Tenant Satisfaction and Commercial Building Performance*

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Abstract

Information asymmetry between landlords and tenants can significantly contribute to inefficiencies in the real estate market. Tenants' satisfaction with the building is a typical private information, which are opaqued to landlords without investigation. However, there is presently a dearth of studies evaluating the economic importance of this information, which could implicitly indicating their willingness to pay and demand for office space and critical for landlords to formulate targeted strategies to enhance property performance. In this study, we use a unique dataset combining the largest tenant survey of U.S. office tenants with rental contracts retrieved from CoStar to estimate how tenant satisfaction shapes their demand for office space. Our sample includes 2,906 U.S. office buildings and 46,075 corporate tenants. We document that a 1-point increase in tenant satisfaction (on a Likert scale of 1 to 5) is positively correlated to an 8.62% higher willingness to renew the lease; an 11.52% higher likelihood to recommend the property to prospective tenants; and a 14.62% lower probability of moving out of the property. In addition, the analysis of the financial performance of properties shows that a 10% higher building-level average satisfaction among the tenants in the building is associated with a 0.18% higher growth of gross rents; a 0.86% higher growth in effective gross rent; and a 0.3% drop in the vacancy rate change. Heterogeneity analyses suggest that the role of satisfaction is strongest for short-term tenants and those properties located in submarkets with high vacancy rates. Our research provides novel evidence for the financial implication of customer relationship management in the real estate sector.

Keywords: Information asymmetry, Tenant satisfaction, Tenant decision, Commercial building performance

JEL-codes: R30, R32, R33, M31

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1. Introduction

Information asymmetry is a potential source of market failure, which also exists in the real estate market and leads to inefficiency(Chau and Wong, 2016). Tenant's satisfaction with the the property they are residing in as a private information, is typically asymmetric between landlord and tenant(Myers, 2020). Although the customer-oriented operating strategy is already incorporated in many advanced property management companies' portfolio managing strategy(JLL, 2022), there are scarce of studies that evaluate the economic value of this information, which will not only leads to the ignorance of investing in getting tenant's satisfaction information, but might also hinder the future prevailing adoption of customer-oriented strategy in real estate market. After the economic shock triggered by the COVID-19 and the widespread availability of remote work policies, firms are reconsidering the amount and purpose of their office spaces nowadays (Fiorentino et al., 2022; Van Nieuwerburgh, 2023), which makes the importance of knowing the their space demand opinion even more prominent, with this information the investor maybe able to predicting future dynamics and making corresponding strategy, this is relevant to the future of commercial real estate markets across the U.S., Europe, and Asia(Aksoy et al., 2022; van Dijk et al., 2020; Gupta et al., 2022)(a market that is estimated to be over USD 20 trillion in the U.S. alone (NAREIT, 2022)).

This paper provides the first micro-econometric evaluation of corporate tenants' decision-making processes. In particular, we focus on the role of satisfaction in the demand for office space. Extensive evidence from the marketing and psychology literature shows the relevance of customer satisfaction in determining the demand for goods and services(Bolton and Drew, 1991; Fornell et al., 2010; Huang and Sudhir, 2021), and consumer behaviour Guerola-Navarro et al. (2021). Higher customer satisfaction is associated with a higher propensity to recommend products and services as well as a higher willingness to pay (Homburg et al., 2005). In addition, higher customer satisfaction has been linked to a variety of financial performance indicators, including a lower cost of sales(Lim et al., 2020), higher market share(Rego et al., 2013), higher profitability(Anderson et al., 1994), higher cash flows (Gruca and Rego, 2005), and elevated stock

market-based valuations (Aksoy et al., 2008; Jacobson and Mizik, 2009). While it is therefore reasonable to expect that satisfaction will also shape rental contracts of firms, there is a shortage of data and evidence investigating this link. This is surprising, given the widespread use of customer relationship management (CRM) and tenant satisfaction surveys among real estate practitioners in the design of their operating strategies(JLL, 2022). This paper hold valuable implications to property management practices in the context of ongoing structural changes, especially in knowledge-intensive and service-based sectors, which have impacted the office space utilisation. We also provides implications to the wide group of real estate participants by indicating the transformation of tenants from "price-takers" to "customers", and the fundamental shift in investment notion from "safe asset" or emphasising the "capital-dominated" to "user-dominated" strategy.

In this study, we compiled a unique longitudinal survey dataset comprising 46,075 tenants surveyed from 2009 to 2023. In total, the dataset includes 123,051 survey responses and covers 2,906 office buildings located in major metropolitan areas across the U.S. For each building in our sample, we collated a detailed list of hedonic attributes and financial indicators (i.e., rent and vacancy rates). In an econometric analysis, we link annual tenant satisfaction measures for each building to multiple financial performance metrics of the building, controlling for an extensive list of property characteristics. Our results show that a 1-point increase in overall tenant satisfaction (on a scale of 1 to 5) is associated with an 8.36% higher willingness to renew the lease; an 11.52% higher likelihood to recommend the property to prospective tenants; and a 15.80% lower probability of vacating the property. In addition, the analysis of the financial performance found that a 10% higher building-level average overall satisfaction is correlated with a 0.18% higher growth in gross rents; a 0.86% higher growth of effective gross rent; and a 0.34% lower growth of vacancy rate. The results are robust after controlling for a rich set of building characteristics, flexible trends in local real estate markets, and building fixed effects. Finally, results from a heterogeneity analysis show that the relationship between tenant satisfaction and tenant decision is stronger for those tenants who have stayed in the building for a long time, and the association between tenant satisfaction

and financial performance is stronger for those properties located in submarkets with higher vacancy rates.

Our paper is mostly related to the work of Huang and Sudhir (2021) which utilized the surveys conducted by a large credit card issuer on 42,000 customers who had called and spoken to a customer service representative between March 2008 and December 2009. This study shows that credit card customer satisfaction is positively correlated to various forms of behavioural loyalty including a greater willingness to recommend it to their friend and a lower probability of account attrition. Our research diverges from this paper in that we are researching the impact of client satisfaction in the real estate sector– tenants, on their loyalty, and behavioural decisions in terms of renewing or vacating. Besides the relationship between tenants' satisfaction levels and their migratory behaviour, we also investigate its association with the financial performance of the building.

Our research complements the nascent literature that tries to quantify the impact of tenants on the financial performance of real estate assets (see Sanderson and Read (2020) for a review). By using the occupier satisfaction survey data obtained from 240 UK commercial properties between 2002 and 2013, Sanderson and Devaney (2017) indicates a positive correlation between occupiers' satisfaction with the property management service and the investment performance of commercial real estate in the UK. Our study includes a richer set of financial performance indicators, and by employing econometrics-based empirical research, to obtain a more robust understanding of how the bottom line is affected by tenant satisfaction. Some studies try to explore the role of tenant quality on building performance: such as the study by (Liu et al., 2019) which investigated the tenant credit quality and valuation of the building, work by Lu-Andrews (2017) indicated that a financially healthy tenant would lower the additional liquidity held by the REITs. More recent work by Wang and Zhou (2021) found that, after the outbreak of COVID-19, those REITs holding properties with corporate tenants that are more resilient to social distancing perform better financially. And Zheng and Zhu (2021) found that tenant concentration structures of REITs will affect the gross rental income, net operating income, and eventually market valuations of the REIT's performance. These studies

however fail to incorporate the role of tenant satisfaction and its associated impacts on retaining tenants, ignoring the fact that the tenant will generate good cash flow for the building only when they are willing to remain in the building. In this paper, we research the implication of tenants' perceptions on the building's direct financial performance, including rents and vacancies, complementing the literature which seeks to improve the operating efficiency of the building.

Another string of literature is research on landlord-tenant information asymmetry, the impact of their relationship management, and their price bargaining. Using evidence from the farmland market, Bryan et al. (2015) indicates that a better relationship between the landlord and the farm tenant will lead to a lower rate the landlord is charging the current tenant. There are also some examples from the residential market, for example, Larsen and Sommervoll (2009) use the tenancy length of the tenant and whether the tenant is resident at the same building as the landlord to proxy the landlord-tenant relationship, indicating the positive relationship between good landlord-tenant interaction and lower rents. Phillips (2012) and Myers (2020) indicate the different statements about the thermal comfort of their rental properties between landlord and tenant will lead to willingness to pay disparity and selection bias of isolation installment, which is a potential explanation of energy isolation gap, and the tenants less likely to know about the physical quality of the buildings may therefore lead to rental market does not provide an economic return on efficiency investments. Using the theoretic model, Larsen and Sommervoll (2009) indicates that when landlords are not informed of the view of the tenant on the residential unit also leads to lower bidding rents to lower the risk of searching cost. For the commercial real estate area, using the office market leasing data from Amsterdam, Dröes et al. (2017) indicates that the office market has information asymmetry, but delegates an agency could mitigate the information asymmetry and lead to a better deal for the delegator. Chau and Wong (2016) found that information asymmetry affects negotiations between landlords and tenants when seeking the new equilibrium rent level, the bias could ultimately lead to a deviation in the vacancy rate from the natural vacancy rate. This paper contributes to the current literature in that we indicate the tenant's experience in the building as typical private information,

its differences among tenant and buildings could predict different future performance, which implies that this information is economically valuable and it could be priced in the real estate market, which emphasize the importance of eliminating this information asymmetry in making property operating more efficient.

We organize the remainder of this paper as follows: Section II discusses our data sources and presents descriptive statistics; Section III details the methodology; and Section IV presents the empirical results. Section V serves as the robustness check; Section VI details the heterogeneity analysis; while Section VII summarises the work and offers conclusions.

2. Data and Descriptive Statistics

2.1 Tenant Survey Data

Our main dataset contains all the responses to the universe of office tenants participating in the *Kingsley* survey, as designed and implemented by the Grace Hill Group, to inform building owners and property management companies about the experiences and needs of their corporate tenants [1]. This survey was selected as it represents the largest tenant satisfaction survey available in the United States from the past two decades.

In particular, our main analysis relies on the annual *Kingsley* monitoring survey of corporate tenants[2]. The survey is distributed as an online questionnaire every year to each tenant in those buildings owned and operated by the client. In total, the survey contains data from 860 commercial real estate owners distributed across the U.S. Respondents are typically facility managers or office managers involved in any decision to renew the lease. At the beginning of the survey, it is stated that the survey results are not anonymous and will be shared with the property management office to "resolve

[1]The Grace Hill Group (https://gracehill.com/) is a solution provider for the real estate sector that aims to improve the operating efficiency of client buildings. Their clientele is predominantly comprised of real estate investment companies, real estate management companies, and other real estate sector participants. Besides corporate tenant survey, kingsley also conduct survey in other sectors like multifamily property residence satisfaction assessment, employee satisfaction assessment etc.

[2]Kingsley could also customize survey questions and branding to fit the needs of their clients (e.g., an evaluation of tenants' satisfaction with sustainability and ESG compliance).

any immediate concerns and to improve service delivery". The survey is administered throughout the calendar year for different office buildings. After receiving the invitation to complete the survey, tenants have a window of 4 to 6 weeks for its completion. The response rate of the official survey is high — around 70% — reducing concerns of attrition and self-selection bias in our sample [3].

The standard questionnaire contains 116 questions divided into five different blocks pertaining to: (1) overall satisfaction; (2) perceptions of building features; (3) satisfaction with management, leasing, and maintenance service; (4) current needs and priorities; and, (5) renewal intention and the likelihood of recommendation. Respondents rate their experience inside the building across multiple dimensions on a Likert scale from 1 to 5, wherein a score of 1 signifies "Poor", 2 "Fair", 3 "Average", 4 "Good", and 5 "Excellent" [4]. Each respondent is asked to state their intentions to renew their lease on the date they are filling out the survey. [5] (a full list of the questions used in the analysis is included in Appendix A.18) [6]

Our sample comprises 2,906 office buildings across the U.S. located in 74 metropolitan areas (MSAs) and 397 cities in 38 states. Approximately, 90% of the observations were located in the 50 largest MSAs of the country. The dataset includes iconic buildings in the U.S., including the Empire State Building and 30 Rockefeller Plaza. The sample includes answers from 46,075[7] corporate tenants from 2009 to 2023. In total, the sample

[3]Of course, selection bias is still present, given that not all commercial real estate assets are included in the Kingsley survey. That said, most of the institutional landlords in the U.S. employ the Kingsley survey and, as such, results reported in this paper can be generalized more broadly to the commercial real estate sector.

[4]For example, for the overall satisfaction questions, the survey will ask participants to "Please rate your overall satisfaction as a tenant". In addition, the survey requires tenants to rate their satisfaction with a specific aspect of their experience as a tenant.

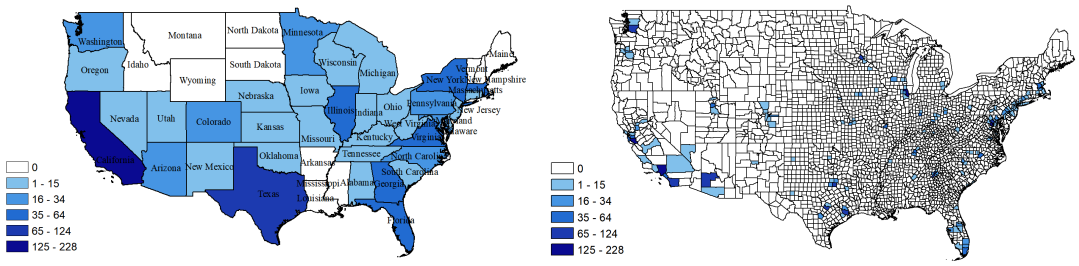
[5]The exact wording of the question is: "If the renewal decision had to be made today, how likely would your company be to renew the lease?", an answer of "1" means "Definitely would not"; "2" means "Probably will not"; "3" means "Unsure"; "4" means "Probably would"; and 5 means "Definitely would". Finally, the likelihood to recommend the building is based on the following question, "How likely would you be to recommend this building to others?" with the answers scored again from 1 to 5.

[6]There are also some questions that could prompt verbal answers, such as "What is the other area that requires attention?".

[7]For the tenant company with subsidiaries or branches located in different buildings and across different cities, we consider different branches and subsidiaries of the same parent company as being the same tenant. For example, for the "JP Morgan Chase Bank" and "JP Morgan Securities", which have the same parent company "JP Morgan Chase & Co.", we consider them to be the same tenant. If

includes 123,051 unique survey responses, allowing us to track all office buildings in our sample over multiple years. On average, each tenant completes 3 surveys. The tenants in our sample span a wide range of large U.S. and international companies [8] In addition, it also includes many small to medium-sized companies (SMEs).

Figure 1 depicts the geographical distribution of the survey responses in our data. The figure shows that our sample covers almost all states in the U.S. (our dataset covers 37 states and Washington District of Columbia (D.C.) with only 13 states not included by our sample, namely Alaska, Arkansas, Hawaii, Idaho, Louisiana, Maine, Mississippi, Montana, New Hampshire, North Dakota, South Dakota, Vermont, and Wyoming). The figure shows that our observations are primarily concentrated in California and Texas, followed by New York, Washington D.C., Illinois, and Florida. Panel B in Figure1 indicates that our samples are mostly concentrated in large cities such as New York City, Los Angeles, San Francisco, and Washington D.C..



(a) State level (b) County level

Figure 1: **Geographic distribution of Kingsley buildings between years 2009 to 2023**
Notes: Figure 1 Present the sum of the number of office buildings of Kingsley dataset across the United States.

Panels A and B present the descriptive statistics in Table 1 showing the distribution of the different variables retrieved from the tenant survey. On a scale from 1 to 5, the

the companies concerned have since experienced an acquisition or merger, we treat the companies with the same parent company after the merger as being the same tenant. For example, the company "HQ Global Holdings" was acquired by "Regus", and so we take "HQ Global Holdings" and "Regus" to be one and the same tenant. Thus, we have 65,023 office tenants in total if we consider those branches of the same company located in different buildings to be different companies.

[8]For example, the dataset covers many of the subsidiaries and branches of Apple, Morgan Stanley, Bank of America, Goldman Sachs, Prudential Financial, MetLife, Wells Fargo, CVS Health, Amazon, Google, Microsoft, IBM, etc. The data set covers 71% of the branches and subsidies of the S&P 500 companies, and survey responses from these S&P 500 companies constitute 5.3% (5,644 of 123,051) observations in our research samples.

company-level average overall satisfaction score is 4.34, while the building-level average satisfaction is 4.31. The average scale of renewal intention in our sample is 3.83 on a scale of 1 to 5, with a relatively large standard deviation of 0.94. Finally, the average building recommendation is 4.29, with 41.79% of tenants vacating the property by the end of the sample.

Figure 2 shows the summary statistics of the overall satisfaction values by city (top 30 cities by population), and all the cities present with overall satisfaction values ranging between 4.00 to 5.00 (for the statistics of all cities, 85% of the cities have average overall satisfaction values of between 4.00 to 5.00). Given that the tenant level average overall satisfaction is 4.30 (on a scale of 1 to 5) with a standard deviation of 0.78, we can observe some meaningful heterogeneity in overall satisfaction within geographic locations. For example, company tenants in Washington D.C. are generally happier than company tenants located in New York City (0.25 points higher). [9]

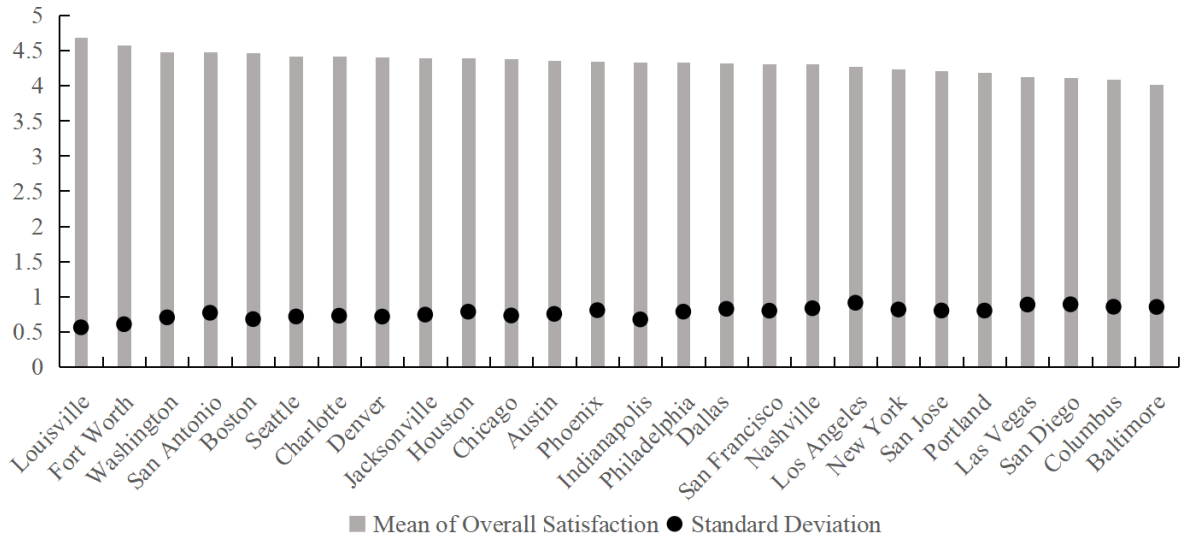


Figure 2: Geographic distribution of satisfaction(Top 30 cities by population)
Notes:The city-level average overall satisfaction is the arithmetic average of the overall satisfaction score of all the respondents in the corresponding city over the entire sample period from 2009 to 2021. The top 30 cities are ranked by population, although Detroit and El Paso were dropped due to a dearth of observations, as were Albuquerque (6 responses), Memphis (1), and Oklahoma City (1).

[9]In the empirical analysis, we control for the location fixed effect to account for the influence of those geographical characteristics which will affect tenant's satisfaction level but did not change over time.

Table 1: Descriptive statistics

Variable	Obs.	Mean	Std.	Min	Max
Panel A: Tenant Decision (Company Level)					
$RenewalIntention_{i,b,t}$ (Score 1-5)	93,912	3.830	0.94	1.00	5.00
$BuildingRecommendation_{i,b,t}$ (Score 1-5)	60,530	4.281	0.76	1.00	5.00
$FinalMoveOut_{i,b}$ (YES=1)	65,808	0.418	0.49	0.00	1.00
Panel B: Tenant Perception					
$OverallSatisfaction_{i,b,t}$ (Score 1-5)(Company Level)	123,051	4.338	0.77	1.00	5.00
$AverageOverallSatisfaction_{b,t}$ (Score 1-5)(Building Level)	10,478	4.312	0.47	1.00	5.00
Panel C: Building Characteristics (Building Level)					
Building Class(percent):					
$ClassA_b$ (YES=1)	2,906	0.667	0.47	0.00	1.00
$ClassB_b$ (YES=1)	2,906	0.309	0.46	0.00	1.00
$ClassC_b$ (YES=1)	2,906	0.024	0.15	0.00	1.00
Age_b (Years)	2,906	38.17	25.67	1.00	165.00
Built Year (percent):					
$Before1970_b$ (YES=1)	2,906	0.156	0.36	0.00	1.00
$1970-1979_b$ (YES=1)	2,906	0.096	0.30	0.00	1.00
$1980-1989_b$ (YES=1)	2,906	0.327	0.47	0.00	1.00
$1990-1999_b$ (YES=1)	2,906	0.150	0.36	0.00	1.00
$After2000_b$ (YES=1)	2,906	0.270	0.44	0.00	1.00
Stories (percent):					
Low_b (<10 floors) (YES=1)	2,906	0.612	0.49	0.00	1.00
$Medium_b$ (10<and<20 floors) (YES=1)	2,906	0.210	0.41	0.00	1.00
$High_b$ (>20 floors) (YES=1)	2,906	0.167	0.37	0.00	1.00
$Renovated_{b,t}$ (YES=1)	10,341	0.284	0.45	0.00	1.00
$TypicalFloorSize_b$(thousand SF)	2,906	28.187	19.15	2.70	356.75
$RentableBuildingArea_b$(thousand SF)	2,906	279.174	319.82	2.70	3235.53
$Amenities_b$ (YES=1)	2,906	0.596	0.49	0.00	1.00
$Green_{b,t}$ (YES=1)	9,368	0.401	0.49	0.00	1.00
$GMgmt_{b,t}$ (YES=1)	9,368	0.645	0.48	0.00	1.00
Panel D: Financial Indicators (Building Level):					
Growth:					
$\Delta Rents_{b,t+1,t}$ (%)	6,472	1.828	6.14	-21.05	28.15
$\Delta EffectiveRents_{b,t+1,t}$ (%)	6,463	1.937	13.71	-42.03	57.68
$\Delta VacancyRate_{b,t+1,t}$(%)	11,147	0.633	9.38	-100.00	100.00
Level data:					
$Rents_{b,t}$ ($/SF yr)	7,311	37.160	14.83	8.00	121.70
$EffectiveRents_{b,t}$ ($/SF yr)	7,310	32.238	14.61	0.00	120.00
$VacancyRate$(%)	11,711	11.518	14.18	0.00	100.00
Panel E: Leasing Contract Characteristics (Contract Level):					
$Rents_{g,b,t}$($/SF yr)	6,211	33.814	21.30	1.70	758.12
$EffectiveRents_{g,b,t}$($/SF yr)	5,620	29.164	19.16	0.00	691.07
$MonthsonMarket_{g,b,t}$(Years)	6,211	2.182	2.52	0.00	20.42
$ContractLength_{g,b,t}$(Years)	6,211	4.592	3.85	0.08	65.00
$FreeRent_{g,b,t}$(Years)	6,211	0.017	0.11	0.00	2.17
$Log(SizeLeased_{g,b,t})$(SF)	6,211	8.439	1.09	5.13	13.11

Notes: Data Source: Grace Hill, CoStar, USGBC, and Delos. The summary statistics displayed above consider the full sample period (from 2009 to 2023). For those tenants with subsidiaries in different buildings, we regard them as being different tenants in the descriptive statistics. The performance data presented in panel D are winsorised at their respective 1st and 99th percentiles to reduce the influence of outliers. We retained only those years with survey observations for the summary statistics of financial variables. $\Delta Rents_{b,t+1,t}$ is calculated as ($Rents_{b,t+1}/Rents_{b,t}$ - 1)*100, $\Delta EffectiveRents_{b,t+1,t}$ is calculated as ($EffectiveRents_{b,t+1}/EffectiveRents_{b,t}$ - 1)*100, $\Delta VacancyRate_{b,t+1,t}$ is calculated as ($VacancyRate_{b,t+1} - VacancyRate_{b,t}$). The rents and vacancy data we use for our analysis is the direct rents and direct vacancy

2.2 Building Characteristics and Financial Performance

The financial indicators of the properties and building characteristics in our sample were retrieved from CoStar, the largest data provider of commercial real estate information in the U.S. with a database of over 6 million properties [10]. For each building in our sample, we retrieved a comprehensive list of characteristics, including location, building class, year of construction, the year when the last renovation took place, number of stories, building size, and amenities within the property [11]. In addition, we collated the historical data of the property management company of the building [12], as well as information about the building owner and leasing company at the time the data was downloaded [13].

In addition, we use LEED and WELL to capture the sustainability attributes of the office buildings. For each property in our sample, we collected the certification records from the two major sustainability grading systems in the U.S., specifically the LEED certification programme of the U.S. Green Building Council (USGBC) [14], and the WELL certificate managed by the International WELL Building Institute (IWBI) [15]. LEED primarily targets environmental sustainability and resource efficiency, although it also has some requirements for the health attributes of the building. The WELL certificate focuses on human health and well-being within the built environment and could be applied to three different development statuses for the building, namely new and existing buildings, new and existing Interiors, and core and shell compliance. To attain a WELL certificate, the building must meet certain environmental threshold requirements with respect to air, water, nourishment, light, movement, thermal comfort, sound, materials, mind, and community. Additionally, the WELL certification process involves on-site

[10] https://www.costar.com/about

[11] The amenities included in the sample comprise banking, convenience stores, dry cleaners, fitness centres, food courts, food service, and restaurants.

[12] CoStar maintain historical records of property management of the building, including the date that the property manager was last changed.

[13] CoStar maintains the record of the current property owner and current leasing representative company of the building at the time the data was collected.

[14] https://www.usgbc.org/

[15] https://delos.com/

testing and verification by a third-party assessor to ensure that the building meets the standards set by the IWBI. [16]

For each green certification, we collated information on the building address, date of registration, date of certification, type of certification, and level of certification. Table 1 Panel C displays the descriptive characteristics of the green certificate in our sample. We have 1,177 green buildings in total (40.52% of our buildings sample), of which 1,152 were only LEED-certified; 7 were only WELL-certified; and 18 were certified by both LEED and WELL. 40.10% of buildings in our sample were surveyed after the building was certified as "green". [17]

In addition, we collated detailed financial performance data for each building. First, we gathered quarterly weighted averages of the asking rent and vacancy rate of each property (e.g., from 1982Q1 to 2023Q4) together with all details of the terms in leasing contracts attached to the property since 1986. CoStar reports the weighted average asking rent for each quarter for each leasing type (e.g., sublease, direct lease, and total of the sublease and direct lease) if there is space available in the building, otherwise the asking rent information will be displayed as missing. The asking rent describes, therefore, the average of the asking rent of the available space weighted by the square footage of the corresponding listed space [18]. Costar also reports on the vacancy rate of the building every quarter, defining vacancy as any space that is not physically occupied by a tenant [19]. For each leasing contract signed between 2009 and 2023 (i.e., a period overlapping with the tenant satisfaction survey), we collated the contract terms of the lease, including the agreed rent, signing date, start date, move-in date, expiration date,

[16]WELL Certification is valid for three years from the date of the certification award letter.

[17]The characteristics of green buildings in our samples are similar to the figures of Holtermans and Kok (2019), wherein green buildings constitute a higher proportion of Class A buildings, are larger in the area and vertical elevation, are more likely to have on-site amenities, achieve higher gross rents and tend to exhibit lower vacancy rates.

[18]for example, if building A had two spaces available for lease and was listed on the market during 2023Q4 and the size was 90 and 100 and the asking rents were 100 and 120, respectively, then the average asking rent is given as 100*90/190+120*100/190 = 110.53.

[19]Data on commercial office buildings provided by CoStar includes liquid commercial office space only and so owner-occupied headquarters buildings are underrepresented. "Demand" denotes the total occupied space in a market, while the vacancy rate is given by 1 - (demand or stock).

space leased, free rent period, lease type (i.e., direct or sublease), deal type (i.e., new or renewal), contract service type (full-service gross, industrial gross, modified gross, negotiable net, plus all utilities, plus cleaning, plus electric, tenant electric, double net, and triple net.), tenant company, and tenant industry.

Table 1 displays the descriptive characteristics of buildings in our sample. Panel C in Table 1 describes that the office buildings in our sample are skewed towards prime 'Class A' and 'Class B' offices. Nearly 66.70% of the buildings are designated as "Class A", while 30.90% are "Class B". The average age of these office properties is 38.17 years, while 28.40% reported a renovation. The average size of the properties across our sample is 279,174 square feet; while 59.60% of the office buildings in our sample had on-site amenities [20]. Table 1 Panel B shows the descriptive statistics associated with the average financial performance of properties in our sample. The average growth of rents is 1.828%; the average growth of effective rents is 1.937%; and the average vacancy growth is 0.633%[21]. The average asking rent is 37.16$/SF; the average effective rent is 32.238$/SF; and the average vacancy rate is 11.518%. Similar to the asking rents, the average contract rent is 33.81$/SF; the average on-market time is 2.18 years; the average contract length is 4.59 years; and the average rent-free period is 0.21 months. The distribution of rents and vacancies in our sample of buildings is similar to those presented in recent studies of the U.S. office market (see, for instance An et al., 2016; Holtermans and Kok, 2019).

2.3 Data Construction

For the econometric analysis, we matched the tenant satisfaction survey data with building characteristics and financial data from the property, all based on the building address. We implement a number of data processing measures. First, we excluded those observations where the building age was smaller than or equal to zero as well

[20] If the building had one or more of the following amenities available, then it was defined as having on-site amenities, and hence the dummy variable Amenities takes the value of '1' or '0' otherwise.

[21] Around 5.2% of the office buildings in our dataset are single tenancy buildings, which have a relatively stable vacancy rate throughout the sample period, 95% of these buildings with vacancy rate change of 0% throughout the period.

as those with missing information on specific building characteristics. Second, when multiple responses are available per tenant and year for a given building, we computed the average of responses. In total, there were 1,327 survey data observations from those companies with more than 1 respondent. In total, our final dataset contains 123,051 survey entries derived from 2,906 office properties.

In Figure 3, we document the time trend of the main dependent and independent variables over the past 10 years (2014 to 2023) [22]. Figure 3a displays the correlation of tenant satisfaction in our survey with property quality, which although relatively stable over time, shows heterogeneity across different building quality metrics. Tenants tend to have higher satisfaction levels in "Class A" properties throughout the sample period, followed by the "Class B" properties, and "Class C" properties. Second, the time trends in satisfaction of the "Class A" properties show a stable and even an upward trend throughout the sample period; whereas "Class B" properties show a drop; and "Class C" properties exhibited a big drop in 2019 followed by a swift rebound.

Figure 3b displays the time series of stated renewal intentions for the different overall satisfaction levels of the tenant. First, the graph shows that renewal intention is the highest among those tenants who were "very satisfied" (score 5 out of a scale of 1 to 5), followed by those tenants with an overall satisfaction score of 4, 3, 2, and 1, respectively. Second, renewal intention remained constant over the initial phase of the sample period, while all tenants with different satisfaction levels experienced a small drop in 2020 only to rebound partly in 2021. In addition, while the figure shows meaningful heterogeneity across different tenant satisfaction levels, the magnitude of the drop in tenants with a satisfaction score of "1"(on a scale of 1 to 5) was more severe than for other scores.

Figure 3c displays the trend of the willingness to recommend the property across different satisfaction levels. The trend is relatively stable during the period of our research sample, albeit with some heterogeneity. Buildings with "satisfied" tenants showed the best performance, with the most satisfied tenants also being the most willing

[22]Most of our surveys were completed after 2018 and so the observation of the past 5 years (2017 to 2023) takes up 75% of our research sample, while the first 8 years (2009 to 2016) only takes up 26%.

to recommend the property to third parties across the sample.

Figure 3d shows the trend in the average overall satisfaction of direct gross rents by different building levels. [23] On average, those buildings with average satisfaction levels above the median sample value exhibited a stable upward trend, even after the outbreak of COVID-19. The buildings with the lowest average satisfaction (below median) experienced a small drop in direct gross rents during 2021, consistent with the findings of Gupta et al. (2022) who observed a 13.16% fall in the rents of newly signed leases between 2020 and 2021, on average, albeit with heterogeneity.

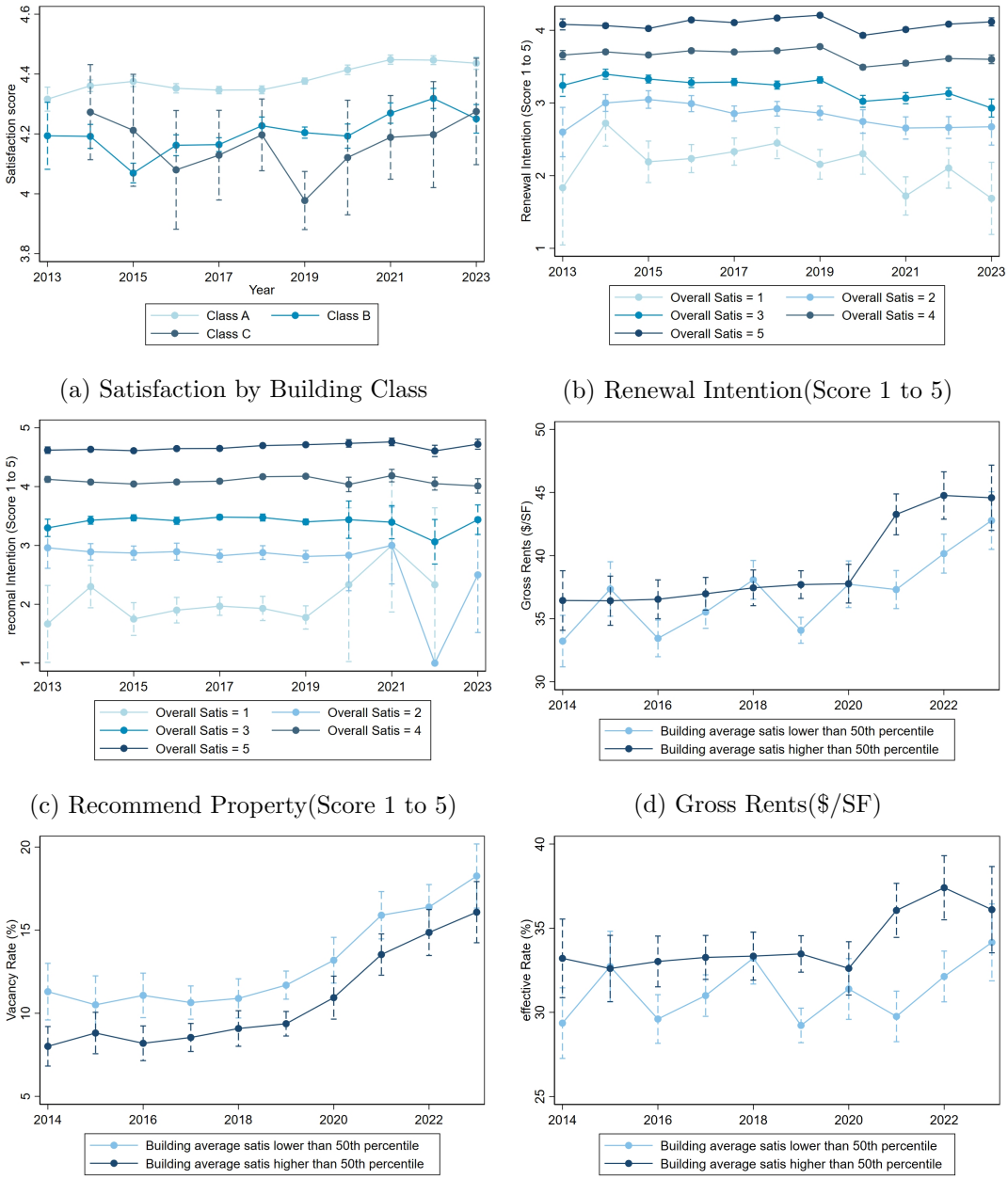
Figure 3e displays the upward trend in vacancy rates since the outbreak of COVID-19 across all average satisfaction levels. However, those buildings with an above-median overall satisfaction rating tended to exhibit lower vacancy rates during this period, even after the beginning of the pandemic. On the other hand, those buildings with below median satisfaction levels exhibit higher vacancy rates throughout the period and have since experienced faster growth in vacancy rates (i.e., around 5%) since the outbreak of COVID-19.

Finally, Figure 3f describes the trend of effective rents. The figure reveals a similar trend to the gross rents. Those buildings with above-median satisfaction levels are relatively stable and even show an upward trend after the outbreak of the pandemic, but for those buildings falling below the median, there was a substantial drop in 2021.

3. Methodology

Figure 4 presents the empirical research design for the study. The goal of the study is to test to what extent tenants' satisfaction with their building affects their willingness to remain in the building and recommend it to others and, therefore, ultimately their decision as to whether to terminate their lease and move on to another property. Changes

[23] Buildings are divided into two groups according to their cross-sectional comparison. For example, if the building's average satisfaction level is below the median, then it was grouped into the "Building average overall satisfaction = 0th - 50th percentile" group. We then take the arithmetic average of the gross rent level of the buildings in the corresponding group to estimate the time trend of each group using only "direct gross rents", which is the listing price obtained directly from the landlord, rather than the subletting, or overall rents, thereby combining direct and subletting rents.



(a) Satisfaction by Building Class

(b) Renewal Intention(Score 1 to 5)

(c) Recommend Property(Score 1 to 5)

(d) Gross Rents($/SF)

(e) Vacancy Rate(%)

(f) Effective Rents($/SF)

Figure 3: Time series of satisfaction, tenant decision and building performance

Notes: Overall satisfaction, renewal intention, recommendation of property, rental level, vacancy rate, and effective rents are presented as arithmetic averages. Dashed lines delineate the upper and lower 95% confidential intervals. The effective rent is calculated by multiplying the building-level rental rate by its occupancy rate. (We dropped the samples before 2013 because of scarce observations.)

in the attractiveness of extant tenants may ultimately shape the reputation and spatial demand of the building, and these changes in demand could be reflected in changes in rental and vacancy rates, eventually interacting with the cap rate to capitalise on the

value of the building. Therefore, understanding tenant experience and its influence is crucial for property owners and managers who want to improve their building's operating efficiency and maintain property values. In this study, we try to quantify the effect of tenant satisfaction on their decision to renew their leases as well as the impact on the financial performance of the building.

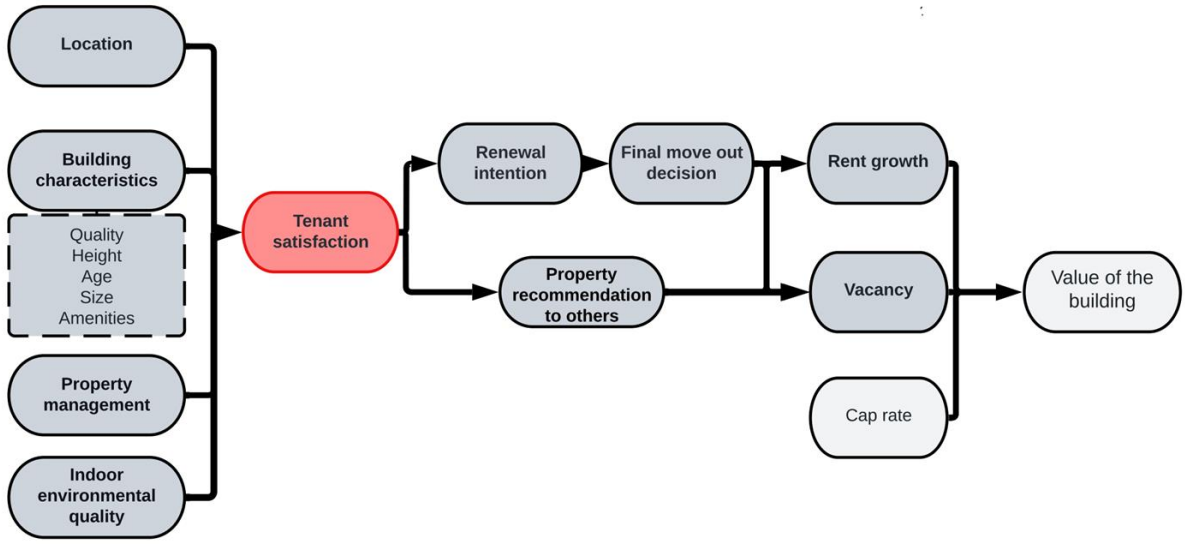


Figure 4: Research framework

3.1 Leasing Contracts and Recommendations

We tested our hypothesis using a model relating tenant satisfaction to three key tenant decision indicators, namely: (1) stated renewal intention; (2) propensity to recommend a building; and (3) likelihood to move out of the property. Equation 1 describes the regression model:

$$RenLease_{i,b,t} = \alpha + \beta Satisfaction_{i,b,t} + \gamma X_b + \mu_t * \lambda_c + \tau_i + \varepsilon_{i,b,t} \tag{1}$$

The dependent variable $RenLease_{i,b,t}$ describes the likelihood of tenant i renewing their lease in building b in year t. The survey allows for testing in terms of the measurement of the renewal of leases in two different ways. Initially, every year the tenant

was asked explicitly for their intention to renew their lease on a scale from 1 (least satisfied) to 5 (most satisfied). Finally, we tracked whether the tenant exited the building (we constructed a dummy variable taking the value of one if the tenant is no longer in the property and zero if otherwise). In addition, tenants are requested to answer their willingness to recommend the property to a third party from 1 (least likely) to 5 (most likely).

For the identification of 'moved out' status, we compared the current tenant information of each building from the CoStar database with the tenant information in the survey data to identify whether the tenant was still resident in the building. If the tenant who filled out the survey appears on CoStar's current tenant section, then we regard them as "existing", otherwise their status is changed to "moved out". We also cross-verified the tenant's occupancy status using the Google Maps database and the official website of the tenant company (if it existed). Thus, if Google Maps indicated the tenant as "operating" in the building, then we regarded it as "existing" or else the status was altered to "move out". If the contact address of the tenant company as published on their website was the same as the address in the survey, then we regarded the tenant as "existing" and if not, then as "move out" [24]. [25]

The variable $Satisfaction_{i,b,t}$ describes the reported level of satisfaction of tenant i with building b in year t on a scale from 1 (least satisfied) to 5 (most satisfied). The key coefficient of interest is β which captures the influence of tenant satisfaction on the different outcomes describing the process of lease renewal. Vector X_b describes the set of controls for building characteristics, including the following hedonic building charac-

[24]For those tenants who filled out the survey: (1) If the information of the tenant could not be found in any of the three data sources (i.e., CoStar/Google Maps/Company's official website), then we regarded it as having left; (2) If any of the 2 or all 3 data sources show the tenant as "existing", then we consider the tenant as having remained in the building; although (3) if the current contact address information shown on the official website is not the same as the address derived during the survey period, no matter what the existing or move out status indicated on Google Maps or the CoStar database, then we consider it as not existing in the building.

[25]There might arise worries of the cost of moving, tenant loyalty or co-location effect, such as paper by Hatch (2017), which indicates regulation on the landlord-tenant relationship might affect the household moving decision. But usually, commercial real estate does not have leasing norms or regulations etc. that would limit the tenant moving decision.

teristics: building class, vintage, number of floors, whether experienced a renovation in the building when the building was surveyed, size of the building, and whether there are on-site amenities.

All regressions include time (μ_t), city-effects (λ_c), and tenant-fixed-effects (τ_i) [26]. The city×year fixed effect will absorb the variation in the dependent variable at the city level (e.g., due to variations in weather conditions, changes triggered by industries' working methods, overseas outsourcing, collaborative work practices, and cloud-based data sharing etc.)[27]. Tenant-fixed-effects could control for the effect of permanent preference heterogeneity of corporate tenants, which influence tenants' choices or attitudes towards office space demands and indoor services(e.g. such as the industry sectors and their reliance on the traditional office space, or the possibility that good tenant just generally happy in any office space, or satisfaction is driven by the financial performance of the company instead of the satisfaction with the building itself). $\varepsilon_{i,b,t}$ is the error term, clustered at the building level, to capture the correlation of responses within a property.

3.2 Building Financial Performance: Rents and Vacancy Rates

The second part of the analysis estimates the relationship arising between tenant satisfaction and the financial performance of the building, as reflected by the *change* in gross and effective rents as well as the *change* in the vacancy rate. Note that the analysis focuses on *changes* and not levels of financial performance to reduce concerns of omitted variable bias associated with cross-sectional differences in levels (e.g., Eichholtz et al., 2013). In addition, we include a comprehensive list of hedonic characteristics of the building to control for any unobserved characteristics that might otherwise be correlated with financial performance or else affect tenant satisfaction and financial performance concurrently. Equation 2 describes the empirical model relating the average

[26]Tenants with different characteristics might also have different preferences in their leasing decisions (Crosby et al., 2006; Halvitigala et al., 2011; Eichholtz et al., 2011), which will affect satisfaction levels and tenant decision at the same time, or else affect their behavioural preferences without affecting their declared satisfaction levels which cannot otherwise be attributed to the building characteristics itself.

[27]Because the building characteristics are time-invariant if we control for the building fixed effect the coefficient of building characteristics will be absorbed, but we also test the robustness of our results using building×time fixed effect, the conclusion is similar to the findings in our main analysis, and the results are shown in Appendix A.19.

tenant satisfaction of tenants in the building to the average financial performance of the building, as measured by the change in the average gross rents, changes in effective rents, and changes in vacancy rates:

$$\begin{aligned}\Delta Log(Performance_{b,t+1,t}) = \alpha + \beta Log(Satisfaction_{b,t}) + \theta Log(LaggedLevel_{b,t}) \\ + \gamma X_b + \mu_t * \lambda_c + \varepsilon_{b,t}\end{aligned} \tag{2}$$

$\Delta Log(Performance_{b,t+1,t})$ is the observed change in financial performance of building b between years $t+1$. We include three separate financial indicators of the performance of building b between year $t+1$ and year t: (1) $\Delta Log(Rents_{b,t+1,t})$, which is the change in the logarithm of the gross rent per square foot of building b between year $t+1$ and year t, and calculated as $Log(Rents_{b,t+1})$-$Log(Rents_{b,t})$; (2) $\Delta Log(EffectiveRents_{b,t+1,t})$, which is the change in the logarithm of listing effective gross rent per square foot of building b between year $t+1$ and year t and calculated as $Log(EffectiveRents_{b,t+1})$-$Log(EffectiveRents_{b,t})$; and (3) $\Delta VacancyRate_{b,t+1,t}$, which is the change in the vacancy rate of building b between year $t+1$ and year t and calculated as $VacancyRate_{b,t+1}$ - $VacancyRate_{b,t}$[28]. It is important to note that the incremental effect in rent growth which we estimate is coming from new listings, which will not affect the rental levels of existing leasing contracts and is essentially the "updating activity" of the landlord in changing the asking price of the listing space according to prevailing market conditions. Compared with contract rents, one significant advantage of using asking rents is that asking rents can reflect the current sentiment of the market (Ibanez and Pennington-Cross, 2013) and thus it serves as a proxy for the landlord's expectation of the extant market value of the available space given the market conditions during the listing. Another advantage of using asking rents is that the asking rent usually has more observations as

[28]CoStar provides with three types of performance measurement for rents and vacancy levels, specifically direct, sublease and overall. For example, gross rents include direct gross rents, sublease gross rents, and overall gross rents. Rules applied to the vacancy rate are similar. Here, we use the direct gross rents and direct vacancy rate for financial performance measurements as the sublease transaction might not reflect the market average situation, but is more likely to be influenced by the financial status and operating strategies of those companies which offer the listing.

compared with leasing contract rents as there may not be a newly signed leasing contract every year.

The key variable of interest, $Log(Satisfaction_{b,t})$, describes the average overall satisfaction level of all tenants completing the tenant satisfaction survey for building b in year t. β describes the sensitivity of the financial performance indicators to tenant satisfaction. In particular, the coefficient allows for testing of differences in vacancy rates or rents in those buildings with comparable hedonic characteristics that have different tenant satisfaction levels. Besides the hedonic controls listed in Equation 1, we also include the lagged financial performance $Log(LaggedLevel_{b,t})$ of building b in year t, to mitigate the potential of endogeneity that certain tenants may selectively choose buildings based on their preferences: (1) The logarithm of listing gross rent per square foot of building b in year t; and, (2) the logarithm of vacancy rate of building b in year t. [29] [30]. The vector of control variables of building characteristics follows the specification in Equation 1, but different in that we didn't include the tenant fixed effect[31].

Even if we have controlled the lagged financial performance of the building, we still cannot eliminate the possibility that tenants seeking a better experience will sort into those high-quality buildings with higher rents, which will subsequently reflect in more positive feedback in survey data. We undertook another two measures to mitigate this concern: (1) We examine the tenant satisfaction distribution across buildings of varying rent levels and vacancy rates, as illustrated in Figure Appendix A.6. The results suggest that, regardless of the distribution level of rents or vacancy rates, the distribution of satisfaction appears to be approximately random. This implies a degree of

[29] We follow Verbrugge et al. (2017) which studies the dynamics of rents of individual properties, indicating that the relative rental level can predict the rent growth over the ensuing period. Similarly, Wheaton et al. (1997); Gabriel and Nothaft (2001), who explored the mechanisms of market-level rent dynamics by developing a general specification which indicates that the vacancy incidence possibility, vacancy length, tenant inflow, and current rent level all have a direct impact on rental price adjustments. Similarly, research by Grenadier (1995a) on the determinants of the vacancy rates of the U.S. office market also uncovered a significant impact of the current vacancy rate on vacancy dynamics.

[30] For the analysis of gross rent change, we controlled for the lagged rent level. For the analysis of the change of effective gross rent, we controlled for the lagged rent level and lagged vacancy rate. For the analysis of changes in the vacancy rate, we controlled for the lagged vacancy rate.

[31] In this equation, both the financial performance and tenant satisfaction variables are building-level average data.

random allocation of tenants across different buildings. (2) We investigate potential matching patterns between tenants and landlords, or between tenants and property management companies. The results indicate that the allocation of tenants to specific landlords or property management companies also exhibits a random pattern. These efforts contribute to the reliability of the examination of the association between tenant satisfaction dynamics and their leasing decision, but also the building performance.

4. Empirical Results

4.1 Tenant Satisfaction and Tenant Decision

Table 2 presents the estimates described in Equation 1, which investigate the relationship between tenant satisfaction and the decision to renew a lease and recommend the property to prospective tenants. The coefficients associated with these control variables are not displayed in the main text due to spatial constraints (the full table is available in Appendix Table A.10 and A.11).

Columns (1) - (3) in Table 2 present the results on renewal intention, adding sequentially controlled variables, time and city-fixed effects, and tenant-fixed effects, respectively. Column (1) indicates that a 1-point higher overall satisfaction will lead to a 0.43-point higher renewal intention, and the magnitude and sign of coefficient are similar when adding time and city-fixed effects. Column (3) presents the most conservative specification by including tenant-fixed effects. The results indicate that a 1-point higher overall satisfaction will lead to a significant increase of 0.33-point in the willingness to renew the leasing contract. The size of the increase in renewal intention represents an economically meaningful metric since it represents 8.62% of the average on the likelihood of renewal scale (8.62% = 0.33/3.83).

Columns (4) to (6) describe the results of the inclination to provide a building recommendation to other tenants, again adding controls sequentially to the model to test the stability of our estimates. Column (6) shows that a 1-point improvement in satisfaction is related to a 0.49-point increase in the willingness to recommend a property to peers. This means a 1-point higher tenant satisfaction level will lead to an 11.52% (0.49/4.27)

improvement in willingness to recommend a property, respectively, as compared with the average in the 5-point Likert scale that describes the propensity to recommend a property. In summation, the results in Columns (1) - (6) of Table 2 indicate a strong positive relationship between tenants' satisfaction and their self-reported intention to renew the lease and recommend the property to others.

Columns (7) - (8) show the results of conditional Logit estimation results for the impact of satisfaction on tenants' actual move-out status [32]. Column (8) indicates that, on average, a 1-point higher overall satisfaction will lead to a 14.62[33] percentage-point lower probability of leaving. These results indicate that satisfaction not only affects tenants' self-reported commitment but is also a strong predictor of their *actual* leasing behaviour [34].

4.2 Tenant Satisfaction and The Dynamics of Building Financial Performance

Table 3 presents the estimates of the model delineated in Equation 2. Based on the weighted average of asking rents per square foot of the building, Columns (1) - (3) in Table 3 reveal the impact of tenant satisfaction on the logarithmic change in gross rents. On average, a 1% higher average building-level satisfaction is correlated to a 0.018% higher growth in gross rents. Columns (4) - (6) in Table 3 describe the impact of tenant satisfaction on the logarithmic change in effective rents. The results mirror those of Columns (1) - (3), yet the magnitudes of the coefficients are larger. Column

[32]The results of the equivalent linear OLS model display high consistency in terms of statistical significance and magnitude. Results are displayed in Appendix Table A.13.

[33]$14.62\% = [100 * (e^{-0.158} - 1)]$

[34]For the analysis presented in Columns (7) - (8), we preserved only the latest reply from each tenant. This approach helps to avoid the sample being over-represented by tenants who have filled out surveys more frequently. Additionally, the latest opinions of the tenant about the building are closer to their final leaving status in terms of the time point of concern, which might serve as a better indicator of their actual decision: for instance, if a tenant had filled out a survey between 2015 and 2019, we would only preserve the survey from 2019 to explain their actual leaving status. The results are similar if we preserve all the survey responses from each tenant. We did not control for the tenant-fixed effect in Columns (7) - (8), because every tenant in each building only has one status of staying or leaving, and thus controlling for the tenant-fixed effect will absorb that sample of tenants who do not have subsidiaries or branches, thereby preserving only those tenants who have subsidiaries in different buildings (which would cause the loss of almost all of our research observations).

Table 2: Tenant Satisfaction, Tenant Leasing Decision, and Property Recommendation

	Renewal Intention$_{i,b,t}$ (Score 1-5)			Building Recommend$_{i,b,t}$ (Score 1-5)			Move Out Property$_{i,b,t+1}$ (YES=1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Overall Satisfaction$_{i,b,t}$	0.432***	0.433***	0.329***	0.598***	0.594***	0.473***	-0.208***	-0.158***
	(0.005)	(0.005)	(0.008)	(0.005)	(0.005)	(0.008)	(0.016)	(0.034)
Constant	2.016***	1.804***	2.266***	1.315***	1.220***	2.132***	0.445	2.236
	(0.113)	(0.125)	(0.219)	(0.085)	(0.093)	(0.175)	(0.641)	(2.212)
Control$_b$	YES	YES	YES	YES	YES	YES	YES	YES
Time * City FE	NO	YES	YES	NO	YES	YES	NO	YES
Tenant FE	NO	NO	YES	NO	NO	YES	NO	NO
Observations	100,305	100,178	79,474	64,607	64,544	49,394	45,586	27,664
# Buildings	2,796	2,762	2,439	2,134	2,112	1,898	2,628	2,633
R-squared	0.123	0.157	0.554	0.374	0.394	0.670	0.014	0.194

Notes:Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable in Columns (7) - (8) is a binary variable, taking the value of one if the tenant is no longer resident in the building today and zero otherwise. Columns (1) - (6) are OLS regressions and (7) - (8) are Logit regressions. The full table, with the estimation of all control variables, is presented in Appendix Table A.10.

(6) in Table 3 shows that a 1% improvement in satisfaction will lead to a 0.086% higher growth in effective rent. Columns (7) - (9) present the analysis of the vacancy rates. A 1% improvement in tenant satisfaction is correlated to a 0.0343% lower vacancy rate growth [35][36].

The research results offer two plausible explanations. Firstly, landlords appear to leverage survey outcomes as a negotiation tool during the execution of new leasing contracts. In this scenario, incoming tenants who lacking firsthand knowledge of the building's experience might rely on survey results and accepting the bidding of the landlord, while the landlord's confidence was enhanced from positive survey feedback,

[35]To avoid the impact of unobservable building characteristics, which might be correlated to the rental and vacancy levels of the property, while the satisfaction level of the property might not be correlated to these characteristics (e.g., gorgeous decoration and more expensive amenities will all be capitalised into the building's rent level. However, tenants might be getting used to the environment they are situated in (Palacios et al., 2020; Loewenstein and Ubel, 2008; Galiani et al., 2018), even if it is a bad-quality building or they might still feel satisfied with the building just so long as they feel what they pay is good value. As we can see in the scatter plot of the distribution of satisfaction across different rent levels in Appendix A.10, at each rent level there might be a large variance in the distribution of tenant satisfaction). If we add the building-level fixed effect and re-estimate (2), then the results shown in A.19 are found to be essentially similar to those of our primary conclusion.

[36]For the statistics of financial performance, we use the direct rents and direct vacancy rate, because these indicators are directly linked to the profitability of real estate investors. If we use the total average of sublease rents and direct rents indicators, we get a similar conclusion.

Table 3: Tenant Satisfaction and Building Financial Performance

	$\Delta Log(Rent_{b,t+1,t})$ ($/SF)			$\Delta Log(EffectiveRent_{b,t+1,t})$ ($/SF)			$\Delta VacancyRate_{b,t+1,t}$ (%)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(Overall Satis$_{b,t}$)	0.006	0.005	0.018**	0.063***	0.053**	0.086***	-3.345***	-2.936***	-3.434***
(Score 1-5)	(0.007)	(0.007)	(0.009)	(0.020)	(0.021)	(0.025)	(0.755)	(0.770)	(0.839)
Constant	0.053***	0.060***	0.144***	-0.092***	-0.132**	-0.140*	7.880***	11.162***	12.993***
	(0.013)	(0.022)	(0.037)	(0.034)	(0.057)	(0.075)	(1.311)	(2.839)	(3.051)
Lagged Level$_{b,t}$	YES	YES	YES	YES	YES	YES	YES	YES	YES
Control$_b$	NO	YES	YES	NO	YES	YES	NO	YES	YES
Time * City FE	NO	NO	YES	NO	NO	YES	NO	NO	YES
Observations	5,156	5,156	4,477	5,155	5,155	4,476	9,079	9,079	8,226
# Buildings	1,690	1,690	1,515	1,598	1,598	1,427	2,166	2,166	1,997
R-squared	0.006	0.009	0.236	0.050	0.055	0.273	0.067	0.071	0.237

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Explained variables are winsorised at their respective 1st and 99th percentiles to reduce the influence of outliers. The full table with the estimation of all control variables is in Appendix (Table A.11).

which may subsequently influence negotiations with both new and existing tenants and thereby contributing to an upward adjustment in pricing. Alternatively, tenants may have already taken their satisfaction with the building into the rental prices that they are willing to pay, even without the case of landlord showing tenants the survey results, which means tenant might be the leading role in pricing their experience information.

5. Robustness Check

This section presents a series of robustness checks to test the stability of the results.

5.1 Tenant Satisfaction and Achieved Rents

Using weighted average asking rents for an analysis of the change in building financial performance has some advantages, including the availability of a larger dataset and the high correlation of asking and transaction rents (Jennen and Brounen, 2009), which is more predominant for the regression of hedonic pricing models in existing studies. However, there are some issues with using asking rents. After all, the rent that the landlord is asking for cannot be guaranteed to be realised in any future leasing activities. The data might also be over-represented by those buildings that have space available more frequently, which might be correlated with the functionality of the building (Jaffee

et al., 2019) and thus under-represent well-performing properties that are otherwise fully occupied. Considering these issues with asking rent data, in this section we use leasing *contract* data to estimate Equation 2, to investigate the effect of satisfaction on achieved rents:

$$\begin{aligned} Log(ContractRent_{g,b,t+1}) =& \alpha + \beta Log(Satisfaction_{b,t}) + \\ & \theta Log(LaggedLevel_{b,t}) + \gamma X_b + \mu_t * \lambda_c + \varepsilon_{b,t} \end{aligned} \tag{3}$$

, where $Log(ContractRent_{g,b,t+1})$ is the logarithm of the rental level specified in a given rental contract g in building b for the year $t+1$ (the year after tenants have completed the survey). We also control for the current period financial performance indicator $Log(LaggedLevel_{b,t})$, which is the logarithm of the current period average contract rent of building b in year t weighted by the size of realised leased space. For the analysis of the effective rents, the explanatory variable $Log(EffectiveContractRent_{g,b,t+1})$ is the logarithm of the effective rents of leasing contract g in building b in year $t+1$, while the control variable $Log(LaggedLevel_{b,t})$ is, in this case, $Log(AverageContractRent_{b,t})$, which is the logarithm of the current period average contract rent of building b in year t weighted by the size of realised leased space and also the $Log(VacancyRate_{b,t})$ which is the direct vacancy rate of building b in year t. The explanatory variable $Log(Satisfaction_{b,t})$ is the same as for the analysis presented in Table 2, which is the building-level average of overall satisfaction of building b in year t.

Following Eichholtz et al. (2013), we control for the influence of rental contract features, such as lease length, the square of lease length to account for the impact of non-linearity, and the impact of the rent-free period, size of leased space, and number of days on the market. The control variables for building characteristics and fixed effects are the same as those presented in the preceding analysis, although we also incorporate

fixed effects for the type of leasing contract services [37] to account for the different rental levels that contribute to the leasing contract type.

Table 4 shows the estimated coefficients described in Equation 3 using leasing contract data [38]. To facilitate a comparison of results, Columns (1) and (4) display the estimation results for those asking rents displayed in Columns (3) and (6) in Table 3.

Table 4: Tenant Satisfaction and Contract Rents

	$\Delta Log(Rent_{b,t+1,t})$ (\$/SF)	Log(Contract Rent$_{g,b,t+1}$)(\$/SF)		$\Delta Log(Effective$ Rent$_{b,t+1,t}$)(\$/SF)	Log(Effective Contract Rent$_{g,b,t+1}$)(\$/SF)	
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Overall Satis$_{b,t}$)	0.017*	0.055	0.058	0.086**	0.192**	0.202*
	(0.009)	(0.070)	(0.098)	(0.025)	(0.079)	(0.110)
Contract Characteristics:						
Time on Market$_{g,b,t+1}$			0.004			0.006***
(Years)			(0.003)			(0.002)
Contract Length$_{g,b,t+1}$			0.025***			0.026***
(Years)			(0.009)			(0.008)
Contract Length$^2_{g,b,t+1}$			-0.000***			-0.000***
(Years^2)			(0.000)			(0.000)
Log(Size Leased)$_{g,b,t+1}$			-0.017***			-0.010*
(SF)			(0.006)			(0.006)
Free Rent Period$_{g,b,t+1}$			-0.147***			-0.148***
(Years)			(0.055)			(0.048)
Constant	0.138***	2.528***	2.352***	-0.198*	2.372***	2.045***
	(0.042)	(0.251)	(0.359)	(0.118)	(0.273)	(0.371)
Lagged Level$_{b,t}$	YES	YES	YES	YES	YES	YES
Control	YES	YES	YES	YES	YES	YES
Time*City FE	YES	YES	YES	YES	YES	YES
Contract type FE	NO	YES	YES	NO	YES	YES
Observations	4,477	7,202	3,338	3,802	7,182	3,327
# Buildings	1,515	872	587	1,427	757	503
R-squared	0.236	0.759	0.764	0.266	0.772	0.771

Notes:Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Explained variables are winsorised at their respective 1st and 99th percentiles to reduce the influence of outliers.

Columns (2) and (3) in Table 4 provide the results of the relationship arising between

[37]Contract type FE is the fixed effect of different leasing contract types. In our sample, we have 12 contract types in total, including Double Net, Full-Service Gross, Industrial Gross, Modified Gross, Negotiable Net, Plus All Utilities, Plus Cleaning, Plus Electric, Tenant Electric, and Triple Net.

[38]In this section, only those properties have survey responses for the current period and have signed leasing contracts for the current period and thus the next period will enter into our regression. In addition, the regression only includes those leasing contracts with observations of all the variables describing the leasing term in order to mitigate the possibility that there are unobserved characteristics that may affect the rent levels or both the satisfaction and rent levels concurrently.

tenant satisfaction and the contract rent per square foot in the next period. Column (2) controls for building characteristics, the current period average contract rents level, and time-city-fixed effects. The coefficient associated with tenant satisfaction shows that, on average, a 1% higher overall satisfaction is related to an insignificantly 0.06% higher contract rent. Column (3) is the result after we add in the contract characteristics based on Column (2). The results are similar in terms of magnitude and lack of statistical significance when including controls for contract characteristics (Column (3) in Table 4).

Columns (5) and (6) show the estimates associated with tenant satisfaction on the effective contract rent per square foot. Column (5) is the result of controlling for building characteristics, current period performance, and time-city-fixed effects. As displayed by the coefficient, on average, a 1% higher overall satisfaction is related to 0.19% higher effective contract rents. Column (6) indicates that, after controlling for the contract characteristics, the effective improvement in rent effect is even higher, with a 1% higher overall satisfaction correlated to 0.20% higher effective rents. The results above support our main finding, namely that tenant satisfaction has positive implications for the future financial performance of the building.

5.2 The Marginal Effect of Tenant Satisfaction Improvement

The categorical character of survey answers, with censored top or bottom response values, might introduce biases associated with respondents selecting the extreme values of the Likert scale. For example, for the samples with a response value of "5" to the overall satisfaction question, some respondents might be very happy, but some others are "super happy", and would have given a "6", or even a "7", were that answer available. Similarly, a score of "1" might also include some "very unhappy" tenants. The existence of these respondent patterns might lead to an overestimation in terms of satisfaction. Another concern is that the large proportion (90%) of the distribution of answers to the tenant satisfaction question is concentrated on scores of 4 and 5 and might be biased by the over-represented "high score" samples.

To address these issues, we decompose the satisfaction scale into each of the original

categories in our original data. In particular, we include each value between 1 and 5 of the survey answer as a separate dummy variable in the regression. For example, $OverallSatisfactionScore2_{i,b,t}$ is a binary value which is equal to "1" if the overall satisfaction answer value of tenant i in building b in year t is equal to "2", and is ascribed a value of "0" otherwise. We specified the tenant samples with overall satisfaction scores equal to "1" as being the baseline group. Therefore, the estimated coefficients will describe observed differences in outcomes between the corresponding level of satisfaction and buildings being rated by tenants with a score of "1" (i.e., baseline category). Other control variables and fixed effects are the same as those presented in Table 2.

Table 5 shows the results of Equations 1 and 2 replacing the original, continuous variable describing tenant satisfaction with a set of dummies describing each of the categories in the tenant satisfaction question. Panel A in Table 5 presents those estimates describing the association between tenant satisfaction, renewal intention, and their leasing decision. Columns (1), (3), and (5) are the results of the main regression. Column (1) presents our main results in Table 3. Column (2) indicates that, when compared with the baseline group with tenants' satisfaction scores being equal to "1", the magnitude of the improvement effect is bigger as the tenant satisfaction score in the building is higher. However, for each point increase in the scale of tenant satisfaction, the marginal effect of improving tenant satisfaction is smaller. For example, on average if the satisfaction score improves from 1 to 2 (On a scale of 1 - 5), the renewal intention will improve by 0.48 points (on a scale of 1 - 5) and, if the satisfaction score improves from 4 to 5, the renewal intention will improve by only 0.30 points. Results presented in Columns (4) and (6) reveal the propensity to recommend the property to a third party and the likelihood of moving out of the property, respectively. Consistent with the estimates showing the impact on renewal intention, the satisfaction score is positively correlated to higher property management recommendations and a lower probability of final move out. In addition, similar to our estimates on renewal intention, the marginal effect is smaller as the satisfaction score increases.

Panel B in Table 5 describes the results of the impact of tenant satisfaction on the financial performance of the property. For this test, we decompose the distribu-

tion of average satisfaction to buildings in our sample into quartiles. For example, $Log(AverageOverallSatisfaction)20-40percentile_{b,t}$ is a binary value that equals "1" if the average overall satisfaction answer value of building b in year t lies between the 20th and 40th percentiles, and "0" if otherwise. We specified the building samples with average satisfaction scores located at the lowest 20th percentile as the baseline group. The control variables and fixed effects are the same as those presented in Table 2.

Panel B in Table 5 presents the marginal effect of satisfaction on financial performance. Column (1) and (2) show that, relative to the baseline group (i.e., those properties with overall satisfaction located at the lowest 20th percentile), the high score group does not show a significantly higher asking rent level. Results in Columns (3) and (4) indicate that higher satisfaction is associated with higher effective rents, results in Columns (5) and (6) indicates that higher satisfaction is associated with lower vacancy rates. But the improvement effect of satisfaction becomes smaller as the satisfaction score becomes higher, which means the financial performance improvement effect may be mainly driven by those properties that improve from "no satisfied" to "satisfied" instead of from "satisfied" to "very satisfied". This is similar to the findings of Anderson and Sullivan (1993), which find a negative correlation between satisfaction level and the elasticity of repurchase intention to satisfaction. In sum, the results above indicate that our main results are not driven by extreme values in tenant satisfaction, but there is a monotonic relationship between tenant satisfaction, the decision to renew the lease, and the financial performance of buildings.

5.3 COVID-19 Shock and Move-out Decision Making

COVID-19 as a exogenous shock which have big impact on the office market, through not only the work from home policy channel but also the financial status of the company, both of which will have tremendous and negative influence on the office space demand and tenant's leasing decision-making. Whether the relationship between tenant's leasing decision and their satisfaction is affect by COVID-19? In this section we try to test the robustness of our main conclusion about satisfaction and leasing decision by three ways: (1) Whether the relationship between satisfaction and move-out decision holds before

Table 5: The Marginal Effect of Tenant Satisfaction Improvement

	Renewal Intention$_{i,b,t}$ (Score 1-5)		Building Recommend$_{i,b,t}$ (Score 1-5)		Finally Move Out$_{i,b,t+1}$ (YES=1)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Tenant Satisfaction and Tenant Decision						
Overall Satisfaction$_{b,t}$	0.329***		0.473***		-0.158***	
(Score 1 - 5)	(0.008)		(0.008)		(0.032)	
Overall Satisfaction Score 2$_{i,b,t}$		0.477***		0.719***		-0.706***
(YES=1)		(0.071)		(0.093)		(0.271)
Overall Satisfaction Score 3$_{i,b,t}$		0.824***		1.229***		-1.766***
(YES=1)		(0.068)		(0.089)		(0.271)
Overall Satisfaction Score 4$_{i,b,t}$		1.181***		1.758***		-1.907***
(YES=1)		(0.067)		(0.087)		(0.272)
Overall Satisfaction Score 5$_{i,b,t}$		1.484***		2.182***		-1.883***
(YES=1)		(0.068)		(0.088)		(0.275)
Constant	2.252***	2.399***	2.126***	2.281***	-1.631	-0.758
	(0.219)	(0.229)	(0.176)	(0.193)	(1.730)	(1.740)
Control	YES	YES	YES	YES	YES	YES
Time*City FE	YES	YES	YES	YES	YES	YES
Tenant FE	YES	YES	YES	YES	NO	NO
Observations	79,466	79,466	49,385	49,385	26,408	26,408
# Buildings	2,439	2,439	1,898	1,898	1,697	1,697
R-squared	0.594	0.594	0.695	0.696	0.313	0.195
Panel B:Tenant Satisfaction and building Financial Performance						
	$\Delta Log(Gross$ Rent$_{b,t+1,t})(\$/SF)$		$\Delta Log(Effective$ Rent$_{b,t+1,t})(\$/SF)$		$\Delta Vacancy$ Rate$_{b,t+1,t}(\%)$	
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Overall Satis$_{b,t}$)	0.016**		0.085***		-3.868***	
(Score 1 - 5)	(0.008)		(0.026)		(1.101)	
Log(Overall Satis) 20-40 percentile$_{b,t}$		0.004		0.022***		-1.127***
(YES=1)		(0.003)		(0.007)		(0.364)
Log(Overall Satis) 40-60 percentile$_{b,t}$		-0.000		0.014*		-1.292***
(YES=1)		(0.003)		(0.007)		(0.376)
Log(Overall Satis) 60-80 percentile$_{b,t}$		0.004		0.017**		-1.500***
(YES=1)		(0.003)		(0.008)		(0.384)
Log(Overall Satis) 80-100 percentile$_{b,t}$		0.003		0.027***		-1.807***
(YES=1)		(0.003)		(0.008)		(0.410)
Constant	0.161***	0.193***	-0.063	0.023	13.731***	8.739***
	(0.036)	(0.035)	(0.076)	(0.062)	(3.020)	(2.828)
Lagged Level$_{b,t}$	YES	YES	YES	YES	YES	YES
Control	YES	YES	YES	YES	YES	YES
Time*City FE	YES	YES	YES	YES	YES	YES
Observations	5,056	5,787	5,042	5,773	9,272	10,371
# Buildings	1,515	1,515	1,427	1,427	1,997	1,997
R-squared	0.260	0.278	0.278	0.284	0.243	0.251

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For panel B, the explained variables are winsorised at their respective 1st and 99th percentiles to reduce the influence of outliers. Columns (1), (3), and (5) of Panels A and B are the results of the main regression, essentially the same as those presented in Tables 2 and 3.

COVID-19? (2) Whether the relationship between satisfaction and move-out decision holds after the outbreak of COVID-19? (3) To what extent the satisfaction before COVID-19 could predict the move out decision after COVID-19? Table 6 shows the regression results of Equation 1:

Table 6: Move-out Decision Sensitivity to Covid Shock

	(1)	(2)	(3)	(4)	(5)
	Main Regress	New identification	After Covid	Before Covid	Pre Covid Satis
Move out probability	49.2%	48.6%	16.7%	42.1%	19.9%
Overall Satisfaction	-0.158***	-0.219***	-0.567***	-0.143***	-0.270***
(Score 1 - 5)	(0.034)	(0.032)	(0.054)	(0.032)	(0.044)
Constant	2.236	-3.177*	-1.410	0.856	-1.957
	(2.212)	(1.825)	(2.463)	(1.075)	(1.624)
Control	YES	YES	YES	YES	YES
Time * City FE	YES	YES	YES	YES	YES
Tenant FE	NO	NO	NO	NO	NO
Observations	26,432	26,432	12,045	18,884	9,336
#Buildings	2,633	2,633	1,717	2,528	1,190
R-squared	0.312	0.312	0.409	0.096	0.273

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependant variable is move out decision, which is defined as whether the tenant have left the building, if yes equal to 1 and 0 otherwise. Column (1) is using the google map to identify whether the tenant have finally left the building, for Column (2) to (5) the dependant variable of whether and when the tenant have left the building is identified using the survey data, and defined as: whether they stop respond the survey for one year or more prior to the latest tracking year of the building they are in, if yes, then we use the next year after their latest respond year as the year they left the building. 1. Column (1) is the same as the results in Table 2, and use only the latest tenant's respond to explain their final leaving status. 2. Column (2) is using the survey data to identify whether and when the tenant left, and use the latest tenant's respond to explain their final leaving status. 3. Column (3) investigates the extent to which tenant decision after Covid is affected by their latest satisfaction level after the Covid. We preserve the latest and after covid respond of tenant to explain their final leaving status(For example, if a tenant answers a survey between 2015-2023, then we preserve the 2023 survey response; if the tenant have answer the survey between 2016-2018, drop these samples because they didn't have after covid response.). 4. Column (4) investigates the extent to which move out decision before Covid is affected by their latest satisfaction level before Covid. We preserve only the latest response of the tenant before the outbreak of COVID-19, and use 2020 as the screenshot time to define whether the tenant have left the building using the survey data(For example, if a tenant answers a survey between 2015-2023, then we preserve the 2019 survey response, and define the tenant as staying in the buiding as of 2020; if the tenant have answer the survey between 2016-2018, then we difined the tenant have left the building as of 2019, and preserve the 2018 respond.) 5. Column (5) investigates the relationship between satisfaction before Covid-2019 and the move-out decision after Covid-2019. We drop those tenants who left before COVID-19 and those who entered after COVID-19, and preserve those samples have response before covid and are still in the building as of 2019(For example, if a tenant answer the survey between 2016-2021, and left in 2022, we use the response of 2019 to explain their move out decision.).

Although the Google Map dataset and Costar dataset can only provide the current tenant information, by comparing the survey dataset with the Costar and the Google

Map, we could still approximately identify when the tenant left the building: For those tenants who stopped answering the survey for one year or more prior to the latest tracking year of the building, mostly they had left the building. We show the accuracy of this identification method by comparing the move-out rate between identification using survey data and identification using Google map data, the results are shown in Appendix A.12: We can observe the year difference between the tenant's latest answer year with the latest response of the building from the survey data, we show that if the tenant stopped answering one year or more before the latest response year of the building, on average, 90% of the tenants did leave the building, this number could variate a bit across different buildings with different latest tracking year but the overall conclusion still holds. Thus, we define the move-out year as the year next to when they stop responding to the survey(For example, if the tenant has filled out the survey between 2016-2018, and the latest response from the building is 2021, which indicates the tenant stopped respond 3 years then the move out year for the tenant is 2019). An important assumption behind this inference is that it is not common for tenants to skip the answer to the survey while they are still in the building and when they have filled the survey before(According to our statistics, 80% of the tenants did not skip survey response but only have a continuous response to the survey).

From Column (2) we can see that the direction of the coefficient is the same as the main regression, but the relationship between satisfaction and the move-out decision is stronger, this might be because when we use the Google map to identify whether the tenant has left the building, some tenants might be happy and still staying in the building the next year after they stopped responding, and also possibly their contract period has not expired yet, so when we use the survey data to identify when they left the building it is still identified as "staying", especially for those with the last respond is the same as the latest tracking year of the building, but in google map's dataset they have already left, and the move-out decision might be attributed to reason beyond the building itself.

Column (3) results show when we use the latest response of the tenant to explain their move-out decision, the effect is even stronger, which might be because (1)those

unhappy tenants with expired contracts will choose to leave. (2)For those samples in the building between 2020 and 2023 are more likely to be still in the building, thus the overall probability for move out for all the tenants is lower, and only those super unhappy samples are moving out. This indicates a more significant inference value for the recent investigation of how tenant feel: in recent years their response has been even more predictive of their decision.

Column (4) indicates when we use the before Covid latest response of the tenant to explain their before-Covid move-out decision, the effect is also similar to the main regression result, which indicates that before COVID the leasing decision might have been influenced by more than just their satisfaction with the office itself, there might be some tenant happy but move out, and unhappy but didn't move out because of the operating status of the company itself or the industry cycle which lead to shifting in office demand.

Results in Column (5) illustrate when we use the before Covid latest response of the tenant to explain their post-Covid move-out decision(excluding those who moved out before the Covid outbreak, but preserving those who existed in the building before COVID and how their decision was affected by Covid), the relationship between satisfaction and move out decision is still strong, which means for these samples which exist during covid, their move out decision is strongly affected by the covid instead of their satisfaction itself, the financial and operating concern dominate more on their leasing and moving out decision.

5.4 Effect of Improving Satisfaction

The results in our main analysis indicate that after controlling observable building attributes, tenant individual inherent heterogeneity, and the interaction term of geographic and time-varying differences, on average, the different values of individual tenant's satisfaction can indicate their different reaction to future leasing decisions, and the different building level satisfaction also can predict the different building level financial performances. But when it comes to practice, what the investor or the property management company cares about is if they take some measures to improve the satisfaction level,

whether it finally helps retain the tenant and improve the building's performance.

In this section, we try to explore whether for a certain tenant, improving satisfaction could lead to their decision in a better way for the investor. We approach this question by using the change in tenant satisfaction to explain the change in their decision[39]:

In this section, we exclude those tenant samples with satisfaction that didn't change[40]. The specification is below:

$$\Delta RenLease_{i,b,t+1,t} = \alpha + \beta \Delta Satisfaction_{i,b,t+1,t} + \gamma X_b + \mu_t * \lambda_c + \varepsilon_{i,b,t} \tag{4}$$

Where $\Delta RenLease_{i,b,t+1,t}$ is the leasing decision difference of tenant i in building b between yeat $t+1$ and year t. $\Delta Satisfaction_{i,b,t+1,t}$ is the satisfaction level difference of tenant i in building b between yeat $t+1$ and year t. And the Control variables and fixed effects are the same with those in 1.

Table 7 shows the regression results. Column (1) shows that 1 point higher in tenant satisfaction will lead to 0.248 points higher their renewal intention, and Column (2) shows that 1 point higher the tenant satisfaction will lead to a bigger effect of 0.358 higher their willingness to property recommend, and Column (3) shows that for those tenant who experience an upward changing of their satisfaction level, their move out probability is 14.9% lower than those experiencing an downward changing. These results above indicate that for the same tenant, improving satisfaction could lead to positive change in the performance indicators.

[39]Because each tenant only have one value of staying or leaving in our dataset, there is obstacle for the identification of the change in tenant satisfaction when we try to use the change in satisfaction to explain their move out decision: For the same tenant, their satisfaction could change as time goes by and this is not necessarily a unidirectional change, some individual tenant might have their overall satisfaction going from low to high, some might have their satisfaction going from high to low, but some might going from low to high and then low again.

[40]If the tenant didn't change their view on the property it might be difficult for us to identify the effect of "change in satisfaction". There are 74% of the tenant didn't change their view of the building throughout their period responding to the survey, 20% with their difference between highest and lowest is only 1 point, 4.2% with a difference of 2 points, 1.0% with a difference of 3 points and 0.3% with a difference of 4 points. Thus for the change in satisfaction and their leasing decision, we use the change in satisfaction to explain the move-out decision. We doing this by seperate the tenants into "improving" and "descending" samples, following are the steps: (1)If the most recent satisfaction response is the highest among all the responses of a certain tenant, then take it as an improving sample. If the most recent is not the highest, we take it as "descending" samples.

Table 7: Effect of Improving Satisfaction

	$\Delta RenewalIntention_{i,b,t}$ (Score 1-5) (1)	$\Delta BuildingRecommend_{i,b,t}$ (Score 1-5) (2)	Finally Move Out$_{i,b,t+1}$ (YES=1) (3)
$\Delta Satisfaction_{i,b,t}$ (Score 1-5)	0.248*** (0.016)	0.358*** (0.017)	
Satisfaction Improving (YES=1)			-0.149*** (0.055)
Constant	0.140*** (0.043)	1.158*** (0.096)	-0.200* (0.121)
Control$_b$	YES	YES	YES
City*Time FE	YES	YES	YES
Tenant FE	YES	YES	No
Observations	22,157	13,760	9,101
# Buildings	1,515	1,190	1,427
R-squared	0.388	0.414	0.310

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

6. Heterogeneity Analysis

This section explores the heterogeneity in treatment effects across different market conditions and tenant types.

6.1 Local Market Conditions

In this subsection, we explore whether the role of tenant satisfaction varies across submarkets. In particular, we test whether satisfaction is more impactful in those markets with a high availability of office space (i.e., high vacancy rates) as compared to those markets with low availability of office space (i.e., low vacancy rates). If the (sub)market has a higher vacancy rate, then the tenant would have more options for moving out and, therefore, the relationship between tenant satisfaction and the likelihood of terminating a lease might therefore weaken.

We divide the submarkets in our sample into high and low vacancy subsamples to examine any geographic variation of the satisfaction effect in terms of the building performance. In particular, we take the average of the historical vacancy rates for each of the 484 submarkets in our sample during our research period and define the high vacancy market as those markets above the median value, and the low vacancy market as those markets below the median value. Submarket vacancy is the average vacancy

level of the office submarket in which the building is located. For example, if the tenant is in a building located in the Brookfield/New Berlin submarket in county Brookfield in the State of Wisconsin, then we take the average of the vacancy level of this submarket for each quarter from 2009 to 2023. We then have the average vacancy level for this submarket [41]. Table 8 shows the results of Equations (1) and (2) for the two separate samples according to submarket vacancy rates [42]. The regression model for Columns (1) - (3) is the same as for Equation 1, and the regression model for Columns (4) - (6) is the same as delineated in Equation 2.

Panel A in Table 8 describes the results in the high vacancy submarket sample. Panel B in Table 8 displays the estimated result in the low vacancy submarket sample. Columns (1) - (3) describe the estimation results in the regression model describing the intention to renew the lease, recommend the property to a third company, or move out of the property. The table shows a significant difference in estimates across the two subsamples, indicating that tenant satisfaction is more important for defining renewal intention and recommending the property in markets with low vacancy rates. Columns (4) - (6) describe the analysis of how the submarket vacancy level affects the financial performance's sensitivity to satisfaction levels. As shown in Column (4) in Panel A, the listing rents of buildings located in high vacancy markets are not sensitive to the satisfaction level of the tenant. In contrast, Columns (5) and (6) show that the effective rents and vacancy rates are more sensitive to satisfaction in high vacancy submarkets, thereby indicating that vacancy rates are sensitive to the tenant's opinion and reputation in markets with high vacancy rates. Columns (4) - (6) in Panel B show that tenant satisfaction also have significant influence the building's financial performance in markets with low vacancy rates.

These findings above reveal the heterogeneity inherent in our results. While in a

[41] The ranking of submarkets is relatively stable over time, please see the submarket vacancy ranking table in Appendix A.17, on average, 88% those submarkets with an average vacancy rate located within the upper 50th percentile remain in the high vacancy category over time, similar to those with low vacancy submarkets.

[42] The number of observations is different for the top 50% vacancy submarket and the bottom 50% submarket as the concentration of properties and survey observations are not evenly distributed across cities.

Table 8: Market Vacancy and the Effect of Tenant Satisfaction

	Tenant decision			Financial performance		
	(1) Renewal Intention$_{i,b,t}$ (Score 1-5)	(2) Building Recommend$_{i,b,t}$ (Score 1-5)	(3) Finally Move Out$_{i,b,t+1}$ (YES=1)	(4) $\Delta Log($ Rent$_{b,t+1})$ (\$/SF)	(5) $\Delta Log(Effective$ Rent$_{b,t+1})$ (\$/SF)	(6) $\Delta Vacancy$ Rate$_{b,t+1}$ (%)
Panel A: High vacancy submarket(Top 50% percentile)						
Overall Satisfaction$_{i,b,t}$	0.319***	0.454***	-0.124***			
(Score 1-5)	(0.010)	(0.011)	(0.043)			
Log(Overall Satis$_{b,t}$)				-0.001	0.055	-3.239**
(Score 1-5)				(0.010)	(0.034)	(1.557)
Constant	1.896***	1.680***	-0.057	0.156***	0.344**	12.405***
	(0.337)	(0.263)	(2.914)	(0.048)	(0.135)	(4.140)
Lagged Level$_{b,t}$	NO	NO	NO	YES	YES	YES
Control	YES	YES	YES	YES	YES	YES
Time*City FE	YES	YES	YES	YES	YES	YES
Tenant FE	YES	YES	YES	NO	NO	NO
Observations	45,536	27,586	16,375	2,690	2,687	4,747
# Buildings	1,034	1,034	1,034	841	803	1,083
R-squared	0.618	0.717	0.352	0.331	0.305	0.272
Panel B: Low vacancy submarket(Bottom 50% percentile)						
Overall Satisfaction$_{i,b,t}$	0.335***	0.475***	-0.266***			
	(0.011)	(0.011)	(0.041)			
Log(Overall Satis$_{b,t}$)				0.013	0.074*	-4.326***
(Score 1-5)				(0.013)	(0.038)	(1.460)
Constant	1.468***	1.699***	1.158	0.185***	-0.209	12.396***
	(0.358)	(0.249)	(2.660)	(0.068)	(0.162)	(3.994)
Lagged Level$_{b,t}$	NO	NO	NO	YES	YES	YES
Control	YES	YES	YES	YES	YES	YES
Time*City FE	YES	YES	YES	YES	YES	YES
Tenant FE	YES	YES	YES	NO	NO	NO
Observations	37,423	24,167	15,268	2,608	2,599	5,120
# Buildings	1,019	759	702	851	795	1,159
R-squared	0.609	0.699	0.313	0.259	0.278	0.248

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For panel B the explained variables are winsorised at their respective 1st and 99th percentiles to reduce the influence of outliers.

high vacancy market, lower rents and higher vacancy rates are associated significantly with lower tenant satisfaction, this relationship is more significant in markets with low vacancy rates.

6.2 Tenancy Length

Tenants have different characteristics and moving costs, so tenants might have different sensitivities in terms of moving-out decisions based on their apparent satisfaction levels and renewal intentions. In general, because of their giving up the satisfied leasing

conditions as negotiated with the landlord, or because of the high cost of changing the location of operation activities, those who have already stayed in the building for a long time might incur a higher burden of moving out.

In this section, we study the interaction between tenant satisfaction and how long they have already stayed at the point at which they completed the survey. This reveals variations in the satisfaction effect between different tenants. We matched the tenant survey data to the leasing contract data from CoStar based on the tenant's company name and building address. This allowed us to get the move-in date for the tenant. Our matching process finally yielded 15,545 survey data from 6,389 tenants that could serve to identify tenants' leasing activities. For every natural year, we generated the median number of years for which tenants had already stayed by that certain year. If the length of time for which tenants had already stayed was higher than the median, then it was assigned to the "Stayed Long Group", otherwise it was assigned to the "Stayed Short Group". Table 9 provides a set of results:

Panel A is the result of that tenant subsample which has stayed for a long time. The coefficient of Column (1) in panel A is the sensitivity of renewal intention to the satisfaction level of the "stayed long" tenant group. A 1-point higher overall satisfaction correlates to a 0.287-point higher renewal intention, which is smaller to the results obtained in panel B.

The specifications in Column (2) examine the impact on building recommendations. The coefficient of satisfaction in panel A is 0.50, while the coefficient of panel B is 0.48, and the satisfaction effect for the "stayed long" group is similar to those who "stayed short".

Column (3) analysed the impact of tenant satisfaction on the final move-out status while considering how long the tenant has already stayed. Consistent with the findings of Column (2), the magnitude of the coefficient of panel A is much bigger. This conclusion is consistent with the findings of Grenadier (1995b), which indicates that large corporate or institutional tenants tend to look for long-term stability that minimises moving costs, and smaller companies are more concerned with the flexibility to allow for future expansion, thereby avoiding lock-in effect of long leases.

Table 9: Move Out Burden and Move Out Decision

	(1) Renewal Intention$_{i,b,t}$ (Score 1-5)	(2) Building Recommend$_{i,b,t}$ (Score 1-5)	(3) Finally Move Out$_{i,b,t+1}$ (YES=1)
Panel A: Stayed Long Tenants(top 50th percentile)			
Overall Satisfaction$_{i,b,t}$	0.287***	0.498***	-0.306***
(Score 1-5)	(0.032)	(0.039)	(0.093)
Constant	1.821	0.412	2.911
	(1.336)	(1.990)	(3.140)
Control	YES	YES	YES
Time*City FE	YES	YES	YES
Tenant FE	YES	YES	NO
Observations	4,019	2,489	1,641
# Buildings	799	615	598
R-squared	0.606	0.688	0.271
Panel B: Stayed Short Tenants(Bottom 50th percentile)			
Overall Satisfaction$_{i,b,t}$	0.363***	0.476***	-0.210*
(Score 1-5)	(0.055)	(0.075)	(0.112)
Constant	4.389**	4.517*	-0.152
	(1.906)	(2.519)	(3.400)
Control	YES	YES	YES
Time*City FE	YES	YES	YES
Tenant FE	YES	YES	NO
Observations	2,185	1,216	977
# Buildings	760	542	617
R-squared	0.693	0.762	0.251

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The regression model for Columns (1) - (3) is derived from Equation 1. The difference in observations between panels A and B arises because of tenant asymmetry in terms of missing valid data for the survey response which will lead to observations dropping in the regression. Further, time-city-fixed effects will drop those samples with only one tenant observation in a specific city in a certain year. For the analysis of Column (3) in both panels A and B, we only preserve the last response from the tenant.

7. Conclusion

Information asymmetry between the landlord and tenant about the tenant's experience and view of the property is prevailing in the real estate market. Especially after the outbreak of COVID-19, which has sensitised people's attention to the impact of what their tenants are thinking as companies have swiftly adapted to the work-from-home trend. Although customer satisfaction has gained much attention from both practitioners and scholars in the business field and has been proven to be a leading indicator of client demand and purchasing decisions, the importance of the role of client satisfaction in real estate: and tenant satisfaction, plays remains unclear. Tenant surveys provide us with the tools to link the tenant's view to their leasing decision and finally the performance of the building.

Using a large data set of 123,051 tenant surveys gleaned from 2,906 office properties in the U.S., matched with the building characteristics, rents, and vacancy data obtained from the CoStar Group, we quantified the financial implications of tenant satisfaction on the performance of the commercial real estate sector. The findings of the hedonic models show that the more satisfied a tenant is, the more positively correlated any decision to renew the lease becomes. Further analysis reveals that those properties with higher tenant satisfaction levels indeed enjoyed stronger growth in terms of rental and occupancy rates. The analysis of using leasing contracts to measure contractual rents (vs. listed rents) uncovers a bigger positive effect on tenant satisfaction. Finally, the analysis of the marginal effect found that, for those properties or tenants who have lower original satisfaction levels, the beneficial effect of their satisfaction level improvement is even more significant. This conclusion is independent of the outbreak of COVID-19. And improving the satisfaction of a certain tenant also going to have a significantly positive impact on their future leasing decision. This effect creates some heterogeneity across the market with different vacancy levels and tenants with different dwelling lengths.

However, our paper has some limitations. The first one is there are constraints arising from the survey data: The landlord and tenant's obligation could be a substantial complex story like price bargaining and strategic decision-making, some leasing or

retrofitting actions could be tenant-led, and the final decisions like moving out are typically reached after multiple negotiations based on specific leasing criteria between the tenant and landlord, survey data did not encompass such information. Secondly, while these criteria might be assumed to be shared across the market, it's important to note that move-out decisions (linked to building vacancy rates) and agreed rents (representing "quantity" and "price" in the rental market) are interrelated. The third one is the disparity of observed outcomes, office amenities preference might change overtime, or the building renovations or facility enhancements always occurring after tenants decide to vacate, but it cannot be captured longitudinally.

Overall, the findings uncovered through this analysis carry significant income implications for the client-centred property management strategy, which means that real estate investors should see the return on investment inherent in cultivating their tenant experience.

References

Aksoy, C. G., Barrero, J. M., Bloom, N., Davis, S. J., Dolls, M., and Zarate, P. (2022). Working from home around the world. Technical report, National Bureau of Economic Research.

Aksoy, L., Cooil, B., Groening, C., Keiningham, T. L., and Yalçın, A. (2008). The long-term stock market valuation of customer satisfaction. *Journal of Marketing*, 72(4):105–122.

An, X., Deng, Y., Fisher, J. D., and Hu, M. R. (2016). Commercial real estate rental index: A dynamic panel data model estimation. *Real Estate Economics*, 44(2):378–410.

Anderson, E. W., Fornell, C., and Lehmann, D. R. (1994). Customer satisfaction, market share, and profitability: Findings from sweden. *Journal of Marketing*, 58(3):53–66.

Anderson, E. W. and Sullivan, M. W. (1993). The antecedents and consequences of customer satisfaction for firms. *Marketing science*, 12(2):125–143.

Bolton, R. N. and Drew, J. H. (1991). A longitudinal analysis of the impact of service changes on customer attitudes. *Journal of Marketing*, 55(1):1–9.

Bryan, J., Deaton, B. J., and Weersink, A. (2015). Do landlord-tenant relationships influence rental contracts for farmland or the cash rental rate? *Land Economics*, 91(4):650–663.

Chau, K. W. and Wong, S. K. (2016). Information asymmetry and the rent and vacancy rate dynamics in the office market. *The Journal of Real Estate Finance and Economics*, 53:162–183.

Crosby, N., Hughes, C., and Murdoch, S. (2006). Flexible property leasing and the small business tenant. *Journal of Property Research*, 23(2):163–188.

Dröes, M., Ziermans, B., and Koppels, P. (2017). Information asymmetry, lease incentives, and the role of advisors in the market for commercial real estate.

Eichholtz, P., Kok, N., and Quigley, J. M. (2013). The economics of green building. *Review of Economics and Statistics*, 95(1):50–63.

Eichholtz, P. M., Kok, N., and Quigley, J. M. (2011). Who rents green? ecological responsiveness and corporate real estate. *W09-4. Berklely. https://urbanpolicy. berkeley. edu/pdf/EKQ_Tenants_to_JoM_070411_wcover. pdf.*

Fiorentino, S., Livingstone, N., McAllister, P., and Cooke, H. (2022). The future of the corporate office? emerging trends in the post-covid city. *Cambridge Journal of Regions, Economy and Society*, 15(3):597–614.

Fornell, C., Rust, R. T., and Dekimpe, M. G. (2010). The effect of customer satisfaction on consumer spending growth. *Journal of Marketing Research*, 47(1):28–35.

Gabriel, S. A. and Nothaft, F. E. (2001). Rental housing markets, the incidence and duration of vacancy, and the natural vacancy rate. *Journal of Urban Economics*, 49(1):121–149.

Galiani, S., Gertler, P. J., and Undurraga, R. (2018). The half-life of happiness: Hedonic adaptation in the subjective well-being of poor slum dwellers to the satisfaction of basic housing needs. *Journal of the European Economic Association*, 16(4):1189–1233.

Grenadier, S. R. (1995a). Local and national determinants of office vacancies. *Journal of Urban Economics*, 37(1):57–71.

Grenadier, S. R. (1995b). Valuing lease contracts a real-options approach. *Journal of Financial Economics*, 38(3):297–331.

Gruca, T. S. and Rego, L. L. (2005). Customer satisfaction, cash flow, and shareholder value. *Journal of Marketing*, 69(3):115–130.

Guerola-Navarro, V., Gil-Gomez, H., Oltra-Badenes, R., and Sendra-García, J. (2021). Customer relationship management and its impact on innovation: A literature review. *Journal of Business Research*, 129:83–87.

Gupta, A., Mittal, V., and Van Nieuwerburgh, S. (2022). Work from home and the office real estate apocalypse. *Available at SSRN*.

Halvitigala, D., Murphy, L., and Levy, D. (2011). The impacts of commercial lease structures on landlord and tenant leasing behaviours and experiences. *Pacific Rim Property Research Journal*, 17(4):560–583.

Hatch, M. E. (2017). Statutory protection for renters: Classification of state landlord–tenant policy approaches. *Housing Policy Debate*, 27(1):98–119.

Holtermans, R. and Kok, N. (2019). On the value of environmental certification in the commercial real estate market. *Real Estate Economics*, 47(3):685–722.

Homburg, C., Hoyer, W. D., and Koschate, N. (2005). Customers' reactions to price increases: do customer satisfaction and perceived motive fairness matter? *Journal of the Academy of Marketing Science*, 33(1):36–49.

Huang, G. and Sudhir, K. (2021). The causal effect of service satisfaction on customer loyalty. *Management Science*, 67(1):317–341.

Ibanez, M. R. and Pennington-Cross, A. (2013). Commercial property rent dynamics in us metropolitan areas: An examination of office, industrial, flex and retail space. *The Journal of Real Estate Finance and Economics*, 46(2):232–259.

Jacobson, R. and Mizik, N. (2009). The financial markets and customer satisfaction: Reexamining possible financial market mispricing of customer satisfaction. *Marketing Science*, 28(5):810–819.

Jaffee, D., Stanton, R., and Wallace, N. (2019). Energy factors, leasing structure and the market price of office buildings in the us. *The Journal of Real Estate Finance and Economics*, 59(3):329–371.

Jennen, M. G. and Brounen, D. (2009). The effect of clustering on office rents: evidence from the amsterdam market. *Real Estate Economics*, 37(2):185–208.

JLL (2022). Corporate real estate teams join the wider business conversation. *https://www.us.jll.com/en/views/corporate-real-estate-teams-join-the-wider-business-conversation*.

Larsen, E. R. and Sommervoll, D. E. (2009). The impact on rent from tenant and landlord characteristics and interaction. *Regional Science and Urban Economics*, 39(3):316–322.

Lim, L. G., Tuli, K. R., and Grewal, R. (2020). Customer satisfaction and its impact on the future costs of selling. *Journal of Marketing*, 84(4):23–44.

Liu, C. H., Liu, P., and Zhang, Z. (2019). Real assets, liquidation value and choice of financing. *Real Estate Economics*, 47(2):478–508.

Loewenstein, G. and Ubel, P. A. (2008). Hedonic adaptation and the role of decision and experience utility in public policy. *Journal of Public Economics*, 92(8-9):1795–1810.

Lu-Andrews, R. (2017). Tenant quality and reit liquidity management. *The Journal of Real Estate Finance and Economics*, 54(3):272–296.

Myers, E. (2020). Asymmetric information in residential rental markets: Implications for the energy efficiency gap. *Journal of Public Economics*, 190:104251.

NAREIT (2022). Estimating the size of the commercial real estate market. *https://www.reit.com/news/blog/market-commentary/estimating-size-commercial-real-estate-market*.

Palacios, J., Eichholtz, P., and Kok, N. (2020). Moving to productivity: The benefits of healthy buildings. *PloS one*, 15(8):e0236029.

Phillips, Y. (2012). Landlords versus tenants: Information asymmetry and mismatched preferences for home energy efficiency. *Energy Policy*, 45:112–121.

Rego, L. L., Morgan, N. A., and Fornell, C. (2013). Reexamining the market share–customer satisfaction relationship. *Journal of Marketing*, 77(5):1–20.

Sanderson, D. C. and Devaney, S. (2017). Occupier satisfaction and its impact on investment returns from uk commercial real estate. *Journal of Property Investment & Finance*.

Sanderson, D. C. and Read, D. C. (2020). Recognizing and realizing the value of customer-focused property management. *Property Management*, 38(5):749–764.

van Dijk, D. W., Geltner, D. M., and van de Minne, A. M. (2020). The dynamics of liquidity in commercial property markets: Revisiting supply and demand indexes in real estate. *The Journal of Real Estate Finance and Economics*, pages 1–34.

Van Nieuwerburgh, S. (2023). The remote work revolution: Impact on real estate values and the urban environment: 2023 areuea presidential address. *Real Estate Economics*, 51(1):7–48.

Verbrugge, R., Dorfman, A., Johnson, W., Marsh III, F., Poole, R., and Shoemaker, O. (2017). Determinants of differential rent changes: mean reversion versus the usual suspects. *Real Estate Economics*, 45(3):591–627.

Wang, C. and Zhou, T. (2021). Face-to-face interactions, tenant resilience, and commercial real estate performance. *Available at SSRN 3743818*.

Wheaton, W. C., Torto, R. G., and Evans, P. (1997). The cyclic behavior of the greater london office market. *The Journal of Real Estate Finance and Economics*, 15:77–92.

Zheng, C. and Zhu, B. (2021). Concentrate or diversify? the relationship between tenant concentration and reit performance. *Review of Quantitative Finance and Accounting*, 57(3):899–927.

Appendix A. Appendix

Appendix A.1 Full Table of Main Regression

Table A.10: Tenant Satisfaction and Tenant Decision

	Renewal Intention$_{i,b,t}$ (Score 1-5)			Building Recommend$_{i,b,t}$ (Score 1-5)			Finally Move Out$_{i,b,t+1}$ (YES=1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Overall Satisfaction$_{i,b,t}$	0.426***	0.427***	0.330***	0.598***	0.593***	0.492***	-0.208***	-0.158***
(Score 1-5)	(0.005)	(0.005)	(0.007)	(0.005)	(0.005)	(0.007)	(0.016)	(0.034)
Building Class:								
Class A$_b$	-0.147***	-0.093*	0.074	0.007	0.025	-0.013	0.288	0.411
(YES=1)	(0.047)	(0.050)	(0.091)	(0.035)	(0.039)	(0.057)	(0.303)	(0.682)
Class B$_b$	-0.125***	-0.088*	0.033	-0.044	-0.006	-0.056	0.369	0.696
(YES=1)	(0.046)	(0.049)	(0.090)	(0.035)	(0.038)	(0.056)	(0.300)	(0.655)
Construction Year:								
1970_1980$_b$	0.024	0.008	-0.012	-0.018	-0.032**	-0.043	-0.071	-0.037
(YES=1)	(0.020)	(0.020)	(0.032)	(0.014)	(0.016)	(0.028)	(0.112)	(0.304)
1980_1990$_b$	0.001	-0.003	0.025	0.009	0.003	-0.009	-0.259**	-0.568*
(YES=1)	(0.017)	(0.019)	(0.032)	(0.012)	(0.015)	(0.026)	(0.101)	(0.304)
1990_2000$_b$	-0.026	-0.032	0.025	0.052***	0.034**	-0.007	-0.429***	-0.525
(YES=1)	(0.020)	(0.021)	(0.035)	(0.014)	(0.016)	(0.028)	(0.121)	(0.364)
After 2000$_b$	-0.012	-0.011	0.034	0.050***	0.045***	0.028	-0.467***	-0.395
(YES=1)	(0.021)	(0.023)	(0.036)	(0.014)	(0.016)	(0.029)	(0.121)	(0.355)
Stories:								
High$_b$	-0.001	-0.018	-0.026	0.027***	0.030*	0.022	0.183***	0.016
(YES=1)	(0.013)	(0.018)	(0.030)	(0.010)	(0.015)	(0.028)	(0.071)	(0.280)
Medium$_b$	0.012	0.001	0.015	-0.004	-0.002	-0.006	0.126*	-0.158
(YES=1)	(0.013)	(0.015)	(0.021)	(0.010)	(0.012)	(0.019)	(0.067)	(0.221)
Renovated$_{b,t}$	0.005	0.011	0.035**	0.029***	0.012	-0.004	-0.348***	-0.342
(YES=1)	(0.012)	(0.012)	(0.018)	(0.010)	(0.010)	(0.015)	(0.076)	(0.219)
Log(RBA$_b$)	0.001	0.019	0.017	0.032***	0.041***	0.047***	0.011	-0.031
(SF)	(0.011)	(0.012)	(0.020)	(0.008)	(0.009)	(0.016)	(0.060)	(0.180)
Amenities$_b$	0.024*	0.019	0.039*	0.014	0.016	-0.001	0.205***	0.723***
(YES=1)	(0.013)	(0.015)	(0.021)	(0.009)	(0.010)	(0.017)	(0.072)	(0.232)
Constant	2.082***	1.861***	2.106***	1.326***	1.238***	1.699***	0.445	2.236
	(0.117)	(0.128)	(0.227)	(0.087)	(0.094)	(0.166)	(0.641)	(2.212)
Time * City FE	NO	YES	YES	NO	YES	YES	NO	YES
Tenant FE	NO	NO	YES	NO	NO	YES	NO	NO
Observations	100,305	100,178	79,474	64,607	64,544	49,394	45,586	27,664
# Buildings	2,796	2,762	2,439	2,134	2,112	1,898	2,628	1,697
R-squared	0.123	0.157	0.554	0.374	0.394	0.670	0.014	0.194

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable in columns (8) - (9) is a binary variable that takes one if the tenant is no longer in the building today, and zero otherwise. Columns (1) - (6) are OLS regression, and (7) - (8) are Logit regression.

Table A.11: Tenant satisfaction and building financial performance

	$\Delta Log(Rent_{b,t+1,t})$ ($/SF)			$\Delta Log(EffectiveRent_{b,t+1,t})$ ($/SF)			$\Delta VacancyRate_{b,t+1,t}$ (%)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(Overall Satis$_{b,t}$)	0.006	0.005	0.017**	0.063***	0.053**	0.086***	-3.345***	-2.936***	-3.434***
(Score 1-5)	(0.007)	(0.007)	(0.009)	(0.020)	(0.021)	(0.025)	(0.755)	(0.770)	(0.839)
Lagged Level:									
Log(Rent$_{b,t}$)	-0.012***	-0.014***	-0.047***	-0.006	-0.013**	-0.032**			
($/SF)	(0.003)	(0.003)	(0.008)	(0.006)	(0.006)	(0.014)			
Vacancy Rate$_{b,t}$					0.002***	0.003***	-0.140***	-0.145***	-0.170***
(%)					(0.000)	(0.000)	(0.011)	(0.011)	(0.013)
Building Class:									
Building Class A$_b$		0.008	0.015		0.014	-0.001		-1.125	-0.960
(YES=1)		(0.013)	(0.014)		(0.024)	(0.024)		(1.221)	(1.189)
Building Class B$_b$		0.009	0.012		0.006	-0.007		-0.726	-0.578
(YES=1)		(0.013)	(0.014)		(0.024)	(0.024)		(1.224)	(1.170)
Construction Year:									
1970_1980$_b$		-0.000	-0.002		-0.001	0.003		0.265	0.299
(YES=1)		(0.004)	(0.005)		(0.009)	(0.010)		(0.393)	(0.421)
1980_1990$_b$		-0.003	-0.005		-0.004	0.004		0.575*	0.006
(YES=1)		(0.004)	(0.005)		(0.008)	(0.009)		(0.341)	(0.381)
1990_2000$_b$		-0.005	-0.005		-0.002	0.002		0.339	0.024
(YES=1)		(0.004)	(0.005)		(0.010)	(0.011)		(0.405)	(0.490)
After 2000$_b$		-0.005	-0.002		-0.001	0.011		-0.204	-1.052**
(YES=1)		(0.004)	(0.005)		(0.010)	(0.010)		(0.387)	(0.441)
Stories:									
High$_b$		0.004	0.008*		0.006	0.006		-0.206	0.076
(YES=1)		(0.004)	(0.005)		(0.007)	(0.009)		(0.378)	(0.427)
Medium$_b$		0.003	0.003		0.008*	0.007		0.035	0.100
(YES=1)		(0.002)	(0.003)		(0.005)	(0.006)		(0.273)	(0.316)
Renovated$_{b,t}$		-0.003	0.002		0.006	0.015***		-0.187	-0.612**
(YES=1)		(0.002)	(0.002)		(0.005)	(0.005)		(0.231)	(0.255)
Log(RBA)$_b$		-0.001	-0.000		0.006	0.008		-0.283	-0.317
(SF)		(0.002)	(0.002)		(0.004)	(0.005)		(0.202)	(0.224)
Amenities$_b$		0.004*	0.003		-0.010*	-0.009		0.799***	0.643**
(YES=1)		(0.002)	(0.003)		(0.005)	(0.006)		(0.248)	(0.294)
Constant	0.053***	0.060***	0.144***	-0.092***	-0.132**	-0.140*	7.880***	11.162***	12.993***
	(0.013)	(0.022)	(0.037)	(0.034)	(0.057)	(0.075)	(1.311)	(2.839)	(3.051)
Time * City FE	NO	NO	YES	NO	NO	YES	NO	NO	YES
Observations	5,156	5,156	4,477	5,155	5,155	4,476	9,079	9,079	8,226
# Buildings	1,690	1,690	1,515	1,598	1,598	1,427	2,166	2,166	1,997
R-squared	0.006	0.009	0.236	0.050	0.055	0.273	0.067	0.071	0.237

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Explained variables are winsorized at their respective 1st and 99th percentiles to reduce the influence of outliers.

Appendix A.2 Identification accuracy of move-out status using survey data

Table A.12: Percentage of tenants actually move out when they stopped respond to survey

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Distribution of move-out identification accuracy						
Stopped N year before the latest tracking year	0yr	1 yr	2 yr	3 yr	4 yr+	Average of 1yr+
Most recent traced year of building						
2019	22%	88%	93%	95%	97%	94%
2020	20%	87%	90%	94%	97%	93%
2021	23%	80%	86%	86%	95%	90%
2022	20%	79%	78%	88%	94%	89%
2023	19%	78%	79%	90%	93%	88%
Average	21%	85%	87%	89%	96%	90%
Panel B: Distribution of tenant's most recent answer and most recent observation of the building						
Year before the latest track	All	2019	2020	2021	2022	2023
0	24,967	11,153	962	2,024	5,966	4,862
1	4,708	905	248	445	1,641	1,469
2	6,528	3,540	199	760	1,055	974
3	5,533	965	133	612	2,513	1,310
4	5,927	1,097	131	305	2,200	2,194
5	4,625	840	83	257	1,968	1,477
6	2,045	105	63	185	676	1,016
7	1,444	16	5	93	470	860
8	800	0	6	21	412	361
9	781	0	0	0	122	659
10	77	0	0	0	46	31
Total	57,435	18,621	1,830	4,702	17,069	15,213
Percentage	100%	32.15%	3.44%	8.89%	30.36%	25.11%

Notes: Dependant variable: Moved out probability. If we define those tenants who stopped answering the survey 1 year or more prior to the latest tracking date of the building as already moving out of the building, compared with the google map identification of existing states, on average, the accuracy of the move-out status identification strategy using survey data is around 90%.

Although we can identify whether the corporate tenant is still in the building as of the inquiry date(for the research time as 2023 December) using the Google map dataset and the Costar dataset, but database that explicitly record when exactly the tenant moving out of the building or moving into the building is still scarce. One way to proximate when the tenant moved out of the building is using the survey data itself: We define those tenants with latest respond date are 1 year or more prior to the most recent tracking date of the building as already left the building, and the year that tenant left the building as the subsequent year after their latest survey responding year(For example, for those buildings' most recently traced year is 2019, while the tenant stopped answering

it before 2019, we regard it as leaving in 2020, for those buildings' most recently traced year is 2020, we regard it as leaving in 2021, for the year 2021, 2022 and 2023 we apply the similar rules.); for those samples with the most recent response year the same as the most recent tracking year of the building, and compare with the google map if it actually not existing anymore, we regard them as leaving the year afterwards. Table A.12 indicates the accuracy rate of our identification of when does the tenant leaves using the combination of survey data and Google Maps data. On average, the accuracy rate is around 90%, for the buildings with the most recent tracking year is 2019, the accuracy level is even higher at 94%. And the identification accuracy between buildings with different latest tracking years are also shown in of Table A.12 Panel A. Panel B of Table A.12 listed the distribution of observations of the difference between tenant's latest respond year and the building's latest respond year, and also the statistics divided by the latest tracking year of the building.

Thus we can separate our move out activities into the move out before covid samples and move out after covid samples: (1) For those tenant with latest respond year is before and equal to 2018, we categorised them as moved out before Covid. (2) For those tenant with latest respond year is equal to or after 2019, we categorised them as move out after Covid or existing depending on the staying status indicated by Google map.

Appendix A.3 OLS model results for move-out status

Table A.13: Tenant Satisfaction and Move Out Decision

	Logit Regression		OLS model		
	(1)	(2)	(3)	(4)	(5)
Overall Satisfaction$_{i,b,t}$	-0.208***	-0.158***	-0.051***	-0.010***	-0.010**
(Score 1-5)	(0.016)	(0.034)	(0.004)	(0.002)	(0.004)
Constant	0.445	2.236	0.610***	0.475***	0.580***
	(0.641)	(2.212)	(0.156)	(0.151)	(0.136)
Control$_b$	YES	YES	YES	YES	YES
Time * City FE	NO	YES	NO	YES	YES
Tenant FE	NO	NO	NO	NO	YES
Observations	45,586	18,245	45,586	45,404	12,875
# Buildings	2,628	1,697	2,628	2,584	2,170
R-squared	0.014	0.194	0.019	0.761	0.842

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) and (2) are the same as the results in Table 2. The dependent variable is a binary variable that takes one if the tenant is no longer in the building today and zeroes otherwise.

Appendix A.4 Tenant Satisfaction and Bottom Line

Table A.14: Dependant Variable: Logarithm of Net Operating Income of 2022 May

	(1)	(2)	(3)
Log(Average Overall Satisfaction$_{b,t}$)	0.305	0.854*	0.072
(Score 1-5)	(0.707)	(0.487)	(0.413)
Constant	2.457**	1.659**	-0.183
	(1.048)	(0.720)	(1.339)
Control	NO	NO	YES
City FE	NO	YES	YES
Observations	200	178	178
#Buildings	200	178	178
R-squared	0.003	0.327	0.460

Notes: Robust standard errors are clustered at the city level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Log(NOI) is the net operating income as of the screenshot of 2022 May, which is calculated as: NOI = Effective rents per SF - Operating expense per SF(If data is available). And the building level average satisfaction is the most recent observation of the building.

Appendix A.5 Density distribution of Main Research Variables

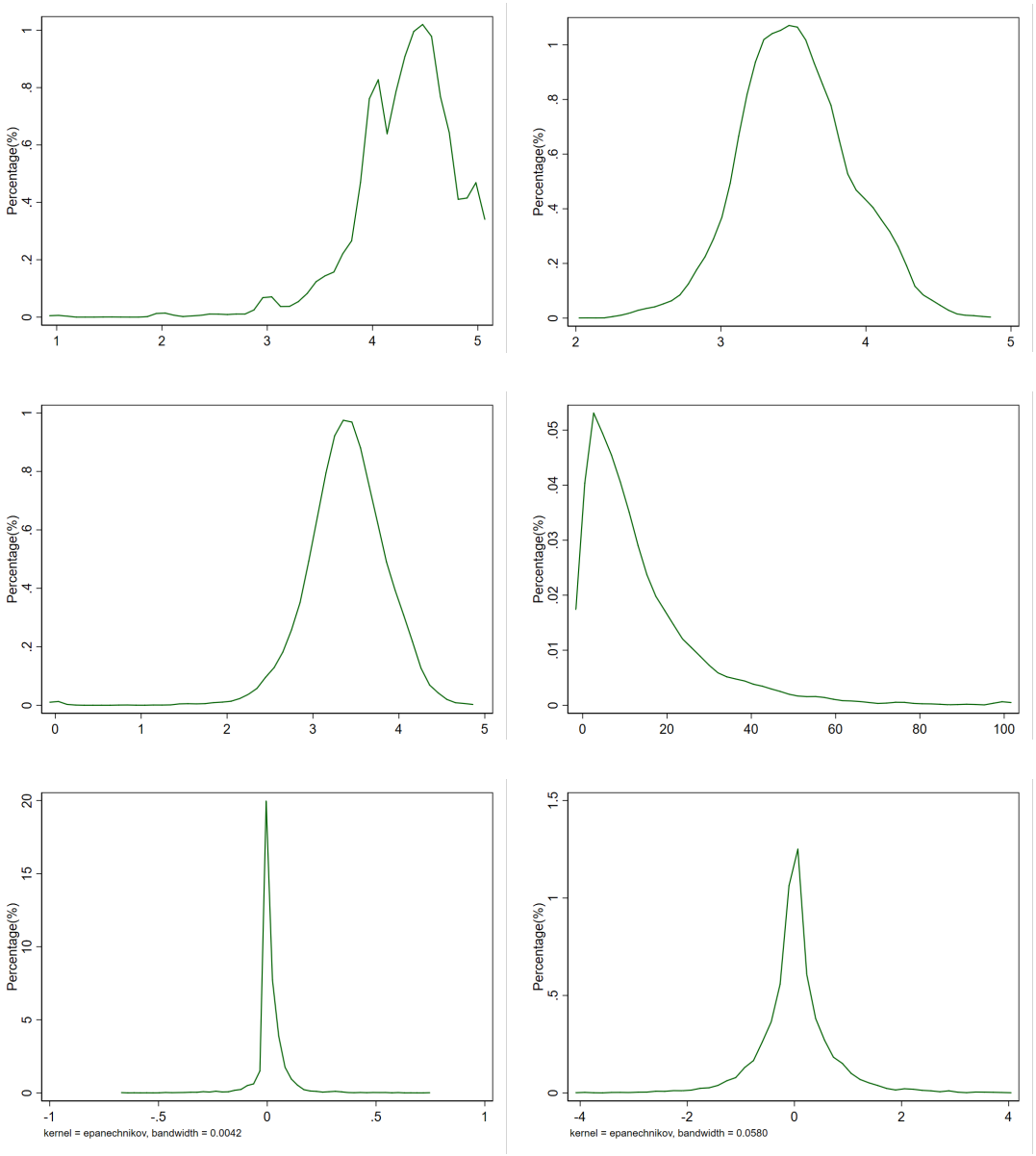


Figure A.5: Density distribution of Main Research Variables(Building Level)

Notes: Satisfaction, Renewal intention, Vacancy rate, Gross rent, and Effective rents are the arithmetic average. In this section, the statistics of the Vacancy rate, Gross rent, and Effective rents are only the observations of those properties in years that have survey responses.

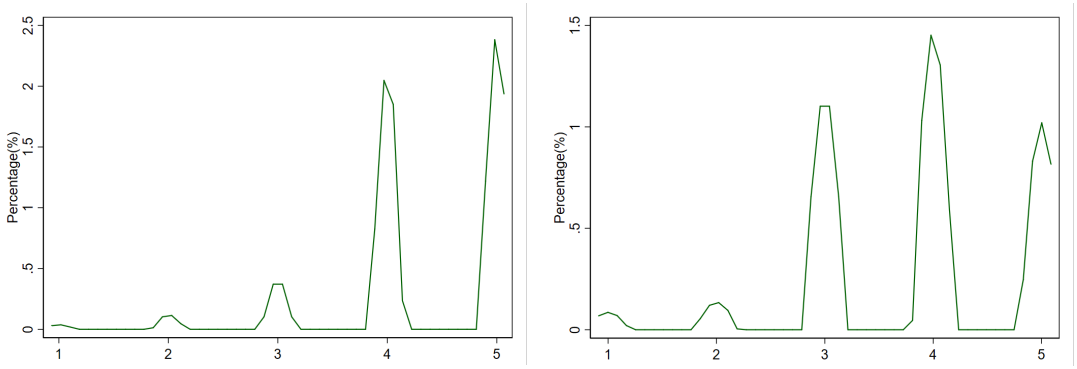
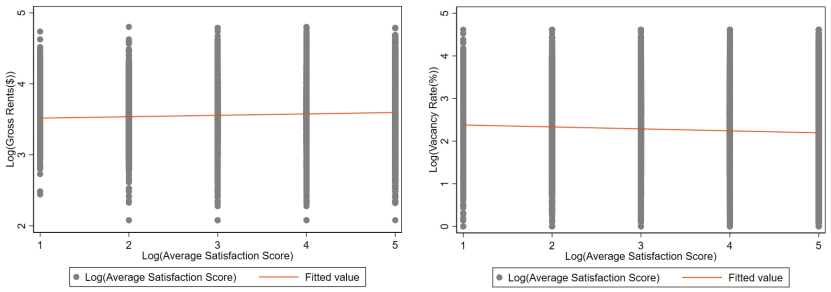


Figure A.6: Density distribution Main Research Variables(Tenant Level)

Appendix A.6 Distribution correlation of research variables, residual and satisfaction

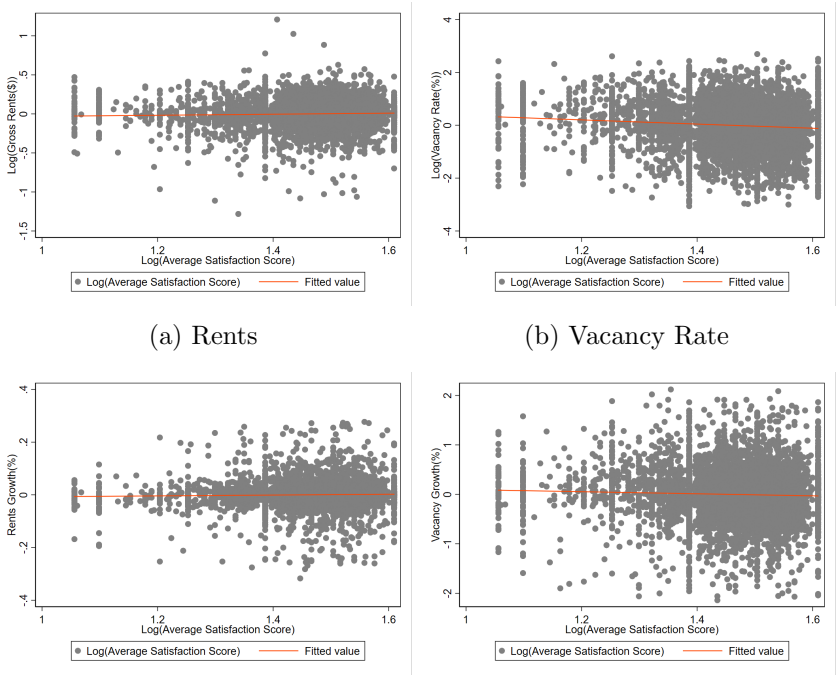
Figure A.7: Distribution correlation of research variables and satisfaction



(a) Rents and Satisfaction (b) Vacancy and Satisfaction

Notes: For Figures (a) and (b), the Y axis is the current financial performance, the X axis is the tenant level overall satisfaction.

Figure A.8: Distribution of Residual and Satisfaction



(a) Rents (b) Vacancy Rate

(c) Rents Growth (d) Vacancy Growth

Notes: For Figures (a) and (b), the Y axis is the residual from regressing the explained variables with a vector of building characteristics control variables same as Equation 2, and city-by-year fixed effects, the X axis is the logarithm of building level average overall satisfaction.

Appendix A.7 Tenant satisfaction, rents level, and vacancy rate

Table A.15: Tenant satisfaction, rents level, and vacancy rate

	(1) Log(Rent$_{b,t}$) ($/SF)	(2) Log(Effective Rent$_{b,t}$) ($/SF)	(3) Vacancy Rate$_{b,t}$ (%)
Log(Average Overall Satisfaction$_{b,t}$)	0.075*	0.329***	-0.849***
(Score 1-5)	(0.039)	(0.079)	(0.161)
Building Class:			
Class A$_b$	0.127	0.215	0.244
(YES=1)	(0.090)	(0.241)	(0.280)
Class B$_b$	0.016	0.077	0.304
(YES=1)	(0.090)	(0.243)	(0.280)
Construction Year:			
1970_1980$_b$	-0.039	-0.042	-0.014
(YES=1)	(0.027)	(0.036)	(0.078)
1980_1990$_b$	-0.033	-0.019	0.011
(YES=1)	(0.024)	(0.032)	(0.074)
1990_2000$_b$	0.030	0.037	-0.061
(YES=1)	(0.028)	(0.037)	(0.096)
After 2000$_b$	0.090***	0.124***	-0.350***
(YES=1)	(0.027)	(0.036)	(0.089)
Stories:			
High$_b$	0.140***	0.180***	-0.084
(YES=1)	(0.022)	(0.028)	(0.069)
Medium$_b$	0.066***	0.102***	-0.091
(YES=1)	(0.016)	(0.022)	(0.059)
Renovated$_{b,t}$	0.026*	0.036*	0.023
(YES=1)	(0.014)	(0.021)	(0.046)
Log(Typical Floor Size)$_b$	-0.021	0.010	-0.165***
(YES=1)	(0.013)	(0.019)	(0.046)
Amenities$_b$	0.029*	0.012	0.117**
(YES=1)	(0.016)	(0.023)	(0.050)
Constant	3.463***	2.552***	4.896***
	(0.166)	(0.324)	(0.536)
Time*City FE	YES	YES	YES
Observations	4,503	4,266	6,030
# Buildings	1,635	1,570	2,090
R-squared	0.802	0.678	0.306

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Explained variables and main explanatory variables are winsorized at their respective 1st and 99th percentiles to reduce the influence of outliers.

Appendix A.8 Satisfaction sub-component analysis and summary statistics

Table A.16: Satisfaction sub-component analysis and summary statistics

Panal A: Principal component (PC) loadings																				
Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9	Comp10	Comp11	Comp12	Comp13	Comp14	Comp15	Comp16	Comp17	Comp18	Comp19	Comp20
Management:																				
Statement Accuracy	0.20	-0.09	-0.02	0.37	0.88	0.14	-0.07	0.06	0.07	0.01	-0.02	0.01	0.03	0.00	0.01	-0.02	0.01	0.01		
Accessibility	0.24	-0.29	0.01	-0.03	-0.05	0.06	0.06	-0.05	-0.08	0.37	0.76	-0.28	-0.02	0.07	0.06	-0.07	-0.19	-0.01		
Special Needs	0.24	-0.30	-0.05	-0.05	-0.08	-0.02	-0.04	0.05	-0.01	-0.58	0.18	-0.08	0.56	0.06	-0.11	0.15	0.32	0.02		
Communication	0.25	-0.32	-0.03	-0.05	-0.04	0.02	-0.03	0.00	-0.02	-0.01	-0.05	0.11	-0.55	-0.17	-0.10	0.67	0.17	-0.03		
Problem Solving	0.25	-0.30	-0.08	-0.04	-0.07	-0.02	-0.06	0.03	0.08	-0.43	-0.17	0.02	-0.22	0.01	0.01	-0.27	-0.69	-0.05		
Professionalism	0.23	-0.33	0.06	-0.07	-0.07	-0.01	0.10	-0.03	0.00	0.52	-0.45	0.14	0.48	0.09	0.04	0.18	-0.20	-0.05		
Responsiveness	0.24	-0.34	-0.03	-0.07	-0.08	-0.01	0.03	0.01	-0.01	0.12	-0.17	0.10	-0.23	-0.07	0.08	-0.62	0.53	0.11		
Building Quality:																				
Amenities	0.23	0.17	0.24	0.10	-0.13	-0.03	-0.76	0.12	-0.14	0.08	0.14	0.42	0.07	-0.06	0.03	-0.04	-0.03	0.02		
Location	0.25	0.25	-0.09	-0.24	0.01	0.36	0.09	-0.04	-0.03	-0.03	-0.01	-0.07	0.15	-0.75	0.28	0.00	-0.05	-0.03		
Quality	0.22	0.22	-0.28	-0.08	-0.10	0.70	-0.02	-0.24	-0.02	0.00	-0.03	0.12	-0.05	0.46	-0.18	-0.01	0.04	0.01		
Elevator Appearance	0.26	0.20	0.23	-0.31	0.16	-0.23	0.12	-0.20	0.11	-0.04	0.06	0.10	-0.04	0.11	-0.06	-0.06	0.09	-0.75		
Elevator Performance	0.25	0.20	-0.34	0.25	-0.10	-0.26	0.07	-0.03	0.12	0.15	0.03	0.00	0.06	-0.28	-0.71	-0.10	-0.04	0.03		
Commom Area	0.23	0.18	-0.44	0.30	-0.16	-0.26	0.00	-0.08	0.42	0.00	0.05	0.07	0.00	0.15	0.56	0.11	0.06	-0.02		
Restroom	0.24	0.18	-0.12	0.16	0.02	-0.24	0.22	-0.07	-0.84	-0.08	-0.08	-0.01	-0.04	0.11	0.16	0.02	-0.03	0.03		
Lobby	0.18	0.08	0.58	0.55	-0.26	0.22	0.40	0.08	0.12	-0.10	0.03	0.10	-0.03	-0.03	0.01	-0.01	0.00	-0.01		
Indoor Environmental Quality:																				
IAQ	0.26	0.15	0.22	0.05	-0.07	-0.03	-0.33	-0.09	0.06	0.04	-0.30	-0.79	-0.07	0.09	-0.01	0.03	0.07	0.04		
Heating	0.23	0.22	-0.05	-0.27	0.03	0.00	0.15	0.87	0.05	0.06	0.01	-0.04	-0.05	0.19	-0.01	0.03	0.01	0.06		
Lighting	0.24	0.20	0.28	-0.35	0.17	-0.23	0.16	-0.31	0.18	-0.05	0.07	0.16	-0.02	0.09	-0.02	0.05	-0.07	0.65		
Cum explained(%)	52.74%	65.05%	69.98%	74.04%	77.44%	80.60%	83.35%	85.83%	87.96%	89.73%	91.45%	93.04%	94.45%	95.79%	97.00%	98.11%	99.11%	100.00%		

Panel B: Distribution of Satisfaction Measures																				
Percentile	f1	f2	Accu	Acce	Spe	Com	Prob	Prof	Resp	Ame	Loca	Qual	EleA	EleP	Comm	Rest	Lobby	IAQ	Heating	Light
1	-3.14	-2.55	1	2	1	2	1	2	2	1	3	2	1	1	2	1	2	1	1	2
5	-1.88	-1.63	3	3	3	3	3	3	3	2	4	3	2	2	3	2	3	2	2	3
10	-1.31	-1.22	3	4	4	4	3	4	4	3	4	3	3	2	3	3	4	3	2	3
25	-0.60	-0.57	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	3	4
50	0.16	0.14	4	5	5	5	5	5	5	4	5	4	4	4	5	4	5	4	4	4
75	0.88	0.37	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
90	1.08	0.93	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
95	1.08	1.59	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
99	1.08	3.07	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Panel C: Correlation of liquidity proxies																				
	f1	f2	Accu	Acce	Spe	Com	Prob	Prof	Resp	Ame	Loca	Qual	EleA	EleP	Comm	Rest	Lobby	IAQ	Heating	Light
f1	1.00																			
f2	0.00	1.00																		
Management:																				
Statement Accuracy	0.62	-0.13	1.00																	
Accessibility	0.74	-0.43	0.48	1.00																
Special Needs	0.75	-0.45	0.47	0.71	1.00															
Communication	0.76	-0.48	0.50	0.74	0.74	1.00														
Problem Solving	0.78	-0.45	0.50	0.70	0.78	0.79	1.00													
Professionalism	0.71	-0.50	0.46	0.70	0.70	0.74	0.72	1.00												
Responsiveness	0.75	-0.51	0.48	0.74	0.74	0.79	0.79	0.77	1.00											
Building Quality:																				
Amenities	0.71	0.25	0.39	0.41	0.42	0.42	0.43	0.38	0.40	1.00										
Location	0.55	0.12	0.33	0.36	0.33	0.33	0.33	0.34	0.33	0.46	1.00									
Quality	0.79	0.23	0.44	0.48	0.48	0.48	0.51	0.46	0.47	0.68	0.51	1.00								
Elevator Appearance	0.76	0.36	0.39	0.42	0.41	0.41	0.43	0.37	0.40	0.56	0.38	0.64	1.00							
Elevator Performance	0.67	0.32	0.36	0.37	0.36	0.37	0.39	0.32	0.35	0.48	0.32	0.54	0.71	1.00						
Appearance of Commom Area	0.79	0.30	0.42	0.46	0.45	0.45	0.47	0.43	0.45	0.60	0.44	0.69	0.68	0.52	1.00					
Appearance of Restroom	0.69	0.32	0.35	0.37	0.39	0.38	0.41	0.35	0.37	0.52	0.34	0.56	0.65	0.52	0.63	1.00				
Appearance of Lobby	0.75	0.29	0.39	0.43	0.42	0.43	0.44	0.41	0.41	0.56	0.42	0.65	0.65	0.49	0.83	0.58	1.00			
IEQ:																				
IAQ	0.76	0.29	0.43	0.43	0.44	0.44	0.46	0.39	0.43	0.54	0.38	0.60	0.62	0.57	0.58	0.57	0.54	1.00		
Heating	0.70	0.26	0.39	0.39	0.42	0.41	0.46	0.35	0.40	0.49	0.32	0.55	0.56	0.55	0.52	0.51	0.48	0.77	1.00	
Lighting	0.75	0.26	0.43	0.43	0.44	0.44	0.45	0.40	0.43	0.54	0.41	0.60	0.61	0.53	0.62	0.55	0.57	0.68	0.60	1.00

Notes: The survey question asked respondents "Please rate your satisfaction with the property in the following areas on a scale from 1 to 5", and is the B, C, and D part of the Appendix A.18 question library. For the first component, the Eigenvalue is 9.79, and for the second component, the Eigenvalue is 2.30. We have 22,684 survey observations with valid answer values for all the survey questions. The principle component is calculated as the linear combination of the sub-component of tenant satisfaction. Panel A shows the principle components loading for each satisfaction sub-component, and Panel B shows the distribution of satisfaction sub-components. Panel C shows the correlation matrix of the original satisfaction sub-components and the converted measure of satisfaction.

Appendix A.9 Stability of Submarket Vacancy Ranking Liquidity

Table A.17: Submarket vacancy ranking liquidity of 50th percentile

		NO	YES	Total
Top 50 percentile	NO	88.08	11.92	100
Bottom 50 percentile	YES	11.92	88.08	100
	Total	50	50	100

Notes: The quarterly submarket vacancy rate data are from the CoStar database, we take the average of four quarters to measure the average vacancy rate of a certain submarket in a certain year. In each year, the submarkets will be separated into two groups: "Top 50 percentile" or "Bottom 50 percentile". The ranking of submarkets is "in-sample", which is based on the submarkets that have survey data in our dataset. For those submarkets ranking as the first 50 percentile for a certain year, the "Top 50 percentile" is "YES", otherwise the "Top 50 percentile" is "NO". As shown in A6, 88% of the submarket will remain in the same group as the last year.

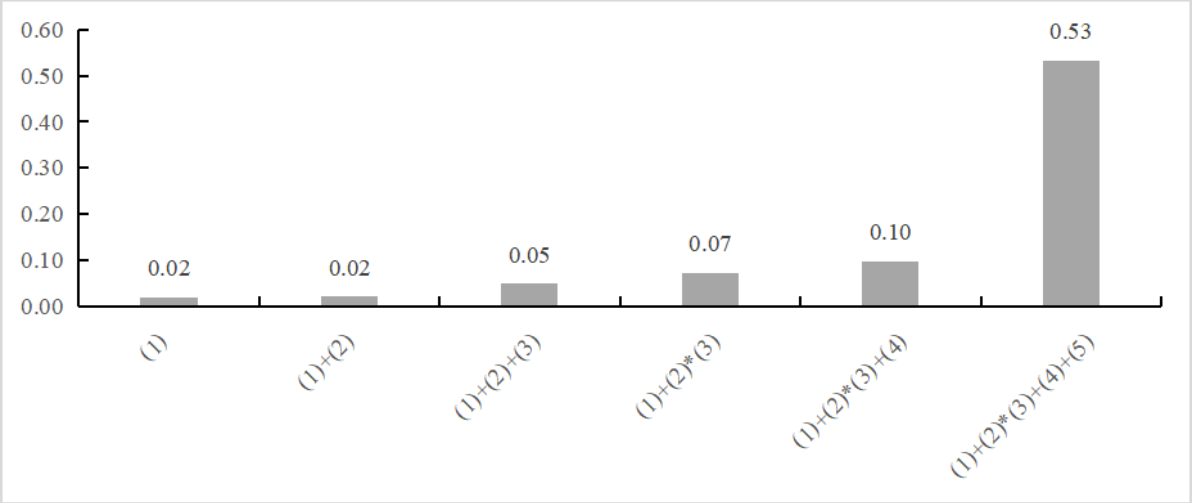
Appendix A.10 Question Library

Table A.18: Question Library

Interpretation of question	Answer Scale
A.Overall Questions	
Please rate your overall satisfaction as a tenant.	Poor to excellent
How likely would you be to recommend this property to others?	Definitely would not to definitely would
How likely would your company be to renew the lease?	Definitely would not to definitely would
B.Property Management	
Please rate your property management staff in the statement accuracy.	Poor to excellent
Please rate your property management staff in accessibility.	Poor to excellent
Please rate your property management staff in the accommodation of special requests.	Poor to excellent
Please rate your property management staff in the communication.	Poor to excellent
Please rate your property management staff in problem resolution	Poor to excellent
Please rate your property management staff in professionalism/courtesy	Poor to excellent
Please rate your property management staff in responsiveness.	Poor to excellent
C.General Property Features	
Please rate the building amenities of your property	Poor to excellent
Please rate the location of your property	Poor to excellent
Please rate the quality of your property	Poor to excellent
D.Interior Property Features	
Please rate the appearance of common areas of your property	Poor to excellent
Please rate the appearance of the lobby of your property	Poor to excellent
Please rate the appearance of restrooms of your property	Poor to excellent
Please rate the elevator appearance of your property	Poor to excellent
Please rate the elevator performance of your property	Poor to excellent
Please rate the heating and A/C of your property	Poor to excellent
Please rate the indoor air quality of your property	Poor to excellent
Please rate the workspace lighting of your property	Poor to excellent

Appendix A.11 R-square explained for each stage

Figure A.9: R-square explained of overall satisfaction for each stage



Notes:(1) is the building characteristics, (2) is the year fixed effect, (3) is the city fixed effect, (4) is the property management fixed effect, and (5) is the tenant fixed effect.

Table A.19: Worries from the distribution of survey answers

	Tenant decision			Financial performance		
	(1) Renewal Intention$_{i,b,t}$ (Score 1-5)	(2) Building Recommend$_{i,b,t}$ (Score 1-5)	(3) Finally Move Out$_{i,b,t+1}$ (YES=1)	(4) $\Delta Log($ Rent$_{b,t+1})$ ($/SF)	(5) $\Delta Log(Effective$ Rent$_{b,t+1})$ ($/SF)	(6) $\Delta Vacancy$ Rate$_{b,t+1}$ (%)
Overall Satisfaction$_{i,b,t}$	0.321***	0.454***	-0.270***			
(Score 1-5)	(0.008)	(0.008)	(0.018)			
Log(Overall Satis$_{b,t}$)				0.020**	0.069*	-2.724***
(Score 1-5)				(0.009)	(0.037)	(1.019)
Constant	1.896***	1.680***	-0.057	0.156***	0.344**	12.405***
	(0.337)	(0.263)	(2.914)	(0.048)	(0.135)	(4.140)
Lagged Level$_{b,t}$	NO	NO	NO	YES	YES	YES
Time*Building FE	YES	YES	YES	NO	NO	NO
Tenant FE	YES	YES	NO	NO	NO	NO
Time FE	YES	YES	YES	YES	YES	YES
Building FE	YES	YES	YES	YES	YES	YES
Observations	77,957	48,641	48,804	5,226	5,213	9,524
# Buildings	2,439	1,898	1,697	1,515	1,427	1,997
R-squared	0.653	0.735	0.351	0.456	0.451	0.396

Notes: Robust standard errors are clustered by building in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) - (3) are the results of tenant satisfaction and tenant decision, and Columns (4) - (6) are the results of tenant satisfaction and building financial performance. For the analysis of Columns (4) - (6), the explained variables are winsorized at their respective 1st and 99th percentiles to reduce the influence of outliers.

Appendix A.12 Worries from the Distribution of Survey Answers

Table A.19 shows the results of Equations 1 after we control the cross term of building and time fixed effects. And the results of Equation 2 after we control the building fixed effect and time fixed effect separately. The magnitude and sign of the coefficients are similar to the findings in our main regression in Table 2 and Table 3.

Appendix A.13 Mediation Model

$$Log(Satisfaction_{b,t}) = \alpha + \beta Green_{b,t}/GMgmt_{b,t} + \gamma X_b + \mu_t * \lambda_c + \varepsilon_{b,t} \tag{A.1}$$

$$\Delta Log(Performance_{b,t+1,t}) = \alpha + \beta Green_{b,t}/GMgmt_{b,t} + \theta LaggedLevel_{b,t} + \gamma X_b + \mu_t * \lambda_c + \varepsilon_{b,t} \tag{A.2}$$

$$\begin{aligned} \Delta Log(Performance_{b,t+1,t}) &= \alpha + \delta Log(Satisfaction_{b,t}) \\ &+ \beta Green_{b,t}/GMgmt_{b,t} + \theta LaggedLevel_{b,t} + \gamma X_b + \mu_t * \lambda_c + \varepsilon_{b,t} \end{aligned} \tag{A.3}$$

Equation A.1 tries to analyze whether the property management quality and the indoor environment have some influence on tenant satisfaction. Equation A.2 investigates whether property management quality and the indoor environment affect the tenant's decision and building performance. Equation A.3 tries to study how overall satisfaction mitigates the effect of property management quality and the indoor environment.

$Green_{b,t}$ is a dummy variable specified whether building b is certified as green in year t(The year tenant answers the survey). $Green_{b,t}$ equals 1 means it's a green building, and 0 otherwise[43].

$GMgmt_{b,t}$ is a dummy variable specified whether the property management group of building b in year t(The year the tenant answers the survey) is a good one. $GMgmt_{b,t}$ equals 1 means it's a good quality property management company, and 0 otherwise[44]. We define a good property management group as those property management companies that have a score of "satisfaction with the property management quality" higher than the medium of our sample[45][46]. The control variables are the same

[43]In this section, we did not distinguish between LEED or WELL, partially certified or the whole building, or the certified level.

[44]We assume the allocation of good and bad management are random across buildings. If this assumption was violated we might attribute the satisfaction improvement effect to better property management wrongly

[45]We calculate the average score of the satisfaction of the individual answer about the property management company, that is the arithmetic average of the satisfaction score with property management from all the tenant in all the building this specific property management company is managing during our research sample, for example, the average score of tenant's satisfaction level with property management company CBRE is the arithmetic of the answer "Please rate your satisfaction level with the property management company" from all the tenant of all the building that CBRE managed during 2009 to 2023 in our sample, and if the building change property management company, then only the period a certain property management company that is managing the building would the answer be part of the component of the average score. We can track the date when there is a change in the property management firm associated with a building using the Costar database, the Costar database records the historical changes of the property management company of the building, including the change date, previous property management firm, and new property management firm. If the change happens during the first half of the year, then we take the new property management firm as the property management of that year, if the change happens in the second half of the year, then we take the previous property management firm as the property management company of that year. Then we take the property management company samples that are located at the upper 50% as a good property management firm, and the lower 50% as a bad property management firm.

[46]There is no problem with certain companies managing just only a certain quality type of buildings,

in Equation 2, including all the observable building characteristics, cross term of time and city fixed effects, and tenant fixed effects.

tenants live in different quality buildings with different property management companies because they will accommodate the environment they are in they still give a high score to the building, then the property management only affect performance but not satisfaction, then the measurement of good/bad property management groups based on the survey data might be biased. For each property management company, the buildings they manage are across different rent levels and building classes, and for different rent levels, there are high satisfaction level property management companies and low satisfaction ones. Thus the allocation of satisfaction should be more likely to be based on the service quality itself, not just the building quality. 1110 buildings were always managed by the lower 50% percentile property management company

Appendix A.14 State level average overall satisfaction

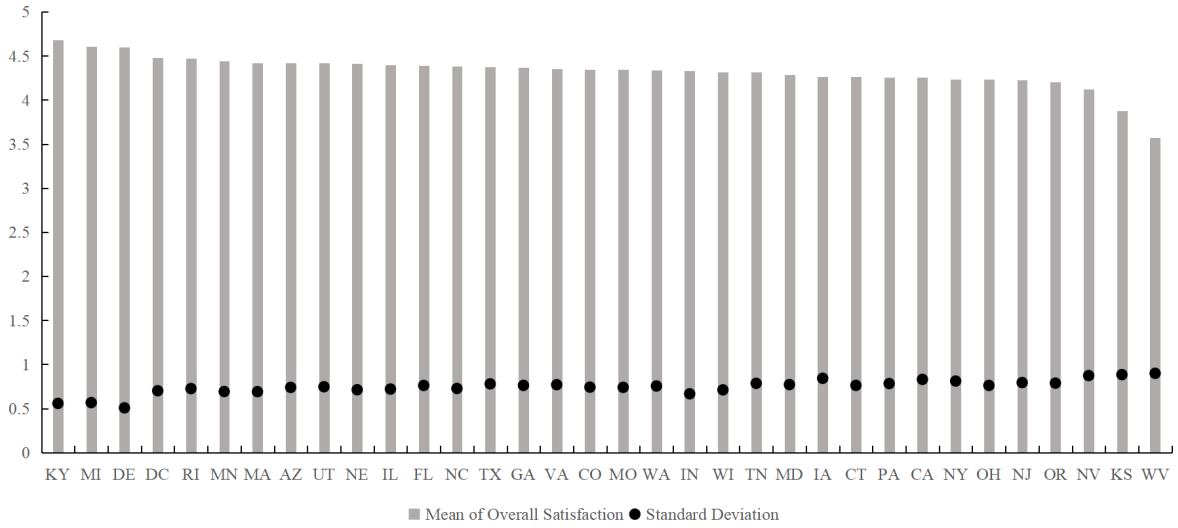


Figure A.10: Geographic distribution of satisfaction(State level)

Notes: The state-level average overall satisfaction is the arithmetic average of the overall satisfaction score of all the respondents in the corresponding state over the entire sample period, from 2009 to 2021. We drop the statistics of AL(1 response), NM(6 response), OK(1 response), and SC(6 response) because of too few observations.