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Sustainability and Private Equity Real Estate Returns

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Abstract

This paper explores private equity real estate fund performance and voluntary environmental, social, and governance (ESG) disclosures. Using data from the National Council of Real Estate Investment Fiduciaries (NCREIF), it examines the relationship between performance for funds in the Open Ended Diversified Core Equity (ODCE) Index and reporting to the Global Real Estate Sustainability Benchmark (GRESB), a platform for disclosure about fund/firm-level ESG strategies and performance. The empirical analyses suggest four conclusions. First, there has been substantial adoption of and reporting to GRESB in the last 5 years, suggesting that reporting to GRESB is a form of table stakes for ODCE members. Second, GRESB participation and performance are both significant predictors of cross-sectional fund returns. Third, GRESB participation and performance are associated with the price appreciation component of fund total returns but not with the income component. Fourth, the relationships between fund returns and GRESB participation and scores are independent of local economic conditions. These results close an important gap in the literature about private equity real estate fund performance and ESG/climate change mitigation efforts in commercial real estate markets.

Keywords Private equity · Real estate · ESG · Sustainability · GRESB · Benchmarking

JEL Classification G31; G32; O30; Q55; Q56; R33

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Introduction and Background

Private capital markets have grown in size and importance over the last 20 years. In 2020, there were more than $7T of private assets under management (AUM) at more than 11,000 funds; private equity real estate (PERE) represents approximately 20% of this capital (McKinsey & Company, 2021). Concurrently, climate change and responses to it have also grown in importance. Recent data indicate that the earth's surface temperature and atmospheric concentrations of greenhouse gasses are reaching their highest ever levels, underscoring evidence from the Intergovernmental Panel on Climate Change (IPCC) on the rapid, wide-spread, and intensifying nature of the climate crisis and its anthropogenic causes.[1] Given the size of the market and that buildings in the United States consume approximately 35% of all energy produced and produce approximately 16% of greenhouse gas emissions (GHGs) (Eichholtz et al., 2019), the environmental performance of commercial real estate has never been more important.

Firms can do both well and good in this space as environmental, social, and governance (ESG) certified assets, particularly those designed and managed to address climate change, have proven to outperform traditional comparable assets (Eichholtz et al., 2010; Holtermans & Kok, 2019). Important for this paper, the plurality of the empirical research focuses on assets—both buildings (Fuerst & McAllister, 2011) and securitized mortgages (An & Pivo, 2020). Evidence about fund and firm performance is thinner, and overwhelmingly oriented towards publicly-traded markets (Real Estate Investment Trusts-REITs) where information is more plentiful (Ling et al., 2014) and ESG activity disclosure is a far more common behavior (Coën et al., 2018; Devine & Yönder, 2021).

The limited prior focus on private firms and emerging private firm data from the Global Real Estate Sustainability Benchmark (GRESB) suggest an opportunity and need to close the knowledge gap around ESG behavior among PERE funds. Described more fully in the Data section, GRESB is a non-profit organization that supports a platform and process for voluntary disclosure about ESG activities across multiple dimensions for real estate and infrastructure funds and firms. GRESB utilizes the disclosed information to create a set of standardized and validated data as well as benchmarks. REITs have been disclosing their ESG activities to GRESB for some time (Feng & Wu, 2021). That PERE funds have also begun to voluntarily disclose their ESG activities to GRESB opens a window to important actions (and information) that heretofore were largely unobservable and which may prove to be material in evaluating fund value and performance.

In this context, we create a novel data set merging Open Ended Diversified Core Equity (ODCE) fund performance data from the National Council of Real Estate Investment Fiduciaries (NCREIF) with fund ESG reporting data from GRESB. Using this data set, we examine the extent to which ODCE fund performance is associated with voluntary ESG reporting. ODCE funds are are infinite life vehicles

[1] See: https://www.ipcc.ch/assessment-report/ar6/

that invest using low leverage in stabilized operating properties with geographic and property type diversification. The integration of the GRESB and ODCE data facilitates exploration of PERE fund behavior among a sample of relatively similar private equity funds, attenuating concerns about sample selection bias and endogeneity rising from missing information regarding fund/firm quality and investment strategies.

Our paper connects three threads in the literature. The first is research identifying factors associated with cross-sectional and time series variation in fund and firm returns (Eugene & French, 1992; Couts, 2019). This is a mature literature that has expanded commensurate with the growth of data available for analysis (Harvey & Liu, 2021). It details the presence of hundreds of factors with significant relationships though distinguishes between theory and data mined contributions, the challenges of overcoming endogeneity concerns, and the temporal limits of factors identified in academic research (Feng et al., 2020; Giglio & Xiu, 2021; McLean & Pontiff, 2016). The factor and firm performance literature explores real estate via analyses of both REITs and PERE (Naranjo & Ling, 1997; Allen et al., 2000; Ling et al., 2014). This work motivates and shapes our inquiry, especially given the extent to which it identifies how macro-economic, market, and fund/firm characteristics influence variation among private equity fund returns (Arnold et al., 2017). Our paper builds on Arnold et al. (2019) and examines the role of voluntary ESG disclosures as a potential factor driving PERE returns. In doing so, the paper extends the literature describing private equity real estate returns (Pagliari et al., 2005; Riddiough et al., 2005).[2] It also contributes the literature using the NCREIF data to explore the differences between capital appreciation and dividend/income gains and other related questions (Fisher et al., 2004; Cannon & Cole, 2011; Slade et al., 2022; Haghani Rizi, 2022).

The paper connects a second thread in the literature exploring climate risk within financial markets–also known as climate finance (Hong et al., 2020). The foundational climate finance literature draws on the work of Matthews et al. (2009) which elucidates the mechanism of long-term climate change: cumulative carbon emissions leading to permanent temperature change. Importantly, Matthews et al. (2009) details the complexity of carbon-climate modeling and provides a simplified empirical model. Recent empirical climate finance work explores physical risks associated with climate change in asset prices (Alok et al., 2020; Barnett et al., 2020), investor behavior (Krueger et al., 2020), and residential real estate (Kousky et al., 2020; Murfin and Spiegel, 2020). This work influences our paper by demonstrating the complexity of climate risk in multiple markets and its contours relative to fixed location assets. It also helps to show how different perspectives and geography shift market equilibrium (Baldauf et al., 2020). As much of the climate finance real estate work focuses on housing and the residential mortgage market (Issler et al., 2020; Ouazad & Kahn, 2019), we contribute by applying lesson from the factor literature

[2] Additional PERE literature includes Shilling and Wurtzebach (2012), Alcock et al. (2013), Andonov et al. (2015), Arnold et al. (2021), Farrelly and Stevenson (2016), Farrelly and Stevenson (2019), Case (2015), van der Spek (2017), and Kiehelä and Falkenbach (2015).

and climate finance to commercial real estate and focus on fund level performance and the firm behavior designed to mitigate climate change.

The third research thread to which our paper connects is the sustainable real estate literature. This body of work demonstrates the connectivity between ESG oriented investments and asset, firm, and fund-level performance (Eichholtz et al., 2010, 2019; Clayton et al., 2021). In the sustainable real estate literature, there is significant price and performance differentiation between ESG certified and traditional comparable assets, with evidence echoing across asset classes (Pivo & Fisher, 2011; Chang & Devine, 2019; Gabe et al., 2021; Devine & Yönder, 2021) and time (Holtermans & Kok, 2019). Findings from the debt markets are complementary and illustrate the relationship of ESG certification to default (Kaza et al., 2014; An & Pivo, 2020). This literature also examines firm motivations and differentiation (Christensen et al., 2022; Jain & Robinson, 2018), ESG certifications and behavior relative to differentiated returns and valuations among publicly listed real estate firms (Eichholtz et al., 2012; Coën et al., 2018; Devine & Yönder, 2021). Recent work on REITs reveals that firms reporting to GRESB tend to have lower costs of debt and higher valuations Feng and Wu (2021).

There is not, to the best of our knowledge, work exploring voluntary ESG disclosures among PERE funds. It is this gap we seek to close. In doing so, we draw on and are informed by the theory and prior evidence within these four strands of literature.

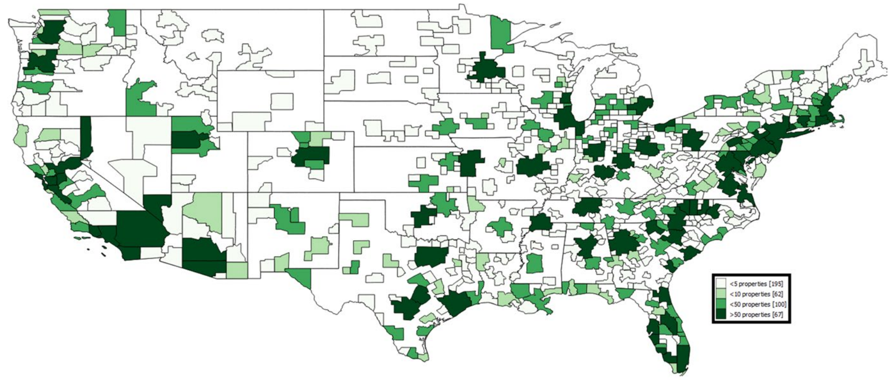
Data & Descriptive Analysis

GRESB is a voluntary ESG performance reporting framework for real assets, providing standardized and validated data to the capital markets. The investor-driven program originated in The Netherlands in 2009 because other existing and well-known, yet more general, sustainability and ESG benchmarking tools proved a poor fit for the unique aspects of real assets. GRESB provides an industry-specific measurement toolkit for the built environment, assessing fund/firm-level performance for commercial real estate assets and, since 2017, infrastructure assets.

GRESB Assessments are dynamic and undergo continuous review to ensure materiality of content. They complement several international reporting frameworks such as the Global Reporting Initiative (GRI), the Sustainable Accounting Standards Board (SASB), the Taskforce on Climate-Related Financial Disclosures (TCFD), the Paris Climate Agreement, the United Nations Principles for Responsible Investment (PRI) and Sustainable Development Goals (SDGs), and region-specific disclosure guidelines and regulations.[3] The dominant GRESB tool, and the one utilized in this study, is the Real Estate Assessment. It is an annual voluntary survey completed at the fund/firm-level in the spring, with results first validated (during the summer) and then compiled to track fund/firm performance both year over year and in comparison

[3] While complementary, reporting through GRESB does not ensure alignment with the other reporting frameworks listed above.

Panel A: GRESB Real Estate Assessment Assets



Panel B: ODCE Assets

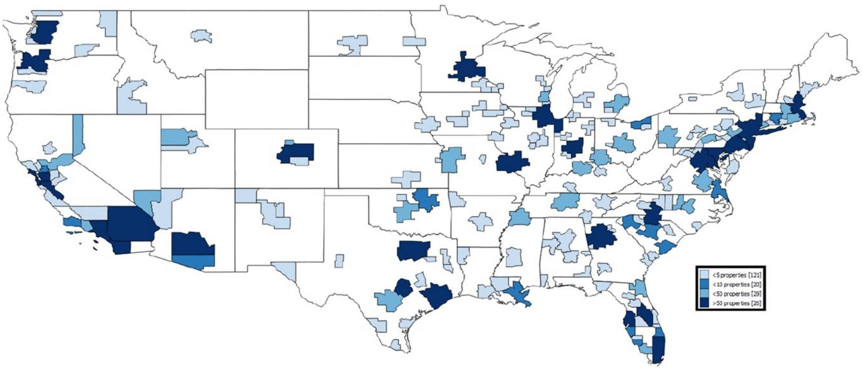


Fig. 1 Both maps highlight the density of assets within continental U.S. Core Based Statistical Areas (CBSAs). Of the 921 CBSAs, the map identifies only CBSAs in which there is a non-zero number of assets observed. Panel **A** presents the asset count reported to the 2020 GRESB Real Estate Assessment across all funds/firms; Panel **B** presents the asset count associated with ODCE funds in 2020. Each map breaks asset count into four categories: fewer than 5 assets; 5-10 assets; 10-50 assets; and, more than 50 assets. Higher asset counts are represented with darker shades

with peer organizations. Each year in the fourth quarter, GRESB produces a Real Estate Benchmark, a Real Estate Development Benchmark, an Infrastructure Fund Benchmark, and an Infrastructure Asset Benchmark, as well as providing each participating organization with a comparative business analysis. GRESB scores are assigned on a zero-to-five-star basis.

The GRESB real estate program has experienced extensive market adoption; the 2020 GRESB benchmark covered more than 1,200 funds/firms and 4.8T USD in value of assets under management, representing 96,000 assets in 64 countries; Fig. 1, Panel A provides a map of the real estate assets covered under GRESB reporting as of 2020, by CBSA. Of the 921 continental U.S. CBSAs, approximately one in four contains at least 10 GRESB assets, with 67 CBSAs having more than 50. Visual inspection confirms that investors in major institutional investment markets

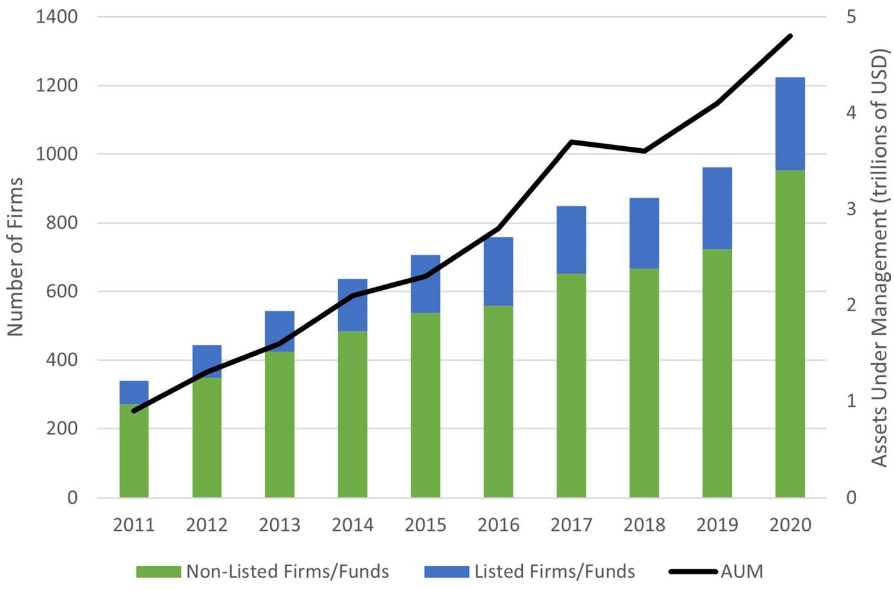


Fig. 2 The graph describes adoption of the annual GRESB Real Estate Assessment Survey by funds/firms for the past decade. The bar graph measures the number of funds/firms completing the survey, broken down into public (listed) and private (non-listed) funds/firms, with values denoted on the left axis. The line graph measures the total value of assets under management by those funds/firms, measured in trillions of USD and denoted on the right axis

and gateway cities are heavy adopters of GRESB reporting. As seen in Fig. 2, reporting to GRESB has grown significantly over the last ten years, both in terms of fund/firm count and assets under management. Indeed, 953 of the approximately 1,200 participating funds/firms in 2020 are non-listed funds, suggesting that while the market penetration of this innovation is in the early stages, adoption by private equity funds is substantial.

The Real Estate Assessment is broken into three components: Management; Performance; and, Development. The Management component describes organizational ESG strategy and leadership policies along with information about risk management and investor engagement. Performance data captures fund/firm level performance across an array of ESG elements on standing investments. Importantly, as of 2020 the addition information on asset-level disclosure is required, governing building characteristics and (where available) energy and water consumption, waste creation and divergence, and greenhouse gas emissions. Development data describes attributes of ESG during construction (if assets in a fund/firm are new builds). Both quantitative and qualitative data are collected, with scoring weighted more toward the former (70% vs. 30%). Topics covered under each component range from resource consumption and emissions performance data to diversity, equity, and inclusion policies and metrics. Notably, green building certification accounts for approximately 10% of GRESB scoring under the Performance category. GRESB component scores are expressed as a percentage, and scoring takes asset allocation and property type distribution into account for both scoring and benchmarking purposes.[4] For the purpose of this study we focus on the Management and Performance components as they are reported for all funds/firms, whereas Development data are only available for funds/firms actively engaged in asset construction, which represents a small portion of the sample funds.

NCREIF provides investment performance indices and firm, fund, and asset-level performance data for U.S. commercial properties and their associated entities. The organization compiles quarterly data on PERE fund returns, composition, geographic distribution, property values, characteristics, and operating details. In this study we will examine the PERE funds included in the NCREIF ODCE index.[5] This index tracks open-end funds pursuing a core investment strategy, generally characterized by low risk, low levered, stable properties geographically diversified across U.S. markets. ODCE represents investment returns on 38 open-end, comingled funds which have been report on both a current and historical basis since ODCE's inception in 1977; 24 funds are currently active in the index. As of Q2 2021, the ODCE funds represented approximately $218B in net assets, earning an annual total return of 8.02%. Figure 1, Panel B presents the real assets under ODCE ownership as of 2020, by CBSA. Of the 921 continental US CBSAs, ODCE assets are clustered in approximately 21% of the markets, with only 26 CBSAs housing more than 50 ODCE assets. As with GRESB assets, ODCE assets are predominantly situated in major institutional investment markets and gateway cities, at yet an even higher concentration that observed in GRESB reporting (Fig. 1, Panel A).

As environmental sustainability commitments and reporting are voluntary in most markets, efforts to study adoption and impacts are often plagued by selection bias. The intersection of GRESB and ODCE funds offers a unique laboratory, as all funds currently active on the index have adopted GRESB Real Estate Assessment reporting over the recent years. As seen in Fig. 3 Panel A, more than half the funds reported as of 2015 and the balance of the funds adopted GRESB since that time; no fund has stopped reporting to GRESB once adopted. During this horizon, the year-over-year performance of ODCE funds has overwhelmingly been the maintenance of their current GRESB rating. However, each year two to three funds experience a downgrading, while between two and five funds experience an upgrading.

Figure 3 Panel B provides deeper insight into the performance record according to GRESB component, as well as the sub-component measuring Building Certifications. Generally, each category has experienced upward trends in their year-over-year performance, with some corrections evident. Such corrections may reflect notable changes in the stated goals of the component, such as the prescribed asset-level consumption and emissions data requirements instituted as part of the Performance component in 2020. Standard deviations were calculated for each score

[4] For more detailed information on GRESB questionnaires and component scoring, please visit: https://documents.gresb.com/

[5] Per NCREIF, ODCE funds must have (based on market value): 80% of their real estate assets invested in PERE properties; 95% invested in U.S. real estate; at least 80% invested in office, industrial, apartment, and retail assets; at least 80% invested in operating properties; and, no more than 65% invested in in a single property type or region.

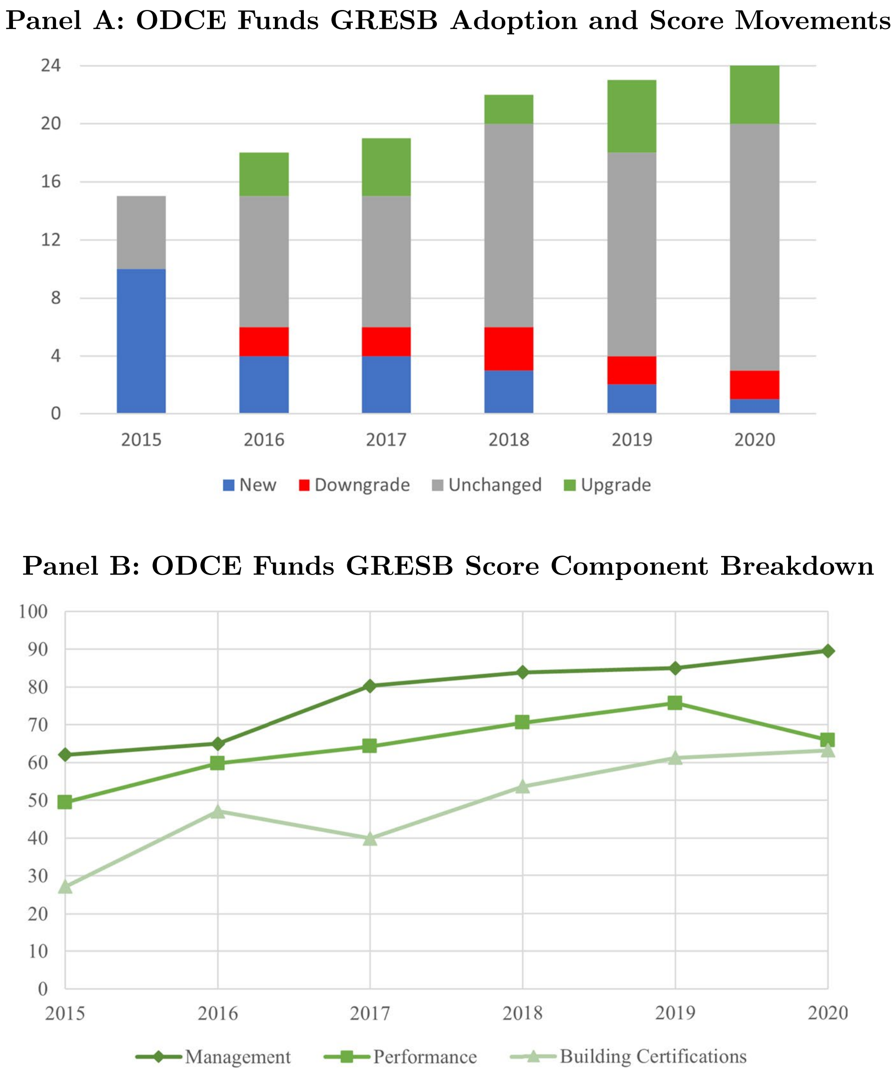


Fig. 3 GRESB Reporting Year represents the previous fiscal year data. Panel **A** describes adoption and year-over-year score change for the GRESB Real Estate Assessment Survey by NCREIF ODCE funds. The bar graph measures the number of funds adopting the Real Estate Assessment survey, broken down into newly reporting funds (blue) those experiencing GRESB score downgrade/unchanged/upgrade (red/grey/green) over the previous year; GRESB scores scale from 0 to 5 stars. Panel **B** presents the yearly average GRESB Component rating for ODCE funds for the 2 (of 3) pertinent GRESB Real Estate Assessment components (Management and Performance), and for Building Certifications scores (representing a substantial portion of the Performance component)

component-year bucket.[6] The variance in score components decreases over time, except for an increase in Performance score variance in 2020, which aligns with the

[6] These results are suppressed to conserve data privacy.

Table 1 The table presents summary statistics for the sample of 376 ODCE fund-quarter observations. See Sections 2 and 3 for detailed variable descriptions

	Average	Std Dev	p25	p50	p75
Return Variables					
Total Return	1.94	0.94	1.45	1.81	2.29
Income Return	0.91	0.19	0.79	0.90	1.02
Appreciation Return	1.04	0.91	0.56	0.91	1.37
GRESB Variables					
GRESB	0.70	0.46	0	1	1
GRESB Score	2.23	1.83	0	2.5	4
Fund & Market Control Variables					
Past Return	6.09	2.92	4.78	5.76	7.91
GeoHHI	0.10	0.07	0.09	0.10	0.11
TypeHHI	0.30	0.06	0.27	0.28	0.31
Ln(Assets)	22.69	0.97	21.93	22.77	23.32
Leverage (%)	0.23	0.05	0.20	0.23	0.25
Cash	2.17	1.25	1.19	1.89	2.83
Ln(Avg Asset)	18.23	0.54	17.98	18.24	18.56
GMP Growth	5.34	0.79	4.82	5.30	5.95
Gateway	0.51	0.14	0.42	0.53	0.59
Local Variables					
TDD	1296	543	825	1019	1705
Density	13,149	5,409	8,869	12,840	16,193
Bachelor	44.14	2.92	42.48	44.28	46.07
ELE	1.68	0.89	1.07	1.51	1.90
HOMECON	4.61	5.49	0.00	3.31	9.00
GeoGRESB	0.039	0.004	0.036	0.039	0.041

change in reporting requirements described above. While score component variation decreases over time, scores still remain sufficiently varied to allow for informative score component analysis. Notably, these generally-improving scores may reflect funds modifying their policies and practices to adhere to GRESB goals, or changes in policies and practices independent of ”rating-chasing” behavior.

T-tests compare overall GRESB performance of ODCE PERE funds and non-ODCE funds/firms which also report to GRESB. Results indicate ODCE funds outperform the balance of the reporting organizations, both in global and regional GRESB rankings and benchmarking; these results are highly statistically significant. ODCE funds also outperform their counterparts in both the Management and Performance components, albeit at lower degrees of statistical significance.[7]

[7] T-test results suppressed to conserve space, yet are available upon request. Development component results are not examined as ODCE funds are, by definition, not active real estate developers.

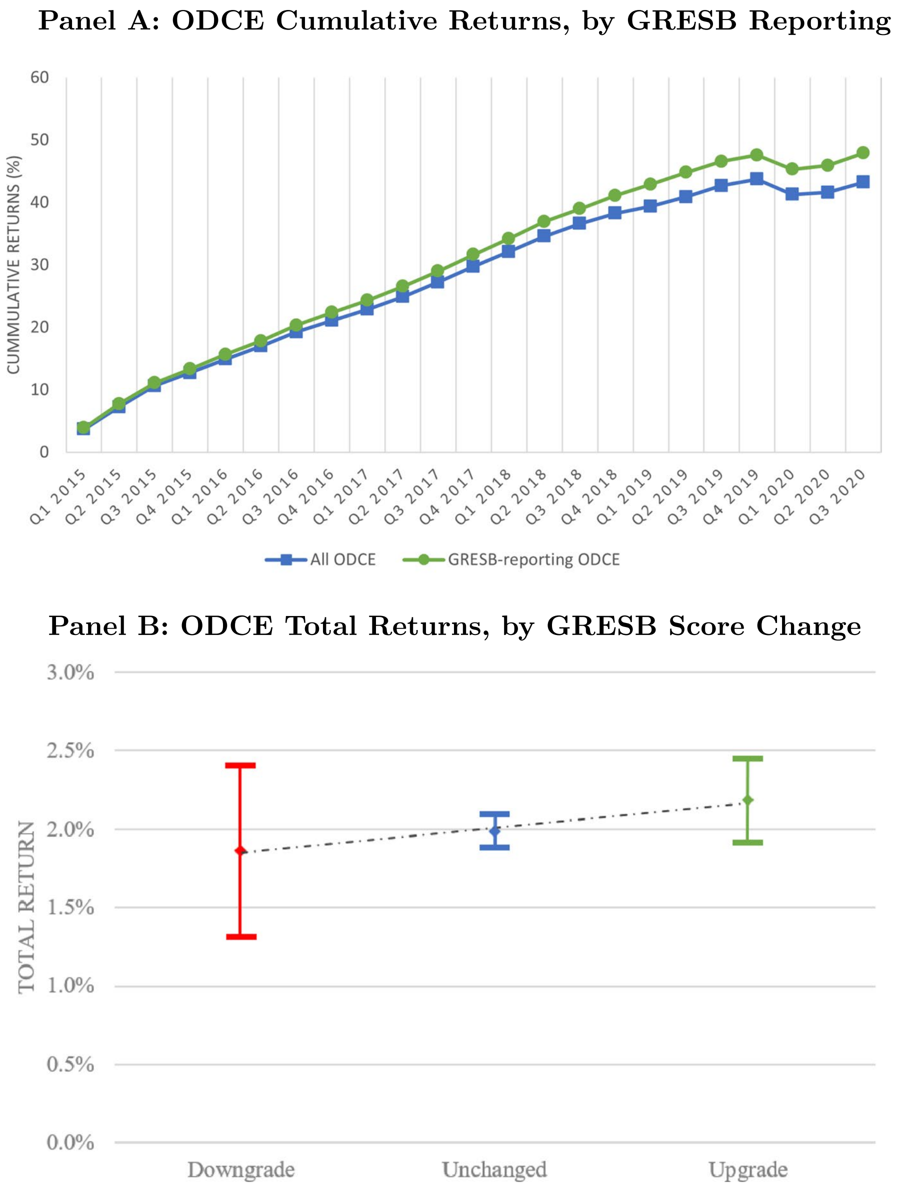


Fig. 4 These figures present the relationship between ODCE fund returns and GRESB reporting. Panel **A** presents the value-weighted cumulative returns for all ODCE funds (blue line) and ODCE funds participating in the GRESB Real Estate Assessment (green line). Panel **B** presents the average and 95% confidence interval for GRESB-reporting ODCE fund *Total Return* sorted into three buckets: those experiencing a *GRESB Score* downgrade, those with an unchanged *GRESB Score*, and those experiencing a *GRESB Score* upgrade. The upgrade bucket includes initial GRESB reporting years

Table 1 provides summary statistics information for the 376 fund-quarter ODCE observations studied here. *GRESB Reporting* indicates that 70% of these observations coincide with GRESB reporting, while the balance pre-date GRESB reporting for each fund; no ODCE fund stopped GRESB reporting after they began. Fund *GRESB Ratings* scales from zero to five stars, with the zero star category representing both earned zero stars (rare) and periods of non-GRESB reporting. The table details the distribution of all dependent and independent variables utilized in this study, including various measures of fund returns, fund financial and asset-specific control variables, and a number of local control variables. These geographic, demographic, macroeconomic, and climatic controls aim to address possible endogenous drivers of GRESB adoption; see the Methodology section for an in-depth discussion of these variables.

Figure 4 details our first analysis. Panel A compares the quarterly cumulative returns for all ODCE funds to the subset of those funds that are actively GRESB reporting.[8] This highlights superior returns for GRESB funds. Notably, both sets of funds are similarly impacted by systemic market changes, indicating an ESG return premium but not a growth premium, consistent with Holtermans and Kok (2019). Panel B presents the linear prediction of the average *Total Return* and 95% confidence intervals for ODCE funds which report to GRESB, sorted into three buckets: those which experienced a *GRESB Score* downgrade; those which had an unchanged *GRESB Score*; and, those which experienced a *GRESB Score* upgrade; this final bucket includes initial GRESB reporting as well. Results indicate an improving expected *Total Return* with each improving *GRESB Score* change bucket status. Together these descriptive results provide the basis for inferential work exploring the relationships observed here.

Methodology

We start by sorting PERE fund-quarters into portfolios according to various definitions of GRESB adoption, including: *GRESB* participation/reporting (yes or no); the direction of change in *GRESB Score*; and the year-over-year change in *GRESB Score*. We then use these portfolios to explore which attributes contribute most/least to *GRESB Score* (as compared to their possible contribution level), and how non-listed funds reporting to GRESB perform against each other, against their non-participating in-sample counterparts, and against their publicly-listed counterparts, by year.

Next, we examine the relationship between GRESB reporting and fund-level return for a sample of non-listed ODCE funds from 2015Q1 to 2019Q4. Specifically, we sort the ODCE funds according to their GRESB reporting activity and then examine the return performance of the resulting GRESB and non-GRESB

[8] We also compare GRESB-reporting ODCE funds to non-GRESB reporting ODCE funds, and the relationship holds. This comparison, while more insightful, is suppressed to preserve data privacy for the late-adopting GRESB funds.

portfolios in quarter t. The former (the portfolio of GRESB adopters) is more likely to be making ESG investments than the latter. Both portfolios are re-balanced at the end of each year, consistent with the frequency of GRESB reporting (announced Q4 each year). We expect to see that our portfolio of GRESB adopters outperforms the non-GRESB portfolio because the literature finds that funds/firms with more environmentally certified properties are associated with better operating performance (Devine & Yönder, 2021).

Our baseline regressions examine whether GRESB reporting predicts quarterly total return in a multivariate context. Fama-MacBeth analyses regress quarterly fund-level returns against our GRESB proxies, controlling for a wide range of fund characteristics highlighted by the literature.

$$r_{i,t} = \alpha + \beta(GRESB_{i,y-1}) + \gamma X_{i,t-1} + \epsilon_t \quad (1)$$

where $r_{i,t}$ is the total return of fund i on quarter t. $GRESB_{i,y-1}$ is defined as either an indicator variable for *GRESB* adoption or the overall *GRESB Score* which each participating fund obtains at the end of the prior year. $X_{i,t-1}$ is a vector of characteristics of fund i on quarter $t-1$, including: the chain-linked total return from quarter $t-4$ to $t-1$ (*PastReturn*), the geographic Herfindahl index (*GeoHHI*), the property-type Herfindahl index (*TypeHHI*) (Ling et al., 2018), the logarithm of fund size (*ln*(*Assets*)), the ratio of total debt to fund size (*Leverage*(%)), the ratio of cash and cash equivalents to fund size (*Cash*), and the logarithm of average asset size in square feet (*ln*(*AvgAsset*)).

Controlling for *PastReturn* is important in the context of this analysis because investors might tilt their holdings toward funds with better past performance (Couts, 2019)). As the outperformance of ESG-committed funds might be a manifestation of their size and/or excessive use of debt, we control for their size and use of debt using *ln*(*Assets*) and *Leverage*(%), respectively. *GeoHHI* and *TypeHHI* are calculated using the squared proportion of a fund's market value of properties invested across MSAs or property types. Herfindahl–Hirschman indices (HHIs) measure the extent of concentration of a fund's property portfolio. The coefficient of interest is β. A positive coefficient estimate indicates that GRESB adoption or the level of fund ESG commitment positively predicts PERE fund performance. As the scale of an asset may shape financial and sustainability-related commitments, we control for the average asset size (measured in square feet) within the fund. Finally, fund performance may be shaped by the general performance of the market in which the fund's assets are situated. Therefore, we control for both the asset value-weighted year-over-year growth in gross metropolitan product (*GMPGrowth*) and the proportion of the fund's assets which are situated in the six leading U.S. investment markets: New York, Chicago, Boston, Los Angeles, San Francisco, and Washington D.C. (*Gateway*). Gross metropolitan product data is taken from the Bureau of Economic Analysis.

To further control for the impact of unobserved fund-level heterogeneity on fund performance in the cross section, we include fund-type fixed effects in the cross-sectional regressions. Finally, a panel analysis robustness test will employ the above equations, but with fund-type and year-quarter fixed effects included to allow for comparison across model specifications.

We next examine the channel(s) through which *GRESB Score* predicts subsequent fund returns. Specifically, we conjecture that higher valuation of sustainable funds is likely attributed to: (1) managerial ESG commitment (*Management*); (2) superior fund-level ESG-related performance (*Performance*); and/or, (3) asset-level environmental certification (*Certification*). Given that *Performance* is partially derived from *Certification*, we replace $GRESB_{i,y-1}$ in equation (1) with *Management* and *Performance* or *Management* and *Certification*, respectively to avoid potential multicollinearity issue; our findings are qualitatively similar if we include all three components in the same regression.

We decompose quarterly total returns into an income return component (*Income Return*) and a price appreciation component (*Appreciation Return*). Ghent et al. (2019) find that the income return component is homogeneous across commercial real estate indices and exhibits little volatility, whereas the price appreciation component varies significantly across the two markets.[9] This is likely due to the fact that rental income changes slowly and is much easier to predict than changes in capitalization rates (Ling et al., 2021). In the context of this study, while information on GRESB adoption might be capitalized into PERE returns at a timely manner, its effect on rental income may take time to materialize. In other words, GRESB adoption is likely associated with higher future rental growth rate captured by the price appreciation component rather than higher current level of rental income. This also helps us mitigate concerns regarding funds with high-quality assets self-selecting to adopt the GRESB standard.

Potential Endogenous Adoption Drivers

Research exploring the impact of sustainability on fund/firm performance is often plagued by omitted variable bias and causality issues. As this study is not a randomized control trial, our data may be exposed to a number of sources of bias in both sample selection and measurement of the treatment. These issue arise in two categories: first, better performing funds/firms and managers may be more likely to invest in sustainability (Margolis et al., 2009); and second, an out-sized demand for sustainable assets may exist in some markets (Addoum et al., 2020). We benefit from uniquely deep data and have designed our study to address as many of these issues as possible.

In the last set of analyses, we measure the impact of several variables which may shape a market's propensity to demand environmental investments, consistent with the extant finance and economics literature. We first explore a climate intensity proxy, capturing the combined impact of heating and cooling needs, measured together as total degree days (*TDD*). This data is collected from the NOAA and the National Centers for Environmental Information. Consistent with the literature (Qiu and Kahn, 2019; Clayton et al., 2021; Addoum et al., 2020), we use this metric

[9] The absence of volatility in the income return component does not suggest that cash flows from property investments are smooth. In fact, the volatility in the cash flows is reflected in the price appreciation component and income return is reflective of cap rates.

as a proxy for potential demand for environmental sustainability at the asset level. The number of degree days measures the deviation of the local temperature from an ambient temperature of 65 degrees Fahrenheit. Heating degree days measure the absolute deviation below this standard and cooling degree days measure the absolute deviation above the standard. Summed together, they can serve as a proxy for for weather variability. The larger the number of degree days, the more costly an inefficient building may prove. Therefore, properties in areas with larger needs for heating or air-conditioning due to the local climate will benefit more from energy efficient building practices.[10]

Next, in the spirit of Engle et al. (2020), we proxy for local awareness and demand of sustainability-related issues using geographically-weighted population density (*Density*), education attainment (*Bachelor*), and the number of electric car charging stations (*ELE*). *Density* measures thousands of residents per ZIP code, which teases out a possible urban versus rural mindset regarding sustainability commitments. *Bachelor* captures the share of the population over 25 years old within a ZIP code with a 4-year college degree or higher, serving as a proxy for educational attainment. These demographic data are obtained from the U.S. Census and American Community Survey.

ELE captures the density of electric vehicle charging stations situated near each ODCE PERE fund asset. We hypothesize that an electric vehicle charging station will only be operated where it is demanded. Since people usually refuel their automobiles near their homes and work locations, an electric vehicle charging station is a strong proxy for the local presence of electric vehicles. Alternative fuel vehicles are an accepted proxy for environmentally-sustainable ideology in the literature (Kahn and Vaughn, 2009; Bond & Devine, 2016b). The U.S. Department of Energy provides a continuously-updated database of every clean fuel station in the U.S. A count of the electric vehicle charging stations (the most prevalent form of alternative fuel for passenger automobiles) situated within each property's ZIP code serves as a proxy for the local market's propensity to be green. The number of electric car charge stations may proxy for a local sustainability demand, which may affect the corporate decision to make asset-level ESG investments in a geography, but should not be correlated with fund/firm financial determinants.

Reflecting Cooper and Kaplanis (1994) and Cashman et al. (2019), we control for the fund preference for assets situated in their home markets (*HOMECON*) or markets where sustainable properties are more accessible (*GeoGRESB*). The latter captures the average of MSA-level percentages of GRESB-certified properties, weighted by the percentage of the fund's portfolio (in market value) allocated to each county at the end of the previous quarter. It might be considered a barometer for concentration risk. Finally, to control for the impact of unobserved heterogeneity in fund performance over time, we include year-quarter fixed effects.

We first perform a comparative analysis across the above-described proxies for sustainability adoption and local demographic and economic variables. We then include all variables in the same regression. Due to limited sample size, this exercise

[10] We also tested heating degree days and cooling degree days, but found no additional explanatory power over their combined effect measured in total degree days.

Table 2 All models are estimated using Fama-MacBeth regressions with Newey-West standard errors. The dependent variable in all estimations is *Total Return*. *GRESB* is a dummy variable tracking GRESB Real Estate Assessment participation and *GRESB Score* represents the earned score on that Assessment, scaling from zero to five. The omitted category for model estimations (1), (2), and (3) is *Past Return*, which is included in model estimations (4), (5), and (6). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

	(1)	(2)	(3)	(4)	(5)	(6)
GRESB		0.339***			0.349***	
		(3.25)			(3.38)	
GRESB Score			0.077***			0.090***
			(3.39)			(4.48)
Past Return				0.024	0.006	-0.000
				(0.82)	(0.19)	(-0.01)
GeoHHI	-0.204	-1.375	1.776	-0.242	-0.605	3.171
	(-0.09)	(-0.61)	(0.85)	(-0.11)	(-0.23)	(1.55)
TypeHHI	-0.488	0.787	0.784	-0.709	0.535	0.539
	(-0.42)	(0.58)	(0.56)	(-0.71)	(0.48)	(0.45)
Ln(Assets)	-0.062	-0.087	-0.087	-0.042	-0.068	-0.075
	(-0.77)	(-1.14)	(-1.03)	(-0.52)	(-0.81)	(-0.84)
Leverage (%)	0.940	1.507	0.696	1.156	1.298	0.321
	(0.68)	(1.21)	(0.59)	(0.90)	(1.01)	(0.28)
Cash	-0.055	-0.028	-0.029	-0.045	-0.022	-0.023
	(-1.42)	(-0.72)	(-0.78)	(-1.33)	(-0.60)	(-0.63)
ln(Avg Asset)	0.059	0.027	0.023	0.064	0.037	0.033
	(0.71)	(0.28)	(0.22)	(0.67)	(0.33)	(0.28)
GMP Growth	0.253*	0.125	0.172	0.246	0.129	0.157
	(1.70)	(0.92)	(1.17)	(1.60)	(0.92)	(1.06)
Gateway	-0.754	-0.241	-0.885*	-0.641	-0.200	-0.973**
	(-1.61)	(-0.53)	(-1.88)	(-1.51)	(-0.42)	(-2.19)
Constant	1.389	2.258*	2.386**	0.738	1.678	2.121*
	(1.53)	(1.89)	(2.39)	(0.74)	(1.34)	(1.98)
R-squared	0.504	0.584	0.577	0.564	0.649	0.642
Observations	376	376	376	376	376	376

Baseline Analysis of GRESB and PERE Fund Returns, in the Cross-Section

is subject to multi-collinearity issues and its findings should be interpreted with caution. These proxies are perceived as shocks to the awareness of ESG issues among local stakeholders and are likely to confound our GRESB proxies. In particular, local investors who are more exposed to extreme weather conditions might pay more attention to fund-level environmental sustainability (e.g., GRESB adoption) (Hong et al., 2021). It might be claimed that there could be unobservables related to location quality affecting both asset-level ESG investments and fund financials. This is why we utilize a large set of controls related to education, business activity, and the quality of property portfolio, etc.

Results, Discussion, and Implications

Building upon the initial sorting analysis, we explore the extent to which reporting to GRESB is associated with a fund's quarterly total return. Table 2 indicates that GRESB participation, when measured using a binary approach, is associated with a 0.349% quarterly (or 1.4% annualized) increase in total return, holding other factors constant. When compared to the mean total return of 1.94%, the statistically significant result is also economically significant.

With respect to PERE funds' GRESB performance, the models demonstrate that every one point increase in scoring is associated with a 0.09% quarterly or 0.36% increase in annualized total returns; this result is independent of the fund's past returns. Here, both prior returns and fund type fixed effects increase the model fit though they do not materially change the GRESB reporting or scoring coefficients. Additionally, the participation and performance findings are independent of geographic and asset type Herfindahl indices accounting for fund concentration levels by place and asset type where managers can attenuate risk through diversification. Table 7 robustness tests, described in "Endogeneity and Robustness Tests", offer additional context for the contribution and connect with recent work by Couts et al. (2020).

The results demonstrate the importance of both participation and performance relative to sustainability and ESG reporting schemes. Here, GRESB participation illustrates the coarse distinction whereas GRESB Scores help to isolate a more nuanced concept associated with differentiated returns beyond the traditional factors that help to explain return patterns including leverage, total assets, and cash positions. The GRESB Score coefficient *t*-statistic surpasses the threshold proposed by Harvey et al. (2016) for new substantive contributions to traditional modeling frameworks.

Speaking to the implications of these results, we expect that as the adoption of voluntary disclosure grows within this cluster of funds, differentiated out-performance is unlikely to hold and will transition towards a discount for failure to disclose and engage in ESG activities (Kok et al., 2011). Consequently, ESG reporting appears to be a form of table stakes among elite funds/firms and is unlikely to abate given anticipated policy regime shifts both in the U.S. and globally (Deborah Cloutier et al., 2021).[11]

Exploring fund returns using a different lens, Table 3 describes which components of GRESB scores are associated with subsequent fund returns. Two GRESB components are significantly associated with total returns: *Management* and *Performance*. An increase in *Management* from the lower to the upper quartile is

[11] The question of the extent to which firms that have been reporting for longer know better how to score well on GRESB arose and was discarded given a two factors. First, firms may utilize external expertise to prepare/submit their GRESB reporting, effectively buying themselves the GRESB expertise that would otherwise be garnered by a firm reporting for a number of years. Second, the GRESB Grace Period allows first-time reporting firms to not make their results public for one year. This affords anyone interested a one-year period to familiarize their organization with GRESB reporting and calibrate their procedures accordingly.

Table 3 All models are estimated using Fama-MacBeth regressions with Newey-West standard errors. The dependent variable in all estimations is *Total Return*. *Management* and *Performance* are two of the three components of overall *GRESB Score*. *Certification* is a sub-component of *Performance* capturing the impact of green and healthy building certification of PERE fund assets, and comprising the largest individual portion of the *GRESB Score*. The omitted category for model estimations (1) and (2) is *Past Return*, which is included in model estimations (3) and (4). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

	(1)	(2)	(3)	(4)
Management	0.009***	0.003*	0.011***	0.003*
	(2.67)	(1.74)	(3.18)	(1.74)
Performance	-0.006*		-0.008**	
	(-1.90)		(-2.05)	
Certification		0.001		0.002
		(0.61)		(0.82)
Past Return			-0.001	0.007
			(-0.03)	(0.23)
GeoHHI	-0.204	-0.728	1.434	1.520
	(-0.08)	(-0.27)	(0.55)	(0.61)
TypeHHI	0.612	-0.624	0.868	-0.303
	(0.37)	(-0.34)	(0.60)	(-0.20)
Ln(Assets)	-0.078	-0.070	-0.041	-0.035
	(-0.99)	(-0.89)	(-0.52)	(-0.45)
Leverage (%)	1.713	2.362*	1.150	1.429
	(1.43)	(1.87)	(1.04)	(1.15)
Cash	-0.019	-0.028	-0.011	-0.025
	(-0.59)	(-0.61)	(-0.37)	(-0.62)
Ln(Avg Asset)	0.022	0.022	0.008	0.012
	(0.20)	(0.19)	(0.07)	(0.11)
GMP Growth	0.215	0.224	0.209	0.194
	(1.42)	(1.39)	(1.41)	(1.26)
Gateway	-0.549	-0.340	-0.733*	-0.662
	(-1.24)	(-0.59)	(-1.76)	(-1.31)
Constant	1.730	1.683	1.148	1.237
	(1.45)	(1.19)	(0.88)	(0.89)
R-squared	0.645	0.622	0.719	0.681
Observations	376	376	376	376

GRESB Score Components and PERE Fund Returns, in the Cross-Section

associated with an increase in quarterly returns where *Performance* is negatively associated with subsequent quarterly returns, a prima facia unexpected result. Notably, the impact of *Management* swamps the *Performance* effect, resulting in a similar net loading associated with ESG Management efforts across the models (approximately 0.003% increase in quarterly returns).[12]

ESG building certifications are not significant predictors of fund returns where they are predictors of asset level returns (Eichholtz et al., 2010).The finding that building certifications are not a material predictor of returns at the fund level

[12] The difference between the upper and lower quartiles of *Management* is 19, 19 × 0.01% ≈0.2%

warrants a bit more discussion given the robust literature indicating differentiation between ESG certified and traditional buildings. We attribute the finding to diffusion of ESG certifications in the market (Kok et al., 2011) and the durability of their out-performance (Holtermans and Kok, 2019)–consistent with the notion of a brown discount in lieu of a green premium. Given the nature of reporting at the fund level and that ODCE funds are buying core assets in core markets, there is a high probability they are all buying a majority envrionmentally-certified space. That limited variation restricts the ability of this channel to influence fund level returns.

Importantly, traditional control variables for fund return models also do not appear to confound the coefficients. Neither prior returns nor fund type fixed effects materially change the results in Table 3 though they are significant predictors, findings consistent with the private equity literature (Kaplan & Schoar, 2005) (and its applications to commercial real estate (Arnold et al., 2019)).

We interpret the *Management* result as congruent with management and finance theory contending funds/firms generate value from ESG activities via two channels: product differentiation and corporate image (McWilliams & Siegel, 2001). Applied to commercial real estate, signals about these two channels are observed in differentiated returns as well as signals about where funds/firms trade or where returns deviate from the net value of their underlying real estate assets. Where the prior analysis described elements of product differentiation, the sample (and attendant sample selection issue) is helpful here in illustrating the substantive nature of the corporate image element relative to the *Management* coefficient. As each of the ODCE funds is an elite, high performing, professionally managed organization, the *Management* result here seems to reflect improved and differentiated corporate image for reporting ESG behavior and activities. Since GRESB is a fund/firm-level reporting platform, this result is conceptually consistent with the lack of significance for the building certification component of disclosures. It is also consistent with evidence from finance related to transparency (Bouvard et al., 2015; Bennedsen et al., 2019). It is plausible that in PERE where information asymmetry is *de rigeuer*, transparency of this sort contributes to a premium. Naturally, GRESB is a signal. While no signal is perfect, it seems to pay to remember that ”in the land of the blind, the one-eyed is king.”

Though unexpected on their face, we interpret *Performance* category results as an adjustment to changes within the GRESB reporting scheme. 2020 was the first year funds and firms had to provide asset-level waste, water, energy, and emissions data (on an as-possible basis). There was an observable step back in reporting, and for those funds/firms which did continue to GRESB report (including all ODCE funds) the overall *Performance* category results suffered. We also acknowledge the potential for COVID related workflow effects. Though not part of the data used for analysis, 2021 GRESB results indicate a 24% increase in reporting in this category. This suggests that the negative coefficient for performance was likely related to funds/firms adjusting to evolving reporting requirements. The results provide useful signals about the channels through which private funds/firms harvest value from ESG activities. Further, the results provide utility for future work as it seeks to make comparisons across and between private funds working in other asset classes (Hong et al., 2020; Giglio & Xiu, 2021).

Table 4 All models are estimated using Fama-MacBeth regressions with Newey-West standard errors. The dependent variable in (1), (2), and (3) is *Income Return* and in (4), (5), and (6) is *Appreciation Return*. *GRESB* is a dummy variable tracking GRESB Real Estate Assessment participation and *GRESB Score* represents the earned score on that Assessment, scaling from zero to five. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

	(1)	(2)	(3)	(4)	(5)	(6)
		– Income Return –			*– Appreciation Return –*	
GRESB		0.017			0.333***	
		(0.93)			(3.14)	
GRESB Score			-0.012*			0.102***
			(-1.90)			(4.92)
Past Return	-0.022**	-0.023**	-0.023**	0.041	0.024	0.018
	(-2.39)	(-2.26)	(-2.55)	(1.49)	(0.81)	(0.63)
GeoHHI	1.618	1.776*	0.895	-2.343	-2.825	1.847
	(1.54)	(1.75)	(0.80)	(-1.04)	(-1.12)	(0.92)
TypeHHI	-0.720*	-0.648	-0.921**	0.269	1.457	1.708
	(-1.86)	(-1.67)	(-2.56)	(0.28)	(1.40)	(1.52)
Ln(Assets)	0.027	0.025	0.032	-0.081	-0.103	-0.116
	(1.46)	(1.27)	(1.58)	(-1.06)	(-1.30)	(-1.36)
Leverage (%)	0.655**	0.583*	0.908**	0.362	0.621	-0.688
	(2.08)	(1.84)	(2.31)	(0.29)	(0.47)	(-0.66)
Cash	0.013	0.015*	0.007	-0.052	-0.033	-0.026
	(1.59)	(1.85)	(0.70)	(-1.72)	(-0.92)	(-0.79)
ln(Avg Asset)	-0.084***	-0.087***	-0.067***	0.151	0.125	0.101
	(-4.56)	(-4.28)	(-3.69)	(1.61)	(1.14)	(0.82)
GMP Growth	0.069	0.062	0.076*	0.201	0.090	0.104
	(1.63)	(1.45)	(1.83)	(1.30)	(0.64)	(0.68)
Gateway	-0.858***	-0.842***	-0.802***	0.253	0.673	-0.137
	(-6.32)	(-6.02)	(-5.59)	(0.57)	(1.48)	(-0.31)
Constant	1.908***	2.024***	1.575***	-1.076	-0.267	0.637
	(6.18)	(5.48)	(6.16)	(-1.00)	(-0.21)	(0.54)
R-squared	0.727	0.735	0.743	0.508	0.604	0.600
Observations	376	376	376	376	376	376

Decomposition of GRESB Impact on PERE Fund Income and Appreciation Returns, in the Cross-Section

In addition to describing the components of GRESB related to total returns, we also examine the relationship between GRESB reporting and the principal components of fund returns. Table 4 demonstrates that the price appreciation component of total return is positively and significantly associated with GRESB participation and performance whereas the income appreciation component is not. Both the binary and continuous measurements of GRESB reporting are significant predictors of income appreciation as they were for total returns. Similar to the results presented in the cross-sectional return models, the GRESB Score t-statistic is quite high and

Table 5 All models are estimated using Fama-MacBeth regressions with Newey-West standard errors. The dependent variable in all estimations is *Total Return*. Control variables included in all previous model specifications are included, with results suppressed to conserve space. Panel A presents the impact of each LOCAL variable on PERE fund *Total Return*. Panels B and C replicate those models, adding in the *GRESB* and *GRESB Score* variables, respectively. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

Definition of LOCAL	(1) *TDD*	(2) *Density*	(3) *Bachelor*	(4) *ELE*	(5) *HOMECON*	(6) *GeoGRESB*
Panel A: LOCAL control without GRESB variables						
LOCAL	-0.001*	-0.000	-0.064*	-0.143**	0.015	18.714
	(-1.79)	(-0.41)	(-1.98)	(-2.15)	(1.27)	(0.56)
Panel B: With LOCAL controls and *GRESB*						
GRESB	0.334**	0.290**	0.198*	0.344***	0.357***	0.343***
	(2.48)	(2.56)	(1.65)	(3.70)	(3.36)	(3.17)
LOCAL	-0.002	-0.000	-0.057	-0.036	0.000	7.642
	(-1.69)	(-0.43)	(-1.64)	(-0.62)	(0.00)	(0.26)
Panel C: With LOCAL controls and *GRESB Score*						
GRESB Score	0.092***	0.076***	0.041*	0.093***	0.084***	0.090***
	(4.55)	(3.53)	(1.65)	(4.93)	(3.25)	(3.91)
LOCAL	-0.002*	-0.000	-0.069*	-0.080	0.004	13.219
	(-1.89)	(-0.53)	(-1.79)	(-1.21)	(0.32)	(0.41)

Comparative Analysis of Sustainability Adoption Drivers and PERE Fund Returns

overcomes the threshold test from Harvey et al. (2016) for making a material and meaningful contribution to a factor based model.

The results appear to suggest that the disclosure of ESG activities to GRESB is anticipatory. That is, among successful elite private funds, revelations about ESG oriented actions portend higher future rental growth capitalized in price appreciation as compared the capitalization of higher current levels of rental income. This finding adds ballast and dimensionality to the *Management* finding above. It is also congruent with the literature on private equity performance (Harris et al., 2014) where prior returns, persistence, and subsequent fundraising are also anticipatory (Kaplan and Schoar, 2005). The connections to the broader literature and the results from Table 4 raise questions about the extent to which understanding phenomena like this confound the predictability of future returns. In informationally symmetrical and efficient markets, advantages can be short lived (McLean & Pontiff, 2016). In private equity where asymmetrical information abounds, it will be useful to investigate this phenomenon across time.

Endogeneity and Robustness Tests

Consistent across the finance and economics literature, climate, political economy, and demography are known predictors of various phenomena. They are useful controls and variables of interest in real estate (Kok et al., 2011), municipal bonds

(Goldsmith-Pinkham et al., 2019), and mutual funds (Alok et al., 2020)—albeit at different levels of specificity and importance. For example when analyzing the signals about climate change and mutual fund performance, county level data provided helpful contours for Alok et al. (2020). In commercial real estate, spatial relationships and local economic conditions are known drivers of value (Anas, 1990) and recent analyses suggest that urban spatial structure factors are helpful in mitigating endogeneity concerns (Gabe et al., 2021).

In Table 5, we explore the relationship between PERE fund return predictability, ESG behavior, and local demographic, economic, and climatic conditions. Using a comparative analysis approach, we find no evidence that local spatial and economic factors are significant predictor of fund returns. Moreover, the relationship between fund returns and ESG disclosure/behavior is not abrogated by spatial or political economy factors. Further, both ESG reporting scheme participation and performance are significant predictors of fund returns; with performance offering greater explanatory power across the model types.

These findings are, to a large extent, expected in the context of ODCE fund definitions/requirements and fund level reporting. In both Fig. 1 and descriptive analyses, we observe that ODCE funds tend to invest heavily in gateway markets. However, their holdings have substantial geographic variation. There does not appear to be concentration risk in the sample. We interpret the results here as consistent with the conditions of listing in the ODCE index, one of which is to have substantial geographically and asset type diversification. Concentration risk and local political and economic forces do not influence returns over and above the other factors in the model. This is not to say that spatial factors are not important–there is ample evidence in the literature demonstrating they are. Instead, it seems that across elite, professionally managed, diversified core PERE funds holding similar assets from a structural and locational bias basis, these conditions do not have a super or supra effect on returns.

The results from additional variations of the model provide a robustness check on the aggregated local economic measurement in Table 5. Table 6 indicates that when decomposed to individual measures detailed in the sub-section on endogeneity, we find that only the electric car charging metric is significant, which is consistent with the prior literature (Kahn and Vaughn, 2009; Bond & Devine, 2016a).

Finally, as a robustness test of our baseline results, we re-examine the findings from Table 2 using panel regression techniques with standard errors are clustered at the fund level. The aim of this exercise is to strip away some of the traditional capital markets risk and observe the extent to which the ESG reporting participation and performance findings hold. Following Couts (2019), we replace the raw returns on the left hand side of the model with Fama-French-Carhart Alphas. This removes the systematic capital markets risk from the model and leaves behind signals about idiosyncratic risk. Critically, in Table 7 we observe that GRESB reporting is positively related to PERE Fama-French-Carhart risk-adjusted returns in the cross section. As expected, the size and strength of the effects are smaller than when focused on raw total returns, a helpful outcome that provides additional context and framing of the initial results in Table 2. Differing from Table 2, GRESB participation is significant while GRESB scores are not.

Table 6 All models are estimated using Fama-MacBeth regressions with Newey-West standard errors. The dependent variable in all estimations is *Total Return*. *Management* and *Performance* are two of the three components of overall *GRESB Score*. *Certification* is a sub-component of *Performance* capturing the impact of green and healthy building certification of PERE fund assets, and comprising the largest individual portion of the *GRESB Score*. LOCAL variables *HOMECON* and *GeoGRESB* are suppressed from this analysis due to multicollinearity impacts. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

	(1)	(2)	(3)	(4)	(5)
GRESB		0.331**			
		(2.32)			
GRESB Score			0.079***		
			(3.08)		
Management				0.014*	0.013***
				(1.69)	(2.77)
Performance				-0.011	
				(-0.65)	
Certification					-0.004
					(-0.40)
TDD	-0.002	-0.002	-0.001	0.000	-0.001
	(-1.24)	(-0.92)	(-0.52)	(0.12)	(-0.26)
Density	-0.000	-0.000	-0.000	-0.000	-0.000
	(-0.92)	(-0.88)	(-1.04)	(-0.03)	(-1.42)
Bachelor	-0.047	-0.021	0.119	-0.058	-0.012
	(-0.56)	(-0.34)	(0.20)	(-0.12)	(-0.02)
ELE	-0.328**	-0.117	-0.134*	-0.120	-0.036
	(-2.46)	(-1.38)	(-1.87)	(-1.37)	(-0.30)
Past Return	0.091*	0.065	0.043	0.015	-0.063
	(1.87)	(1.38)	(0.92)	(0.34)	(-0.38)
GeoHHI	-1.694	-3.643	-3.732	0.809	5.971
	(-0.21)	(-0.69)	(-1.01)	(0.11)	(0.74)
TypeHHI	4.807*	2.993*	2.456	7.635	2.216
	(1.79)	(1.73)	(1.25)	(1.55)	(0.48)
Ln(Assets)	-0.040	-0.057	-0.059	0.151	0.127
	(-0.56)	(-0.71)	(-0.69)	(0.76)	(0.90)
Leverage (%)	-2.166	0.192	-0.131	-0.987	-1.843
	(-0.79)	(0.10)	(-0.11)	(-0.53)	(-0.38)
Cash	-0.105	0.014	0.005	0.315	-0.062
	(-0.83)	(0.21)	(0.08)	(1.71)	(-0.45)
ln(Avg Asset)	0.463	0.219	0.179	-0.378	0.272
	(1.30)	(1.00)	(1.01)	(-0.89)	(0.95)
GMP Growth	0.480*	0.279	0.443	0.722	0.634
	(1.86)	(1.15)	(1.53)	(1.35)	(1.16)
Gateway	-0.666	-0.430	-1.428	-2.303	-2.388
	(-0.41)	(-0.33)	(-0.92)	(-1.26)	(-1.69)
Constant	-5.143	-1.119	-1.955	-1.445	-7.623
	(-1.23)	(-0.32)	(-0.52)	(-0.26)	(-0.78)
R-squared	0.816	0.875	0.879	0.917	0.909
Observations	376	376	376	376	376

Stacked Sustainability Adoption Drivers and PERE Fund Returns

Table 7 All models are estimated using OLS with standard errors clustered at the fund level. The dependent variable in all estimations is Fama-French-Carhart Alphas. The omitted category for model estimations (1), (2), and (3) is *Past Return*, which is included in model estimations (4), (5), and (6). Quarter-Year fixed effects are included in all model estimations. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

	(1)	(2)	(3)	(4)	(5)	(6)
GRESB		0.153**			0.105*	
		(2.36)			(1.74)	
GRESB Score			-0.003			-0.024
			(-0.15)			(-1.48)
Past Return				0.111***	0.108***	0.114***
				(7.43)	(7.20)	(7.55)
GeoHHI	2.249*	1.618	2.280*	1.811*	1.388	2.069*
	(1.97)	(1.43)	(1.96)	(1.68)	(1.31)	(1.94)
TypeHHI	-3.579***	-2.864***	-3.626***	-2.727***	-2.254***	-3.108***
	(-4.13)	(-3.19)	(-3.81)	(-3.58)	(-2.85)	(-3.92)
Ln(Assets)	0.186***	0.174***	0.187***	0.170***	0.162***	0.182***
	(3.47)	(3.31)	(3.48)	(3.30)	(3.20)	(3.55)
Leverage (%)	-1.196	-1.206	-1.194	-0.536	-0.556	-0.493
	(-1.57)	(-1.61)	(-1.56)	(-0.71)	(-0.75)	(-0.65)
Cash	-0.055**	-0.053**	-0.055**	-0.047**	-0.046**	-0.048**
	(-2.33)	(-2.23)	(-2.32)	(-2.10)	(-2.04)	(-2.13)
ln(Avg Asset)	0.128	0.120	0.129	0.096	0.091	0.099
	(1.56)	(1.47)	(1.56)	(1.21)	(1.15)	(1.24)
GMP Growth	0.040	0.016	0.042	-0.036	-0.050	-0.022
	(0.53)	(0.22)	(0.57)	(-0.49)	(-0.70)	(-0.32)
Gateway	-1.425***	-1.271***	-1.429***	-0.886***	-0.792**	-0.903***
	(-4.60)	(-4.16)	(-4.69)	(-2.73)	(-2.54)	(-2.84)
Constant	-2.544**	-2.328**	-2.576**	-2.502**	-2.355**	-2.786***
	(-2.32)	(-2.17)	(-2.35)	(-2.38)	(-2.29)	(-2.67)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.514	0.521	0.514	0.583	0.586	0.586
Observations	376	376	376	376	376	376

Panel Analysis of GRESB and Risk-Adjusted PERE Fund Returns

Conclusions

Given substantial growth in the private capital markets and the collective need to address climate change, this paper explored the relationship between PERE fund disclosure of ESG activities and fund level financial performance. Specifically, the paper examined the extent to which ODCE fund returns are materially related to GRESB reporting. We combine data from NCREIF with reporting from GRESB at the fund level to assess how elite, well managed, professional private equity funds perform relative to their peers. This is important in commercial real estate where firm/fund strategy, type, and management quality can all vary within competition for the same assets.

Informed by theory and prior evidence, our models suggest four conclusions. First, reporting to GRESB has become a form of table stakes among ODCE funds. Second, both GRESB participation and variation in performance were significant predictors of fund total returns, all else equal. Third, GRESB participation and variation in performance were associated with variation in the price appreciation component of fund total returns though they were not associated with the income component. Fourth, the relationships between fund returns and GRESB participation/scores were not obscured by local economic, demographic, and climatic conditions when those conditions are measured either in aggregate or individual specifications.

The results are consistent with the arc of the climate finance and sustainable real estate literature focused on firms (e.g., Devine & Yönder 2021). In equilibrium, it seems that there is differentiated performance among private market participants for disclosing information about the ESG, or climate change mitigation activities, in which they have engaged. The results are also consistent with the asset oriented sustainable real estate literature where there is evidence of differentiated performance between ESG certified assets and their non-certified counterparts (Eichholtz et al., 2010; Holtermans & Kok, 2019).

We are on the precipice of major change in the policy landscape addressing climate action and carbon disclosure (Deborah Cloutier et al., 2021). Consequently, the results here offer insight into the advantages firms/funds have captured as first movers in this space. They also raise questions, like those from McLean and Pontiff (2016), on the duration of these advantages as greater volumes of information become public or what a new information equilibrium means for asset pricing models in commercial real estate (and beyond). The results point to opportunities to for additional research. Future research could leverage granular property-level data to study the relation between the income return component and the price appreciation component as well as explore causal pathways. Future work might also examine firm level environmental performance, a topic that is front of mind given recent SEC announcements about impending climate and carbon disclosure regulation.

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References

Addoum, J.M., Ng, D.T., & Ortiz-Bobea, A. (2020). Temperature shocks and establishment sales. *The Review of Financial Studies*, *33*, 1331–1366.

Alcock, J., Baum, A., Colley, N., & Steiner, E. (2013). The role of financial leverage in the performance of private equity real estate funds. *The Journal of Portfolio Management*, *39*, 99–110.

Allen, M.T., Madura, J., & Springer, T.M. (2000). Reit characteristics and the sensitivity of reit returns. *The Journal of Real Estate Finance and Economics*, *21*, 141–152.

Alok, S., Kumar, N., & Wermers, R. (2020). Do fund managers misestimate climatic disaster risk. *The Review of Financial Studies*, *33*, 1146–1183.

An, X., & Pivo, G. (2020). Green buildings in commercial mortgage-backed securities: the effects of leed and energy star certification on default risk and loan terms. *Real Estate Economics*, *48*, 7–42.

Anas, A. (1990). Taste heterogeneity and urban spatial structure: the logit model and monocentric theory reconciled. *Journal of Urban Economics*, *28*, 318–335.

Andonov, A., Eichholtz, P., & Kok, N. (2015). Intermediated investment management in private markets: Evidence from pension fund investments in real estate. *Journal of Financial Markets*, *22*, 73–103.

Arnold, T.R., Ling, D.C., & Naranjo, A. (2017). Waiting to be called: the impact of manager discretion and dry powder on private equity real estate returns. *The Journal of Portfolio Management*, *43*, 23–43.

Arnold, T.R., Ling, D.C., & Naranjo, A. (2019). Private equity real estate funds: returns, risk exposures, and persistence. *The Journal of Portfolio Management*, *45*, 24–42.

Arnold, T.R., Ling, D.C., & Naranjo, A. (2021). Private equity real estate fund performance: a comparison to reits and open-end core funds. *The Journal of Portfolio Management*, *47*, 107–126.

Baldauf, M., Garlappi, L., & Yannelis, C. (2020). Does climate change affect real estate prices? only if you believe in it. *The Review of Financial Studies*, *33*, 1256–1295.

Barnett, M., Brock, W., & Hansen, L.P. (2020). Pricing uncertainty induced by climate change. *The Review of Financial Studies*, *33*, 1024–1066.

Bennedsen, M., Simintzi, E., Tsoutsoura, M., & Wolfenzon, D. (2022). Do firms respond to gender pay gap transparency? *The Journal of Finance*. https://doi.org/10.1111/jofi.13136

Bond, S.A., & Devine, A. (2016a). Certification matters: is green talk cheap talk?. *The Journal of Real Estate Finance and Economics*, *52*, 117–140.

Bond, S.A., & Devine, A. (2016b). Incentivizing green single-family construction: Identifying effective government policies and their features. *The Journal of Real Estate Finance and Economics*, *52*, 383–407.

Bouvard, M., Chaigneau, P., & Motta, A.D. (2015). Transparency in the financial system: Rollover risk and crises. *The Journal of Finance*, *70*, 1805–1837.

Cannon, S.E., & Cole, R.A. (2011). How accurate are commercial real estate appraisals? evidence from 25 years of ncreif sales data. *The Journal of Portfolio Management*, *37*, 68–88.

Case, B. (2015). What have 25 years of performance data taught us about private equity real estate? *Journal of Real Estate Portfolio Management*, *21*, 1–20.

Cashman, G.D., Harrison, D.M., Seiler, M.J., & Sheng, H. (2019). The relation between intrafirm distances and information opacity: Evidence from stock market liquidity. *Journal of Real Estate Research*, *41*, 639–668.

Chang, Q., & Devine, A. (2019). Environmentally-certified space and retail revenues: a study of us bank branches. *Journal of Cleaner Production*, *211*, 1586–1599.

Christensen, P.H., Robinson, S., & Simons, R. (2022). Institutional investor motivation, processes, and expectations for sustainable building investment. *Building Research & Information*, *50*, 276–290.

Clayton, J., Devine, A., & Holtermans, R. (2021). Beyond building certification: the impact of environmental interventions on commercial real estate operations. *Energy Economics*, *93*, 105039.

Coën, A., Lecomte, P., & Abdelmoula, D. (2018). The financial performance of green reits revisited. *Journal of Real Estate Portfolio Management*, *24*, 95–105.

Cooper, I., & Kaplanis, E. (1994). Home bias in equity portfolios, inflation hedging, and international capital market equilibrium. *The Review of Financial Studies*, *7*, 45–60.

Couts, S. (2019). Stale prices, fragility, and detrimental cash: Evidence from private real estate funds. USC Lusk Center of Real Estate Working Paper Series.

Couts, S., Gonçalves, A., & Rossi, A. (2020). Unsmoothing returns of illiquid funds. Kenan Institute of Private Enterprise Research Paper.

Deborah Cloutier, C., Robinson, S., & Sullivan, G. (2021). The coming us regulatory oversight of, and demand for, climate disclosure. *Regulation (SFDR)*, *3*, 4.

Devine, A., & Yönder, E. (2021). Impact of environmental investments on corporate financial performance: Decomposing valuation and cash flow effects. *Journal of Real Estate Finance and Economics*. https://doi.org/10.1007/s11146-021-09872-y

Eichholtz, P., Kok, N., & Quigley, J.M. (2010). Doing well by doing good? green office buildings. *American Economic Review*, *100*, 2492–2509.

Eichholtz, P., Kok, N., & Yönder, E. (2012). Portfolio greenness and the financial performance of REITs. *Journal of International Money and Finance*, *31*, 1911–1929.

Eichholtz, P., Holtermans, R., & Kok, N. (2019). Environmental performance of commercial real estate: New insights into energy efficiency improvements. *The Journal of Portfolio Management*, *45*, 113–129.

Engle, R.F., Giglio, S., Kelly, B., Lee, H., & Stroebel, J. (2020). Hedging climate change news. *The Review of Financial Studies*, *33*, 1184–1216.

Eugene, F., & French, K. (1992). The cross-section of expected stock returns. *Journal of Finance*, *47*, 427–465.

Farrelly, K., & Stevenson, S. (2016). Performance drivers of private real estate funds. *Journal of Property Research*, *33*, 214–235.

Farrelly, K., & Stevenson, S. (2019). The risk and return of private equity real estate funds. *Global Finance Journal*, *42*, 100471.

Feng, Z., & Wu, Z. (2021). ESG disclosure, REIT debt financing and firm value. *Journal of Real Estate Finance and Economics*. https://doi.org/10.1007/s11146-021-09857-x

Feng, G., Giglio, S., & Xiu, D. (2020). Taming the factor zoo: a test of new factors. *The Journal of Finance*, *75*, 1327–1370.

Fisher, J., Gatzlaff, D., Geltner, D., & Haurin, D. (2004). An analysis of the determinants of transaction frequency of institutional commercial real estate investment property. *Real Estate Economics*, *32*, 239–264.

Fuerst, F., & McAllister, P. (2011). Green noise or green value? measuring the effects of environmental certification on office values. *Real Estate Economics*, *39*, 45–69.

Gabe, J., Robinson, S., & Sanderford, A. (2021). Willingness to pay for attributes of location efficiency. *Journal of Real Estate Finance and Economics*. https://doi.org/10.1007/s11146-021-09847-z

Ghent, A.C., Torous, W.N., & Valkanov, R.I. (2019). Complexity in structured finance. *The Review of Economic Studies*, *86*, 694–722.

Giglio, S., & Xiu, D. (2021). Asset pricing with omitted factors. *Journal of Political Economy*, *129*, 000–000.

Goldsmith-Pinkham, P., Gustafson, M., Lewis, R., & Schwert, M. (2019). Sea level rise and municipal bond yields. Rodney L. White Center for Financial Research.

Haghani Rizi, M. (2022). Real estate investment trusts and commercial property markets in US. *Journal of Real Estate Portfolio Management*. https://doi.org/10.1080/10835547.2022.2033391

Harris, R.S., Jenkinson, T., & Kaplan, S.N. (2014). Private equity performance: What do we know? *The Journal of Finance*, *69*, 1851–1882.

Harvey, C.R., & Liu, Y. (2021). Lucky factors. *Journal of Financial Economics*, *141*, 413–435.

Harvey, C.R., Liu, Y., & Zhu, H. (2016). ... and the cross-section of expected returns. *The Review of Financial Studies*, *29*, 5–68.

Holtermans, R., & Kok, N. (2019). On the value of environmental certification in the commercial real estate market. *Real Estate Economics*, *47*, 685–722.

Hong, H., Karolyi, G.A., & Scheinkman, J.A. (2020). Climate finance. *The Review of Financial Studies*, *33*, 1011–1023.

Hong, H., Wang, N., & Yang, J. (2021). Welfare consequences of sustainable finance. Technical Report. National Bureau of Economic Research.

Issler, P., Stanton, R., Vergara-Alert, C., & Wallace, N. (2020). Mortgage markets with climate-change risk: Evidence from wildfires in california. Available at SSRN 3511843.

Jain, P., & Robinson, S.J. (2018). Do large-scale owners enjoy brand-induced premiums? *Journal of Real Estate Portfolio Management*, *24*, 35–49.

Kahn, M.E., & Vaughn, R.K. (2009). Green market geography: The spatial clustering of hybrid vehicles and LEED registered buildings. *The BE Journal of Economic Analysis & Policy, 9*(2).

Kaplan, S.N., & Schoar, A. (2005). Private equity performance: Returns, persistence, and capital flows. *The Journal of Finance*, *60*, 1791–1823.

Kaza, N., Quercia, R.G., & Tian, C.Y. (2014). Home energy efficiency and mortgage risks. *Cityscape*, *16*, 279–298.

Kiehelä, S., & Falkenbach, H. (2015). Performance of non-core private equity real estate funds: a european view. *The Journal of Portfolio Management*, *41*, 62–72.

Kok, N., McGraw, M., & Quigley, J.M. (2011). The diffusion of energy efficiency in building. *American Economic Review*, *101*, 77–82.

Kousky, C., Kunreuther, H., LaCour-Little, M., & Wachter, S. (2020). Flood risk and the us housing market. *Journal of Housing Research*, *29*, S3–S24.

Krueger, P., Sautner, Z., & Starks, L.T. (2020). The importance of climate risks for institutional investors. *The Review of Financial Studies*, *33*, 1067–1111.

Ling, D.C., Naranjo, A., & Scheick, B. (2014). Investor sentiment, limits to arbitrage and private market returns. *Real Estate Economics*, *42*, 531–577.

Ling, D.C., Naranjo, A., & Scheick, B. (2018). Geographic portfolio allocations, property selection and performance attribution in public and private real estate markets. *Real Estate Economics*, *46*, 404–448.

Ling, D.C., Wang, C., & Zhou, T. (2021). Asset productivity, local information diffusion, and commercial real estate returns. *Real Estate Economics, 50*(1), 89–121.

Margolis, J.D., Elfenbein, H.A., & Walsh, J.P. (2009). Does it pay to be good... and does it,matter? a meta-analysis of the relationship between corporate social and financial performance, working paper.

Matthews, H.D., Gillett, N.P., Stott, P.A., & Zickfeld, K. (2009). The proportionality of global warming to cumulative carbon emissions. *Nature*, *459*, 829–832.

McKinsey & Company. (2021). A year of disruption in the private markets: McKinsey Global Private Markets Review 2021. April 2021.

McLean, R.D., & Pontiff, J. (2016). Does academic research destroy stock return predictability? *The Journal of Finance*, *71*, 5–32.

McWilliams, A., & Siegel, D. (2001). Corporate social responsibility: a theory of the firm perspective. *Academy of Management Review*, *26*, 117–127.

Murfin, J., & Spiegel, M. (2020). Is the risk of sea level rise capitalized in residential real estate? *The Review of Financial Studies*, *33*, 1217–1255.

Naranjo, A., & Ling, D.C. (1997). Economic risk factors and commercial real estate returns. *The Journal of Real Estate Finance and Economics*, *14*, 283–307.

Ouazad, A., & Kahn, M.E. (2019). Mortgage Finance and Climate Change: Securitization Dynamics in the Aftermath of Natural Disasters. Technical Report. National Bureau of Economic Research.

Pagliari, J.L. Jr, Scherer, K.A., & Monopoli, R.T. (2005). Public versus private real estate equities: a more refined, long-term comparison. *Real Estate Economics*, *33*, 147–187.

Pivo, G., & Fisher, J.D. (2011). The walkability premium in commercial real estate investments. *Real Estate Economics*, *39*, 185–219.

Qiu, Y., & Kahn, M.E. (2019). Impact of voluntary green certification on building energy performance. *Energy Economics*, *80*, 461–475.

Riddiough, T.J., Moriarty, M., & Yeatman, P. (2005). Privately versus publicly held asset investment performance. *Real Estate Economics*, *33*, 121–146.

Shilling, J., & Wurtzebach, C. (2012). Is value-added and opportunistic real estate investing beneficial? if so, why? *Journal of Real Estate Research*, *34*, 429–462.

Slade, B.A., Fisher, J.D., & D'Alessandro, J. (2022). A comparison of NCREIF, INREV, and ANREV open-end core fund indices. *Journal of Real Estate Portfolio Management*. https://doi.org/10.1080/10835547.2021.2003506

van der Spek, M. (2017). Fee structures in private equity real estate. *Journal of Real Estate Research*, *39*, 319–348.

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