficient of the GRESB score is significant at the conventional levels.

Functional form and correction for selection bias

The functional form used in our regression estimates is generally a log-log model due to its desirable properties as described in the literature with time and REIT property-type fixed effects. Random effects estimation was also conducted to establish whether this would yield better results but the Hausman diagnostics obtained from these estimations pointed to a fixed-effects estimation. An obvious concern is selection bias in our sample of GRESB

participants. It is possible that the REITs in the GRESB universe are not a random selection of REITs but choose to voluntarily respond to the GRESB survey, possibly because they have the resources and capacity to do so. This may introduce bias into the estimates as the unobserved criteria for respondents may lead to overestimating the impact of the GRESB rating on financial performance. For example, if only large REITs participate in GRESB and large REITs also achieved better returns, we may wrongly attribute outperformance to GRESB participation, even if controlling for REIT size in the reduced form estimation (Achen 1986 and Imbens 2004 provide a more comprehensive discussion of selectivity and omitted-variable biases and possible remedies). Hence, we supplement the single equation estimation with a two-step Heckman correction which takes the following form (see Heckman, 1979):

Stage 1: GRESB = $\alpha + \beta_1 X_1 + u$

Stage 2: ROA$_{it}$ [..]=$\alpha + \beta_1 \mathrm{GRESB}_{\mathrm{it}} + \beta_2 \mathrm{X}_2 + \beta_3 \mathrm{X}_3 + \beta_3 \dot{\bar{\lambda}} + \varepsilon$

with

$$GRESB = \begin{cases} 1 = GRESB\ respondent \\ 0 = non - respondent \end{cases}$$

In this estimation procedure, X_1 represents a vector of characteristics that may determine whether a REIT participates in GRESB. Some of these factors may also be relevant as drivers of financial performance and are therefore included in both stages. All other factors in the specification are assumed to be strictly exogenous. X_2 and X_3 represent REIT and market characteristics respectively as before and $\dot{\bar{\lambda}}$ is the inverse Mills ratio produced in the first-stage estimation which is included as an instrument to correct for selection bias in the second stage estimating the coefficient of the variable of interest (the GRESB score).

Data

The core dataset necessary to perform this analysis was provided by GRESB containing 442 detailed sustainability ratings for REITs in the 2011-14 time period. The survey conducted annually by GRESB collects company-specific sustainability data on seven core aspects (plus a separate aspect on new construction and major renovations) and aggregates these aspects to generate the overall GRESB score for each company which is expressed as a 0 to 100 percentage of the maximum possible The scoring takes into account the asset allocation of each REIT and company, in particular the predominant property type and the

typical profile of the REIT invested in this particular property type, both for scoring and benchmarking purposes.

An important consideration for the validity of our empirical analysis is whether the GRESB benchmarking system captures a sufficiently large fraction of the overall market to be considered representative of the broader REIT universe. GRESB (2014) reports that 637 listed property companies and private equity real estate companies submitted their data to GRESB, covering 56,000 buildings with an aggregate value of USD 2.1 trillion. For comparison, the FTSE EPRA/NAREIT Global Index has a combined market capitalisation of approximately USD 2 trillion. To relate these figures to the size of the total global investable real estate universe, Chen and Mills (2009) report that the core investable universe (including all direct and indirect investments worldwide) was US$8.0 trillion in 2006 based on an estimate by UBS Global Asset Management Real Estate Research. A more recent estimate by PWC (2014) estimates the global stock of institutional-grade real estate at US$29.0 trillion as of 2012. While many of these figures are based on estimates, they demonstrate that the GRESB rating system capture a sizable proportion of the commercial real estate and particularly the REIT universe.

Table 2 contains summary statistics on the GRESB and financial performance variables used in this study. An overview of definitions and sources is provided in Appendix 2.

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min	Max
GRESB variables				
Management	67.35	23.44	0.00	100.00
PolicyDisclosure	51.13	26.99	0.00	100.00
RisksOpportunities	64.40	21.92	0.00	100.00
Monitoring~S	50.77	27.14	0.00	100.00
Performanc~s	33.76	23.61	0.00	93.08
BuildingCe~r	31.12	26.06	0.00	100.00
Stakeholder~t	48.17	18.78	1.60	94.21
NewConstruction	30.13	26.97	0.00	91.67
GRESB score	46.40	18.97	1.66	89.10
ManagementPolicy	58.61	20.82	0.00	97.40
Financial variables				
ROA	2.67	7.59	-39.28	81.62
ROE	5.28	9.22	-37.11	83.16
Age	11.32	10.26	0.00	54.00
REITstatus (binary)	0.90	0.31	0.00	1.00

Volatility	1,094	5,263	0	120,183
Risk free rate	3.05	1.83	0.53	37.47
Price-Book	158.12	101.91	1.12	743.60
Number of Properties	267	939	100	27,173
Asset Growth	13.16	42.77	-95.12	929.75
Debt Book Capitalisation	50.67	19.07	0.00	315.22
Total Return	0.05	0.17	-0.49	0.52
Country Index Return	0.04	0.12	-0.41	0.55

Preliminary analysis

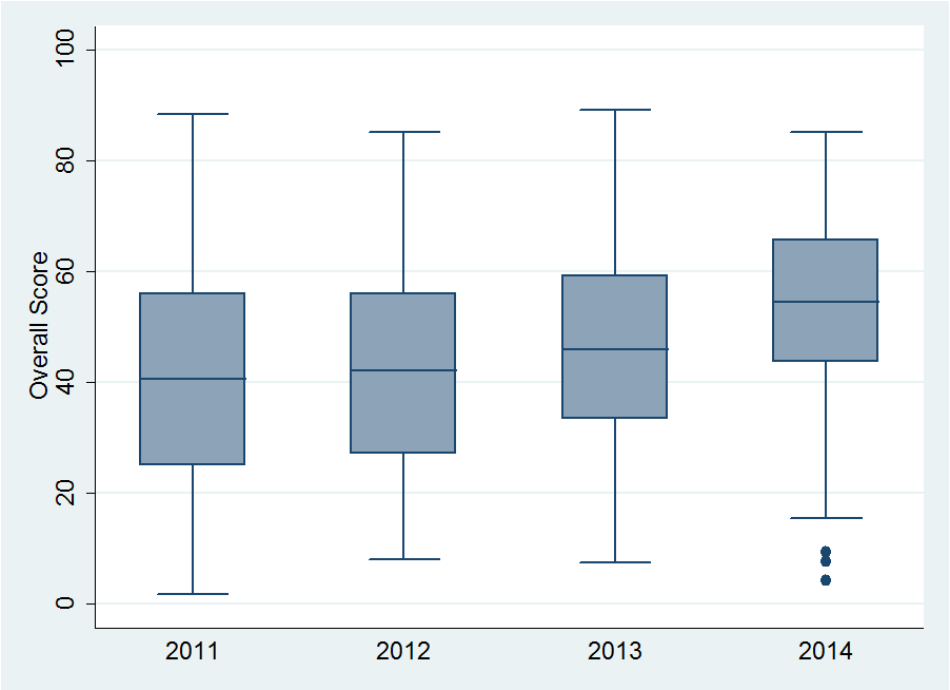
The exploratory analysis shown in Table 2 compares the average financial performance of GRESB participants to non-participants. While the former exhibit somewhat higher returns for some metrics in more recent years, there is no immediate indication of systematic differences in financial performance between the GRESB sample and the control sample.

Table 2: Average financial performance of GRESB versus non-GRESB participants (% annual return)

	2011	2012	2013	2014 (YTD)
Non-GRESB ROA	3.193	3.599	3.696	3.335
GRESB ROA	3.618	2.683	3.055	3.711
Non-GRESB ROE	5.994	7.577	6.607	7.465
GRESB ROE	7.949	6.267	7.011	8.515
non-GRESB RI	-0.55%	7.48%	2.77%	4.13%
GRESB RI	-2.44%	6.16%	4.21%	4.08%

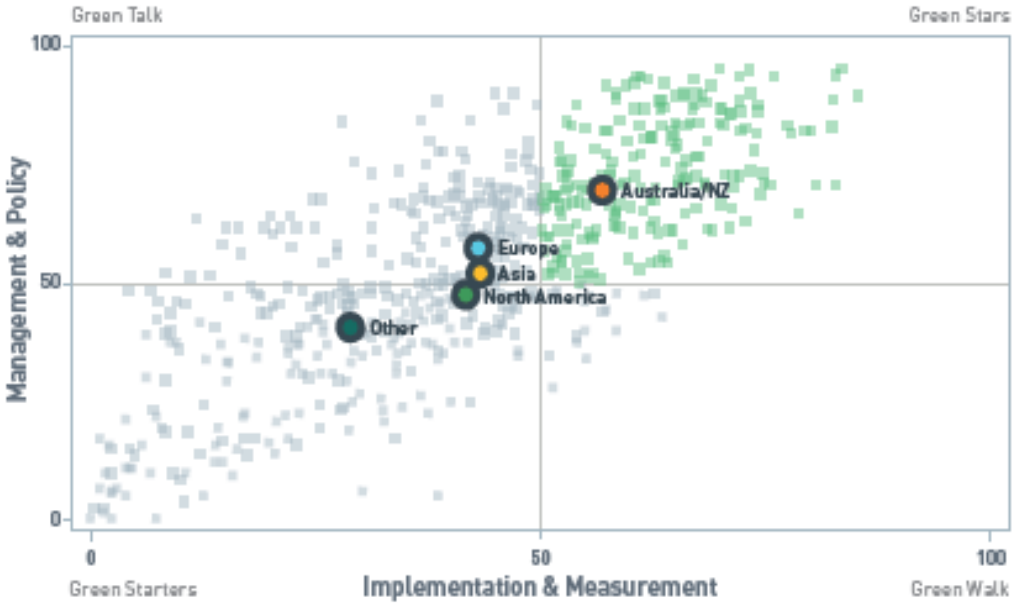
We next examine the distribution of the GRESB rating scores. The boxplots in Figure 2 demonstrate that the average sustainability performance of rated real estate companies has improved since GRESB's inception in 2011 and the spread of performance ratings has narrowed. Although the number of GRESB participants has grown considerably and the number of monitored sustainability criteria has increased, variation in scores has markedly decreased, possibly due to a standardisation of processes and adoption of best practices across real estate investment companies.

Figure 2: Boxplot of distribution of overall score



However, differences in the averages and variability of scores exist not only over time but also across regions and continents. Figure 3 shows the average score of all GRESB participants of a given world region broken down into the two dimensions Management & Policy and Implementation & Measurement. The averages of European, Asian and North American GRESB participants are remarkably similar given the differences in institutional and economic frameworks between these world regions. Australia and New Zealand exhibit considerably higher scores in both dimensions of the overall GRESB score, possibly due to some of the most stringent regulatory requirements in these countries to disclose and benchmark the sustainability performance of commercial properties such as the Commercial Building Disclosure Programme (CBD) in Australia.

Figure 3: Average GRESB scores by dimension and continent



Source: GRESB

Results

The first test of a possible link between financial and sustainability performance involves the two most widespread metrics of operational performance of a REIT and its overall sustainability. Table 3 reports the regression estimates using the overall GRESB score along with a vector of control variables to test if they are predictive of financial performance as measured by ROA, ROE and stock market returns. For ROA and ROE, the pooled OLS and Heckman estimation with time and property-type fixed effects confirm a positive significant effect of the overall GRESB score. ROA is shown to increase by roughly 1.26% (fixed effects) or 1.33% (Heckman) for each 1% percent increase in the GRESB score. It is important to bear in mind that the dependent variables are the logarithms of percentage values so the coefficients of the log-log model are roughly equivalent to percentage changes, not percentage points. Similarly, the GRESB score is scaled from 0-100 but the coefficient expresses the effect of a percentage change on the average baseline score of a REIT. For example, assuming an average annual 5% ROA and a GRESB rating of 50 at baseline, a GRESB score of 55 (10% above baseline) is associated with an ROA that is 67

basis points higher, while a GRESB score of 60 (20% higher) yields an ROA that is 133 basis points higher. For ROE, the effect is more pronounced with an increase of 3.29% (3.49% in the Heckman estimation) for each 1% increase in the GRESB score. It should be noted that these effects are based on estimates from both the within (same REIT over time) and between (across different REITs) effects of the panel data. Hence, the financial effects of an individual REIT's efforts to improve their score may well deviate from these general estimates. Turning to stock market performance, no clear association is detectable. The fixed effects estimation shows an insignificant relationship between a REIT's GRESB score and stock performance. After applying the Heckman correction, there is a marginally significant impact but the lambda value indicates that these results are to be treated with caution.

One possible explanation of the difference between operational performance (ROA and ROE) and stock market performance is that REIT investors are not fully informed about a REIT's sustainability activities as this information is often unavailable, unstructured, intangible and opaque, thus investors are unable to factor this information into investment expectations. A contrarian argument posits that management performance of a REIT as described by its sustainability activities is generally known to investors but behaves in a relatively stable and predictable manner and is hence already priced into stock prices, hence no outperformance will be observed. Further research is required to explore the empirical foundations of these opposing arguments in more depth.

Table 3: Regression estimates for overall GRESB score and financial performance

Dependent variable	(1) log ROA	(2) log ROA	(3) log ROE	(4) log ROE	(5) log stock return	(6) log stock return
Estimation method	Fixed effects	Heckman	Fixed effects	Heckman	Fixed effects	Heckman
ln_GRESB score	0.0126** (2.30)	0.0133** (2.74)	0.0329** (2.71)	0.0345** (3.15)	0.000153 (1.51)	0.000161* (1.75)
ln_age_sq	-0.00384 (-1.40)	-0.00329 (-1.61)	-0.00922 (-1.56)	-0.00792* (-1.71)	-0.0000686 (-1.54)	-0.0000814** (-2.07)
ln_marketvalue	0.00506** (2.31)	0.00776** (3.68)	0.0155** (3.04)	0.0220** (4.60)	-0.0000424 (-0.82)	-0.000111 (-1.53)
ln_debtbookcap	-0.00420 (-0.38)	-0.0134 (-1.22)	0.0577** (2.49)	0.0359 (1.44)	0.0000960 (0.39)	0.000104 (0.49)
ln_asset growth	0.0315 (1.55)	0.0275** (3.13)	0.0813* (1.73)	0.0718** (3.62)		
ln_risk free	1.462* (1.91)	1.365* (1.86)	3.101* (1.80)	2.871* (1.73)	0.0155 (1.65)	0.0178 (1.27)
ln_Benchmark index					1.018** (10.21)	1.043** (9.02)
ln_PriceBook					0.000301**	0.000441**

					(2.17)	(2.96)
_cons	-2.329	-1.885	-10.48	-9.434	-0.158	-0.284
	(-0.66)	(-0.56)	(-1.31)	(-1.23)	(-0.34)	(-0.52)
property-type fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Mills lambda		0.0136**		0.0324**		-0.000157
		(3.07)		(3.22)		(-1.24)
adj. R^2	0.176		0.232		0.571	
AIC	-1588.3	.	-931.2	.	-4670.7	.
BIC	-1468.4	.	-811.3	.	-4547.5	.
N	402	1899	402	1886	393	1833

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$
Robust standard errors used in all estimations, first-stage results of Heckman estimations are available upon request

While the model specification used in Table 3 takes into account a number of indirect risk characteristics such as the risk-free rate and the stock market index of the respective country in which the REIT is domiciled, the financial performance variables (dependent variables) were not directly risk-adjusted. Table 4 shows estimates using the Sharpe ratios of the set of dependent variables to adjust more directly for volatility.

Model estimates 1-6 are supportive of a positive and strongly significant link between financial and sustainability performance. Additionally, when adjusting for risk, a significant and positive effect on stock market returns and GRESB scores is now found. This means that REITs with higher GRESB ratings do indeed appear to deliver higher returns per unit of risk (or more accurately, per standard deviation) whereas no conclusive results were found for unadjusted stock returns in the previous table.

To investigate the stock market performance further, we now turn to the estimation of alphas (outperformance) and betas (sensitivity to systematic risk) as obtained by the standard 3-factor Fama-French estimation. Including a number of controls such as the age of a REIT as well as country-specific information and time and property-type fixed effects, we find that REITs with higher GRESB ratings consistently generate higher alphas (outperformance) but this relationship fails to meet the required significance levels once the Heckman correction is applied. Conversely, there is no indication that higher GRESB scores result in higher betas, and hence in higher risk, but the results are marginally significant in the Heckman estimation. However, the lambda diagnostic indicates that the first stage regression does not perform strongly and hence the unadjusted estimation appears more relevant in this case. Overall, the prediction of alphas and betas derived from daily stock market prices is more difficult than the lower-frequency estimations as evidenced by the markedly lower R^2.

Table 4: Regression estimates for overall GRESB score and risk-adjusted returns (Sharpe ratios) and alphas/betas

DV	(1) Log Sharpe ROA	(2) Log Sharpe ROA	(3) Log Sharpe ROE	(4) Log Sharpe ROE	(5) Log Sharpe stock return	(6) Log Sharpe stock return	(7) Log alphas	(8) Log alphas	(9) Log betas	(10) Log betas
Estimation method	Fixed effects	Heckman	Fixed effects	Heckma	Fixed effects	Heckman	Fixed effects	Heckman	Fixed effects	Heckman
ln_GRESB score	0.0146**	0.0153**	0.00657**	0.00679**	0.0693**	0.0703**	0.000291**	0.000203	0.000229	0.000752*
	(2.02)	(2.03)	(2.12)	(2.01)	(3.38)	(2.98)	(2.19)	(0.99)	(0.94)	(1.94)
ln_age_sq	-0.00698*	-0.00639**	-0.00254*	-0.00235*	-0.0259*	-0.0273**	0.0000790	0.0000341	0.0000803	-0.000142
	(-1.80)	(-2.01)	(-1.73)	(-1.65)	(-1.93)	(-2.69)	(1.41)	(0.34)	(0.69)	(-0.75)
ln_market value	0.00765**	0.0105**	0.00481**	0.00573**	-0.00398	-0.0119				
	(2.35)	(3.23)	(3.30)	(3.94)	(-0.33)	(-0.64)				
ln_debtbookcap	-0.00684	-0.0166	0.0193**	0.0162**	-0.0250	-0.0244				
	(-0.39)	(-0.97)	(2.58)	(2.10)	(-0.44)	(-0.44)				
ln_asset growth	0.0447*	0.0404**	0.0225*	0.0211**						
	(1.79)	(2.93)	(1.73)	(3.40)						
ln_risk free	1.023	0.920	0.816	0.783	8.439*	8.704**	-0.0283**	-0.0632**	-0.00336	0.0170
	(0.81)	(0.81)	(1.54)	(1.54)	(1.83)	(2.44)	(-3.51)	(-4.47)	(-0.20)	(0.63)
ln_Benchmark index					-26.35	-23.46	0.476**	0.596**	0.335**	0.900**
					(-1.05)	(-0.79)	(6.24)	(4.87)	(2.93)	(3.95)
ln_PriceBook					0.128**	0.144**				
					(5.50)	(3.80)				
ln_betas							-0.0241	-0.0271		
							(-0.91)	(-1.00)		
_cons	3.494	3.964	6.204**	6.353**	89.88	75.25	2.654**	2.276**	3.076**	0.382
	(0.60)	(0.75)	(2.54)	(2.69)	(0.77)	(0.54)	(7.03)	(4.11)	(5.49)	(0.36)
property-type fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Mills lambda		0.0146**		0.00467		-0.0180		-0.000123		0.000371
		(2.11)		(1.52)		(-0.55)		(-0.67)		(1.07)
adj. R^2	0.199		0.247		0.201		0.083		0.003	
AIC	-1229.0	.	-1875.9	.	-313.7	.	-7243.7	.	-6349.0	.
BIC	-1109.1	.	-1756.1	.	-194.6	.	-7170.4	.	-6280.3	.
N	402	1899	402	1886	392	1832	722	1634	722	1634

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$
Robust standard errors used in all estimations, first-stage results of Heckman estimations are available upon request

As described in the previous section, the overall GRESB score comprises seven core aspects. Each participant also obtains a more aggregate rating on the two GRESB

dimensions 'Implementation & Measurement' and 'Management & Policy'. Table 5 reports the results of the model estimates separately for these two dimensions. While the results follow largely the same pattern described for the overall GRESB score estimation in Table 3, it becomes evident that the actual implementation and monitoring of sustainability measures is a vastly more significant and more powerful driver of financial performance than the management and policy metric. This seems to indicate that the outperformance of REITs with higher overall GRESB scores may be driven by the more tangible measures captured in the Implementation & Measurement score. The importance of this dimension is also reflected in its 70% weighting in the overall GRESB score while the Management & Policy score only obtains a 30% weight.

Table 5: Individual impact estimates of the dimensions 'Implementation & Measurement' and 'Management & Policy'

	(1) ln_ROA	(2) ln_ROA	(3) ln_ROE	(4) ln_ROE	(5) ln_stockreturn	(6) ln_stockreturn
Estimation method	Fixed effects	Heckman	Fixed effects	Heckma	Fixed effects	Heckman
ln_ImplementationMeasurement	0.0139**	0.0115**	0.0325**	0.0266**	0.0000497	0.0000589
ln_ManagementPolicy	-0.00440	-0.0000416	-0.00546	0.00511	0.0000971	0.0000913
Full model	Yes	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.180		0.236		0.570	
N	402	1899	402	1886	393	1833
	(7) ln_RI_Sharpe	(8) ln_RI_Sharpe	(9) ln_alphas	(10) ln_alphas	(11) ln_betas	(12) ln_betas
Estimation method	Fixed effects	Heckman	Fixed effects	Heckma	Fixed effects	Heckman
ln_ImplementationMeasurement	0.0528*	0.0538**	0.0000434	0.000383*	0.000534*	0.000892**
ln_ManagementPolicy	0.00882	0.00818	0.000255	-0.000505	-0.000538	-0.000639
Full model	Yes	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.200		0.081		0.006	
N	392	1832	722	1634	722	1634

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$
Robust standard errors used in all estimations, first-stage results of Heckman estimations are available upon request
Full model specification as in Table 3, all coefficient estimates are available upon request

In the next step, we repeat the above estimation using the full model specification for the seven individual aspects that are scored in the GRESB survey. As can be seen from Table

6, very few of these sub-scores appear sufficiently powerful to result in significantly higher operational or stock market returns. A negative association is found for Monitoring & EMS and a strongly positive relationship is found for Performance metrics particularly for ROAs and ROEs, possibly underlining the importance of tangible sustainability metrics in achieving higher operational performance. It is important to note, however, that the scores of these aspects are correlated to the extent that 'high achiever' REITs obtain excellent scores in nearly all of these categories and vice versa. This problem could be circumvented in future research by extracting the unique and orthogonal dimensions underlying the various aspects and the individual survey questions on which they are based.

Table 6: Individual impact estimates of the seven aspects incorporated in the overall GRESB scores

	(1) ln_ROA	(2) ln_ROA	(3) ln_ROE	(4) ln_ROE	(5) ln_stockreturn	(6) ln_stockreturn
Estimation method	Fixed effects	Heckman	Fixed effects	Heckma	Fixed effects	Heckman
Management	0.0000496	0.0000265	0.000139	0.0000783	-0.00000152	-0.00000251
	(0.36)	(0.19)	(0.45)	(0.24)	(-0.42)	(-0.89)
PolicyDisclosure	0.0000299	0.000218	0.0000404	0.000516	0.00000235	0.00000301
	(0.30)	(1.61)	(0.17)	(1.66)	(0.80)	(1.05)
RisksOpportunities	0.0000875	0.000119	0.000146	0.000227	0.00000303	0.00000271
	(0.75)	(0.94)	(0.55)	(0.78)	(1.14)	(1.08)
MonitoringEMS	-0.000469**	-0.000458**	-0.000862**	-0.000834**	0.000000871	0.000000262
	(-3.88)	(-3.58)	(-2.86)	(-2.84)	(0.31)	(0.10)
PerformanceIndicators	0.000331*	0.000265*	0.000648*	0.000480	0.000000415	0.00000140
	(2.60)	(2.01)	(2.06)	(1.58)	(0.13)	(0.51)
BuildingCertificationBenchmar	0.0000245	-0.0000381	0.000118	-0.0000400	-0.00000191	-0.00000153
	(0.21)	(-0.30)	(0.44)	(-0.14)	(-0.72)	(-0.60)
StakeholderEngagement	-0.000129	-0.000209	-0.000242	-0.000445	-0.000000956	-0.000000711
	(-0.79)	(-1.33)	(-0.64)	(-1.23)	(-0.31)	(-0.22)
Full model;	Yes	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.231		0.267		0.407	
N	332	1827	332	1814	324	1762

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$
Robust standard errors used in all estimations, first-stage results of Heckman estimations are available upon request
Full model specification as in Table 3, all coefficient estimates are available upon request

Conclusions

Performance attribution analysis is well established in the academic REIT literature but the role of sustainability efforts as a financial performance driver is still poorly understood. This may be even more surprising given that the financial implications of energy efficiency and sustainability for commercial real estate have been addressed in a number of asset-level studies, and the empirical body of literature on the economics of green buildings now covers a large number of markets and countries. The present study investigated whether GRESB sustainability scores, as a comprehensive measure of a real estate company's sustainability commitment and practice, are significantly associated with higher operational and financial performance.

Drawing upon a large sample of Global GRESB-rated REITs in the 2011-14 period, we find some empirical evidence for the hypothesis that the increased transparency on sustainability measures correlate to superior financial performance for REITs rated by the annual GRESB survey. Both the returns on assets and returns on equity of REITs with high GRESB scores appear to outperform the rest of their cohort. The evidence is less clear-cut regarding absolute stock market performance; however, adjusting for risk using a basic Sharpe ratio measure reveals a significant link between sustainability and stock market performance.

Overall, the results of this global study suggest that investing in sustainability pays off for REITs both in terms of enhancing operational performance and lowering risk exposure and volatility. However, there remains significant room for improvement in the sustainability performance of REITs. Despite improvements in the REIT ratings in recent years, the overall GRESB score is 53 out of 100 in 2014 and 44 over the 2011-14 period, underlining the vast untapped potential for further optimization of most REITs' sustainability practices.

A caveat of the findings reported in this paper is that the available empirical data do not permit us to ascertain a true causal relationship between sustainability and financial performance. The fact that the scoring relies to some extent on self-reporting, despite GRESB's increasing efforts to introduce stringent validation procedures and site visits,

presents a further potential complication. However, this study has, for the first time, established that a link exists between fund-level sustainability scores as measured by the comprehensive GRESB assessment scores and REIT financial performance while controlling for the most important performance drivers reported in the extant literature. Future research may investigate the temporal and causal sequence of GRESB assessments and financial outcomes in more detail as a longer and richer panel dataset becomes available. More in-depth analysis is also required to ascertain if and to what extent detailed information on the sustainability performance of each REIT is known to investors through GRESB and other information channels and how this information is reflected in market prices.

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Appendix 1: Processes and structures of the GRESB survey

GRESB gathers survey data at the portfolio level for both listed companies and private funds that invest directly in real estate via its online portal from property companies and private funds annually between April and July, covering information on environmental, social and governance. The information is reviewed continuously and the results are published in September. Individual performance data is generally confidential and will not be disclosed in the report or any third parties. As an incentive for participating, survey respondents obtain a detailed scorecard which allows them to gauge their individual sustainability performance against the GRESB universe and access to portfolio analysis tools via the GRESB web portal. Next, GRESB requests feedback from all survey participants, the regional Benchmark Committees, the Advisory Board and GRESB investor members to obtain feedback on the published report.

The survey questions relate to seven sustainability aspects as defined below and make up the total GRESB score which is scaled 0 to 100. The total GRESB score can be divided into two dimensions, 1) implementation and measurement and 2) management and policy. These two dimensions reflect the role of sustainability in an organization's structure and portfolio of real estate assets. There is also an optional eighth aspect for participants with significant development activities (New Construction & Major Renovations) which is not included in the overall GRESB score to preserve the comparability of scores across all participants.

Appendix 2: Variable definitions and sources

Name	Definition	Source
Management & Policy	The means by which a company or fund manages sustainability in its organization, portfolio and stakeholders and the principles of action adopted by the company/fund	GRESB
Implementation & Measurement:	The process of executing a decision or plan, or the act of measuring something related to the portfolio.	GRESB
Management	Reflects how an organization addresses sustainability implementation in the context of its overall business strategy. In 2014, 88 percent of participants reported that they had available sustainability objectives. Of these, 72 percent have made their objectives publicly available, compared to 44 percent in 2013. 80 percent of participants report that they integrate their sustainability objectives into their overall business strategy.	GRESB
Policy & Disclosure	Disclosure of sustainability performance allows participants to show how sustainability policies and management practices are being implemented and their impact on the business. 84 percent of participants now disclose their sustainability performance. 61	GRESB

	percent of this group discloses its performance in a stand-alone sustainability report (2013: 38 percent).	
Risks & Opportunities	Sustainability risk assessments help to reduce exposure to long-term risks. In the acquisition process, these assessments demonstrate a focus on mitigating risks that might impact returns, and a forward-looking approach to the development of the portfolio. 81 percent of participants now perform sustainability risk assessments as a standard part of their due diligence process for new acquisitions. Climate risks (55 percent of those undertaking assessments) and climate change-related risks (45 percent) are increasingly assessed.	GRESB
Monitoring & EMS	A data management system enables organizations to monitor environmental performance in an efficient and effective way. 76 percent of participants now have a data management system in place, on average covering 87 percent of their portfolio. 52 percent of participants use an external data management system. The most commonly monitored metrics included are energy consumption (95 percent), water consumption (84 percent), GHG emissions (75 percent), and waste (63 percent).	GRESB
Performance Indicators	Collecting and measuring key environmental performance data enables property companies and funds to assess their aggregate consumption and footprint, and to set clear targets for reducing the portfolio's operational cost and environmental impact. In 2014, the results show an overall reduction in energy consumption of 0.82 percent over the 2012-2013 reporting period (4.8 percent in 2013 for 319 participants), based on like-for-like data from 508 participants. GHG emissions decreased by 0.31 percent (2013: 2.5 percent) and water consumption decreased by 2.3 percent (2013: 1.2 percent).	GRESB
		GRESB
Building certification	Green building certificates are a measure of the intrinsic quality of the asset and its design to meet the requirements of environmental standards. In 2014, 22 percent of GRESB participants obtained green building certificates for building design, development and structure, at the time of construction. 14 percent of participants obtained green	GRESB

	building certifications for operational buildings, based on actual operational data for a specific period. Globally, LEED and BREEAM are the most commonly used schemes.	
Stakeholder Engagement	Tenant satisfaction surveys identify occupiers' key issues and concerns, which can then be addressed in improvement measures and/or programs adopted by the landlord. Proper follow-up demonstrates commitment to the tenant engagement process, and to developing and maintaining tenant satisfaction. 52 percent of participants now undertake tenant satisfaction surveys (2013: 50 percent), on average covering 68 percent of tenants. Effective implementation of sustainability strategies also includes integration of organizations' sustainability-specific requirements into their supply chain. 65 percent of participants include sustainability-specific requirements in their procurement processes.	GRESB
New Construction & Major Renovations	On-site renewable energy generation reduces environmental and economic impacts associated with fossil fuel energy use. 35 percent of participants have new construction and major renovation projects that are designed to generate energy from on-site renewable sources (2013: 27 percent). On average, 47 percent of participants' projects are covered, and 19 percent of the total projected energy use for these projects is expected to be produced on-site	GRESB
ROA (Return on Assets)	Return on average assets; net income as a percent of average assets	SNL
ROE (Return on Equity)	ROE weighted by Average Assets. Return on average equity; net income as a percent of average equity. or companies with more than one class of equity capital, the market value is expressed according to the individual issue.	SNL
Age	Years since REIT status established	SNL
Volatility	Standard deviation of daily total returns, calculated using SNL Total Return Index	SNL
Price Book	Closing price of the REIT stock divided by the latest quarter's book value per share	SNL

Asset Growth	Growth in total asset value in percent	SNL
Debt to BookCapitalization	Debt as a percent of total book value capitalization	SNL
Market Value	Share price multiplied by the number of ordinary shares in issue. The amount in issue is updated whenever new tranches of stock are issued or after a capital change.	Datastream
Stock return (total return)	Total Return from DataStream. A return index (RI) is available for individual equities and unit trusts. This shows a theoretical growth in value of a share holding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity or unit trust at the closing price applicable on the ex-dividend date.	Datastream
Index return	Total Returns of benchmark returns calculated from SNL data on MSCI, FTSE and SNL indices for country/region (as available)	Datastream
Risk free rate (%)	10 year rate in quarterly benchmark (BM) government bond rates and tracker rates (TR) where benchmark rates are unavailable	Datastream

Appendix 3: Geographical distribution of the REIT study sample

Country	Percent
United States	26.77
United Kingdom	14.54
Japan	11.58
Australia	8.11
France	4.70
Germany	3.93
Switzerland	3.54
Singapore	2.51
Sweden	2.12
Belgium	1.93
Netherlands	1.93
Canada	1.35
Diversified/multi-country	11.71
Other (share >1%)	5.28
Total	100

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