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WHY DO COMPANIES RENT GREEN? REAL PROPERTY AND CORPORATE SOCIAL RESPONSIBILITY

by

Piet Eichholtz
Nils Kok
John M. Quigley

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Piet Eichholtz	Nils Kok	John M. Quigley
Maastricht University	Maastricht University	University of California
Netherlands	Netherlands	Berkeley, CA
p.eichholtz@finance.unimaas.nl	n.kok@finance.unimaas.nl	quigley@econ.berkeley.edu

Abstract

This paper provides the first systematic analysis of the choice by organizations to occupy green office space. We develop a framework of ecological responsiveness, and we formulate five propositions to explain why specific firms and industries may be more likely to lease green space. We test these propositions by analyzing the decisions of more than 11,000 tenants to choose office space in green buildings or in otherwise comparable non-green buildings located nearby. We find that corporations in the oil and banking industries, as well as government-related and non-profit organizations, are among the most prominent green tenants. After appropriately controlling for building quality and for location within one quarter mile, our empirical analysis shows that firms in mining and construction and organizations in public administration are relatively more likely to lease green rather than conventional office space. Furthermore, organizations employing higher levels of human capital (as measured by skills and compensation) are more likely to lease green office space.

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INTRODUCTION

The TNT Group, a global express delivery service headquartered in the Netherlands, recently announced that it would move its operations to three newly-developed green office buildings. The decision is rooted in the broader corporate social responsibility (CSR) policy adopted by the TNT Group. The firm's policy states that "it is our aim to invest in mitigating our impact on the environment." This is but one of a great many examples of conscious decisions by firms to choose "green" buildings. It suggests that real estate is a key element of the CSR and marketing policies of some firms. Similar considerations may influence strategic decision-making in many different kinds of organizations.

Yet the use of green space by firms and organizations has received scant attention in the fast growing management literature relating business organizations and the natural environment. In a recent comprehensive survey of this literature, corporate housing decisions were not mentioned at all (Etzion, 2007). But real estate decisions can form a large part of the environmental footprint of corporations. After all, buildings and their associated construction activity account for almost a third of world greenhouse gas emissions (Royal Institute of Chartered Surveyors, RICS, 2005).

The behavior of corporate tenants can have important implications for the shift to a more sustainable built environment, as changes in demand force real estate suppliers to adapt rapidly to the environmental expectations of tenants. These expectations translate into financial incentives for the property investment industry, as the shifting preferences of tenants affect rental rates on commercial buildings and the volatility of flows of rental income arising from changes in occupancy. If tenants increasingly prefer to lease green

space rather than conventional office space, then a differential in rental rates between green and conventional buildings is inevitable. Moreover, it is possible that the non-green commercial properties will depreciate faster, and occupancy rates might be lower.

In a recent paper (Eichholtz, Kok, & Quigley, 2009), we analyzed the economic value of U.S. office buildings certified with a green label, that is, buildings with an Energy Star or LEED certification. We found that these "green" buildings command a premium in rental rates and sales prices over conventional office buildings. Moreover, the analysis indicated that occupancy rates are higher, and these rates are less volatile than rates in commercial office buildings without a green label. This suggests that there is an identifiable group of tenants willing to pay a premium to lease green space. Prior research also shows that part of the rental and value increment can be explained by climatic factors and the thermal attributes of green buildings, so immediate effects on firm profitability derived from lower utility costs are important. However, a part of the increment commanded by a green building may not be explained by energy savings alone. Other factors are at work.

Clearly, some particular firms must have preferences for green office space. Understanding the motivation for this choice of "sustainable" real estate may be important for two reasons. First, for the property sector to undertake the development of sustainable commercial real estate and for the investment community to finance these investments, it is important to identify the characteristics of potential tenants for this more expensive space (Hoffman & Henn, 2008). Second, a better understanding of those firms predisposed to seek "sustainable'" real estate may allow researchers, managers, and policy makers to determine the scope for voluntary measures, relative to regulation and

command-and-control mechanisms, to promote more sustainable investments (Bansal & Roth, 2000).

In this paper, we create a framework of ecological responsiveness with respect to corporate space-leasing decisions. First, occupancy of buildings with a green label can be economically profitable, as the operating costs of these buildings may be lower, and improved employee well-being may enhance productivity or reduce labor costs (Eichholtz et al., 2009; Fisk & Rosenfeld, 1997). Second, a green corporate headquarters and the use of green space in general, may signal to stakeholders and customers that a firm has a long-run commitment to a CSR policy. If this translates into an improved reputation (Fombrun & Shanley, 1990), then the occupancy of sustainable buildings can have indirect economic effects. For example, such a policy may attract and retain employees and customers (Porter & Van der Linde, 1995). Third, by voluntarily accepting higher environmental standards now, firms can anticipate future legislation and avoid the risk of costly adjustment later. Fourth, although the attention of investors is focused understandably on firm profits, there is a distinct group of potential tenants for whom the non-financial utility from pursuing an active CSR policy exceeds the potential monetary costs of such a policy. The concept of environmental ideology (Kahn, 2007) suggests that non-profit organizations and government agencies may be actively engaged in CSR in advance of purely profit-maximizing firms (Wood, 1991).

In consideration of this framework of ecological responsiveness in leasing decisions, we postulate that firms in specific industries, for example, those in the space-intensive tertiary sector, or firms whose operations may be judged more costly to the environment, are more willing to lease green office space, even if this implies paying

premium rents. We test these propositions exploiting a unique sample of office buildings with an Energy Star and/or LEED-rating, matched with a control sample of nearby office buildings without such ratings.

We collect data on the identity of tenants and the industry characteristics of tenants in these buildings and construct a control sample of other office buildings matched on geographical characteristics. Using data on more than 3,100 tenants in 1,180 green office buildings, and on a control sample of approximately 8,000 tenants in 4,000 conventional office buildings, we find that a substantial number of firms in the oil and the financial services industry are among the largest occupiers of green office buildings. The empirical analysis shows that mining and construction companies, as well as government and government-related organizations, are systematically more likely to lease green office space rather than conventional space when compared to corporate tenants in other industries. Furthermore, employee skill and compensation are positively related to the propensity to lease green office space.

This paper is organized as follows. In Section 2, we summarize previous work on the ecological responsiveness of private firms, and we develop a theoretical framework to address why firms in some specific industries might choose to pay higher occupancy costs to "rent green." Section 3 provides an overview of the data, the methods, and some descriptive information. Section 4 presents results, and Section 5 is a brief conclusion.

CSR AND INVESTMENTS

The mantra of "corporate social responsibility" is increasingly popular among business leaders, and it has become an important element in strategic decision-making (Delmas & Toffel, 2008). In addition, the business case for recognizing CSR is getting

stronger; several empirical studies have concluded that companies that take CSR into account outperform other firms in financial terms.[1] The investment community has embraced the concept of socially responsible investments (SRI) with enthusiasm. For example, the number of SRI mutual funds has grown rapidly. SRI assets under management increased from $639 billion in 1995 to $2.71 trillion in 2007 (Social Investment Forum, 2007). Important institutional investors like APG in the Netherlands and TIAA-CREF in the United States have formulated and implemented an SRI strategy, a strategy which is consistently communicated to the capital markets and to their clients. However, evidence on the relative performance of SRI investments is rather inconclusive.[2]

In evaluating socially responsible investment decisions, investors focus on issues such as the impact of a firm's operations on the environment, the treatment of employees, and the social role of the firm in the broader society – often based on indices of CSR behavior (for example, the benchmarks produced by Kinder, Domini and Lydenberg, KLD, Innovest, or the Dow Jones Sustainability Index) which are now widely available. External agents also routinely screen firms on their corporate real estate and leasing decisions, as it is recognized more clearly that commercial property is of real consequence in matters of environmental sustainability.

Indeed, evidence shows that the property sector accounts for forty percent of U.S. energy consumption and 38 percent of carbon dioxide emissions (U.S. Department of Energy, www.doe.gov). Awareness of these facts has lead to a range of different environmental rating systems for commercial properties, such as the Leadership in

[1] See Orlitzky and Benjamin (2001), for an overview.
[2] See Renneboog et al (2008), for an overview.

Energy and Environment Design (LEED) and Energy Star in the United States, BREEAM in the United Kingdom, and GreenStar in Australia. These environmental labels provide both landlords and tenants with a yardstick to measure the "greenness" of properties.

Incorporating sustainability in real estate investment decisions seems to pay off. Eichholtz et al. (2009) provide evidence that rents and transaction prices in green office buildings exceed those paid for conventional office buildings, while controlling for quality and location-specific characteristics. Effective rents are estimated to be about six percent above rents of conventional office buildings and transaction prices are estimated to be 16 percent higher. Decomposition of this "green" premium provides more insight; the size of the premium in rents and selling prices depends on the extent to which buildings are energy efficient. However, energy efficiency alone does not completely explain the green increment commanded by labeled buildings.

The utility from leasing green space may differ across potential tenants; owners of firms may have a utility function that incorporates a set of corporate and societal values (Bollen, 2008). If these values are important to the owners of firms, we can expect tenants to benefit from leasing space in green buildings, and, more importantly, to obtain economic and other advantages from actively pursuing an environmental policy. In the case of CSR, financial and non-financial motives are not mutually exclusive.

Adapting the framework on corporate environmental responsiveness of Bansal and Roth (2000), we define four rationales that might induce social responsiveness in corporate real estate decision-making: direct economic benefits, indirect benefits, risk avoidance, and ethical motives. Based on these considerations, we develop propositions

as to which industries may be most responsive to social responsibility in their decisions about real estate.

Corporate Responsibility and Real Property

Direct economic benefits

CSR can have a direct effect on the economic profitability of firms. Under a traditional view, CSR poses an inherent conflict between maximizing financial value for shareholders and maximizing social welfare (Baumol, 1991; Friedman, 1970; Shleifer, 2004). Indeed, there is room to question the validity of CSR as a value-enhancing concept (Devinney, 2009). However, an increasing number of studies suggest that incorporating social responsibility in the strategy of the firm need not necessarily reduce – and may even enhance – the value of the firm, for example, through lower operating costs and increased efficiency (Guenster, Derwall, Bauer, & Koedijk, 2009; Porter et al., 1995). Indeed, for commercial buildings, energy – an important element of sustainability – represents a substantial cost of building operations. Energy costs are nearly ten percent of rents. These costs can be decreased through energy efficiency measures that are often integral to green building design. Anecdotal evidence shows that green buildings, on average, use thirty percent less energy than conventional buildings (Kats, 2003). Thus, leasing space in more energy efficient buildings can have a direct impact on occupancy costs.

Another potential benefit of occupancy in a green building is an increase in employee productivity. Several studies report a positive correlation between a building's internal environment (e.g. its indoor air quality) and employee health and productivity.

The potential gains of reduced sick leave and productivity gains are substantial, and it has been asserted that these benefits exceed costs by a wide margin (Apte, Fisk, & Daisey, 2000; Fisk et al., 1997). The enhanced indoor air quality arising from an improved building structure, and from better heating, cooling and ventilation systems is most beneficial for space-intensive firms, especially those with operations primarily located in office buildings, and for firms largely dependent on human capital, such as firms in the tertiary sector.[3]

Indirect economic benefits

Economic opportunities following from the relocation of corporate activities in green buildings could also arise indirectly. These ancillary – often hard to measure – benefits may stem from an improved corporate reputation. Fombrun (1996) argues that a firm's reputation is derived from its credibility, trustworthiness, reliability and responsibility. Responsibility in itself is a function of environmental, financial and social behavior (Miles & Covin, 2000). A continuum in the adaptation of environmental and social behavior ranges from simply complying with legislation to incorporating CSR proactively in daily operations. Leasing space in a green building may reify the environmental and social awareness of a firm and may signal the superior social responsibility of the tenants who locate there. In the end, the implementation of CSR policies rather than the simple policy commitment is necessary to reap the business benefits of CSR (Ramus & Montiel, 2005).

Some have argued that the position of a firm in the CSR continuum is not conditioned externally by society (Devinney, 2009). Nevertheless there is ample evidence

[3] We should note that the scientific basis of assertions about higher productivity in green buildings appears to be quite weak. But a widespread perception of increases in productivity or morale by firm managers may in itself be sufficient to affect the choice of office space.

that stakeholder pressure can affect corporate decision-making. Firms pay more attention to the larger and more powerful corporate stakeholders: investors, customers, and employees (Mitchell, Agle, & Wood, 1997).

Awareness is increasing among investors of the financial impact of inadequate environmental management, and some segments of the investment community avoid investing in corporations that cause social injury or environmental damage (Spicer, 1978). For example, it has been reported recently that institutional investors (such as pension funds, university endowments, banks and insurance companies) are systematically underinvested in so-called "sin" stocks (Hong & Kacperczyk, 2007). Major pension funds such as CalPERS, California and APG, Netherlands, have publicly announced positions to avoid investments in companies with socially unacceptable operations. CalPERS has also initiated one of the first green property funds: the Hines CalPERS Green Development Fund. This fund was formed in August 2006 to develop sustainable office buildings that are certified through the Leadership in Energy and Environmental Design (LEED) program.

If leasing green office space leads to a superior reputation, this may enable firms to attract investors more easily and at better market rates (Milgrom & Roberts, 1986). Some empirical studies have argued that companies with highly developed environmental and social engagement are able to obtain better credit ratings, thereby lowering the cost of debt (Bassen, Meyer, & Schlange, 2006) and lowering the implied cost of equity (Derwall, 2007). Companies that frequently rely on the public capital market will profit from a lower cost of debt or equity.

Second, it is asserted that "customers drive corporations green" (Vandermerwe & Oliff, 1990). Firms operating in competitive markets are exhorted by customers to incorporate environmental responsiveness in manufacturing, research, and marketing. These consumers can now screen firms on their social and environmental engagement. This can pay off. A superior reputation – for example for ethical behavior – may appeal to certain segments of customers (Auger, Devinney, Louviere, & Burke, 2003). This, in turn, may enable firms to increase sales or to charge premium prices (Creyer & Ross, 1997; Klein & Leffler, 1981). The importance of reputation among customers depends on the domain in which a firm operates and the degree to which it interacts directly with retail customers. Reputation effects are important for the largest and most visible firms in an industry, as these companies, like McDonalds, Starbucks, and Wal-Mart, are usually under the direct scrutiny of end-consumers and the media (Fombrun et al., 1990). The availability of information from investment analysts and arbiters of CSR performance might benefit large firms disproportionally, but this simultaneously increases stakeholder pressure to engage actively in sustainable investments.

Alternatively, for those involved in risky technologies (e.g., nuclear or biotechnology), in national and international public policy debates (e.g., those active in certain oppressive societies), or those operating in controversial product-markets (e.g., tobacco or weapons), having a CSR policy may simply be a way to alter a negative image or to offset an otherwise unsavory reputation (Chen, Patten, & Roberts, 2008). In the literature, this is termed "corporate social responsibility for irresponsibility" (Kotchen & Moon, 2007; Strike, Gao, & Bansal, 2006). However, Strahilevitz (2003) argues that CSR activities generally do not enhance the reputation of firms that are perceived to be

unethical. This dictum applies especially for firms supporting causes that are related to their own business, e.g. a tobacco company supporting a cancer foundation, which may simply increase the perceptions of self-serving behavior (Forehand & Grier, 2003). But leasing green space is neutral in that regard. Thus, ecological responsiveness in corporate leasing decisions could potentially help in offsetting a negative corporate image or in improving the reputation of firms in objectionable industries.

Third, a superior reputation may enable firms to attract and retain a better workforce (Turban & Greening, 1997). Indeed, Koh and Boo (2004) show that there is some evidence of a relation between the social activities of companies and employee satisfaction. Increasingly, human capital is viewed as a key source of value creation in modern firms (Zingales, 2000); the attraction and retention of employees is especially important in economies and industries where skilled employees are scarce and skills are inelastically supplied. A recent paper by Edmans (2007) shows that employee satisfaction is positively related to financial performance; employee satisfaction is affected by pecuniary benefits, but also by the quality of working conditions. Green buildings are often asserted to offer a superior working labor environment and could thus help to attract and retain employees.

Risk avoidance

Governmental legislation greatly affects the social responsiveness of firms. This is straightforward; failure to comply with legislation may be costly. A large number of U.S. companies are sued each year for some alleged violation of environmental laws; the likelihood of becoming target of environmental litigation is strongly dependent on the industry type and the location of operations. For example, firms in environmentally

sensitive industries are more exposed to media visibility, which shapes the public's view of firm activities (Fombrun et al., 1990).

The litigation costs can be direct, through administrative and civil penalties, or indirect, through negative market responses following public announcement of an environmental lawsuit (Kassinis & Vafeas, 2002). Especially in hazardous and resource-intensive industries, it may be likely that the monetary gains from going beyond minimal compliance with rules and regulations will largely offset the initial investment. Although the real estate sector can hardly be classified as a particularly hazardous industry, corporate tenants might still be vulnerable to costly litigation related to the labor environment (e.g., asbestos, formaldehyde). Leasing sustainable office space may certainly decrease the risk of future employee litigation, by providing high indoor air quality standards and by demonstrating the firm's commitment to its workforce.

Furthermore, by anticipating future legislative changes, firms can avoid costly organizational and operational restructuring. With respect to real estate, property investors or firms that own their corporate properties risk costly renovations if environmental building standards become very strict. The adoption of the relatively strict building requirements by the U.S. General Services Administration is testimony to this development. By investing in more sustainable buildings, some of this risk can be reduced. Moreover, many energy-saving measures are much cheaper to incorporate in new buildings than in existing ones. Property developers and the future owners of the offices they develop face a trade-off between a certain, but relatively small investment now, and an uncertain, but much larger required investment later. The increasing likelihood of regulation makes early investment more attractive.

Ethical behavior

"Corporate social engagement" originally referred to the ethical motives of firms rather than financial consequences (Bowen, 1953), but for political and economic reasons the focus of social engagement is often directed towards the economic advantages of incorporating CSR in strategic decision-making. However, the first-movers and early-adopters of social and environmental innovations are often those parties for whom monetary gains are of secondary importance. Federal and local governments and non-profit organizations are eager to demonstrate their environmental engagement through leasing space in green buildings, just because this is "the right thing to do" (Wood, 1991). Indeed, environmental ideology may drive the choice for green office space, in a similar way that it is a determinant of the choice of consumers in the private market (Kahn, 2007). In addition, governmental and non-profit organizations are subject to less market discipline. With a soft budget constraint, any premium for renting green space may be less onerous.

Propositions

The four factors relating real estate decision-making to ecological responsiveness imply different weights for firms in different industries. By exploring the varying degrees to which firms from different industries rent space in green offices, we can investigate the motivations for pursuing such a strategy. Based on this premise, we formulate five propositions, which will be analyzed and tested by relying upon detailed information on individual corporate tenants for a large sample of commercial office buildings in the U.S.

Proposition I: Firms in the tertiary sector, i.e. the service industry, profit most from the cost savings and the improved perception of the working environment of green office buildings. Therefore, they will have a higher likelihood of renting green office space.

Proposition II. As stakeholder pressure regarding CSR is more intensely directed at the largest and most visible firms in an industry, these are more likely to act in a social and environmentally responsible manner. These firms will therefore have a higher likelihood of leasing green office space.

Proposition III. Firms with environmentally sensitive operations will be more likely to lease green office space, as this can help to offset otherwise more negative corporate images.

Proposition IV. Firms in industries that are dependent on high levels of human capital and high wage workers are more likely to rent office space in green buildings.

Proposition V: Government, government-related organizations, and non-profit institutions are more likely to act in socially responsible ways, and thus to lease green space, as monetary factors are of less importance. The possibly higher cost of leasing green space can be more easily passed on to the taxpayer or sponsors. They face soft budget constraints.

Analysis

We analyze the phenomenon of tenancy in green buildings in the commercial office sector in three distinct but related ways. We relate each of these analyses to the theoretical framework of ecological responsiveness and the propositions developed in this section. First, we report those entities that consume the largest amount of green office space, and we report the industries (that is, the Standard Industrial Categories, SICs) that consume the largest amount of green office space. Second, we analyze the concentration of tenants in green office buildings relative to concentrations in comparable nearby conventional buildings. We analyze concentration in terms of the number of tenants and the industrial classification of tenants in green buildings as compared to a control sample. Third, we investigate empirically the fraction of office space occupied by various industry groupings in a given green buildings as compared to the fraction occupied by the same industries in otherwise identical control buildings.

DATA AND METHODS

We focus on tenants in commercial office buildings that have received an Energy Star or LEED certification. These green labels represent the most widely used certifications of building sustainability in the United States. They differ in two main aspects: their origin and the aspects of sustainability they measure. The Energy Star label is a joint initiative of the U.S. Environmental Protection Agency and the U.S. Department of Energy. The Energy Star program was initially introduced to measure the energy efficiency of computers and home appliances; the label was later extended to include residential as well as non-residential real estate. The label focuses solely on energy use, and does not measure other building characteristics that are potentially relevant to

sustainability. The energy performance and emissions of commercial and industrial facilities are certified by a licensed engineer. Buildings that are among the top quarter of comparable buildings in the country in energy efficiency are eligible for Energy Star certification.

As of August 2009, there were approximately 7,800 buildings with an Energy Star label, including about 3,100 office buildings.

The Leadership in Energy and Environmental Design (LEED) is a third-party certification program, initiated in 2000 by the U.S. Green Building Council (USGBC), a non-profit organization. Besides energy efficiency, LEED certification is based on a range of criteria, and it relies on a complex point system. The landlord rates the performance of a building in six different categories, and projects must satisfy particular prerequisites to earn points. The six categories include sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation in design. A LEED certificate is awarded based on the aggregate score, where the level of the award can range from certified (pass) to platinum (excellent). There are separate programs for existing buildings and newly developed buildings.

As of August 2009, approximately 3,100 buildings had been awarded a LEED certificate, including about 1,000 office buildings.

The addresses and postal codes of the Energy Star and LEED buildings are publicly available. We match these addresses to office buildings listed in the CoStar database. CoStar is the major repository and provider of commercial real estate financial data. The CoStar Group maintains records on some 2.4 million properties, including commercial property transactions, current rental and occupancy data, and the hedonic

characteristics of buildings. We matched the CoStar database with the Energy Star and LEED address files as of June 2008. This led to 1,360 office buildings in the Costar database matched with a green label; 1,045 buildings were matched to those with an EnergyStar certification, 286 buildings were matched to a LEED certification, and 29 buildings had a certification from both organizations.

Figure 1 provides a geographic summary of our match between the Energy Star-certified commercial office buildings, the LEED-certified buildings, and the population of commercial buildings identified in CoStar. The figure reports the number of certified commercial office buildings in each state, as well as an estimate of the fraction of office space in each state that has been rated for environmental sustainability.[4]

About three percent of U.S. office building space is green-labeled. As the map indicates, in some states – notably Texas, Washington, and Minnesota – more than five percent of office buildings are rated. The incidence of green office space is almost nine percent in California – 122 million square feet of office space are labeled. In a large number of states, however, only a small fraction of office space is certified by EnergyStar or LEED. Apart from California, states with extreme temperatures are apparently more likely to have rated office buildings.

– Insert Figure 1 about here –

The Tenant Sample

[4] Ratios based upon the CoStar data probably overstate the fraction of green office space in the U.S. inventory, since CoStar's coverage of smaller and older office buildings is less complete.

For each green building in the sample, we assembled the names of the five largest tenants, their Standard Industry Classification (SIC) code, and the floor space they occupy. In addition, the CoStar Tenant Module allowed us to determine the total square footage of green office space occupied by each individual firm. Similarly, we collected data on the total square footage of green office space that is occupied in each specific four-digit SIC code.[5] This matching and data extraction yielded a sample of 1,180 green office buildings, occupied by a total of 3,179 different tenants.

Table 1 provides an overview of the green space occupied by the twenty largest tenants in the U.S. Column (1) shows the total square footage of green space occupied by each tenant. Commercial banks, such as Wells Fargo Bank, Bank of America, and ABN-AMRO are all among the largest consumers of green space. This can be partially explained by their extensive use of office space in general; the banking industry is notoriously space intensive. This is in line with Proposition I, in which we hypothesize that firms in the tertiary sector are more likely to rent green space. Furthermore, in support of Proposition V, the federal government and government-related organizations such as the Department of Health and Human Sciences and the Environmental Protection Agency are prominent tenants of green office space. Last, the oil industry seems to be well represented in green office buildings, with tenants such as Shell and Chevron leasing a substantial percentage of the green buildings office stock. This is in line with Proposition III, where we posit that firms with environmentally sensitive operations are possibly more inclined to lease space in green buildings.

[5] The totals of green office space occupied by individual tenants or industry groups are probably underestimated, as CoStar covers approximately eighty percent of the U.S. commercial property market. Moreover, tenant data are not available for all green office buildings.

To account for differences in office space utilization among industries, column (4) shows the total square footage of office space occupied by the largest green tenants and column (5) presents the green office stock rented by each tenant, relative to the total office stock it occupies (as reported in CoStar). Several trends are apparent. First, the California Environmental Protection Agency (Cal/EPA) is not only among the top-twenty occupants of green office space, but all of its office stock has a green label. Indeed, the agency boasts that its headquarters building in Sacramento is equipped with state-of-the-art techniques to improve indoor air quality and to reduce energy use and that it is among the world's most energy and resource-efficient buildings. They note that the building "gives a physical presence to the reality of an agency whose single task is to guard the great environment." This is a clear example of how non-profit or governmental organizations derive non-financial utility from leasing green, supporting Proposition V. As mentioned on the Cal/EPA website, "this approach not only makes environmental sense, but it also makes the building a better place to visit and in which to work." This motivation is in line with Proposition IV.

Some of the commercial banks are not only prominent tenants of green space in absolute terms, but also relative to their total office stock. For example, ABN-AMRO and Wells Fargo lease substantial proportions of their total office needs – 58 percent and 37 percent, respectively – in green buildings. For the former, the headquarters in Chicago provides the main explanation; the 1.3 million square foot office building, which makes up most of the office stock leased by ABN-AMRO, was awarded a "LEED for new construction" label at the gold level in 2007. Wells Fargo occupies several buildings with a green label. In fact, sustainability is a major strategic issue, and the bank has a well-

articulated sustainability policy. In interviews conducted by telephone with the authors, a representative explained that "...it is important to show our environmental focus, for example, by leasing green office space." As argued by Ramus and Montiel (2005), it is the implementation of CSR policies rather than the policy commitment that is necessary to reap direct business benefits. This is in line with reputation Proposition II, as leasing space in a green building may send a signal of social awareness to stakeholders.

For other corporations, such as Adobe Systems, Compuware Corp., or The Vanguard Group, leasing green space may not be a deliberate act, but it may merely come with a preference for high quality office space, in combination with a growing need for space due to rapid expansion. Indeed, it has been shown that green buildings are in general newer, have a higher quality rating, and have more amenities in comparison to conventional office buildings (Eichholtz et al., 2009). Alternatively, the location of firm activities in green buildings may attract and retain highly qualified employees.

Finally, it is worth noting that the twenty tenants documented in Table 1 occupy almost one sixth of the total inventory of green office space in the United States.

– Insert Table 1 about here –

Table 2 reports the aggregate amount of green office space occupied by the largest four-digit SIC codes, in absolute terms as well as relative to the total office stock occupied by the SIC code. Column (1) shows the twenty industry categories with the highest aggregate of total green office space. Legal services – which includes attorneys and their support staffs – is by far the largest occupant of green office space. Although

individual tenants from the legal services industry are not among the major occupiers of green space, the sector as a whole has a clear preference for sustainable office buildings. This reflects the fact that firms in the legal services industry are relatively small, so their choices are not clearly visible at the level of the individual firm when ranked by absolute total green space consumption. The preference of the legal services industry for more sustainable office space is in line with Propositions I and IV, wherein we posit that tenants in the tertiary sector are more likely to lease space in green buildings, as the direct benefits of leasing green space affect these tenants most. Moreover, a superior indoor environment is attractive to the valuable human capital employed.

Other industry categories that are among the largest tenants of green space are Public Administration, National Commercial Banks, Crude Petroleum and Gas, and Investment Advisors. This is generally in line with the evidence in Table 1.

In Column (5), where we document the incidence of green space as a percentage of total office space occupied by the sector (as reported in CoStar), we observe that more than 60 percent of the total office stock occupied by the Crude Petroleum and Gas industry is leased in office buildings with a green label. This fraction is far higher than it is for other industries, and supports our Proposition III; firms in environmentally sensitive industries have a higher likelihood of leasing green. For example, Chevron Corp. has recently occupied a newly developed building in Louisiana, which has been awarded a LEED Gold certification. Leasing green space “supports the company's long-standing commitment to the Gulf Coast and the state of Louisiana. The building is located in a park-like setting, and the three hundred thousand square foot office building

provides a safe, healthy and productive workplace for up to 750 people."[6] Although this expression of social and environmental awareness is unrelated to the core business of Chevron, it might help to improve its reputation among stakeholders.

– Insert Table 2 about here –

Control Sample

Industry observers note that the three most important attributes of real estate are "location, location, and location." We take this maxim seriously by matching each green building to a set of commercial office buildings which are in close proximity. In this way, we identify clusters of nearby buildings. Each cluster contains one green office building and all other office buildings within a 0.25 mile radius. This match, which relies upon the latitude and longitude recorded for each green building, yielded 1,180 clusters, each containing one green building and an average of three nearby control buildings.

Figure 2 illustrates the research design with examples from three different urban environments. For the green building depicted in Chicago, the map indicates that there are 41 non-green office buildings within the surrounding 0.2 square miles. For the green building in Houston, there are six nearby non-green buildings, while for the green building in Columbus, there is only one non-green building within a quarter of a mile.

For each control building, we collect information on the five major tenants, their SIC classifications and their square footage occupied. In total, the control sample includes 4,390 office buildings, with approximately 8,000 unique tenants. Appendix A

[6] Chevron Press Release, May 2008.

provides an overview of the control sample – tenants and industries with the largest aggregate office stock.

– Insert Figure 2 about here –

STATISTICAL ANALYSIS AND EMPIRICAL RESULTS

Tenant Concentration in Green Versus Non-Green Buildings

In Section 2, we hypothesize that specific organizations and industries may have a higher likelihood of leasing green office space, for example governmental and non-profit organizations – to maximize non-financial utility – or the oil industry – to offset negative reputation effects from environmentally sensitive operations. To investigate the propositions more systematically, we calculate the fraction of leased office space per building for each tenant in the sampled buildings. Then we aggregate these fractions based on one-digit SIC codes for each green building and each control building.[7] For each building, this yields the distribution of office space by major industrial category, matched with the characteristics of that building – such as building age, size, and quality, and the presence of an Energy Star and/or LEED certification.

We first investigate differences in tenant composition in green versus conventional office buildings. For instance, if green buildings serve as a "flag" for CSR policies, these buildings may be more likely to be owner-occupied or to have a more

[7] We use one-digit SIC code aggregates rather than two-, three-, or four-digit SIC codes, as these would not yield a reasonable number of observations per industry. Following the standard industry classification structure, we group industries in 1) Agriculture, Forestry and Fishing, 2) Mining and Construction, 3) Manufacturing, 4) Transportation, Communications, Electric, Gas, and Sanitary Services, 5) Wholesale and Retail Trade, 6) Finance, Insurance and Real Estate, 7) Services and 8) Public Administration.

concentrated tenant base. We calculate Herfindahl indices of tenant concentration for each green building and its corresponding set of control buildings.

$$(1) \qquad H_n = \sum_{i=1}^{I} O_{in}^{\ 2} ,$$

where H_n is the Herfindahl index for building n, O_{in} is the total square footage occupied by tenant i as a percentage of the total occupied office space in building n, and I is the number of tenants.

To compare the clustering of tenants and industries in green versus conventional office buildings, while controlling specifically for quality and locational effects, we estimate the following equation:

$$(2) \qquad (H_{gn} - H_{cn}) = \alpha + \beta_n (X_{gn} - X_{cn}) + \sum_{n=1}^{N} \gamma_n c_n + \varepsilon_n,$$

where the dependent variable is the difference between the Herfindahl index in green building g versus control building c in a cluster n. We estimate Equation (2) for two separate Herfindahl indices: one based on the concentration of tenants in the building and the other on the concentration of industries in the building. We also estimate this equation using as the dependent variable the difference in the fraction of space occupied by the largest tenant in a green building and each of the corresponding control buildings. $(X_{gn} - X_{cn})$ is a vector of the hedonic characteristics of the green building – building age, building size and building quality – in cluster n, minus the corresponding quality characteristics of the control building. c_n is a dummy variable with a value of 1 if a building is located in cluster n and zero otherwise. If there are N clusters, and cluster n is composed of M_n buildings, then there are $\sum_{n=1}^{N}(M_n - 1)$ observations in the regression.

These location coefficients account for the unobserved characteristics related to each specific location. We include one dummy for each of the *N* distinct 0.2 square mile clusters. α, β_n, and γ_n are estimated coefficients and ε_n is an error term. Results are presented in Table 3 for ordinary least squares regression models corrected for heteroskedasticity (White, 1980).

Column (1) reports regressions using the difference in the tenant concentration as the dependent variable. The estimated intercept, α, indicates that tenant concentration in green buildings is, on average, 33 percentage points greater than for otherwise comparable office buildings without an Energy Star or LEED label. Note that this difference persists after controlling for variations in building age, quality, and size, and after taking into account the cluster-specific location attributes. In column (2), the dependent variable is the difference in the fraction of office space occupied by the largest tenant in green versus non-green buildings. Holding building quality and location constant, the largest tenants in green buildings occupy 31 percentage points more space on average than the largest tenants in conventional office buildings. Both findings suggests that green buildings are more likely to have a large key – or anchor – tenant, which again suggests that the larger corporations in an industry use green buildings, for example, to demonstrate commitment to corporate social responsibility. The results in Column (3) indicate that the tenant base is more diverse by industry in green buildings, with the Herfindahl index of industry concentration 14 percentage points lower, on average, than in otherwise comparable regular office buildings. So, green buildings attract tenants from different industry categories, as opposed to conventional office

buildings, where similar industries tend to cluster. This also seems to suggest that the choice for green office space is a rather deliberate one.

– Insert Table 3 about here –

The likelihood of leasing green

To investigate the likelihood that certain industries will systematically lease green space rather than conventional office space, we compare the fraction of office space occupied by a specific industry in a green building with the fraction occupied by the same industry in each control building in the same cluster. In this model, we also include summary measures of variations in the average characteristics of each one-digit industry code by metropolitan area. We estimate the following equation for each one-digit SIC code:

$$(3) \qquad (O_{gn} - O_{cn}) = \alpha + \beta_n (X_{gn} - X_{cn}) + \sum_{n=1}^{N} \gamma_n c_n + \delta_n Y_n + \varepsilon_n ,$$

where the dependent variable is the difference between the fraction of square footage occupied by tenants in green building *g* in cluster *n* and the fraction of square footage occupied by tenants in control building *c* – where *c* is located in the same cluster. (X_{gn} – X_{cn}) is a vector of the hedonic characteristics of the green building – building age, building size and building quality – in cluster *n*, minus the corresponding quality characteristics in the control building. c_n is a dummy variable with a value of 1 if building *n* is located in cluster *n* and zero otherwise. Again, these location coefficients account for unobserved characteristics related to each specific location. To control further for differences in the average characteristics of industries across metropolitan areas, we

include a vector Y_n of variables measuring average employee output, payroll per employee, the number of employees per establishment, and the number of establishments. These data were computed for each one-digit SIC code by MSA.[8] α, β_n, γ_n and δ_n are estimated coefficients and ε_n is an error term.

Results are presented in Table 4 for ordinary least squares regression models corrected for heteroskedasticity (White, 1980). Each column corresponds to a specific one-digit SIC code. Note that firms in the 'Finance, Insurance, and Real Estate' and the 'Services' sectors are more inclined to lease green office partially due to the fact that green buildings are of higher quality than conventional office space. The opposite holds for firms in the 'Retail' and 'Manufacturing' sectors, where the choice for green real estate is not primarily determined by the underlying difference in building quality.

Holding other factors in the regression constant, the intercept indicates whether the fraction of office space occupied by tenants in a specific industry is larger (or smaller) in green office buildings as compared to regular office buildings. For most industries, the constant is significantly negative, which indicates that tenants are more likely to lease space in conventional office buildings rather than in environmentally-labeled buildings. This is consistent with the small fraction of the total office stock that has a certified label.

Exceptions to the pattern of significantly negative coefficients are the 'Mining and Construction' and 'Public Administration' industries. The former has a significantly positive constant, which indicates that tenants in this industry group, on average, lease more office space in green buildings than in non-green office buildings, controlling for differences in building quality. This finding is in line with Proposition III, which states

[8] The raw data was obtained form the Office of Advocacy, US Small Business Administration (based on data provided by the US Census Bureau for 1997).

that "...firms with environmentally sensitive operations will be more likely to lease green office space, as this can help to offset otherwise more negative corporate images." As documented in Table 2, companies in the mining and construction industry have a large fraction of office inventory in green buildings, which is confirmed by the results in Column (2) of Table 5. Indeed, the tendency of "irresponsible" organizations to offset an otherwise negative corporate image by responsible "social" or "environmental" behavior is widely acknowledged in the literature (Kotchen et al., 2007; Ramus et al., 2005; Strike et al., 2006). We find an insignificant difference in space occupied in green buildings as compared to regular buildings for the Public Administration sector. This means that, relative to conventional office buildings in the same geographical area, the government and government-related tenants do not occupy significantly more space in green office buildings.

The variables measuring differences in the average characteristics of industries across metropolitan areas – the concentration of establishments and labor productivity – are generally statistically significant. This suggests that there are variations in the propensity to "lease green" by industry across metropolitan areas – arising from variations in industry characteristics across metropolitan areas.

We measure the clustering of certain industries by including a variable reporting the number of establishments for the specific industry in each metropolitan area. The coefficient is negative for the finance, insurance, real estate and services industry. This implies that in areas with a higher office space density, the likelihood of leasing green office space rather than conventional office space is smaller. These locations are likely to be in, or very close to, the Central Business District (CBD), usually the location having

the best locational quality. This result confirms previous research, e.g., Eichholtz et al., (2009), which found that the increased rents and market values reported for green buildings were smaller at the best locations. The variable representing the average size of establishments in terms of number of employees is significantly positive for four out of five industries. This implies that in larger companies, there is a preference for green office space over conventional office space, as suggested in Proposition II.

For the variable measuring the payroll per employee – which is a proxy for the quality of human capital – the coefficient is almost consistently positive. Recall that this variable varies for each industry group by metropolitan area. This implies that tenants who are more dependent on high levels of human capital are more likely to rent office space in green buildings, confirming Proposition IV. Moreover, the significantly positive coefficient on the variable measuring sales per employee indicates that in areas with higher employee productivity – or more value-added per employee – tenants across all industries are more likely to lease green rather than conventional office space.

More productive companies employing valuable human capital are more likely to rent space in these same buildings.

– Insert Table 4 about here –

As a robustness check, we also investigate the propensity of industries to lease green office space rather than conventional office space, using a Tobit approach. Appendix B elaborates on the methodology and the results, but the main conclusion from this additional analysis is that only tenants in public administration have statistically

higher occupancy of green office buildings relative to otherwise comparable regular office buildings (after controlling for quality and locational characteristics).

CONCLUSIONS

Awareness is growing that the built environment is important as a source of greenhouse emissions and as a major consumer of energy and raw materials. Firms more conscious of corporate social responsibility may therefore include real estate in their strategic decision-making by leasing environmentally-labeled office space.

Prior evidence has shown that some corporate tenants are not only willing to lease space in green office buildings, but that these tenants pay a rental premium as well. We identify a framework of four determinants of the penetration of CSR in real estate decision-making. From these, we develop five propositions about which firms or industries may be more willing to rent green space and to pay the rental premium. By building a comprehensive description of the tenants in U.S. office buildings with a green label – awarded by Energy Star or the USGBC – we address these propositions.

The descriptive results show that the oil industry is a major consumer of green office space, which follows from a general proposition that firms in environmentally sensitive industries will actively incorporate sustainability in strategic decisions such as headquarters selection (perhaps merely to enhance reputation). Firms in the legal and financial services industry lease a substantial share of green office space as well. For some of these firms, further investigation shows support for our proposition that firms in

the tertiary sector acknowledge the productivity benefits of green buildings. However, it is likely that for other firms, leasing green is a result of the preference for high quality buildings, rather than a conscious act of "responsible behavior," since green buildings are usually higher-quality buildings.

We then address tenant composition in green buildings as compared to a matched set of conventional office buildings. We find that, controlling for differences in quality and unobserved locational characteristics, tenants are more concentrated in green buildings, occupying larger shares of the buildings. This may indicate the desire to use a building as a flag to signal commitment to CSR.

In general, the descriptive evidence confirms our propositions, to the extent that the expected industries each have a few "green" leaders. The results of the regression and additional Tobit-analyses show that a statistically significant commitment to green space usage currently exists for the manufacturing and mining industry and for public administration, respectively. These findings confirm the proposition that companies with socially challenging operations may use green buildings to offset negative reputation effects. Moreover, the government and government-related organizations, for which non-financial utility may be more important, are substantially more likely to rent green office space than are other sectors. The most prominent example is California's Environmental Protection Agency, with all of its activities located in a highly sophisticated environmental-friendly office building.

The concentration and size of establishments, as well as the extent to which human capital is available across metropolitan areas, has a distinct positive influence on the fraction of environmentally-labeled space that is leased by particular industries. This

is in line with our proposition that the choice for green office space is responsive, at least in part to the perception that labeled office space may bring high-quality labor environment.

For organizations, the findings in this study show clearly that corporate leasing decisions can facilitate the implementation of a socially responsible strategy. Real estate provides a tangible element of a CSR policy to stakeholders.

For developers and investors, the findings in this study have important implications. The higher initial outlay that may be needed for a newly developed sustainable office building, or for the refurbishment of an existing office building, can be recouped through energy savings and lower risk premiums, or through higher net rents. Currently, industry leaders and non-profit organizations (especially government) seem the most willing to pay this rental premium. However, for the critical mass to engage in renting green, more insight about direct and indirect benefits of such a strategy is needed first. This paper provides a first step.

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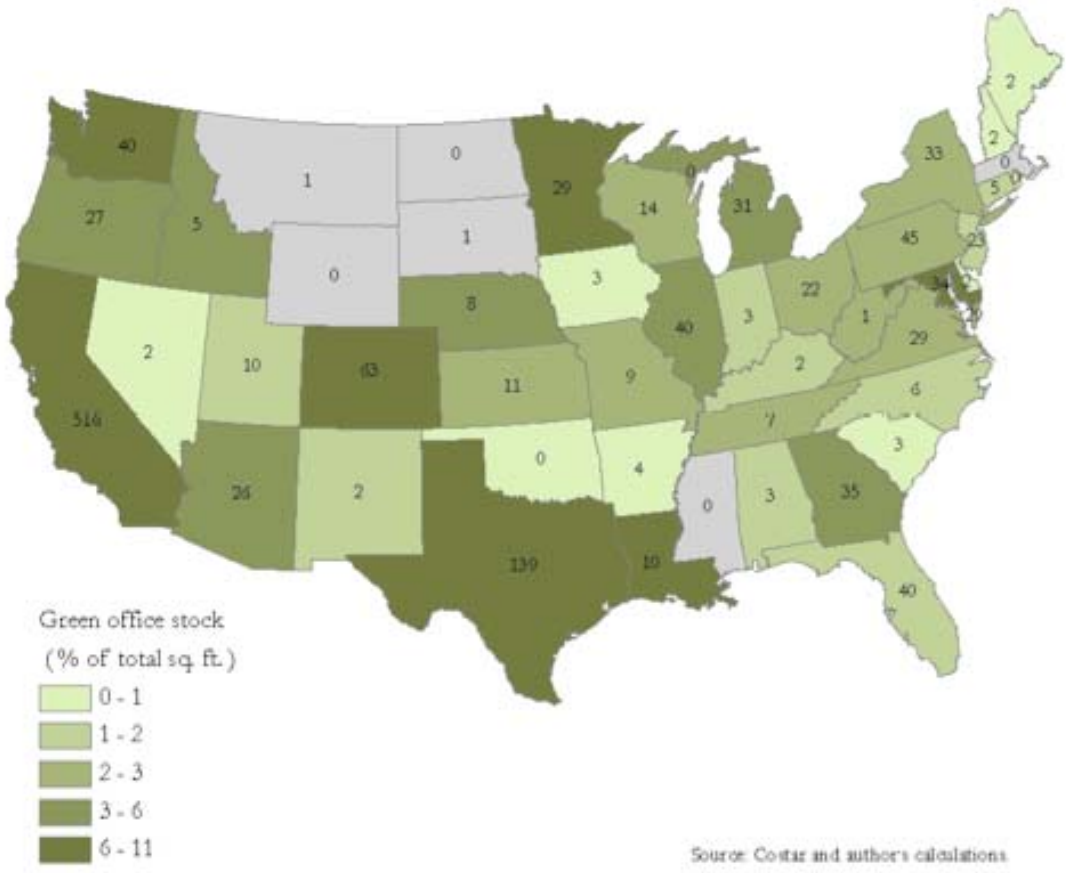
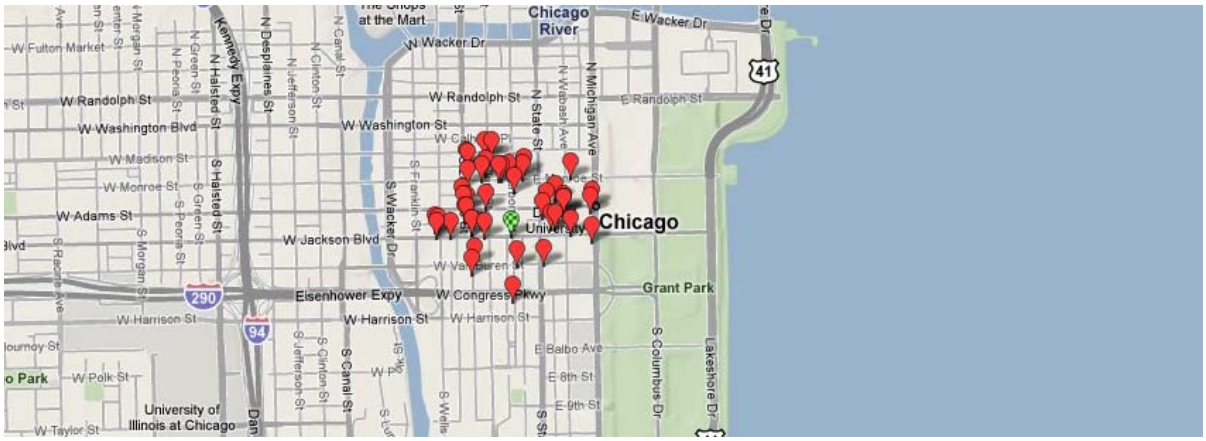
FIGURE 1
Distribution of Green Office Buildings by State
(percent of the stock of office space)
2008



Note: The number of green office buildings in each state is also reported.

FIGURE 2
Clusters of Green and Control Buildings

A. Chicago, IL



B. Houston, TX

C. Columbus, OH

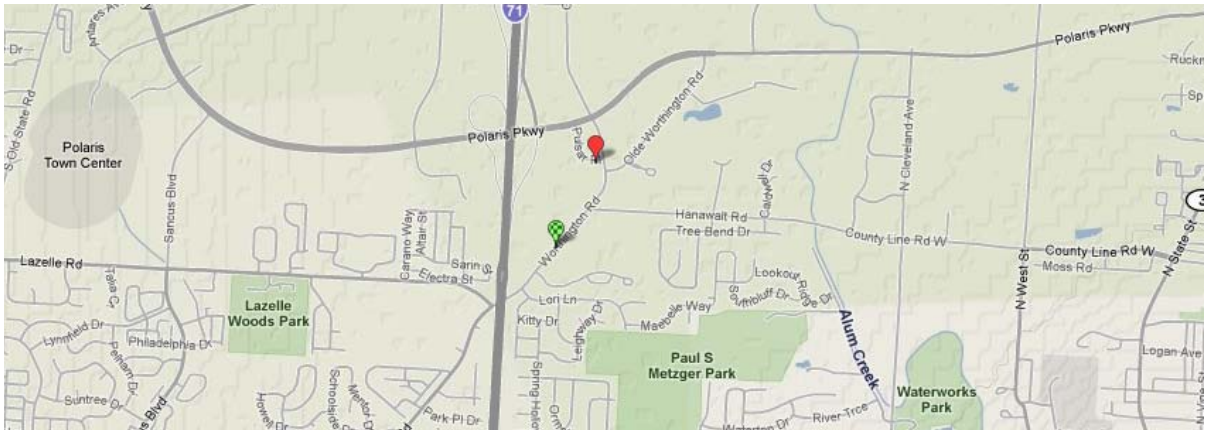


TABLE 1
Incidence of Green Space Utilization by Major Tenants
Fraction of Firm's Office Space Housed in Green Buildings

				Space Occupied		
		(1)	(2)	(3)	(4)	(5)
Tenant Name	Industry Description	Green Office Space	Fraction of Total Green Space	Cumulative Fraction of Total Green Space	Total Space CoStar	Green Space as Fraction of Total Space Rentals
		x 1000 sq. ft.	%	%	*x 1000 sq. ft.*	*%*
Wells Fargo Bank	National Commercial Banks	2,741	1.61%	1.61%	7,343	37.33%
United States Government	General Government	2,415	1.42%	3.03%	14,631	16.50%
Bank of America	National Commercial Banks	2,124	1.25%	4.28%	18,695	11.36%
ABN AMRO	State Commercial Banks	1,724	1.01%	5.29%	2,993	57.60%
State of California	General Government	1,568	0.92%	6.21%	5,706	27.49%
Deloitte and Touche	Accounting, Auditing, Bookkeeping	1,554	0.91%	7.13%	5,131	30.28%
Best Buy	Radio, Television, Consumer Electronics	1,500	0.88%	8.01%	2,104	71.31%
U.S. Dept. of Health – Human Sc.	General Government	1,442	0.85%	8.86%	1,662	86.72%
Shell	Gasoline Service Stations	1,362	0.80%	9.66%	3,989	34.14%
Chevron	Gasoline Service Stations	1,229	0.72%	10.38%	6,181	19.88%
Blue Cross and Blue Shield	Hospital and Medical Service Plans	1,211	0.71%	11.09%	12,251	9.89%
Adobe Systems	Prepackaged Software	1,158	0.68%	11.77%	1,388	83.43%
Compuware Corporation	Prepackaged Software	1,094	0.64%	12.41%	1,300	84.18%
American Express	Personal Credit Institutions	1,018	0.60%	13.01%	6,754	15.07%
The Vanguard Group	Investment Advice	990	0.58%	13.59%	1,569	63.07%
Cal/EPA	Land, Mineral, Wildlife, Forest Conservation	950	0.56%	14.15%	950	100.00%
Mitre Corporation	Commercial Physical and Biological Research	944	0.55%	14.71%	1,293	73.02%
JP Morgan Chase	Investment Advice	907	0.53%	15.24%	10,670	8.50%
Skadden Arps	Legal Services	889	0.52%	15.76%	1,751	50.77%
Ernst and Young	Accounting, Auditing, Bookkeeping	864	0.51%	16.27%	4,149	20.83%

TABLE 2
Incidence of Green Space Utilization by Industry
Fraction of Office Space Housed in Green Buildings by Four-Digit SIC

				Space Occupied		
		(1)	(2)	(3)	(4)	(5)
SIC Code	Industry Description	Green Office Space	Fraction of Total Green Space	Cumulative Fraction of Total Green Space	Total Office Space CoStar	Green as Fraction of Total Space Rentals
		x 1000 sq. ft.	%	%	*x 1000 sq. ft.*	%
8111	Legal Services	25,593	15.04%	15.04%	217,097	11.79%
6021	National Commercial Banks	9,436	5.55%	20.59%	86,782	10.87%
9199	Executive, Legislative and General Office	9,035	5.31%	25.90%	67,081	13.47%
1311	Crude Petroleum and Gas	7,076	4.16%	30.06%	11,304	62.60%
6282	Investment Advice	6,532	3.84%	33.90%	100,939	6.47%
8721	Accounting, Auditing, and Bookkeeping Services	5,158	3.03%	36.93%	136,766	3.77%
5731	Radio, Television, and Consumer Electronics Stores	1,531	0.90%	37.83%	3,888	39.37%
9311	Public Finance, Taxation, and Monetary Policy	822	0.48%	38.31%	14,491	5.67%
7373	Computer Integrated Systems Design	816	0.48%	38.79%	19,487	4.19%
3812	Search, Detection, Navigation, Guidance, …	291	0.17%	38.96%	4,869	5.97%
2759	Commercial Printing, NEC	287	0.17%	39.13%	3,996	7.17%
3069	Fabricated Rubber Products, NEC	285	0.17%	39.30%	769	37.08%
4731	Arrangement Transportation of Freight and Cargo	282	0.17%	39.46%	8,348	3.38%
9621	Regulations and Adm. of Transportation Programs	280	0.16%	39.63%	9,115	3.07%
7997	Membership Sports and Recreation Clubs	274	0.16%	39.79%	1,696	16.15%
8641	Civic, Social, and Fraternal Associations	274	0.16%	39.95%	14,362	1.91%
2086	Bottled and Canned Soft Drinks, Carbonated Waters	261	0.15%	40.10%	5,037	5.19%
5411	Grocery Stores	253	0.15%	40.25%	8,363	3.03%
4724	Travel Agencies	252	0.15%	40.40%	7,539	3.34%
6552	Land Subdividers and Developers,	250	0.15%	40.55%	9,676	2.58%

TABLE 3
Regression Results
Differences in Tenant Concentration in Green Buildings and Non Green Buildings

	Tenant Concentration	Largest Tenant	Industry Concentration
Δ Building Age	-0.001***	-0.000***	-0.000***
	[0.000]	[0.000]	[0.000]
Δ Building Quality	-0.150***	-0.127***	-0.078***
	[0.008]	[0.008]	[0.007]
Δ Building Size	-0.061**	-0.031	-0.060***
(millions of sq. ft.)	[0.024]	[0.024]	[0.021]
Constant	0.325***	0.311***	-0.142***
	[0.017]	[0.016]	[0.015]
Observations	4309	4309	4309
R^2	0.62	0.62	0.61
Adj R^2	0.53	0.54	0.52

Notes:

The dependent variable in Column (1) is the difference in tenant concentration – as measured by the Herfindahl index – in a green building and each of the corresponding control buildings in the same cluster.

The dependent variable in Column (2) is the difference in the fraction of space occupied by the largest tenant in a green building and each of the corresponding control buildings in the same cluster.

The dependent variable in Column (3) is the difference in industry concentration among tenants – as measured by the Herfindahl index – in a green building and each of the corresponding control buildings in the same cluster.

Each regression also includes 1,180 dummy variables, one for each district cluster.

Standard errors are in brackets. Significance at the 0.10, 0.05, and 0.01 levels are indicated by *, **, and ***, respectively.

TABLE 4
Regression Results
Industry Preference and Green Buildings
Differences in Fraction Occupied by SIC in Green Buildings and Non Green Buildings Within the Same Cluster

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Building Age	-0.005	0.000	-0.000*	0.000	-0.000	-0.001***	0.000**	0.000
	[0.004]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Δ Building Quality	0.094	0.004	-0.040***	-0.005	-0.113***	0.029**	0.024*	0.003
	[0.187]	[0.028]	[0.015]	[0.019]	[0.017]	[0.012]	[0.012]	[0.016]
Δ Building Size	-0.114	0.020	0.023	0.007	-0.206***	0.178***	-0.122***	0.021
(millions of sq. ft.)	[0.356]	[0.081]	[0.030]	[0.067]	[0.059]	[0.030]	[0.032]	[0.053]
Employees Per Establishment			0.014***	0.002***	-0.003	0.026***	0.001***	
			[0.000]	[0.000]	[0.004]	[0.001]	[0.000]	
Number of Establishments			0.152***	0.225***	0.135***	-0.269***	-0.371***	
(log)			[0.003]	[0.004]	[0.006]	[0.009]	[0.005]	
Sales Per Employee			0.001***	0.001***	0.001***	0.007***	0.080***	
(thousands of dollars)			[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	
Payroll Per Employee			0.000***	0.000	0.000***	0.000***	0.000***	
(thousands of dollars)			[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
Constant	-1.421**	0.351***	-0.911***	-0.946***	-1.209***	-0.064***	-0.261***	-0.078
	[0.615]	[0.057]	[0.035]	[0.080]	[0.094]	[0.021]	[0.056]	[0.094]
Sample Size	49	447	1231	1021	1689	3307	4109	1013
R^2	0.97	0.89	0.85	0.83	0.71	0.70	0.60	0.87
Adj R2	0.88	0.79	0.77	0.73	0.59	0.61	0.50	0.81

Notes:

Columns correspond to one-digit Standard Industrial Classifications:
(1) Agriculture, Fishing and Forestry
(2) Mining and Construction
(3) Manufacturing
(4) Transportation, communications, electric, gas, and sanitary services
(5) Retail and wholesale trade
(6) Finance, insurance, and real estate
(7) Services
(8) Public administration

Each regression also includes 1,180 dummy variables, one for each distinct cluster.
Standard errors are in brackets. Significance at the 0.10, 0.05, and 0.01 levels are indicated by *, **, and ***, respectively.

APPENDIX TABLE A1
Incidence of Green Space Utilization by Major Tenants
Incidence of Green Space Utilization by Major 4-digit SIC code

			Space Occupied	
		(1)	(2)	(3)
	Industry Description	Green Space	Fraction of Total Green Space	Cumulative Fraction of Total Green Space
		x 1000 sq. ft.	*%*	*%*
Panel A: Top-20 Tenants				
JP Morgan Chase	Investment Advice	3,069	1.31%	1.31%
Bank of America	National Commercial Bank	3,048	1.30%	2.61%
US General Services Admin.	General Government, NEC	2,262	0.96%	3.57%
Verizon Wireless	Communications Services, NEC	2,086	0.89%	4.46%
ATandT	Telephone Communications	1,819	0.77%	5.23%
Pfizer, Inc.	Pharmaceutical Preparations	1,724	0.73%	5.97%
American Express	Personal Credit Institutions	1,632	0.70%	6.66%
Morgan Stanley	Investment Advice	1,592	0.68%	7.34%
Chevron	Crude Petroleum and Oil	1,568	0.67%	8.01%
Charles Schwab	Unit Investment Trusts	1,454	0.62%	8.63%
Wells Fargo Bank	National Commercial Bank	1,433	0.61%	9.24%
Marsh and McLennan	Insurance Agents, Brokers, and Service	1,244	0.53%	9.77%
Washington Mutual	National Commercial Banks	1,109	0.47%	10.24%
Department of Justice	General Government, NEC	1,094	0.47%	10.71%
State Street Corporation	State Commercial Banks	1,045	0.45%	11.15%
Pacific Gas and Electric	Electric and Other Services Combined	1,029	0.44%	11.59%
BP	Crude Petroleum and Oil	949	0.40%	11.99%
News America Marketing	Advertising, NEC	917	0.39%	12.39%
Colorado Inter Gas Comp	Natural Gas Transmission and Distribution	912	0.39%	12.77%
KPMG, LLP	Accounting, Auditing, Bookkeeping Services	910	0.39%	13.16%
Panel B: Top-20 SICs				
8111	Legal Services	34,509	14.70%	14.70%
9199	General Government	12,913	5.50%	20.20%
6021	National Commercial Banks	10,141	4.32%	24.52%
6282	Investment Advice	9,335	3.98%	28.50%
6022	State Commercial Banks	5,355	2.28%	30.78%
6411	Insurance Agents, Brokers, and Service	5,241	2.23%	33.01%
1311	Crude Petroleum and Natural Gas	5,031	2.14%	35.15%
6211	Security Brokers, Dealers, Flotation Comp.	4,837	2.06%	37.21%
4813	Telephone Communications	4,702	2.00%	39.22%
8721	Architectural Services	4,108	1.75%	40.97%
8742	Management Consulting Services	3,663	1.56%	42.53%
2834	Pharmaceutical Preparations	3,492	1.49%	44.01%
8221	Colleges, Universities, Professional Schools	3,252	1.39%	45.40%
8399	Social Services, NEC	2,849	1.21%	46.61%
4911	Electric Services	2,846	1.21%	47.83%
7389	Business Services, NEC	2,752	1.17%	49.00%
4899	Communications Services, NEC	2,544	1.08%	50.08%
6531	Real Estate Agents and Managers	2,541	1.08%	51.16%
8711	Engineering Services	2,402	1.02%	52.19%
8748	Business Consulting Services, NEC	2,188	0.93%	53.12%

APPENDIX B
The Propensity to Rent Green Office Space
Tobit Analysis

To investigate further the extent to which firms in specific industries are more likely to lease green space rather than conventional office space, we analyze the propensity to lease green space for a specific industry. We estimate the following equation for each one-digit SIC code:

$$(4) \qquad O_{in} = \alpha + \beta_i X_i + \sum_{n=1}^{N} \gamma_n c_n + \delta g_i + \varepsilon_{in},$$

where the dependent variable is the total square footage O_{in} occupied by tenants in building i in cluster n as a fraction of total occupied office space in the building. X_i is a vector of hedonic characteristics of building i – building age, building size and building quality and c_n is a dummy variable with a value of 1 if a building is located in cluster n and zero otherwise. These location coefficients allow for differences in tenant concentration at each location, and they account for unobserved characteristics associated with each specific location. g_i is a dummy variable with a value of 1 if building i is rated by Energy Star or LEED and zero otherwise. α, β_i, γ_n, and δ are estimated coefficients and ε_{in} is an error term.

Because the dependent variable has a large number of zeros (i.e., an industrial category rents no space in a particular building), we estimate equation (4) as a Tobit model. In any case, the estimated coefficients indicate the propensities of different industries to locate in various kinds of buildings. Appendix Table A2 presents estimates of Equation (4), with each column corresponding to a specific industry group. The dependent variable represents the fraction of office space occupied by tenants in the corresponding industry group.

APPENDIX TABLE A2
Tobit Regression Results
Industry Preference and Green Buildings
Fraction of Office Space Occupied by One-Digit SIC code in Each Building

	(1)	(2)	(3)	(4)	(5)	(6)
Green Rating (1 = yes)	0.030	-4.134	-0.075	-0.478	-0.178	0.730
	[0.028]	[0.000]	[0.028]***	[0.026]***	[0.019]***	[0.030]***
Building Class†						
Class A (1 = yes)	0.000	0.135	-0.125	0.041	-0.028	0.105
	[0.041]	[0.061]**	[0.034]***	[0.029]	[0.027]	[0.050]**
Class B (1 = yes)	-0.024	0.109	-0.059	0.029	-0.043	0.108
	[0.031]	[0.043]**	[0.023]***	[0.021]	[0.020]**	[0.040]***
Fraction Occupied	-0.012	0.083	0.106	0.055	0.251	0.031
	[0.076]	[0.106]	[0.060]*	[0.052]	[0.051]***	[0.088]
Stories						
High (yes = 1)	0.034	-0.085	-0.152	0.013	-0.029	0.069
	[0.042]	[0.059]	[0.037]***	[0.029]	[0.028]	[0.048]
Intermediate (yes = 1)	0.018	-0.006	-0.095	-0.010	-0.042	-0.029
	[0.029]	[0.040]	[0.024]***	[0.021]	[0.019]**	[0.034]
Age						
< 10 years	0.016	0.014	0.065	0.020	0.071	0.049
	[0.049]	[0.083]	[0.045]	[0.038]	[0.035]**	[0.057]
10 – 20 years	0.026	-0.083	-0.051	0.007	0.009	0.071
	[0.046]	[0.079]	[0.043]	[0.034]	[0.031]	[0.052]
20 – 30 years	-0.052	-0.014	-0.012	0.005	0.020	0.092
	[0.036]	[0.049]	[0.030]	[0.025]	[0.024]	[0.041]**
30 – 40 years	-0.051	-0.005	-0.008	0.033	-0.013	0.012
	[0.038]	[0.051]	[0.032]	[0.026]	[0.025]	[0.043]
Renovated (1 = yes)	0.024	-0.060	-0.013	-0.061	0.016	0.049
	[0.025]	[0.033]*	[0.020]	[0.017]***	[0.016]	[0.030]*
Building Size	0.038	0.161	-0.180	0.077	-0.030	-0.194
(millions of sq.ft.)	[0.052]	[0.073]**	[0.056]***	[0.038]**	[0.038]	[0.067]***
Constant	-0.424	-0.804	-0.525	-0.220	-0.315	-0.896
	[0.099]***	[0.244]***	[0.095]***	[0.083]***	[0.075]***	[0.110]***
Sample Size	10462	10462	10462	10462	10462	10462
Chi^2	1340.17	1123.84	1363.73	1482.93	1070.80	2104.36
Pseudo R^2	0.26	0.29	0.20	0.16	0.08	0.28

Notes:

Columns correspond to one-digit Standard Industrial Classifications:
(1) Manufacturing
(2) Transportation, communications, electric, gas, and sanitary services
(3) Retail and wholesale trade
(4) Finance, insurance, and real estate
(5) Services
(6) Public administration

† Relative to building Class C
Each regression also includes 1,180 dummy variables, one for each distinct cluster.
Standard errors are in brackets. Significance at the 0.10, 0.05, and 0.01 levels are indicated by *, **, and ***, respectively.

Column (1) reports the results for the manufacturing industry, which includes everything ranging from apparel producers to car manufacturers. Office utilization is expected to be rather limited for these sectors. Indeed, the main explanatory variables are inconclusive, and the indicator variable for a green building has no significant effect. The same holds for the transportation and communications industry, as documented in column (2). Office space leased by retail and wholesale trade is mainly in small buildings relatively lower quality. As green certification is more prevalent in new and large buildings, the negative coefficient for the indicator variable for green buildings is in line with expectations.[9]

Columns (4) and (5) report results for the finance, insurance and real estate industry, and the services industry, respectively. Especially for these industries, which include legal services and commercial banking, one would expect that leasing space in green office buildings is rational, as energy efficiency (Proposition I) and perceptions about indoor air quality (Propositions I and IV) are of major importance. However, in contrast to expectations, the results indicate a negative coefficient on the green variable for both estimations. So, although descriptive evidence indicated that some firms in the finance and services industry are among the larger tenants of green space, a more pervasive trend towards leasing green cannot be documented for these industries, when controlling more directly for building and location quality. This suggests that it is rather the larger and more visible firms that move first in the implementation of social and environmental measures, only followed later by the critical mass in the same industry (Proposition II).

[9] Note that for retail and wholesale trade, it would be more informative to examine the extent to which the actual retail space has been awarded a green certificate, rather than the office buildings that are measured here. This is clearly an avenue for future research.

Finally, in line with Proposition V, tenants in public administration seem to have a preference for green office space, indicated by the positive and significant coefficient for the green dummy as documented in Column (6). These results show the increased occupancy of green space by government-related tenants relative to otherwise comparable regular office space, while controlling for quality and locational characteristics.