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Why Do Companies Rent Green? Real Property and Corporate Social Responsibility

Authors
Eichholtz, Piet
Kok, Nils
Quigley, John M.

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WHO RENTS GREEN?

ECOLOGICAL RESPONSIVENESS AND CORPORATE REAL ESTATE

PIET M.A. EICHHOLTZ
Maastricht University
School of Business and Economics
PO BOX 616
6200MD Maastricht
Netherlands
Tel: +31 (0)43 388 3838
Fax: +31 (0)43 388 4875
p.eichholtz@maastrichtuniversity.nl

NILS KOK
Maastricht University
School of Business and Economics
PO BOX 616
6200MD Maastricht
Netherlands
Tel: +31 (0)43 388 3838
Fax: +31 (0)43 388 4875
n.kok@maastrichtuniversity.nl

JOHN M. QUIGLEY
University of California
Berkeley
Haas School of Business
2220 Piedmont Avenue
Berkeley, CA 94720-1900
Tel: 510 643 7411
Fax: (510) 543 7357
quigley@haas.berkeley.edu

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ABSTRACT

This paper investigates the ecological responsiveness of firms and their motivations by analyzing the choices these firms make in occupying office space. We analyze the decisions of more than 11,000 tenants to choose office space in green buildings or in otherwise comparable, conventional buildings nearby. We find that corporations in the oil and banking industries, as well as non-profit organizations, are among the most prominent green tenants. After controlling for building quality and location, we document that firms in mining and construction and organizations in public administration, as well as organizations employing higher levels of human capital, are more likely to lease green office space. These empirical findings confirm the theoretical framework on competitiveness, legitimation, and environmental responsibility as important determinants for the ecological responsiveness of firms.

Keywords: ecological responsiveness, sustainability, corporate real estate, green labels

INTRODUCTION

For firms adopting ecologically responsive business practices, corporate real estate is an obvious point of attention. Firms' energy consumption and carbon emissions are to a large extent determined by the choices they make in their use of real estate. Buildings and their associated construction activity account for almost a third of world greenhouse gas emissions (Royal Institute of Chartered Surveyors, RICS, 2005). The U.S. property sector is responsible for approximately 40 percent of U.S. energy consumption (U.S. Department of Energy, 2003), and for 70 percent of U.S. electricity consumption (Energy Information Administration, EIA, 2008). Moreover, it is reported that about one quarter of greenhouse gas abatement potential involves improving efficiency in the real estate sector, at zero or negative net costs to owners, occupants, or investors. (Enkvist, Naucler, and Rosander, 2007).

Firms' demand for 'green' real estate – real estate labeled for displaying exemplary environmental performance – is on the rise in many parts of the world. Examples range from a 'green campus' of Chevron in Louisiana and a carbon-neutral R&D facility of Royal Dutch Shell in Amsterdam, the Netherlands, to the currently constructed energy-efficient headquarters of Deutsche Bank in Frankfurt, Germany. Moreover, notwithstanding the fact that commercial real estate markets in many countries have been suffering major downturns due to the economic crisis, the number of green buildings is rapidly increasing (Eichholtz, Kok, and Quigley, 2010b).

A recent paper (Eichholtz, Kok, and Quigley, 2010a) studied the economic implications of green office buildings in the U.S., documenting that green buildings command premium rental rates and sales prices over conventional office buildings.

Effective rents are estimated to be about six percent above the rents of conventional office buildings, and transaction prices are estimated to be 16 percent higher. This 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, the increment commanded by a green building cannot be explained by energy savings alone. Other factors seem to be at work.

These empirical findings suggest that there is an identifiable group of corporate real estate users that are willing to pay a premium for leasing green space. Understanding the motivation for this choice of green real estate may be important for four reasons. First, corporations have been increasingly outsourcing the ownership of their properties; corporate real estate ownership has systematically declined over the last two decades, and particularly in the service sector (Brounen and Eichholtz, 2005; Deng and Gyourko, 1999). Thus, for most firms aiming to reduce their ecological footprint, choices as real estate tenants rather than owners are crucial. This paper shows how industry characteristics of firms determine their ecological responsiveness with regard to building choice.

Second, a better understanding of those firms and industries predisposed to opt for ‘green’ real estate may allow researchers, managers, and policy makers to determine the scope for voluntary measures, rather than regulation and taxation, to promote the consumption of more efficient real estate as a path towards the reduction of ecological pressure by corporations.

Third, this paper sheds light on the broader question why firms engage in ecological responsiveness, an issue that has not been empirically resolved in the literature. Bansal and Roth (2000) develop a theoretical framework explaining the ecological stance of firms, but these authors are unable to test the framework empirically (even though they strongly suggest such tests for future research). The degree to which corporations lease 'green' space can be regarded as a measure of their ecological responsiveness.

Fourth, despite the fact that real estate can, and increasingly does, play a large role in reducing firms' 'ecological footprint' (Rees, 1992; Hart, 1995), the use of 'green' space by firms and organizations has received scant attention in the fast-growing management literature that relates business organizations and the natural environment. In a recent comprehensive survey of this literature, corporate housing decisions and real estate were not mentioned at all (Etzion, 2007). This paper aims to fill this gap in our understanding.

Based on the Bansal and Roth (2000) framework, we develop hypotheses as to which types of firms and industries will be most likely to choose green space rather than conventional space. We empirically investigate these hypotheses, using hand-collected data on the identity and industry characteristics of tenants in 'green' buildings in the U.S. We adopt a working definition of green office buildings, as those certified by either Energy Star or the Leadership in Energy and Environmental Design (LEED).[1] We also construct a control sample of other, conventional office buildings, matched on

[1] Energy Star is the energy efficiency certification systems of the U.S. Environmental Protection Agency and U.S. Department of Energy, and LEED is the system of the U.S. Green Building Council, a non-profit industry group.

geographical characteristics. This allows us to test the hypotheses by exploiting a unique, rich dataset of office buildings with an Energy Star and/or LEED-rating, matched with a control sample of nearby office buildings without these ratings.

Using a sample of more than 3,100 tenants in 1,180 green office buildings, and 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 industry 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 the government and government-related organizations, are systematically more likely to lease green office space rather than conventional space, as compared to corporate tenants in other industries. Furthermore, employee skill intensity and compensation are positively related to the propensity to lease green office space. These findings confirm the hypotheses on the determinants of corporate ecological responsiveness.

This rest of this paper is organized as follows. In Section 2, we summarize previous work on the ecological responsiveness of private firms, and we develop hypotheses predicting the likelihood that firms in different industries will choose to 'rent green.' Section 3 provides an overview of the data, the methods, and some descriptive statistics. Section 4 presents results of the statistical analysis. Section 5 provides a discussion and a conclusion.

ECOLOGICAL RESPONSIVENESS AND REAL ESTATE

In their model of ecological responsiveness, Bansal and Roth (2000) distinguish three main motivations to explain corporate ecological responsiveness: competitiveness,

legitimation, and environmental responsibility. We will discuss each of these motivations below. Furthermore, we will argue how these motivations could be related to corporate real estate leasing decisions, and we will develop four hypotheses concerning different industries' intensities in green real estate consumption.

Competitiveness

Competitiveness as a motivation for ecological responsiveness is closely related to the financial performance of the firm. An active environmental policy, or even just complying with environmental regulation, is costly. Konar and Cohen (2001) estimate that U.S. firms annually invest a combined amount of some 1.5–2 percent of GDP on environmental policies, and these expenditures may crowd out productive investments (Palmer, Oates, and Portney, 1995). Nevertheless, the literature mostly reports a positive association between corporate environmental performance and corporate financial performance (Karpoff, Lott, and Rankine, 1999; Klassen and McLaughlin, 1996; Konar and Cohen, 2001).

The positive effect of environmental policies on financial performance may materialize following cost reductions through lowering input and waste disposal costs (Porter and Van der Linde, 1995). Green buildings can play a role in this regard, as the operating costs of these buildings may be substantially lower. For commercial buildings, energy – an important element of sustainability – represents a significant cost of building operations, with energy costs nearly ten percent of total housing costs, on average. These costs can be decreased through energy efficiency measures that are often integral to green building design. Anecdotal evidence shows that LEED-certified buildings, on average,

use 30 percent less energy than conventional buildings (Kats, 2003), and it is claimed that the energy savings on buildings with an Energy Star label are almost 40 percent (U.S. Environmental Protection Agency, 2008). Thus, leasing space in green buildings may have a direct impact on leasing costs.

These costs are likely to be most significant for firms active in sectors that tend to have office space-intensive operations. This holds mostly for firms in the tertiary sector, suggesting that firms in the tertiary sector may be more likely to rent green space as compared to firms in other sectors.

Another, more indirect, benefit following from the occupancy of a green building is an increase in employee productivity. Several studies have reported a positive correlation between a building's internal environment (*e.g.,* its indoor air quality) and employee health and productivity (Hoffman, Wood, and Kreiss, 1993; Wargocki *et al.*, 2004). 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, and Daisey, 2000; Fisk and Rosenfeld, 1997). Given that staff costs represent a major share of total expenditures for the average firm, the potential financial benefits from improved productivity are substantial, and perhaps even larger that the direct cost savings derived from lower energy consumption (Edwards, 2006; Nelson, 2007).

A recent paper by Edmans (2007) shows that corporate financial performance is positively related to employee satisfaction, which is affected by pecuniary benefits, but also by the quality of working conditions. Indeed, Oldham and Rotchford (1983) and Bitner (1992) show that physical office design has significant effects on various measures of employee satisfaction, like communication, concentration and networking

opportunities. Since green buildings are asserted to offer a superior working environment, they could increase employee satisfaction, and thereby productivity.[2]

We should note that the association between 'green' buildings and higher employee productivity has not yet been firmly empirically established. 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. Moreover, even if green real estate did not make a firm's existing work force more productive, it could attract a more productive workforce. This could be the effect of an improved corporate reputation deriving from a commitment to green values.

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. Corporate reputation has been documented to be an important determinant of job choice (Gatewood, Gowan, and Lautenschlager, 1993), and therefore in acquiring human capital. Bauer and Aiman-Smith (1996) show that firms having a positive attitude towards the natural environment are regarded as more attractive employers than otherwise comparable firms without such an attitude. Henriques and Sadorsky (1999) show that the perceived importance of organizational stakeholders, *i.e.*,

[2] Other researchers have also addressed this topic: Klitzman and Stellman (1989) examine the relationship between the quality of the physical office environment and psychological well-being of office workers and conclude that adverse environmental conditions within the office, especially poor air quality and noise, negatively affect worker satisfaction and mental health. Robertson *et al.* (1985) show a clear empirical relation between air quality and the physical health of office workers, with those working in naturally ventilated buildings being significantly more healthy on a range of characteristics than those working in air-conditioned buildings. Headaches and lethargy were reported twice and three times as often in the air-conditioned buildings as compared to naturally ventilated buildings, and these symptoms are both likely to affect productivity.

the workforce, plays a large role in determining the managerial stance towards the environment.

Thus, a positive stance towards the natural environment can increase success in hiring and retaining high-quality human capital. For employees, ‘green’ real estate can be a visible signal of the adoption of an environmental policy, and can therefore contribute to a firm’s success in attracting human capital. This is most salient for organizations for which human capital is crucial: firms in the service industry. Also, the enhanced indoor air quality arising from an improved building structure, and from better heating, cooling and ventilation systems, is most beneficial for firms largely dependent on human capital, such as firms in the financial industry or in professional services.

Hypothesis 1. Firms dependent on high levels of human capital and operating in space-intensive industries, such as firms in the tertiary sector, will be more likely to rent office space in green buildings.

Legitimation

Legitimation as a determinant of ecological responsiveness is strongly related to reputation and credibility with the broader set of stakeholders. 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 the natural environment. If this translates into an improved reputation, then the occupancy of green buildings can have positive but indirect economic effects (Fombrun and Shanley, 1990).

Reputation may also be important for investors. Investors are powerful corporate stakeholders (Mitchell, Agle, and Wood, 1997), and 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 (SIF, 2007). Important institutional investors like APG in the Netherlands, Hermes in the United Kingdom, and TIAA-CREF in the United States, have formulated and implemented SRI strategies, strategies which are consistently communicated to the capital markets and to their clients.[3]

Barnea, Heinkel, and Kraus (2005) show that investors following an SRI approach can induce polluting firms to reform, and Henriques and Sadorsky (1996) find that environmental policies of firms are responsive to shareholder pressure. Non-governmental organizations (NGOs) also increasingly use an SRI approach – by investing in SRI mutual funds – to influence firms to adopt corporate social responsibility (CSR) and environmental policies (Guay, Doh, and Sinclair, 2004).

SRI strategies often imply that investors avoid investing in corporations that cause social injury or environmental damage (Spicer, 1978). This 'negative screening' may lead to institutional investors (such as pension funds, university endowments, banks and insurance companies) being systematically underinvested in so-called 'sin' stocks (Hong and Kacperczyk, 2009). It is likely that corporations with environmentally sensitive operations are exposed more directly to the risk of exclusion. This suggests that the

[3] Evidence on the relative performance of SRI investments is rather inconclusive. Heinkel, Kraus, and Zechner (2001), and Hong and Kacperczyk (2009) show that precisely the presence of ethical investors drives the prices of irresponsible companies lower, thereby increasing their expected total returns. Derwall *et al.* (2005) and Guenster *et al.* (2009) show positive risk-adjusted stock market performance related to corporate 'eco-efficiency'. See Renneboog, Ter Horst, and Zhang (2008) for a recent literature review.

adoption and implementation of an environmentally responsive strategy could reduce the risk of negative SRI screening by institutional investors.

If leasing green office space leads to a superior corporate reputation, this may enable firms to attract investors more easily and at better market rates (Milgrom and Roberts, 1986). Some empirical studies have argued that companies with highly developed environmental engagement are able to obtain better credit ratings, thereby lowering the cost of debt (Bassen, Holz, and Schlange, 2006). Also, evidence shows that these firms can have a lower implied cost of equity (Derwall, 2007).

Customers comprise another important set of stakeholders. Indeed, it is asserted that 'customers drive corporations green' (Vandermerwe and Oliff, 1990). Firms operating in competitive markets are exhorted by customers to incorporate environmental responsiveness in manufacturing, research, and marketing. A superior reputation – for example for ethical behavior – may appeal to certain segments of customers (Auger *et al.*, 2003). This, in turn, may enable firms to attract and retain customers (Porter and Van der Linde, 1995) and to increase sales or else charge premium prices (Creyer and Ross, 1997; Klein and 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. For example, for those firms 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), ecological responsiveness may simply be a way to alter a negative image or to offset an otherwise unsavory reputation. In the literature, this has been termed

as ‘corporate social responsibility for irresponsibility’ (Kotchen and Moon, 2007; Strike, Gao, and Bansal, 2006).

Bansal and Clelland (2004) show that firms with low environmental legitimacy can reduce the associated negative stock performance effects by expressing an active commitment to the natural environment. Using green real estate may be a low-cost and easy-to-implement factor in that commitment. 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. 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.

The likelihood of becoming a target of environmental litigation and public scrutiny 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 and Shanley, 1990). Henriques and Sadorsky (1999) find that the firms engaging most actively in environmental activities tend to place special importance on environmental industry groups.

Thus, the discipline of financial markets and customers may cause firms to implement active CSR policies. Especially for firms with environmentally sensitive operations, the risk of negative screening by investors is likely to be important, and through attention from the media and NGOs, these firms are also more exposed to public scrutiny from consumers. These considerations lead to our second hypothesis:

Hypothesis 2. Firms with environmentally sensitive operations will be more likely to lease green office space.

Environmental Responsibility

Although the attention of investors is focused understandably on firm profits, there is a distinct group of organizations for which the non-financial utility from pursuing an active environmental 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 more active in environmental engagement than purely profit-maximizing firms. Since Energy-Star-labeled office buildings emit at least a quarter less carbon than conventional buildings (Eichholtz *et al.*, 2010b), leasing green buildings may be a logical step for these organizations, even if the rents are higher.

Furthermore, first-movers and early-adopters of environmental innovations are often those parties for whom monetary gains are of secondary importance. For example, the Dutch government announced in 2008 that it will only occupy highly energy-efficient buildings from 2010 onwards. Since just about one third of the Dutch office stock meets these energy standards, that decision considerably narrows the potential supply of space for the public sector, and is therefore likely to increase occupancy costs.

This example illustrates that national and local governments and non-profit organizations are eager to demonstrate their environmental engagement through leasing space in green buildings, 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), and of portfolio managers in the investment industry (Hong and Kostovetsky, 2009).

Furthermore, for a government trying to nudge society towards lower energy consumption and lower carbon emissions, leading by example is an alternative to regulation. Since such a policy does not put a direct – financial – burden on certain groups of consumers or producers, it may politically be more palatable than implementing regulation. These considerations lead to our third hypothesis:

Hypothesis 3: Government, government-related organizations, and non-profit institutions will be more likely to lease green space.

Mixed motivations

The three proposed motivations for the adoption of ecologically responsible business policies are likely to carry a different weight in different industries, and the outcomes in terms of ecological responsiveness are therefore likely to be industry-specific. However, Bansal and Roth (2000) argue that some firms' ecological engagement will be unusually high, which may be due to mixed motivations. Thus, the intensity with which firms consume 'green' real estate may be enhanced if different motives work together. We expect these mutually reinforcing motivations to be reflected especially in the office leasing decisions in the oil and gas industry, where competitiveness (*i.e.*, attracting human capital) and legitimation (*i.e.*, offsetting an otherwise negative environmental reputation) are both at work. This leads to our fourth hypothesis:

Hypothesis 4: The intensity of green space use will be highest for organizations in the oil and gas industry.

GREEN REAL ESTATE AND TENANT DATA

To address empirically the four hypotheses, we collect information on tenants in commercial office buildings that have received an Energy Star or LEED certification. These labels represent the most widely used certifications of green buildings in the United States.

Energy Star is a joint initiative of two Federal agencies, the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy. Energy Star has been established in 1992 as a voluntary labeling program designed to classify and promote energy-efficient products, and was first applied to computer equipment and home appliances. The Energy Star label for new homes was established in 1993, and Energy Star for commercial buildings was adopted in 1995. The label has been promoted as an efficient way for consumers to identify energy-efficient buildings. The Energy Star label is also marketed as an indication of better environmental protection, but the label focuses solely on energy consumption, and does not measure other 'green' characteristics. Its implicit definition of a building's sustainability is quite narrow. The Energy Star website draws attention to the relationship between energy conservation in buildings and other aspects of good 'corporate governance.' But the EPA also stresses that the label is an indication of lower ownership costs, better energy performance, and higher resale values.

Commercial properties can receive an Energy Star certification if the source energy use of the building, as certified by a professional engineer, achieves certain

specified benchmark levels. The benchmark is chosen such that the label is awarded to the top quarter of all comparable buildings, ranked in terms of source energy efficiency.

As of June 2009, 7,338 buildings in the U.S. had been awarded the Energy Star designation, including 2,943 office buildings.

The LEED rating system has been developed by the U.S. Green Building Council (USGBC), a private non-profit organization, to encourage the 'adoption of sustainable green building and development practices.' LEED uses a broad definition of building sustainability and is based on a point system, including a wide range of criteria. The requirements for certification of LEED buildings are more complex than those for the award of an Energy Star rating, and additional points in the certification process are awarded for such factors as 'site selection,' 'brownfield redevelopment,' and the availability of 'bicycle storage and changing rooms,' as well as energy performance.

An external consultant evaluates the performance of a building in six different categories, and projects must satisfy particular prerequisites to earn points. The six main characteristics of building sustainability according to LEED are: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, and Innovation. 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.

It is claimed that LEED-certified buildings have lower operating costs and increased asset values and provide healthier and safer environments for occupants. It is also noted that the award of a LEED designation 'demonstrate[s] an owner's commitment to environmental stewardship and social responsibility.'

As of June 2009, there were 2,706 buildings certified by the LEED Program of the USGBC, including 1,151 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 U.S. commercial real estate financial data. The CoStar Group maintains records on some 2.4 million properties, including current rental and occupancy data and the quality characteristics of buildings. We matched the CoStar database with the Energy Star and LEED address files as of June 2008. We obtained a match for 1,360 office green labeled buildings in the Costar database; 1,045 buildings were matched to those with an Energy Star 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 acquired a green rating.[4]

About three percent of U.S. office building stock 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 is labeled. In a large number of states, however, only a very small fraction of office space is certified by

[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, and these are less likely to have a green rating.

Energy Star or LEED. Apart from California, states with extreme temperatures are apparently more likely to have rated office buildings.

– Insert Figure 1 about here –

Control Sample

Even if corporations base their housing decisions on the environmental characteristics of office buildings, these are not likely to be their paramount considerations. Corporations will also evaluate the quality of the building and, most important, the location of the premises. We therefore match each green building to a set of commercial office buildings that 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.[5] This match, which relies upon the latitude and longitude recorded for each green building, yields 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 0.25 mile radius. 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.

[5] In order to make the location comparison between the green buildings and the control buildings most concise, we aim for a radius that is as small as possible. However, we are limited by the availability of control buildings within each radius. The 0.25 mile radius is the result of a careful tradeoff between location comparability and the available number of control buildings in the radius.

– Insert Figure 2 about here –

Descriptive Statistics

Table 1 provides more detailed information on the green building sample, and on the control sample of conventional office buildings. (Variable definitions are in Appendix Table A1.) The table shows that the green buildings differ substantially on some key quality issues. For example, the green buildings are substantially larger, on average, than the nearby control buildings. They are also slightly taller, by about two stories. The age difference between green buildings and conventional buildings is large: green buildings average about 24 years in age, while buildings in the control sample are about 49 years old, on average. Because they are older, the control buildings are much more likely to have been renovated than are the green buildings.

The overall quality of the green buildings is substantially higher. 79 percent are rated as 'class A,' while only 35 percent of the control buildings have that rating. Only about one percent of the green buildings are rated as class C, while over 16 percent of the control buildings have this rating. A larger fraction of green buildings have on-site amenities such as retail shops, mail rooms, and exercise facilities.

The green buildings have slightly higher occupancy rates, and the cross-sectional variability in occupancy is lower for green buildings than for the control buildings. Green buildings are also more likely to have a net rent contract, in which the tenants pay directly for utilities.

These quality differences illustrate the importance of controlling for building quality when analyzing corporate housing decisions. These decisions are likely to be

made on the basis of many of the quality characteristics presented above, and the greenness of the building is just one of these. For example, building age is also an important determinant of corporate housing decisions, and given the strong relation between age and greenness, not controlling for age could lead to inaccurate inferences.

– Insert Table 1 about here –

ANALYSIS AND EMPIRICAL RESULTS

We hypothesize that the motivations to rent green office space differ across industries, which implies that some industries will have a higher likelihood of leasing green office space as compared to other industries. The *competitiveness hypothesis* is related to operational costs and human capital considerations, and therefore likely to play an important role in the services sector. The *legitimation hypothesis* is linked to corporate reputation, and therefore likely to be more salient in environmentally sensitive industries, like mining and oil. The motive of *environmental responsibility* is probably most prevalent for governmental and non-profit organizations. The intensity of green space consumption is probably higher in case of *mixed motivations*, which may be the case for the oil and gas industry: both *competitiveness* and *legitimation* are likely to play an important role for firms in these industries.

Green Space Consumption by Firms and Industries

The first part of our analysis focuses on the individual firms that are the dominant consumers of green space in the U.S. office market. For each green building in the

sample, we collect the names of the five largest tenants, their Standard Industry Classification (SIC) codes, and the floor space they occupy. In addition, the CoStar Tenant Module allows us to determine the total volume of green office space occupied by each individual firm. Similarly, we collect data on the total square footage of green office space that is occupied in each specific four-digit SIC code.[6] This matching and data extraction yields a sample of 1,180 green office buildings, occupied by a total of 3,179 different tenants. We also collect information on all buildings in the control sample: the five major tenants, their SIC classifications and the square footage occupied for each control building. In total, the control sample includes 4,390 office buildings, with approximately 8,000 unique tenants. (Appendix Table A2 provides an overview of the control sample – tenants and industries with the largest aggregate office stock.)

Table 2 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. These are all firms with high human capital intensity, which lends support to Hypothesis 1. However, this high ranking for the banking sector is partially explained by its extensive use of office space in general; the banking industry is notoriously space intensive.

Furthermore, in support of Hypothesis 3, 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

[6] The totals of green office space occupied by individual tenants or industry groups are probably underestimated, as CoStar covers approximately 80 percent of the U.S. commercial property market. Moreover, tenant data are not available for all green office buildings.

Shell and Chevron leasing a substantial percentage of the green building office stock. This is in line with the *legitimation hypothesis* (Hypothesis 2), where we posit that firms with environmentally sensitive operations are more inclined to lease space in green buildings.

To account for differences in office space utilization among industries, column (4) shows the total volume 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-20 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 Hypothesis 2. 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.'

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.

For other corporations, such as Adobe Systems, Compuware Corp., or The Vanguard Group, leasing green space may not be a deliberate choice, 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. 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 2 occupy, on aggregate, almost one sixth of the total inventory of green office space in the United States in 2007.

– Insert Table 2 about here –

Although the analysis of the leading corporate consumers of green office space provides interesting perspectives on these firms' motivations, this analysis also has a drawback. Since it focuses on the largest firms, it underreports firms in less concentrated industries. We therefore look at 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. These numbers are presented in Table 3. 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 only one individual tenant from the legal services industry – Skadden, Arps – is among the twenty 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 the *competitiveness hypothesis* (Hypothesis 1), 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.

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 2.

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 is in line with the *mixed motivations hypothesis* (Hypothesis 4). 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.'[7] 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 3 about here –

Tenant Concentration in Green versus Non-Green Buildings: Tobit Analysis

To investigate the four hypotheses 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.[8] We consider the following one-digit SIC codes: 0) Agriculture, Forestry and Fishing, 1) Mining and Construction, 2/3) Manufacturing, 4) Transportation, Communications, Electric, Gas, and Sanitary Services, 5) Wholesale and Retail Trade, 6) Finance, Insurance and Real Estate, 7/8) Services, and 9) Public Administration.

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.

To investigate the extent to which firms in specific industries are likely to lease green 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:

[7] Chevron Press Release, May 2008.
[8] 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.

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

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 (1) as a Tobit model. In any case, the estimated coefficients indicate the propensities of different industries to locate in various kinds of buildings. Table 4 presents estimates of Equation (1), with each column corresponding to a specific industry group. The column headers in the table refer to the one-digit SIC codes of the industries considered. Since we do not have enough observations for SIC code 0 (agriculture, forestry, and fishing) and SIC code 1 (mining and construction) we are forced to exclude these industries from the Tobit analysis.

The dependent variable represents the fraction of office space occupied by tenants in the corresponding industry group. Column (2/3) reports the results for the manufacturing industry, which includes firms 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 (4). Column (5) shows that office space leased by retail and wholesale trade is mainly in small buildings of 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 (6) and (7/8) 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 perceptions about indoor air quality and human resource consideration (Hypothesis 1) are of major importance. However, in contrast to expectations, the results indicate a negative coefficient on the green variable for both estimations. 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 finding is in line with Henriques and Sadorsky (1996), who find that firms in the services sector are less likely to have environmental plans. The difference between the results in Table 2 and Table 4 suggests that it is rather the larger and more visible firms that move first in the implementation of social and environmental measures, only followed belatedly by the critical mass in the same industry.

[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. There is an emerging literature addressing "green" issues in the retail industry (Lai, Cheng, and Tang, 2010), but this is clearly an avenue for future research.

Finally, in line with Hypothesis 3, tenants in public administration seem to have a systematic preference for green office space, indicated by the positive and significant coefficient for the 'Green Rating' variable as documented in Column (9). 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 location characteristics.

– Insert Table 4 about here –

Leasing Green Office Space Rather Than Conventional Space

One could argue that a more direct test of tenant preferences would be to investigate the likelihood that certain industries systematically lease green space rather than conventional office space. In our subsequent analysis, we therefore 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. Using this more refined methodology allows for the inclusion of the agriculture, fishing and forestry industry, and the mining and construction industry. 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:

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

where the dependent variable is the difference between the 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.

Again, we control for building and location characteristics that are likely to influence corporate housing choices. ($X_{gn} - X_{cn}$) 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. α, β_n, and γ_n are estimated coefficients and ε_n is an error term.

Results are presented in Table 5 for ordinary least squares regression models corrected for heteroskedasticity (White, 1980). Each column header corresponds to a specific one-digit SIC industry. Given the relatively high adjusted R^2s, our model seems to explain corporate housing decisions quite well.

Columns (6) and (7/8) show that firms in the finance, insurance, and real estate sector and the services sector are more inclined to lease green office partially due to the fact that green buildings are of higher quality than conventional office space, as indicated by the significantly positive coefficient on 'Building Quality.' The opposite holds for firms in the retail and manufacturing industries, where the choice for green real estate is not primarily determined by the underlying differences 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 been certified by the USGBC and/or the Energy Star program.

Exceptions to the pattern of significantly negative coefficients are the mining and construction industry - Column (1) - and public administration sector - Column (9). 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 the *legitimation hypothesis*. The fact that the intensity of green space use for this industry is highest is also in line with the *mixed motivations hypothesis*. As documented in Table 3, 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 (1) 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 and Moon, 2007; Ramus and Montiel, 2005; Strike *et al.*, 2006).

We document 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. But, given the fact that we find significantly negative coefficients for six other industries, the public sector is found to be relatively more likely to rent green office space as compared to most other sectors, which is in line with the *environmental responsibility hypothesis*.

– Insert Table 5 about here –

As a last step, we adapt regression Equation (2), including further controls for differences in the average characteristics of industries across metropolitan areas. We include a vector Y_n of variables that measure average employee output, payroll per employee, the number of employees per establishment, and the number of establishments. These data are computed for each one-digit SIC code by Metropolitan Statistical Area MSA.[10] This leads to the following equation for each one-digit SIC code:

$$(2a) \qquad (O_{gn} - O_{cn}) = \alpha + \beta_n (X_{gn} - X_{cn}) + \sum_{n=1}^{N} \gamma_n \iota_n + \delta_n Y_n + \varepsilon_n$$

Table 6 reports the results. Data limitations inhibit this analysis for three sectors: SIC code 0 (agriculture, forestry, and fishing), SIC code 1 (mining and construction), and SIC code 9 (public administration).

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. This is in line with results documented by Cottrill (1990), Henriques and Sadorsky (1996), and Ramus and Montiel (2005), showing that the extent to which firms engage in CSR and actually implement a stated CSR policy is to a large extent determined by industry characteristics.

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

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 on this variable is negative for the finance, insurance, real estate sector and for the 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), which usually has the highest locational value. This result confirms previous research, *e.g.,* Eichholtz *et al.* (2010), which reports that the increased rents and market values documented for green buildings are smaller at the most desirable locations.

The variable representing the average size of establishments, measured by the number of employees, is significantly positive for four out of five industries. This suggests that in larger companies, there is a preference for green office space.

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.) The results suggest that tenants which are more dependent on high levels of human capital are more likely to rent office space in green buildings, supporting Hypothesis 1. Moreover, the significantly positive coefficient on the variable measuring sales per employee indicates that in areas with higher employee productivity – or higher 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. Again, this is in line with the *competitiveness hypothesis*.

Furthermore, the intercept is significantly negative for both the finance, insurance,

and real estate industry, and the services industry, but it is substantially closer to zero than the intercepts for other industries reported in Table 6. These differences suggest that firms in the financial sector and in the services industry are more likely to rent green space as compared to firms operating in the manufacturing, transportation and communication, and trade industries, which lends further support to the *competitiveness hypothesis.*

– Insert Table 6 about here –

CONCLUSIONS AND DISCUSSION

Awareness is growing that the built environment is an important source of greenhouse gas emissions and a major consumer of energy and raw materials. Industry conferences dedicated to energy-efficient buildings, like EcoBuild in the U.K. and GreenBuild in the U.S. draw record numbers of participants. The number of green commercial properties is rapidly increasing, despite the fact that the U.S. commercial property market has been severely affected by the economic crisis. On average, firms seem to be willing to pay a rental premium for 'green' office buildings, suggesting that this development is at least partly demand-driven. Firms conscious of environmental issues seem to consider real estate choices in their ecological responsiveness.

Both markets and governments have created a variety of environmental rating systems for commercial properties, which can assist corporations in determining the real estate component of their environmental policies. The U.S. labels, LEED and Energy Star, which are centerpieces of this paper, are examples of a broader global trend:

BREEAM is the leading green real estate label in the U.K., Australia uses the Green Star labeling scheme, and Singapore has adopted the GreenMark scheme. These environmental labels provide corporate tenants with a yardstick to measure the 'greenness' of properties, and they create a platform for property funds with a clearly defined green profile. For example, CalPERS has 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 LEED program.

We use the information provided by these labels to conduct an empirical test of Bansal and Roth's (2000) theoretical framework regarding the ecological responsiveness of firms, and we investigate how these instruments of market transparency can help steer corporations towards enhanced ecological performance.

Bansal and Roth (2000) identify three main motivations for firms to engage in ecological activities: competitiveness, legitimation, and environmental responsibility. These motivations are likely to have different weights for different industries; we can exploit them to develop hypotheses regarding the willingness of firms from different industries to consume green space rather than conventional space.

Our descriptive results show that firms in the legal sector and financial services industry lease a substantial share of green office space. This is in line with the *competitiveness hypothesis*, since firms in these space-intensive sectors are likely to profit most from the operational as well as productivity benefits of green buildings. These findings are reinforced by a more robust regression analysis, which shows that the concentration and size of establishments, as well as the extent to which human capital is

available across metropolitan areas, has a distinct influence on the fraction of environmentally-labeled space that is leased. Again, this is in line with the competitiveness motivation for the choice for green office space and the perception that labeled office space may create a high-quality labor environment.

Our findings further show that the mining and construction industry and, more specifically, the oil industry are major users of green office space, which is in line with the *legitimation hypothesis*. Firms in environmentally sensitive industries may actively incorporate sustainability in strategic decisions, such as headquarters selection, to offset negative reputation effects. However, for these decisions, competitiveness rationales related to employee productivity and attractiveness are likely to be mixed with the legitimacy motivation, which could increase the intensity of green space consumption. The results of the regression analysis show that green space consumption is highest for the mining and construction industry, suggesting that *mixed motivations* may indeed lead to stronger ecological responsiveness.

The empirical results also show that government and government-related organizations, for which non-financial utility may be more important, have a relatively strong likelihood to rent green office space. This is likely to be driven by the *environmental responsibility* motivation. The most prominent example is California's Environmental Protection Agency, with all of its activities located in highly sophisticated environmental-friendly office buildings.

For organizations, the findings in this study clearly show that corporate leasing decisions can facilitate the implementation of an ecologically responsible strategy; real estate provides a tangible element of the ecological responsiveness of a firm.

For developers and institutional real estate investors, the findings in this study have important implications. The higher initial outlay that may be needed for a newly constructed 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. This study shows what types of firms, in which industries, are most likely to incur increased occupancy costs.

For policy makers and regulators, this research shows that certain industries already adopt green real estate practices, without regulatory coercion. This suggests that the 'green' labels created by government and industry can serve as an inexpensive tool of market transparency, allowing firms to make informed decisions regarding the real estate dimension of their ecological strategy. These labels further real estate's potential as a factor in global carbon abatement.

Last, the results of this research suggest that the theoretical framework of Bansal and Roth (2000) provides a useful tool for a better understanding of the ecological responsiveness of firms. However, this research is the first attempt to use corporate real estate decisions as a yardstick for firms' ecological responsiveness, and this has some important limitations.

First, we are only able to test part of the Bansal and Roth (2000) theory, which is a framework of contextual dimensions, motivations, and ecological outcomes. Data limitations allow us to investigate firm motivations regarding green property use at the industry level only. Ramus and Montiel (2005) show that industry plays an important role in the degree to which firms implement a stated corporate social responsibility policy, and the use of green real estate can be an important factor in that implementation.

Nevertheless, analysis at the industry level precludes us from viewing the contextual dimensions of ecological responsiveness. Further research will have to be based on more granular firm-level data, which would create a solid basis for the analysis of the relation between context and motivation.

Second, firm-level data would also allow for a much richer investigation into the relation between firm motivations and ecological strategy. Starik and Rands (1995) argue that in order to analyze the ecological sustainability of an organization, different levels of analysis are needed. This is only feasible with detailed firm-level data. For example, the relation of a firm with its employees, and the degree to which a firm is under public scrutiny, or under the scrutiny of the capital markets, are likely to play a role in that firm's ecological stance.

Third, this research is based on U.S. data only, and it remains to be seen whether the conclusions can be extrapolated to other countries. A recent global survey of the environmental management and investment practices of professional real estate investors (Kok *et al.*, 2010) found that these practices tend to differ strongly across countries. These differences may be related to international differences in the corporate demand for green space, suggesting that adding an international dimension to the study of green corporate real estate decisions could substantially enrich the analysis. For that, an international data collection effort would be required.

The literature regarding organizations and the natural environment has been silent on the decisions by corporations to intertwine their consumption of space into their overall environmental strategy. Yet the impact of real estate on the environment makes

corporate housing decisions directly relevant for such strategies. This paper is a first attempt to fill the gap.

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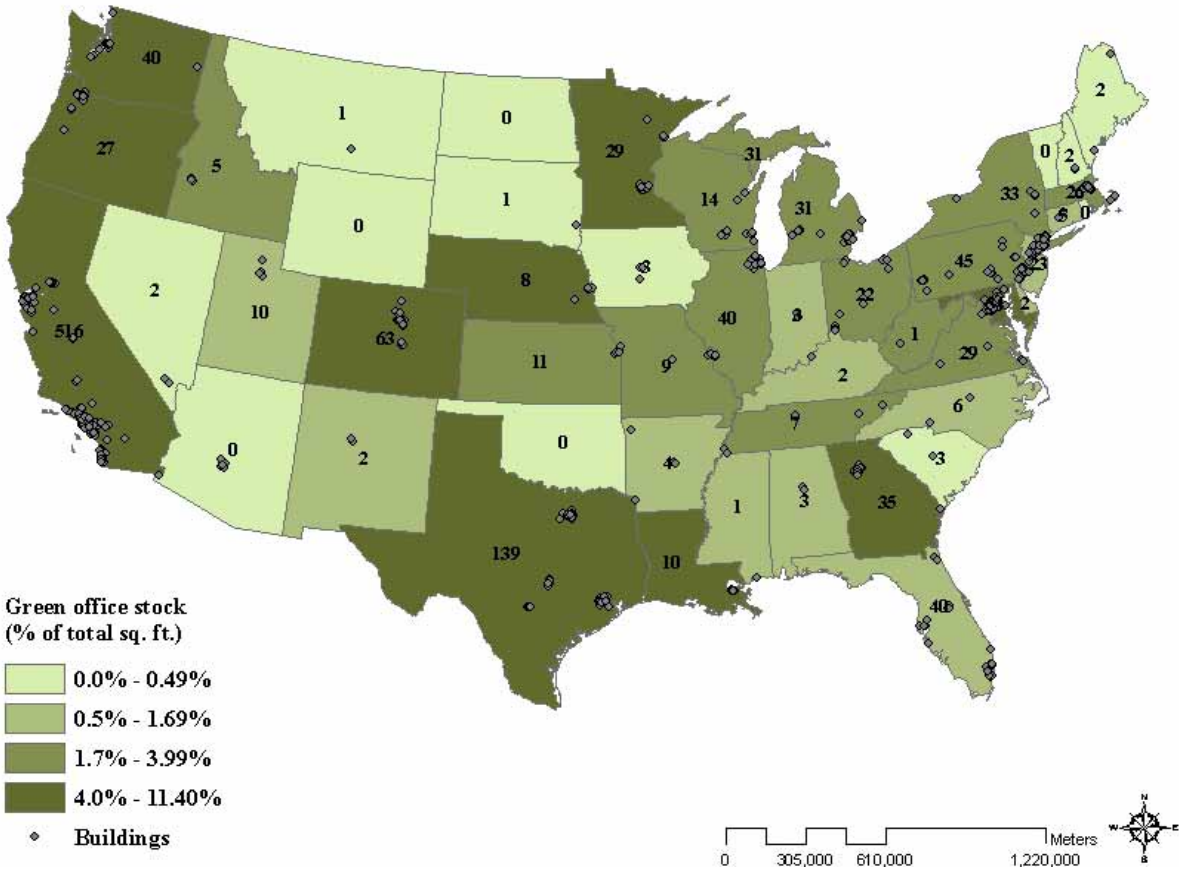
FIGURE 1
Distribution of Green Office Buildings by State
(percent of the stock of office space)
2008



Notes: 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

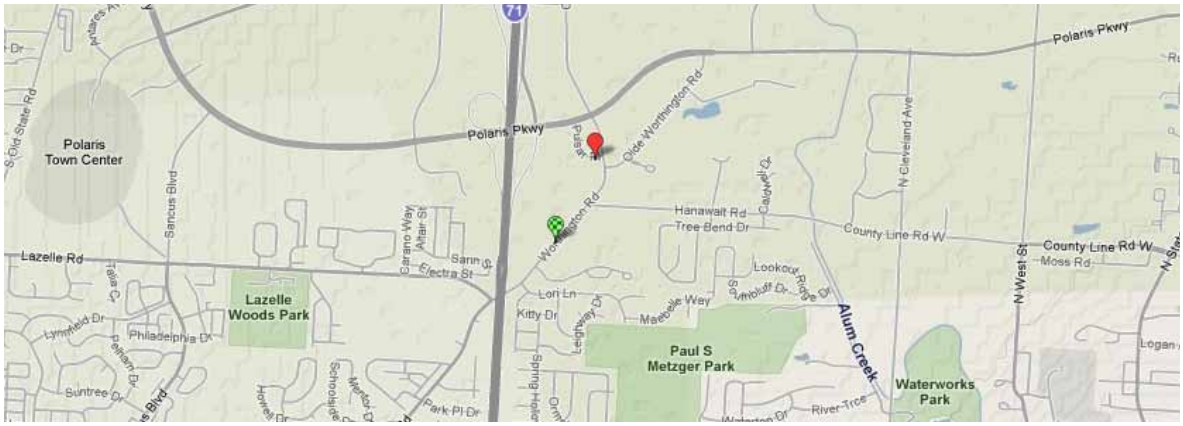


TABLE 1
Comparison of Green-Rated Buildings and Nearby Control Buildings
(standard deviations in parentheses)

	Green Buildings	Control Buildings
Sample Size	1,180	4,390
Building Size (thousands sq. ft.)	324.08 (288.92)	218.69 (293.67)
Stories (number)	15.31 (13.26)	13.07 (12.11)
Stories (percent)		
Low (<10)	46.25 (49.90)	53.49 (49.88)
Medium (10-20)	26.66 (44.25)	25.25 (43.45)
High (>20)	27.08 (44.47)	21.27 (40.93)
Age (years)	23.85 (15.57)	49.45 (32.50)
Age (percent)		
Less than 10 years	14.27 (35.00)	4.87 (21.53)
10 to 20 years	24.06 (42.78)	9.40 (29.19)
21 to 30 years	43.37 (49.59)	25.13 (43.38)
31 to 40 years	11.10 (31.43)	13.25 (33.90)
Over 40 years	7.20 (25.88)	47.34 (49.93)
Building Class* (percent)		
A	79.39 (40.48)	34.94 (47.68)
B	19.45 (39.61)	48.78 (49.99)
C	1.15 (10.68)	16.28 (36.92)
On-Site Amenities** (percent)	71.76 (45.05)	49.22 (50.00)
Renovated Buildings (percent)	21.04 (40.79)	38.51 (48.67)

TABLE 1
Comparison of Green-Rated Buildings and Nearby Control Buildings
(standard deviations in parentheses)
Continued

	Green Buildings	Control Buildings
Asking Rent (dollars/sq. ft.)	29.84 (12.98)	28.14 (15.60)
Net Rent Contract*** (percent)	5.76 (23.32)	3.15 (17.47)
Occupancy Rate (percent)	89.12 (12.76)	81.35 (22.73)

Notes:

The control sample consists of all commercial office buildings within a 0.25 mile radius of each rated building for which comparable data are available.

* Building Classes A, B, and C are nationally standardized quality ratings of commercial property. Class A is best.

** One or more of the following amenities are available on-site: banking, convenience store, dry cleaner, exercise facilities, food court, food service, mail room, restaurant, retail shops, vending areas, fitness center.

*** Net Rent Contracts require tenants to pay separately for utilities.

TABLE 2
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	Petroleum and Gas	1,362	0.80%	9.66%	3,989	34.14%
Chevron	Petroleum and Gas	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 3
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 4
Tobit Regression Results
Industry Preference and Green Buildings
Fraction of Office Space Occupied by One-Digit SIC code in Each Building

	(2/3)	(4)	(5)	(6)	(7/8)	(9)
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	10,462	10,462	10,462	10,462	10,462	10,462
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 Classification (SIC) codes:

(2/3) Manufacturing
(4) Transportation, communications, electric, gas, and sanitary services
(5) Retail and wholesale trade
(6) Finance, insurance, and real estate
(7/8) Services
(9) Public administration

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

TABLE 5
Regression Results
Industry Preference and Green Buildings
Differences in Fraction Occupied by SIC in Green Buildings and Non Green Buildings Within the Same Cluster

	(0)	(1)	(2/3)	(4)	(5)	(6)	(7/8)	(9)
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]
Constant	-1.043	0.356**	-0.521**	-0.815**	-1.146**	-0.537**	-0.279**	-0.191
	[0.531]	[0.048]	[0.047]	[0.081]	[0.101]	[0.036]	[0.059]	[0.100]
Sample Size	49	447	1,231	1,021	1,689	3,307	4,109	1,013
R^2	0.965	0.890	0.848	0.826	0.706	0.697	0.597	0.866
Adj R2	0.880	0.789	0.772	0.728	0.589	0.613	0.504	0.813

Notes:

Columns correspond to one-digit Standard Industrial Classification (SIC) codes:

(0) Agriculture, Fishing and Forestry
(1) Mining and Construction
(2/3) Manufacturing
(4) Transportation, communications, electric, gas, and sanitary services
(5) Retail and wholesale trade
(6) Finance, insurance, and real estate
(7/8) Services
(9) Public administration

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

TABLE 6
Regression Results
Industry Preference and Green Buildings
Differences in Fraction Occupied by SIC in Green Buildings and Non Green Buildings Within the Same Cluster
Including Location Controls

	(2/3)	(4)	(5)	(6)	(7/8)
Δ Building Age	-0.000	0.000	-0.000	-0.001**	0.000*
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Δ Building Quality	-0.040**	-0.005	-0.113**	0.029*	0.024
	[0.015]	[0.019]	[0.017]	[0.012]	[0.012]
Δ Building Size	0.023	0.007	-0.206**	0.178**	-0.122**
(millions of sq. ft.)	[0.030]	[0.067]	[0.059]	[0.030]	[0.032]
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	-0.911**	-0.946*	-1.209**	-0.064**	-0.261**
	[0.035]	[0.080]	[0.094]	[0.021]	[0.056]
Sample Size	1,231	1,021	1,689	3,307	4,109
R^2	0.85	0.83	0.71	0.70	0.60
Adj R2	0.77	0.73	0.59	0.61	0.50

Notes:

Columns correspond to one-digit Standard Industrial Classification (SIC) codes:
(2/3) Manufacturing
(4) Transportation, communications, electric, gas, and sanitary services
(5) Retail and wholesale trade
(6) Finance, insurance, and real estate
(7/8) Services

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

APPENDIX TABLE A1
Variable Definitions

Variable	Description
Size (thousands of square foot)	Building size includes the usable area and its associated share of the common areas
Stories (number)	The number of floors in the building above grade
Low (<10) (1 = yes)	Binary variable is 1 if the number of stories is below 10, and 0 otherwise
Medium (10-20) (1 = yes)	Binary variable is 1 if the number of stories is 10 or larger, but smaller than 20, and 0 otherwise
High (>20) (1 = yes)	Binary variable is 1 if the number of stories is 20 or larger, and 0 otherwise
Building Age (number)	The number of years since an existing building was completed.
Less than 10 years (1 = yes)	Binary variable is 1 if the age is younger than 10 years, and 0 otherwise
10 to 20 years (1 = yes)	Binary variable is 1 if the age is 10 years or older, but younger than 20 years, and 0 otherwise
20 to 30 years (1 = yes)	Binary variable is 1 if the age is 20 years or older, but younger than 30 years, and 0 otherwise
30 to 40 years (1 = yes)	Binary variable is 1 if the age is 30 years or older, but younger than 40 years, and 0 otherwise
Over 40 years (1 = yes)	Binary variable is 1 if the age is 40 years or older, and 0 otherwise
Building Class	The office building class designation is a way of differentiating buildings of the same building type into different categories of quality. These classes represent a combination of a subjective and objective quality rating of buildings that indicates the competitive ability of each building to attract similar types of tenants, with assignment depending on a variety of building characteristics, such as age, total rentable area, building finishes and materials, etc.
A (1 = yes)	In general, a class A building is an extremely desirable investment-grade property with the highest quality construction and workmanship, materials and systems, significant architectural features, the highest quality/expensive finish and trim, abundant amenities, first rate maintenance and in an excellent location with exceptional accessibility.
B (1 = yes)	In general, a class B building offers more utilitarian space without special attractions. It will typically have ordinary architectural design and structural features, with average interior finish, systems, and floor plans, adequate systems and overall condition.
C (1 = yes)	In general, a class C building is a no-frills, older building that offers basic space. The property has below-average maintenance and management, a mixed or low tenant prestige, and inferior elevators and mechanical/electrical systems.
Renovated Building (1 = yes)	Binary variable is 1 if a building has been completely restored so that the existing space becomes ‘new’ space again. The date of the last major renovation is tracked. Minor renovations, such as the improvement of a building's lobby or exterior are not considered full building renovations.
On-Site Amenities (1 = yes)	Binary variable is 1 if the building has one or more special characteristics that can enhance a property's appeal, including the presence of an atrium, banking facilities, concierge, convenience store, day care, dry cleaner, exercise facilities, restaurant, and retail shops.

APPENDIX TABLE A1
(Continued)

Variable	Description
Asking Rent (dollar per square foot)	Asking rent is the weighted average rent for a building or market. Rents are weighted based on the total square footage available at a rental rate. If the rental rate is zero, it is not counted in the average rent. Average rent is calculated from suite-by-suite detail.
Net Rent Contract (1 = yes)	Binary variable is 1 if the building has a lease structure in which the tenant is responsible for all expenses associated with their proportional share of occupancy of the building. This is the opposite of a Gross Rental Contract, a rental rate that includes normal building standard services that are provided and paid by the landlord.
Occupancy Rate (percent)	Occupancy rate is defined as the square footage of space that is physically occupied by a tenant as a fraction of the total rentable office space. It does not include space that is under a lease obligation, where the tenant does not actually occupy the space.
Employees Per Establishment (number)	The total number of paid employees, which consists of full- and part-time employees, including salaried officers and executives of corporations, who were on the payroll during the pay period including March 12.
Number of Establishments (natural logarithm)	An establishment is a single physical location at which business is conducted and/or services are provided. It is not necessarily identical to a company or enterprise, which may consist of one establishment or more. When two activities or more are carried on at a single location under a single ownership, all activities generally are grouped together as a single establishment.
Sales Per Employee (thousands of dollars)	Includes gross receipts from customers or clients for services provided, from the use of facilities, and from merchandise sold during the census year, whether or not payment was received in the year. Calculated as a fraction of the total number of paid employees, which consists of full- and part-time employees, including salaried officers and executives of corporations, who were on the payroll during the pay period including March 12.
Payroll Per Employee (dollars, natural logarithm)	Payroll includes all forms of compensation such as salaries, wages, commissions, dismissal pay, bonuses, vacation allowances, sick-leave pay, and employee contributions to qualified pension plans paid during the year to all employees. Divided by the total number of paid employees, which consists of full- and part-time employees, including salaried officers and executives of corporations, who were on the payroll during the pay period including March 12.

Note:

Sources: CoStar Group and Census.gov

APPENDIX TABLE A2
Control Sample
Incidence of Space Utilization by Major Tenants
Incidence of Space Utilization by Major 4-digit SIC code

			Space Occupied	
		(1)	(2)	(3)
	Industry Description	Control Space	Fraction of Total Control Space	Cumulative Fraction of Total Control 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%
AT&T	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%