Environmental Performance and the Cost of Capital: Evidence from REIT Bonds and Commercial Mortgages

Piet Eichholtz	Nils Kok	Erkan Yönder
Maastricht University	Maastricht University	Ozyegin University
Netherlands	Netherlands	Turkey
p.eichholtz @maastrichtuniversity.nl	n.kok @maastrichtuniversity.nl	erkan.yonder @ozyegin.edu.tr

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Abstract

The real estate sector is responsible for a significant greenhouse gas externality, which has prompted interest from policy makers, as well as the emergence of voluntary disclosure standards. As opposed to general concerns about the potentially negative impact of "sustainability" programs and initiatives on corporate financial performance, energy efficiency measures may lead to significant returns in the real estate sector. This paper investigates the relation between real estate sustainability and the cost of the debt. Using a sample of REITs, we investigate both corporate-level debt, as well as commercial mortgages to finance individual buildings. The results show that the degree to which REITs invest in efficient buildings is positively related to the quality of their credit ratings, and it is also associated with a significantly lower spread. The relation persists at the level of individual buildings and their mortgages: environmentally-certified buildings are financed at significantly lower spread, varying between 30 and 60 basis points, depending on the specification.

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I. Introduction

The increasing attention to greenhouse gas (GHG) emissions as an externality in the production of goods and services has led some of the world's largest companies to price in the risk of a future price on carbon.[1] Such tangible relationship between a firm's "sustainability" and its financial performance has long been a topic of interest for investors, corporations, and policy makers. There is also a significant body of academic research that investigates this relationship, typically focusing on broader measures of corporate social responsibility (CSR). Margolis et al. (2007) survey this literature for the period from 1972 to 2007 and find that environmental performance and other categories of CSR tend to have a positive impact on financial performance.

Whereas pricing the carbon externality is relatively straightforward (that is, once the appropriate price of carbon has been selected from the wide range of estimations), the mechanism by which the broader CSR affects corporate performance is more difficult to disentangle. One such mechanism could be that CSR or environmental performance may lead to an improved corporate image and an enhanced reputation, which could benefit companies on the labor, goods, and capital markets (Turban and Greening, 1997). Another mechanism is more direct, and relates to more efficient use of resources, generating less pollution and waste, and overall increases in organizational effectiveness (Sharfman and Fernando, 2008). While CSR may directly affect the operations of a firm, another mechanism to influence its financial performance is through the cost of capital to finance its operations. It has been argued that CSR-related investments may lead to a reduction in operational risk, and the cost of capital associated with the company.

[1] See https://www.cdp.net/CDPResults/companies-carbon-pricing-2013.pdf.

Specifically, if investments in better CSR are associated with easier access to capital, and a lower cost of debt, this could enhance corporate performance.

The literature that investigates the impact of corporate social responsibility and environmental practices on the cost of debt is relatively limited, and the results are mixed. D'Antonio et al. (1997) investigate the performance of social-screened bond mutual funds, but find no relationship between CSR and yield difference on a risk-adjusted basis. Sharfman and Fernando (2008) document that bond spreads are higher for companies that have a superior environmental performance, and in addition, these companies also have a higher debt capacity. Menz (2010) and Bauer and Hann (2010) also evaluate corporate bonds, and while Menz documents an insignificant impact of CSR performance on European bond spreads, Bauer and Hann find strong evidence that environmental performance is associated with reduced bond spreads. More recently, Goss and Roberts (2011) show that companies with a lower score from KLD – a leading CSR rating agency – have higher spreads on their bank loans. Investments in CSR are rewared only if the borrower has a high credit quality, consistent with the overinvestment hypothesis.

This is the first paper to study the effects of investments in the environmental performance of real estate assets on the cost of debt. Given real estate's key role in the production – and therefore also the reduction – of global greenhouse gas emissions, the sector plays an important component in the global debate on energy efficiency. For instance, the Energy Information Administration (EIA) reports that buildings accounted for more than 40 percent of total US energy consumption in 2011, and the EIA expects that buildings will retain this share in overall energy consumption as far as their furthest projection in 2035.[2] As the regulatory response to increasing energy efficiency in the real estate sector is mostly focused on market-based solutions, for example through improving information transparency, understanding the financial performance of investments in the energy efficiency and sustainability of real estate is important for investors and policy makers.

This paper contributes to the literature on the relationship between environmental performance and the cost of capital. It is among the very few papers that investigates the effect of corporate sustainability on the cost of debt, and it does so both at the corporate level, and, uniquely, also at the level of individual assets and the mortgages to finance these assets. This combination of analyses is possible just for real estate, due to the unequivocal link between real estate assets and loans in the form of commercial mortgage contracts. Using a unique measure of environmental performance, the share of portfolios that are rated as "green" by two leading agencies, we first evaluate the impact of portfolio greenness on the cost of debt at the corporate level. We analyze corporate bond ratings and spreads relative to treasuries of comparable maturities, and document that companies with a higher share of energy-efficient, sustainable properties – as measured by LEED and Energy Star certification – have higher bond ratings from S&P and Moody's. Higher portfolio shares of LEED-certified buildings are also associated with significantly lower bond spreads. A one standard deviation increase in the share of LEED-certified buildings decreases the corporate bond spread by about 8-19 basis points. This accounts for an interest payment decline of $169,457-$423,642 for an average corporate bond.

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[2] *EIA Annual Energy Outlook 2013*. For details, please visit http://www.eia.gov/forecasts/aeo.

We subsequently investigate the mortgage spreads of "green" certified properties owned by REITs. This is a direct test of how the efficiency of collateral is evaluated by the capital market. We document that the spreads of mortgages on certified buildings are significantly lower than those on conventional buildings, with the discount varying between 30 and 60 basis points, depending on the specification. This accounts for a decline of $152,010 to $304,020 in the interest payment of an average commercial mortgage.

These results add to the broader literature on the energy efficiency of assets and the implications for cash flows and property prices. There is some evidence that buildings designated as "green" have a higher and more stable occupancy rate, and higher marginal rents (Eichholtz et al., 2010, 2013; Fuerst and McAllister, 2011), but the cost of capital for real estate investors provides another important component of financial performance.

The findings in this paper have some implications for REIT management teams, investors, but also for general corporates with significant real estate ownership. Financial markets seem to price in the higher quality of more efficient, more sustainable collateral in underwriting. While this is encouraging news for owners of more efficient space, those pools of assets that are considered less efficient may face higher borrowing cost in the near future.

In the remainder of this paper, we first discuss the concept of green buildings, and briefly survey the literature concerning their financial performance. Section III provides information on the data employed in the analysis, and outlines the methodology. Section IV discusses the results, and the paper ends with a Section on conclusions and implications.

II. Sustainability and Real Estate Investments

It has been well-documented that the commercial and residential real estate sector can play a pivotal role in the reduction of global energy consumption, given its significant footprint, and the wide array of seemingly profitable energy efficiency measures and technologies at its disposal. The real estate industry has responded to the global sustainability debate in a number of ways. One particularly important development is the establishment of "green" certification programs, both at the building and at the portfolio level. Information provision about the relative efficiency of assets should, comparable to the miles-per-gallon (MPG) sticker on cars, lead to increased consumer awareness, and thus increased market efficiency. In the US, the two leading certification programs at the building level are LEED and Energy Star, which have been developed by the US Green Building Council (USGBC) and the US Department of Energy, respectively. There are 12,206 commercial buildings with a LEED label (as of June 2012), and 21,420 commercial buildings with an Energy Star label (as of May 2013).

Sustainability in the built environment seems to be relevant to a substantial part of the market. McGraw-Hill Construction estimates that 38 percent of new construction and major renovations in 2011 were green.[3] According to Eichholtz et al. (2012), six percent of the combined property ownership of US Real Estate Investment Trusts (REITs) is Energy Star certified, although that percentage is just one percent for LEED certified buildings. Even though the stock of green buildings is still quite small, there is a significant upward trend in green building (re)development.

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[3] *A Path to Achieving Higher Building Performance 2012*. A report by McGraw-Hill Constructions and Siemens.

Comparable to investments in corporate social responsibility for a general corporation, an important question is to what extent social and environmental benefits of sustainability in real property also generate economic and financial value. A survey by Pivo (2008) shows that REIT managers take into account "concern for risk and return" and "opportunities to outperform" rather than "moral responsibility" when they plan to make a sustainable investments in properties. However, the managers' main concern lies in the lack of information on the financial performance of green buildings.

A growing literature has developed that aims to assess the economic performance of energy efficiency and sustainability in building. Using mostly property-level "green" labels – Energy Star and LEED – this literature generally shows that green-certified buildings in the US tend to generate higher rents and higher and more stable occupancy rates than conventional, but otherwise comparable buildings. This translates into higher cash flows and significantly increased transaction prices for green buildings (Eichholtz et al., 2010, 2013; Fuerst and McAllister, 2011). For UK commercial buildings, certified by the BREEAM sustainability label, Chegut et al. (2014) document similar results.

Investigating the implications of green building investments at the corporate level, Eichholtz et al. (2012) show that Real Estate Investment Trusts (REITs) owning a larger fraction of green-certified buildings have enhanced operating performance, as measured by return on assets (ROA), return on equity (ROE) and funds from operations (FFO). A market model shows that REITs with larger fractions of green space also exhibit significantly lower systematic risk (beta). Interestingly, the equity market seems to incorporate the added value of "green" assets, since the authors find no significant outperformance (alpha), suggesting that the stock market has already priced in any benefits for listed REITs that result from energy efficiency and sustainability.

III. Data and Methodology

a. REITs and Green Buildings

We use the data employed by Eichholtz et al. (2012) and Eichholtz et al. (2014). These studies identify LEED and Energy Star labeled properties in the property portfolios of REITs by matching the addresses of REIT-owned properties, provided by SNL Real Estate, and LEED/Energy Star labeled properties. We use these data directly, linking the presence of a sustainability label on an individual building or a small portfolio of buildings to the mortgage to finance these buildings (see Section III.b).

We also use these data indirectly, using the match to create a portfolio-level measure as in Eichholtz et al. (2012). We calculate a dynamic green portfolio share, which is the ratio of the total square feet of certified buildings (by either LEED or Energy Star) and the total square feet of the property portfolio of a REIT, thus indicating the degree to which a REIT's property portfolio contains efficient assets:

$$Green\ Share_{it}^{g} = \frac{\sum_l Sqft\ of\ Certified\ Property_{ilt}^{g}}{\sum_l Sqft\ of\ Property_{ilt}} \quad (1)$$

where i stands for REIT i, t stands for year t, l stands for property l and g is the certification, which is either LEED or Energy Star.

b. REIT and Treasury Bonds

We obtain corporate bond data for all US equity REITs from SNL Real Estate. SNL Real Estate's coverage universe includes over 800 companies and more than 140,000 properties in 38 different countries around the world. For the corporate bond data, we observe the date of origination, the issue amount, the bond yield, the date of maturity and the bond ratings by Moody's and S&P. Following Anderson et al. (2003), we employ the rating data by first ranking them from lowest to highest, and by then creating a ranking variable that has a value of 1 for the lowest rating, increasing by one for each one step rating increases. For Moody's and S&P ratings, the highest values are 23, corresponding to Aaa+ and AAA+, respectively. In our sample, the ranking variable (rating) for Moody's range from 8 (B2) to 17 (A2) while the ranking variable (rating) for S&P ranges from 7 (B-) to 17 (A).

We collect constant maturity treasury rates (CMT) from the US Department of the Treasury.[4] We calculate the treasury spread of the REIT bonds by subtracting the treasury rate with the same or closest time to maturity from the yield of the bond on the REIT bond's origination date.[5] We also collect a large number of financial characteristics of REITs for the year preceding the origination: total assets, interest coverage ratio, Tobin's Q, and the ratio of cash to total assets (as well as the leverage ratio for the robustness analysis).

We start with 128 REITs for which we can determine whether a property in a REIT property portfolio is green-certified. Among those REITs, there are 437 bond issues by 68 REITs during the period between 2003 and 2011. Matching the bond issue data with the data on the environmental performance of REITs results in a sample of 412

[4] For details, please visit http://www.treasury.gov/resource-center/data-chart-center/interest-rates/.
[5] For the times to maturity of REIT corporate bonds that do not exactly correspond with the times to maturity of the Treasury Bonds, we use the yields of the bonds with the closest time to maturity.

corporate bond issues, by 57 REITs, during the period between 2003 and 2011. The decline arises from some incomplete information on REIT portfolios in aggregate level. For instance, for some properties, we do not observe the size of the property so the total square feet of aggregate property portfolio may not be available for a specific REIT for a specific year. As a result, we cannot create a precise greenness share measure. The number of bond issues is 204 and 222 when we investigate Moody's and S&P ratings, respectively.

Table 1 presents the descriptive statistics of the REIT corporate bond sample. The average bond spread is 170 basis points and the average time to maturity is 9.79 years. Some 72 percent of the bonds issued are callable. We also present the descriptive statistics of the green shares and firm characteristics by firm-years: 1.35 and 2.22 percent of REIT property portfolios in the bond issue sample are LEED and Energy Star certified, respectively. The value of total assets of an average REIT is $5.78 billions. The mean of the interest coverage is 323 percent while the average Firm Q is 1.43.

– Insert Table 1 here –

In the multivariate analysis, we estimate the following equations on bond spreads, credit ratings, and the energy efficiency and sustainability characteristics of REIT portfolios:

Bond Spread = f(Green Share, Bond Characteristics, Firm Characteristics) (2)

Bond Rating = f(Green Share, Bond Characteristics, Firm Characteristics) (3)

In Equations (2) and (3), bond characteristics include the logarithm of the value of the bond, the year to maturity and a dummy variable indicating whether the bond is callable. We expect that the spread should increase by the total value of the debt as the bond becomes riskier when the size of the debt increases. For callable bonds, we expect a premium, reflecting the option value of the call.

Regarding the time to maturity, the literature suggests two possible outcomes: (Goss and Roberts, 2011): according to the "trade-off" hypothesis, there is a positive relationship between spread and time to maturity, as a bond becomes riskier due to the longer lending period, in which more unforeseen events can occur. Conversely, the "credit quality" hypothesis predicts a negative relationship between time to maturity and the spread, because longer-term borrowers are likely to be less risky borrowers.[6]

We use lagged firm characteristics in our model. For these characteristics, we expect that firm size, measured by the logarithm of the total assets, is associated with a lower spread, since larger firms are better able to withstand negative shocks to cash flows and may be less likely to default. As a further measure of financial risk, we apply the interest coverage ratio measured as the EBIT divided by interest expenses.[7] As the interest coverage ratio increases, firms should face lower bond spreads. We use a quadratic form as we expect that lenders are less sensitive to interest coverage ratios for very high levels. We also control for Firm Q, measured by the ratio of the market value of assets to the book value of assets. A higher Firm Q indicates better growth opportunities, implying that the bond spread should shrink. Finally, we control for cash

[6] In unreported regressions, we use dummies for bonds with shorter term maturities (≤5 and ≤10 years). We find a significant positive coefficient indicating that REITs with shorter-term maturities are perceived to be more risky. Our results are robust, with the exception of the Energy Star regression with the maturity dummy.

[7] In unreported regressions, we also apply the debt to assets ratio and cashflow risk and find similar results.

stock, the ratio of available cash to total assets. Cash stock is an important measure for REITs, as they have to distribute 90 percent of their income to shareholders.

For the credit rating regressions, we expect the opposite relationship for all independent variables. All regressions include year and property type dummies and the standard errors are heteroskedasticity robust, clustered by firm.

In estimating the cross-sectional regression reported in equations (2) and (3), we must acknowledge that the endogeneity is a possible concern in non-experimental studies. For example, green buildings are not randomly assigned to portfolios and building owners do not randomly invest the sustainability characteristics of buildings. For OLS estimates of equations (2) and (3) to yield consistent estimates, we must assume that the explanatory is uncorrelated with other explanatory variables.

Alternatively, we apply Two-Staged Least Squares estimation. In the first stage, we regress green share on the lagged green share and a local greenness variable measuring the share of green buildings in the locations where a REIT's properties in the portfolio are located, with the explanatory variables that we use in the bond spread and bond rating regressions. We use the weighted local greenness measure proposed by Eichholtz et al. (2012), where the green shares by MSA in the US are weighted by the ratio of square feet of properties corresponding to each MSA to the total square feet of REIT property portfolio. In the second stage, we regress fitted green share measure on bond spread and bond rating. We perform Hansen J (Hansen et al., 1996) and Kleibergen-Paap (Kleibergen and Paap, 2006) tests in order to test the validity and identification of the models.

$$Green\ Share = f\begin{pmatrix} Green\ Share_{t\text{-}1},\ Local\ Greenness, \\ Bond\ Characteristics,\ Firm\ Characteristics \end{pmatrix} \quad (4)$$

$$Bond\ Spread = f\left(\widehat{Green\ Share},\ Bond\ Characteristics,\ Firm\ Characteristics\right) \quad (5)$$

$$Bond\ Rating = f\left(\widehat{Green\ Share},\ Bond\ Characteristics,\ Firm\ Characteristics\right) \quad (6)$$

c. *REITs and Commercial Mortgages*

SNL Real Estate provides financial data on the assets owned by US REITs, collecting encumbrance (mostly commercial mortgages) data for each property every year since 2001 if there is any commercial mortgage collateralized by the properties in the REIT portfolios. SNL provides the value of the encumbrance (the principal value of the debt), the interest rate, the maturity date, a dummy variable indicating whether it is a fixed rate contract, and a "Cross-Coll" dummy indicating whether the debt contract is cross-collateralized by other properties. SNL Real Estate also provides information on the property characteristics, such as the address of the property, the property type and the property age.

SNL does not provide the day and month of origination for the mortgages, but since SNL reports loan data for every year, the year of origination can be derived from the first appearance of the debt contract. We assume that the day and month of the origination is the same as the day and month of the maturity. Then, we combine this date with the year of the first appearance of the contract in the database in order to derive a complete date of origination. We need the complete date of origination in order to collect the Treasury rate corresponding to the date of origination. We calculate the mortgage spread in a similar manner as described in Section II.c by subtracting the Treasury rate with the same or closest maturity from the mortgage rate. Time to maturity is calculated by the difference between the year of maturity and the derived year of origination.

Since some commercial mortgage contracts are collateralized by multiple properties, we first determine which properties are combined for each debt contract by grouping the debt contracts with exactly the same contractual terms by each year.[8] Then, we calculate loan to value (LTV) by dividing the encumbrance value by the total book value of the properties collateralizing the corresponding contract in the year of derived origination. As mentioned earlier, we identify which REIT properties are LEED or Energy Star certified through a GIS matching procedure. Our complete sample covers the period between 2003 and 2012.

Table 2 presents the descriptive statistics for REIT commercial mortgages. In the complete sample, there are 3,044 properties collateralizing REIT commercial mortgages. The average spread is 284 basis points, while the average time to maturity is 6.18 years. The mean value of a property collateralized by a REIT mortgage is $48.33 million, with an average LTV of 55 percent. 82.39 percent of the properties are financed with fixed rate mortgages and 24.08 percent of the properties collateralize mortgages together with at least one other property. LEED and Energy Star labeled properties account for 1.41 and 2.69 percent of the sample, respectively.

We also summarize the firm characteristics and green shares of property portfolios owned by REITs. The average LEED share and Energy Star share account for

[8] We group the contracts collateralized by different properties by checking for the same interest rate, the same encumbrance, the same date of maturity and the same company.

1.23 and 4.53 percent of the sample of 288 firm-years, respectively. The size and the interest coverage ratio of the REITs in the commercial mortgage sample are smaller than for the corporate bond sample. This indicates that smaller and riskier REITs finance more often through mortgages than corporate bonds. The mean of firm Q is 1.34 and the average cash to total assets ratio is 2.50 percent.

– Insert Table 2 here –

We estimate the following equation in order to obtain the impact of the energy efficiency and sustainability of the mortgaged building on the mortgage spread:

$$\textit{Mortgage Spread} = f(\textit{Green Label, Mortgage and Property Characteristics}) \quad (6)$$

We expect that the presence of a LEED or Energy Star label have a negative impact on the mortgage spread (i.e., lowers the spread). We expect that the Loan-to-Value ratio has a positive relationship with the credit spread. However, there is a possible endogeneity issue in that lenders might keep the LTV lower for riskier firms or properties. Following Titman et al. (2005), we therefore use a dummy variable for LTVs larger than 0.7. This dummy should capture the higher LTV choice of the lenders for less risky firms, so we expect a negative impact for the LTV dummy. We use a property vintage dummy (≤10 years) and the logarithm of the book value of the property in order to capture the impact of property quality.[9] We expect that fixed-rate mortgages face

[9] In unreported regressions, we also directly use the age of the properties but find insignificant results due to nonlinearity in the relationship.

higher spreads and that mortgages collateralized by multiple properties benefit from a diversification effect, which may decrease the spread. In all regressions, we control for year, state, and property-type fixed effects. In some specifications, we also control for firm-fixed effects. In all regressions, the standard errors are heteroskedasticity robust and clustered by firm-years.

IV. Empirical Findings

a. Corporate Bond Spread Regressions

In Table 3, we present the results from the regression of bond spread and bond ratings on firm characteristics, bond characteristics, and the extent to which a REIT portfolio includes LEED and/or Energy Star certified buildings. The standard errors are heteroskedasticity robust and clustered by firm. The signs of the coefficients of the bond and firm controls are as expected, except for cash stock, but that control variable does not have a statistically significant relation with spreads. Time-to-maturity has a negative impact on the bond spreads, supporting the ‘‘credit quality’’ hypothesis proposed by Goss and Roberts (2011). If the bond is callable, the spread increases significantly, reflecting the option value of the call. Larger firms with higher interest coverage face significantly lower bond spreads. However, the impact of interest coverage on spreads is convex: if the interest coverage ratio is significantly high enough, lenders value the marginal benefit of an even higher coverage ratio less. When the interest coverage ratio is higher than 13.27, firms even face higher spreads.

In Columns (1) and (2), where we address the effect of portfolio greenness on the bond spreads, we document that both the coefficients of LEED and Energy Star shares are negative, but the coefficient is only significant for the LEED share, indicating that REITs with greener property portfolios face lower bond spreads. As the LEED share increases by one standard deviation, the spread decreases by 8 basis points. A one standard deviation increase in the share of LEED-certified buildings decreases the corporate bond spread by about 8 basis points. This accounts for $169,457 lower interest payment for a REIT issuing an average value corporate bond.

In Columns (3) to (6), we present the regressions of bond ratings on the shares of green properties in REIT portfolios. Among the controls for bond characteristics, the value of the bond significantly increases the credit rating. The bonds of larger firms with better growth opportunities have significantly better Moody's and S&P ratings.

In all cases, the green shares measured by LEED and Energy Star labels have the expected positive coefficient, but the relationship is significant for LEED labels only. As the share of LEED-certified buildings in the REIT property portfolios increases, the S&P and Moody's ratings increase as well. Around 10 (5) standard deviation increase in LEED share leads to a one-level increase in S&P (Moody's) rating.

– Insert Table 3 here –

Table 4 also shows the Two-Staged Least Square estimation results. We find similar results with higher significance and higher impact of LEED share on bond spread and ratings. A one standard deviation increase in LEED share decreases bond spread by 19 basis points. This accounts for a decline in the interest payment by $423,642 for an average corporate bond. An around 3.5 standard deviation increase in LEED share leads to one-level increase in S&P rating and an around 2.5 standard deviation increase enhances Moody's rating by one level. The controls give similar results to the OLS regression. In all regressions, we reject the null hypothesis of Kleibergen-Paap that the model is underidentified and do not reject the null hypothesis of Hansen J Test that the instruments are valid, indicating that our instruments are valid and performing well.

– Insert Table 4 here –

b. Commercial Mortgage Spread Regressions

Table 5 provides the regression results of the mortgage spreads on the presence of LEED and Energy Star certification. The standard errors are heteroskedasticity robust and clustered by firm-year. While we do not control for firm-fixed effects in the first two columns, we add firm dummies to the regressions in Columns (3) and (4).

The coefficients on the control variables are mostly aligned with expectations. In the first two columns, the coefficient of LTV is significantly positive: a higher level of borrowing at the level of the individual building increases the spread. The dummy indicating that LTV is larger than 0.7 has a significantly negative coefficient, which suggests that less risky firms face lower spreads and that riskier firms are crowded out at high levels of LTV. Time-to-maturity has a negative impact on the spread, supporting the ‘‘credit quality’’ hypothesis. Fixed-rate mortgages have significantly higher spreads, on average at 12 basis points. Finally, when the mortgage contract is collateralized by multiple properties, the spread significantly declines, by some 36 basis points in Columns (3) and (4) of Table 5. This effect is probably due to diversification.

– Insert Table 5 here –

Overall, we document that if a mortgage contract is collateralized by properties certified as more efficient, the borrower faces significantly lower spreads in all specifications. If the building collateralizing a mortgage contract is LEED certified, the mortgage spread significantly declines by 53-60 basis points (at a 5 percent significance level) in Columns (1) and (3). For an average commercial mortgage, a REIT has a lower interest payment by $268,313-$304,020 if the property collateralizing the mortgage is LEED certified. Firms face 29-30 basis points lower spreads if the property collateralizing the mortgage is Energy Star certified. For an average commercial mortgage, a REIT has a lower interest payment by around $152,010 if the property collateralizing the mortgage is Energy Star certified. Our findings suggest that lenders reward firms investing in certified buildings and demand lower mortgage spreads for green buildings. Although we do not have information about the default rates of the underlying assets, the findings are in line with the lower occupancy risk and higher income generated by green buildings (Eichholtz et al., 2010, 2013; Fuerst and McAllister, 2011).

V. Concluding Remarks

This paper is the first to investigate the impact of direct measures of corporate social responsibility – energy efficiency and sustainability performance – on the cost of capital of a large sample of firms. Using the real estate sector as the setting allows us to study mortgage contracts on individual buildings owned by US REITs, directly linking the environmental performance of a building to the costs to debt to finance the asset. Concomitantly, we can also study the effect of the "greenness" of the portfolio on firms' overall cost of debt and perceived borrower quality, as measured by the S&P and Moody's ratings.

First, by analyzing corporate bond spreads and ratings, we document that companies with a higher share of LEED-certified buildings have better S&P ratings. We also find that firms with a more efficient portfolio, measured by both LEED and Energy Star, face significantly lower bond spreads. A one standard deviation increase in the LEED portfolio share decreases the spread by about 8-19 basis points accounting for a $169,457-$423,642 decline in the interest payment for an average corporate bond. These findings show that portfolio greenness has a spread-mitigating impact for REITs, possibly reflecting the lower risk and higher income associated with green buildings. Although this effect is statistically significant, its economic significance at the portfolio level seems quite small, in line with findings for general corporates (Goss and Roberts, 2011).

Second, we evaluate the mortgage spreads of the green certified properties owned by REITs. We document that the commercial mortgages on certified properties have significantly lower spreads than conventional buildings. This effect is economically significant: if the building is LEED certified, the spread is 53-60 basis points lower than on a conventional building, which accounts for a $268,313-$304,020 decline in the interest payments of an average commercial mortgage, and that difference in spread is 29-30 basis points for Energy Star certified buildings accounting for a $152,010 decline in the interest payments.

Our findings have some implications for REITs, investors, and for policy makers. The energy efficiency and sustainability of properties lowers the cost of debt for individual property investments. This provides a strong incentive for investors and corporations to develop more sustainable investment strategies. Importantly, the current regulatory response to the large environmental externality from the built environment is mostly to increase market efficiency through enhanced transparency. More than ten major US cities, including Boston, New York, Washington DC, as well as the state of California, have enacted regulation mandating the disclosure of commercial building energy performance. If the capital market is efficient in pricing in exemplary performance, it will also be able to price in environmental underperformance. This may have implications for the cost of capital of inefficient assets, and their market values.

References

Anderson, R.C., Mansi, S.A., Reeb, D.M., 2003. Founding Family Ownership and the Agency Cost of Debt. Journal of Financial Economics 68, 263-285.

Bauer, R., Hann, D., 2010. Corporate Environmental Management and Credit Risk, Working Paper.

Chegut, A., Eichholtz, P., Kok, N., 2014. Supply, Demand, and the Value of Green Buildings. Urban Studies, Forthcoming.

D'Antonio, L., Johnsen, T., Hutton, R.B., 1997. Expanding socially screened portfolios: an attribution analysis of bond performance. Journal of Investing 6, 79-86.

Eichholtz, P., Kok, N., Quigley, J.M., 2010. Doing Well by Doing Good: Green Office Buildings. American Economic Review 100, 2494-2511.

Eichholtz, P., Kok, N., Quigley, J.M., 2013. The Economics of Green Building. Review of Economics and Statistics 95, 60-63.

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., Kok, N., Yönder, E., 2014. CEO Political Preferences and the Sustainability of REITs, Working Paper.

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.

Goss, A., Roberts, G.S., 2011. The impact of corporate social responsibility on the cost of bank loans. Journal of Banking and Finance 35, 1794-1810.

Hansen, L.P., Heaten, J., Yaron, A., 1996. Finite Sample Properties of Some Alternative GMM Estimators. Journal of Business and Economic Statistics 14, 262-280.

Kleibergen, F., Paap, R., 2006. Generalized Reduced Rank Tests Using the Singular Value Decomposition. Journal of Econometrics 133, 97-126.

Margolis, J.D., Elfenbein, H., Walsh, J., 2007. Does it Pay to be Good? A Meta-Analysis and Redirection of Research on the Relationship between Corporate Social and Financial Performance, Working Paper.

Menz, K.-M., 2010. Corporate Social Responsibility: Is it Rewarded by the Corporate Bond Market? A Critical Note. Journal of Business Ethics 96, 117-134.

Pivo, G., 2008. Exploring Responsible Property Investing: A Survey of American Executives. Corporate Social Responsibility and Environmental Management 15, 235-248.

Sharfman, M.P., Fernando, C.S., 2008. Environmental Risk Management and the Cost of Capital. Strategic Management Journal 29, 569-592.

Titman, S., Tompaidis, S., Tsyplakov, S., 2005. Determinants of Credit Spreads in Commercial Mortgages. Real Estate Economics 33, 711-738.

Turban, D.B., Greening, D.W., 1997. Corporate Social Performance and Organizational Attractiveness to Prospective Employees. Academy of Management Journal 40, 658-672.

Table 1
Descriptive Statistics for Corporate Bonds
(2003-2011)

VARIABLES	Mean	Std. Dev.	Obs.
Bond Characteristics			
Bond Spread (in bps)	170.02	170.35	412
Debt Value (in $millions)	211.82	203.22	412
Time-to-Maturity (in years)	9.79	5.31	412
Callable (in %)	72.09	44.91	412
REIT Characteristics			
LEED Share (in %)	1.35	4.29	232
Energy Star Share (in %)	2.22	7.26	232
Total Assets (in billions)	5.78	5.74	232
Interest Coverage (in %)	323.00	139.56	232
Firm Q	1.43	0.32	232
Cash Stock (in %)	1.53	2.40	232

Notes: Table 1 shows the descriptive statistics for corporate bond data. LEED (Energy Star) share is the ratio of total square feet of LEED (Energy Star) certified properties to the total square feet of property portfolio in year *t*. Bond characteristics cover the debt value, year to maturity and a dummy indicating whether the bond is callable. Firm characteristics cover total assets, interest coverage ratio calculated as the ratio of EBIT to interest expense, firm Q calculated as the ratio of market value of assets to book value of assets and cash stock calculated as the ratio of cash and equivalents to total assets. All of the financial controls are observed at year t-1. The descriptive statistics of bond characteristics are by bond issue and the descriptive statistics of green share and firm characteristics are by firm-years.

Table 2
Descriptive Statistics for Commercial Mortgages
(2003-2012)

VARIABLES	Mean	Std. Dev.	Obs.
Mortgage Characteristics			
Mortgage Spread (in bps)	283.66	185.51	3044
Encumbrance (in $millions)	51.01	83.06	3044
LTV (in %)	55.00	24.08	3044
Time-to-Maturity (in years)	6.18	4.69	3044
Cross-Coll (in %)	24.08	42.76	3044
Fixed Rate (in %)	82.39	38.10	3044
Property Book Value (in $millions)	48.33	10.55	3044
Property Age Dummy ≤10 years	0.32	0.47	3044
LEED Label (in %)	1.41	11.80	3044
Energy Star Label (in %)	2.69	16.19	3044
REIT Characteristics			
LEED Share	1.23	3.55	288
Energy Star Share	4.53	11.27	288
Total Assets (in billions)	3.44	4.86	288
Interest Coverage (in %)	293.69	205.39	288
Firm Q	1.35	0.35	288
Cash Stock (in %)	2.50	7.54	288

Notes: Table 2 shows the descriptive statistics for corporate bond data. LEED/Energy Star Labels show whether a property is LEED/Energy Star labeled. Mortgage characteristics cover LTV, year to maturity, dummies indicating whether the mortgage is fixed rate and whether there is any other property collateralizing the mortgage. Property book value and age are also shown. LEED (Energy Star) share is the ratio of total square feet of LEED (Energy Star) certified properties to the total square feet of property portfolio in year t. Firm characteristics cover the total assets, interest coverage ratio calculated as the ratio of EBIT to interest expense, firm Q calculated as the ratio of market value of assets to book value of assets and cash stock calculated as the ratio of cash and equivalents to total assets. All of the financial controls are observed at year t-1. The descriptive statistics of mortgage and property characteristics are by properties and the descriptive statistics of green share and firm characteristics are by firm-years.

Table 3
OLS Regression Results
The Impact of Green Share on Bond Spread and Credit Rating

VARIABLES	(1) Spread	(2) Spread	(3) S&P	(4) S&P	(5) Moody's	(6) Moody's
LEED Share	-1.967*		2.246*		4.812*	
	[1.147]		[1.289]		[2.762]	
Energy Star Share		-0.563		0.680		0.138
		[0.520]		[0.530]		[0.585]
log(Debt Value)	-0.019	-0.009	0.102**	0.096**	0.099*	0.104**
	[0.071]	[0.067]	[0.046]	[0.047]	[0.049]	[0.048]
Time-to-Maturity	-0.132***	-0.134***	0.000	0.001	-0.004	-0.006
	[0.036]	[0.037]	[0.009]	[0.008]	[0.011]	[0.011]
Callable	0.558**	0.541**	0.036	0.021	0.265	0.199
	[0.245]	[0.242]	[0.214]	[0.211]	[0.242]	[0.228]
log(Firm Size)	-0.238***	-0.273***	0.869***	0.883***	0.725***	0.745***
(lagged)	[0.086]	[0.074]	[0.164]	[0.162]	[0.159]	[0.170]
Interest Coverage	-0.345***	-0.318***	-0.220***	-0.209***	-0.200*	-0.182
(lagged)	[0.056]	[0.056]	[0.067]	[0.075]	[0.101]	[0.136]
Interest Coverage	0.013***	0.010***	0.026*	0.025	0.011	0.011
(squared/lagged)	[0.003]	[0.003]	[0.015]	[0.015]	[0.021]	[0.027]
Firm Q	-0.310	-0.381	2.003***	2.030***	1.436***	1.449***
(lagged)	[0.293]	[0.293]	[0.499]	[0.495]	[0.336]	[0.349]
Cash Stock	2.143	3.485	3.573	2.062	-1.362	-1.796
(lagged)	[3.092]	[3.097]	[3.067]	[2.971]	[3.035]	[3.435]
Constant	9.875***	10.272***	-2.822	-2.998	0.579	0.270
	[1.359]	[1.428]	[2.774]	[2.683]	[2.594]	[2.629]
Property Type	Y	Y	Y	Y	Y	Y
Year Dummies	Y	Y	Y	Y	Y	Y
Observations	412	412	222	222	204	204
Adj. R-squared	0.64	0.64	0.73	0.73	0.72	0.71

Notes: The table represents the regression of bond spread on LEED/Energy Star share, bond characteristics and firm characteristics. LEED (Energy Star) share is the ratio of total square feet of LEED (Energy Star) certified properties to the total square feet of property portfolio in year t. Bond characteristics cover the logarithm of debt value, year to maturity and a dummy indicating whether the bond is callable. Firm characteristics cover the logarithm of total assets, interest coverage ratio calculated as the ratio of EBIT to interest expense, firm Q calculated as the ratio of market value of assets to book value of assets and cash stock calculated as the ratio of cash and equivalents to total assets. All of the financial controls are observed at year t-1. The regressions include property type and year dummies. Heteroskedasticity robust and firm-clustered standard errors are in brackets. * indicates significance at the 10 percent level. ** indicates significance at the 5 percent level. *** indicates significance at the 1 percent level.

Table 4
2SLS Regression Results
The Impact of Green Share on Bond Spread and Credit Rating

VARIABLES	(1) Spread	(2) Spread	(3) S&P	(4) S&P	(5) Moody's	(6) Moody's
LEED Share	-4.529**		6.536**		9.144***	
	[1.766]		[2.823]		[3.538]	
Energy Star Share		-0.646		0.925		0.040
		[0.443]		[0.622]		[0.623]
log(Debt Value)	-0.032	-0.008	0.113**	0.064*	0.094**	0.081**
	[0.071]	[0.065]	[0.046]	[0.034]	[0.048]	[0.041]
Time-to-Maturity	-0.130***	-0.136***	-0.001	0.002	-0.002	-0.006
	[0.034]	[0.036]	[0.009]	[0.008]	[0.011]	[0.010]
Callable	0.586**	0.567**	0.087	-0.137	0.328	0.081
	[0.243]	[0.239]	[0.219]	[0.179]	[0.245]	[0.189]
log(Firm Size)	-0.174*	-0.264***	0.832***	0.848***	0.706***	0.757***
(lagged)	[0.097]	[0.072]	[0.161]	[0.150]	[0.147]	[0.158]
Interest Coverage	-0.358***	-0.306***	-0.272***	-0.207***	-0.219***	-0.166
(lagged)	[0.057]	[0.054]	[0.059]	[0.070]	[0.066]	[0.122]
Interest Coverage	0.016***	0.010***	0.031**	0.024*	0.011	0.010
(squared/lagged)	[0.003]	[0.003]	[0.014]	[0.014]	[0.017]	[0.024]
Firm Q	-0.316	-0.467*	1.980***	2.030***	1.426***	1.469***
(lagged)	[0.271]	[0.278]	[0.464]	[0.458]	[0.308]	[0.320]
Cash Stock	0.577	3.198	4.599	2.130	-1.145	-1.827
(lagged)	[3.072]	[3.003]	[3.149]	[2.803]	[3.030]	[3.145]
Constant	9.119***	9.331***	-3.730	-2.806	0.877	0.755
	[1.401]	[1.662]	[2.755]	[2.534]	[2.425]	[2.365]
Property Type	Y	Y	Y	Y	Y	Y
Year Dummies	Y	Y	Y	Y	Y	Y
Hansen J (Prob.)	0.26	0.17	0.13	0.24	0.02	0.15
Kleibergen-Paap (Prob.)	0.00	0.00	0.00	0.00	0.00	0.00
Observations	410	395	222	216	204	199
R-squared	0.64	0.64	0.72	0.74	0.71	0.72

Notes: The table represents the 2SLS regression of bond spread on LEED/Energy Star share, bond characteristics and firm characteristics. LEED (Energy Star) share is the ratio of total square feet of LEED (Energy Star) certified properties to the total square feet of property portfolio in year t. In the first stage, we regress LEED (Energy Star) share on the lagged LEED (Energy Star) share, local greenness measure and the explanatory variables from the second stage regressions. In the second stage, we use fitted LEED (Energy Star) share as an explanatory variable. Bond characteristics cover the logarithm of debt value, year to maturity and a dummy indicating whether the bond is callable. Firm characteristics cover the logarithm of total assets, interest coverage ratio calculated as the ratio of EBIT to interest expense, firm Q calculated as the ratio of market value of assets to book value of assets and cash stock calculated as the ratio of cash and equivalents to total assets. All of the financial controls are observed at year t-1. The regressions include property type and year dummies. Hansen J and Kleibergen-Paap test probabilities for overidentification and underindentification are reported in the table. Heteroskedasticity robust and firm-clustered standard errors are in brackets. * indicates significance at the 10 percent level. ** indicates significance at the 5 percent level. *** indicates significance at the 1 percent level.

Table 5
Regression Results
The Impact of Green Certification on Mortgage Spread

VARIABLES	(1) Spread	(2) Spread	(3) Spread	(4) Spread
LEED	-0.526**		-0.596**	
	[0.245]		[0.265]	
Energy Star		-0.298*		-0.286*
		[0.173]		[0.170]
LTV	0.502*	0.502*	0.139	0.140
	[0.293]	[0.291]	[0.273]	[0.271]
LTV Dummy	-0.450***	-0.450***	-0.286**	-0.284**
(LTV≥0.7)	[0.139]	[0.139]	[0.137]	[0.136]
Property Age Dummy	-0.182**	-0.184**	-0.108	-0.111
(≤10 years)	[0.082]	[0.082]	[0.074]	[0.074]
log(Property Book Value)	-0.128***	-0.130***	-0.074*	-0.078**
	[0.037]	[0.037]	[0.038]	[0.038]
Time-to-Maturity	-0.118***	-0.118***	-0.116***	-0.116***
	[0.011]	[0.011]	[0.011]	[0.011]
Cross-Coll	-0.078	-0.076	-0.365**	-0.361**
	[0.187]	[0.187]	[0.162]	[0.163]
Fixed Rate	1.722***	1.720***	1.752***	1.753***
	[0.191]	[0.192]	[0.179]	[0.179]
Constant	2.288***	2.304***	1.715**	1.752**
	[0.545]	[0.541]	[0.691]	[0.691]
Year Dummies	Y	Y	Y	Y
Location Dummies by State	Y	Y	Y	Y
Property Type Dummies	Y	Y	Y	Y
REIT Dummies	N	N	Y	Y
Observations	3,044	3,044	3,044	3,044
Adj. R-squared	0.50	0.50	0.56	0.56

Notes: The table represents the regression of mortgage spread on LEED/Energy Star dummy, mortgage and property characteristics. LEED (Energy Star) dummy indicates whether a property collateralizing a mortgage is LEED (Energy Star) certified. Mortgage and property characteristics cover LTV ratio calculated as the ratio of encumbrance to the total book value of properties collateralizing a mortgage, logarithm of property book value, year to maturity and dummies indicating whether the mortgage is fixed rate mortgage and whether there is any other property collateralizing the mortgage. All regressions include property type, year dummies and location dummies by state. Model 3 and 4 also includes firm fixed effects. Heteroskedasticity robust and firm-year-clustered standard errors are in brackets. * indicates significance at the 10 percent level. ** indicates significance at the 5 percent level. *** indicates significance at the 1 percent level.