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DO AMENITIES ENHANCE THE VALUE OF OFFICE BUILDINGS? DYNAMIC CAUSAL IMPACT OF MODERN RETROFITTING

Kazushi Matsuo*[1], Nichika Aoki[2], Morito Tsutsumi[3], Toyokazu Imazeki[4]

[1] *Commercial Property Research Institute, Inc., 4-6-1 Ginza, Chuo-ku, Tokyo 104-0061, Japan; Faculty of Engineering, Information and Systems, University of Tsukuba, 1-1-1 Tennodai, Tsukuba-City, Ibaraki 305-8573, Japan; email: kazushi_matsuo@sanko-e.co.jp, ORCID: 0000-0002-5656-5399*

[2] *Master's Program in Policy and Planning Sciences, Graduate School of Science and Technology, University of Tsukuba, 1-1-1 Tennodai, Tsukuba-City, Ibaraki 305-8573, Japan*

[3] *Faculty of Engineering, Information and Systems, University of Tsukuba, 1-1-1 Tennodai, Tsukuba-City, Ibaraki 305-8573, Japan*

[4] *Commercial Property Research Institute, Inc., 4-6-1 Ginza, Chuo-ku, Tokyo 104-0061, Japan*

* *Corresponding author*

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ABSTRACT

The post-pandemic shift to hybrid work has redefined tenant demand, turning offices from mere workspaces into collaborative, experiential hubs. Aging properties now face an obsolescence trilemma: retrofit, convert, or decline economically. Within the global "flight to quality" trend favoring modern, higher-standard space, this study quantifies the economic impact of building modernization. Using shared tenant lounge installation as a proxy for comprehensive modernization packages, we estimate its causal effect on commercial property performance. Focusing on large office buildings in Tokyo's five central wards, we apply a staggered difference-in-differences framework to a novel, manually constructed panel dataset. Results show that modernization shortens time-on-market by 24.2%–57.0% starting one year after installation, followed by a 1.2%–1.8% decline in vacancy rates from year two onward. Rent premiums then rise dynamically, reaching 7.56% by year five. Placebo-based robustness checks, though limited, substantiate these findings. We further identify a strategic stabilization mechanism: owners first prioritize filling vacancies to restore building vibrancy, then capture rent premiums as tenants' willingness to pay increases. These findings show that amenity-centric modernization creates functional value that mitigates obsolescence, though measured returns reflect an aggregate upgrade strategy rather than an isolated lounge effect, and apply specifically to high-grade assets in central business districts.

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1. Introduction

With the growing diversification of work styles and the evolving role of physical office spaces, modern retrofitting has emerged as a critical strategy for enhancing property value and mitigating functional obsolescence. The widespread adoption of remote work has reduced demand for office space (Gupta et al., 2026) and, by triggering a "flight to quality" as firms seek commute-worthy workplaces (JLL, 2025; Matsuo et al., 2024), has exacerbated the risk of building obsolescence (Liusman & Chau, 2026; Rosenthal et al., 2022). Consequently, property owners are increasingly confronted with a strategic trilemma: passively accept obsolescence (risking asset "zombification"), convert the property for alternative uses (Gupta et al., 2023), or undertake modern retrofitting to remain competitive (Cushman & Wakefield, 2023). Even in the Japanese office market, which has historically maintained robust demand, changing macroeconomic conditions have driven a rise in value-add investment strategies (CBRE, 2026). Property owners are increasingly investing in modern retrofits to reposition existing assets and

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enhance their marketability. However, rigorous quantitative evidence on the impact of these modern refurbishments on building performance remains scarce.

A substantial body of real estate research has employed hedonic pricing models to demonstrate that specific building characteristics command rent and occupancy premiums (Ke, 2024; Matsuo et al., 2024b; Tsolacos et al., 2023). This is particularly evident in the extensive literature on green buildings, in which numerous studies have documented the economic benefits of environmental certification (Chegut et al., 2014; Eichholtz et al., 2010). However, although the "green premium" has been thoroughly examined, empirical studies explicitly identifying the causal effect of non-environmental, tenant-centric renovations, specifically the ex-post installation of targeted lifestyle amenities, remain sparse. To address this gap, the current study examines the installation of shared tenant lounges, a quintessential feature of modern office repositioning. Employing a statistical causal inference framework, we investigate the causal impact of such modern refurbishments on office rents, vacancy rates, and leasing downtime.

The findings of this study offer building owners, developers, and institutional investors robust quantitative evidence of the financial benefits of modernizing aging assets. Furthermore, because shared tenant lounges have become increasingly common in commercial real estate worldwide, our results have significant implications and may be applicable to office markets beyond the primary region of study (i.e., Japan).

2. Material and methods

2.1. Materials

To construct a comprehensive dataset of office buildings, this study utilized proprietary records from Sanko Estate Co., Ltd., one of Japan's leading commercial real estate brokerages. As structured data specifically identifying shared tenant lounges were not available, we hand-curated this information by augmenting Sanko Estate's database with primary sources. Owing to the labor-intensive nature of this manual verification process, the research focus was narrowed to 460 large-scale standard rental office buildings located in Tokyo's five central wards (Chiyoda, Chuo, Minato, Shinjuku, and Shibuya). The sample was restricted to assets that met the following criteria: an area of at least 200 tsubo[1] (approximately 660 m^2) and a total rentable area of 3,000 tsubo (approximately 9,900 m^2). Furthermore, standard rental office buildings excluded company-owned buildings and those with only one tenant.

Shared tenant lounges function as complimentary "third spaces" for building occupants, providing areas designed for dining, informal meetings, and relaxation. Often integrated with supplementary facilities such as rentable conference rooms and on-site cafés, these lounges are instrumental in supporting diverse and flexible work styles. Furthermore, amid the widespread adoption of hybrid work, access to these communal amenities allows tenants to strategically optimize their exclusive leased space, enabling a highly flexible approach to corporate spatial planning (CBRE, 2023).

To ensure methodological rigor and transparency in defining the retrofitting variables, the identification and installation timing of shared tenant lounges were cross-verified across multiple primary sources, including official property websites, leasing brochures, and marketing flyers. To guarantee interrater reliability, the verification process was independently conducted and cross-checked by multiple commercial real estate agents at the brokerage. The core criterion for retrofitting treatment identification relies on whether owners have explicitly marketed the shared tenant lounge in their leasing information. Unadvertised facilities - unrecognized by brokerages or prospective occupants - do not function as market-acknowledged amenities and were thus excluded. Additionally, to prevent arbitrary or subjective categorization, all shared tenant lounges were treated homogeneously regardless of variations in physical size or qualitative features.

An empirical analysis was conducted over the observation period from 2015 to 2025, leveraging three distinct datasets:

1) Vacancy rates (balanced panel): This first dataset captured property-level vacancy dynamics. To eliminate noise from transient, frictional vacancies, the raw monthly data were aggregated into annualized vacancy rates. Specifically, the annualized vacancy rate for each property was calculated by dividing the 12-month cumulative sum of the monthly vacant area by the 12-month cumulative sum of the monthly rentable area within a given year. This

[1] One tsubo is equivalent to approximately 3.3 m^2 (35.58 sq ft). As a traditional unit of area unique to Japan, the tsubo has historically been, and continues to be, commonly used to denote real estate measurements.

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dataset was structured as a strictly balanced panel and incorporated fundamental property characteristics, including building age, area per floor, number of floors, and specific locational attributes.

2) Asking rents (unbalanced panel): The second dataset tracked asking rents. For properties with active market availability, a single representative building-level asking rent was assigned. Because rent observations were inherently contingent on active listings, resulting in missing data for fully stabilized buildings or unlisted spaces, this dataset formed an unbalanced panel. It retained the same foundational building characteristics as the vacancy dataset.
3) Time-on-market (TOM; unbalanced panel): The third dataset measured the TOM. It recorded the exact duration, in days, from the initiation of a leasing campaign to its conclusion, which was measured strictly at the suite level (individual unit level). Similar to the rent data, it constituted an unbalanced panel and included specific suite-level leasable areas along with baseline building attributes.

Appendix A provides detailed definitions of the variables. Table 1 presents the descriptive statistics for each dataset. Because the subject buildings were identical across all datasets, variations in the property attributes were minimal. An average building age of 23.5–29.1 years is higher than that in central and eastern European countries, but lower compared with mature office markets such as London, Paris, and New York (Chegut et al., 2015). Although a large volume of office buildings was constructed in Japan during the high-economic-growth period leading up to the 1990s, the market since 2000 has seen a shift toward large-scale and high-rise properties (Xymax, 2026). Tokyo's office market has a stable pipeline in terms of the supply of large-scale buildings. The neighborhood rentable area (NRA) represents the total rentable office area situated within a 400-m radius of each building, serving as a proxy for the degree of office agglomeration (Matsuo et al., 2024a). As a time-varying variable, the NRA reflects urban growth and enhanced agglomeration economies, thereby depicting the geographical heterogeneity of the office market.

The vacancy rate exhibited a skewed distribution compared with the other two outcomes (Appendix B). The vacancy rate represents proportional data that are strictly bounded between 0 and 100. Furthermore, the Tokyo office market is characterized by exceptionally high global occupancy rates (JLL, 2026), with numerous properties operating at full capacity (0% vacancy rate). In such cases, although models assuming a normal distribution may not be strictly appropriate (Papke & Wooldridge, 1996), in the context of statistical causal inference, it is well documented that standard analytical approaches that assume normality yield reliable estimates of treatment effects, even when dealing with binary or highly skewed dependent variables (Gomila, 2021). Following the established literature, the current study employed conventional analytical methods predicated on a normal distribution. To ensure that our findings are not artifacts of assuming a linear functional form, we estimated an alternative specification using the logit-transformed vacancy rate; the results are presented in Section 3.3.

Table 1

Descriptive statistics for each dataset

Dataset A (vacancy rate)		Min	Median	Mean	Max	Std. Dev.	Sample size
Vacancy rate	$\%(annual)$	0.0	0.4	2.9	100.0	6.51	3957 Treatment: 208 Control: 3749
Age	$Year$	0.0	21.3	23.5	67.7	14.46	
Neighborhood rentable area	$m^2(log)$	9.2	11.9	11.8	13.2	0.72	
Number of floors	$Floors$	6.0	20.0	21.1	55.0	10.25	
Area per floor	m^2	664.5	1563.6	1811.0	7097.5	993.18	
Dataset B (rent)		Min	Median	Mean	Max	Std. Dev.	Sample size
Asking rent	$Yen/Tsubos\ (log)$	9.4	10.3	10.3	11.1	0.30	2218 Treatment: 166 Control: 2052
Age	$Year$	0.0	22.9	24.7	67.7	14.73	
Neighborhood rentable area	$m^2(log)$	9.2	12.0	11.8	13.2	0.69	
Number of floors	$Floors$	6.0	21.0	22.6	55.0	11.04	
Area per floor	m^2	664.5	1671.1	1932.0	7097.5	1107.27	
Dataset C (time-on-market)		Min	Median	Mean	Max	Std. Dev.	Sample size
TOM	Day	1.0	177.0	250.5	1770.0	237.07	2893 Treatment: 416
Age	$Year$	0.1	27.4	29.1	66.8	15.96	

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Neighborhood rentable area	$m^2(log)$	9.3	12.1	11.9	13.2	0.63	Control: 2477
Number of floors	$Floors$	6.0	24.0	26.1	55.0	13.18	
Area per floor	m^2	664.5	1996.7	2227.1	7097.5	1294.85	
Vacancy rate	$\%(monthly)$	0.0	2.0	5.9	100.0	11.43	
Area of available space	m^2	5.3	268.3	421.9	4244.3	475.34	

Source: own study.

2.2. Methods

To estimate the causal effect of installing a shared lounge, we employed a difference-in-differences (DiD) approach. Because the timing of lounge installations varies across properties, we applied the staggered DiD methodology proposed by Sun and Abraham (2021). This approach accounts for the variation in treatment timing, which can cause bias in the standard two-way fixed-effects estimators. Following their methodology, treatment cohorts were defined based on the year in which a building installed a lounge. The baseline event-study specification was formulated as follows:

$$Y_{it} = \alpha_i + \lambda_t + \sum_{\tau=-5,\tau\neq-1}^{5} \gamma_\tau D_{it}^{\tau} + \sum_{k}^{K} X_{itk}\beta_k + \varepsilon_{it} \qquad (1)$$

where Y_{it} represents the outcome variable (vacancy rate, asking rent, or TOM) for building i in year t. D_{it}^{τ} indicates that building i is observed τ years relative to retrofit, $\tau = -1$ is the reference period, and never-treated buildings serve as controls. Pre-period coefficients $\gamma_{-5},\cdots,\gamma_{-2}$ test the parallel trends assumption. The post-period coefficients $\gamma_0,\cdots,\gamma_5$ represent the average treatment effect on the treated (ATT). The terms α_i and λ_t denote building and year fixed effects, and X_{itk} are property-level control variables (age and NRA). This model allows for the evaluation of pre-treatment parallel trends and accurately estimates the dynamic impact of modern refurbishments on property performance.

3. Results

3.1. Overview of lounge installations

First, we describe the installation trends of the shared tenant lounges in our sample. As illustrated in Fig. 1, the installation rate of these lounges was 3.4% in 2015. However, following noticeable shifts in market trends around 2018, particularly from 2023 onward, this rate increased significantly, reaching 16.5% by 2025. Notably, the accelerated growth after 2023 has largely been driven by the active retrofitting of existing buildings. This rapid proliferation underscores that shared tenant lounges are no longer just a premium amenity, but they are rapidly becoming a prerequisite for contemporary office buildings to meet modern workplace demands. Although our empirical sample is exclusively confined to large-scale properties, market observations indicate a parallel increase in the provision of such lounges across broader office buildings.

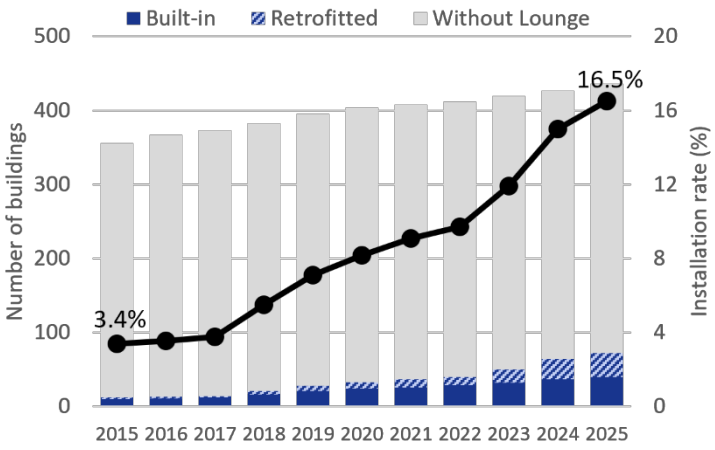


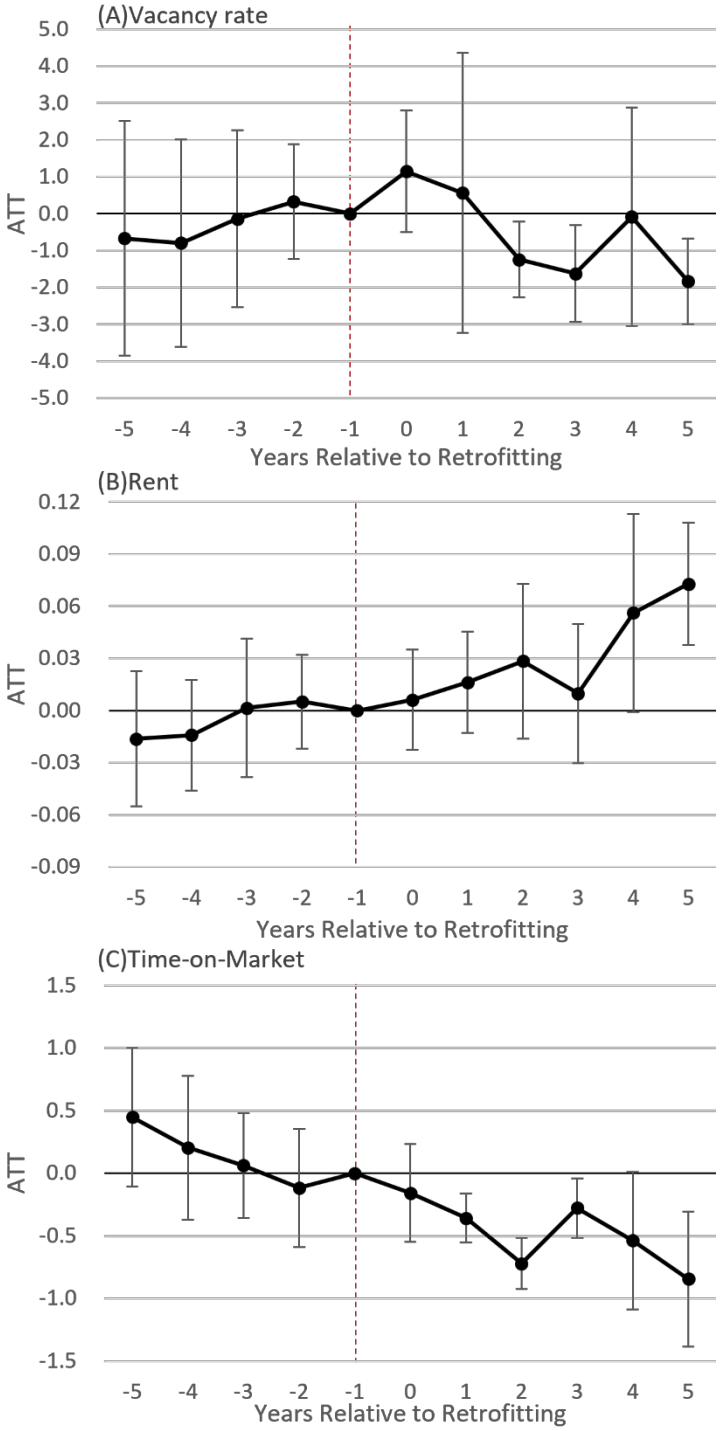
Fig. 1. Installation trends of shared tenant lounges. *Source*: own study.

3.2. Causal impact

Figure 2 shows the three event-study plots derived from the staggered DiD estimations; the regression coefficients and standard errors are provided in

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Appendix C. The joint Wald test for the pre-treatment leads indicates that the assumption of parallel trends is statistically satisfied for the vacancy rate and rent specifications. Although the null hypothesis that the pre-treatment period coefficients are jointly zero is rejected at the 5% level for the TOM outcome, clear and significant treatment impacts are observed immediately following retrofitting across all three metrics.



Notes: The solid line connects the point estimates of average treatment effect on the treated (ATT), and the vertical bars represent the 95% confidence intervals. Standard errors are clustered at the building level. The horizontal axis denotes years relative to the time of retrofitting, with the year prior to retrofitting ($\tau = -1$) serving as the reference period, normalized to zero. The estimates are based on 25 retrofitting events across six distinct treatment cohorts (ranging from 2018 to 2024).

Fig. 2. Event-study estimates the impact of modern retrofitting. *Source*: own study.

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Fig. 2A shows that although the treated buildings tend to exhibit higher vacancy rates immediately following retrofitting compared with the control group, the rate significantly decreases by approximately 1.2%–1.8% (at the 5% significance level) in years 2, 3, and 5 following retrofitting. This finding suggests that shared tenant lounges successfully attract new tenants and contribute to their retention of the existing tenants. The initial spike in vacancies immediately following retrofitting is consistent with market realities; owners frequently execute lounge installations alongside other common area renovations precisely when a building experiences a high vacancy rate or when a large block of space becomes available, such as following the departure of an anchor tenant.

Fig. 2B shows a gradual increase in the asking rent after retrofitting, culminating in a statistically significant premium of approximately 7.56% (at the 5% significance level) by year 5. This indicates that although the installation of a lounge serves as a strong market differentiator, it requires a certain gestation period to translate into a higher willingness to pay (WTP) among the tenants.

Fig. 2C shows a sustained shortening of TOM by 24.2%–57.0% from the year immediately following the retrofit. This indicates the power of modern office amenities to attract prospective tenants, a finding that aligns perfectly with the vacancy rate improvements observed in Fig. 2A.

Collectively, these results provide compelling evidence that the provision of shared tenant lounges contributes significantly to value enhancement across all critical dimensions of property performance, namely, occupancy, rental growth, and leasing velocity.

3.3. Robustness check

Although our results demonstrate simple and powerful effects, several questions remain regarding the estimates. In this section, we examine endogeneity, functional form, and the parallel trends assumption, among other issues, using two additional analyses and two distinct placebo tests (Chen et al., 2023; Malhotra & Dubey, 2025; Song et al., 2025).

3.3.1. Subsample Analysis: Excluding Extraneous Vacancy Shocks

A potential limitation of our identification strategy is the endogeneity of treatment timing. As previously noted, property owners may strategically execute lounge installations during periods of high vacancies or immediately after the departure of an anchor tenant. If the retrofitting decision is systematically triggered by such a temporary vacancy shock, the subsequent decline in the vacancy rate could reflect a mechanical mean reversion rather than the true economic impact of lounge installation, potentially inflating the estimated treatment effects in the immediate post-treatment periods.

To address this concern and isolate the causal effect of transient idiosyncratic shocks, we performed a sensitivity analysis using a restricted subsample. Specifically, we excluded properties that experienced an extreme vacancy spike, defined as a vacancy rate exceeding 10%, at any point within the window immediately preceding or following the treatment. Among the 25 treated properties in our original sample, 7 met this criterion and were excluded, leaving a refined subsample of 18 properties.

The estimated trajectories for rent and TOM remained remarkably consistent with the baseline findings; however, the vacancy rate exhibited distinct dynamics within this shock-excluded subsample (Table 2). Specifically, removing the high-shock properties altered the pre-treatment parallel trends, yet the aggregated ATT was larger than that of the full sample (Appendix D).

Table 2

Aggregated ATT estimates of subsample analysis.

	Vacancy rate				Rent				Time-on-Market			
	Estimate	Std. Error	p-value		Estimate	Std. Error	p-value		Estimate	Std. Error	p-value	
Full sample	-0.057	0.824	0.945		0.024	0.012	0.053	.	-0.383	0.116	0.001	**
Subsample	-0.751	0.343	0.029	*	0.027	0.014	0.057	.	-0.406	0.109	0.000	***

*Notes: ***, **, *, and . denote statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively. The estimates are based on 25 treatment events (18 in the subsample) across six distinct treatment cohorts (ranging from 2018 to 2024).*

Source: own study.

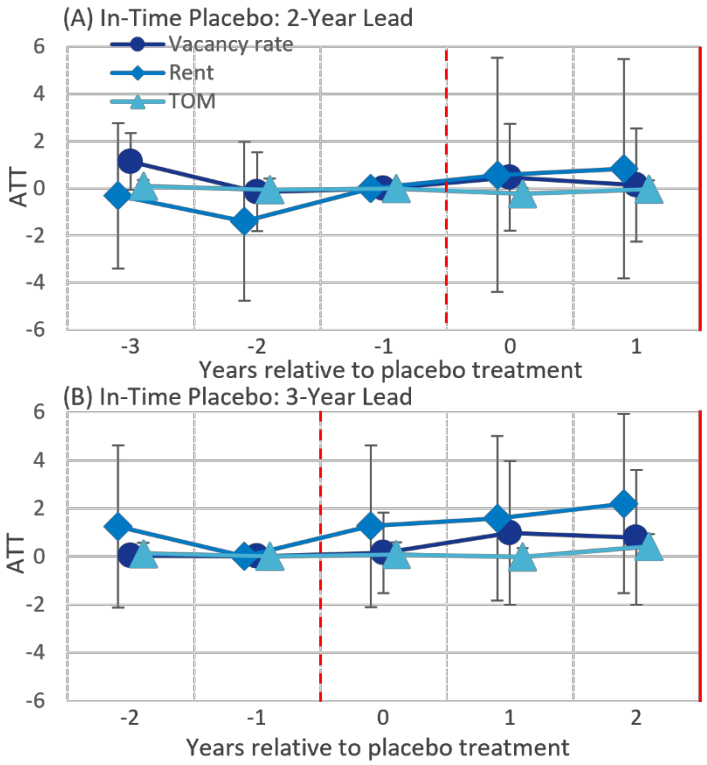
This difference offers important institutional insights into the Tokyo office market. Extreme vacancy shocks, such as the departure of an anchor tenant, typically exert a prolonged negative impact that cannot be immediately neutralized by asset repositioning alone owing to institutional constraints and the lengthy lead times required for corporate relocation contracts. By excluding the heavily shocked properties, in which

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severe leasing friction masked the immediate benefits of the retrofits, our subsample effectively isolated a pool of more responsive buildings. Consequently, the larger treatment effect observed here underscores the fact that when a building is free from catastrophic tenant shocks, the intrinsic value added by lounge installations can manifest more rapidly and visibly in reducing vacancy rates.

3.3.2. Alternative Specification: Logit-Transformed Regression

To verify the robustness of our findings against distributional skewness and functional form assumptions inherent in bounded vacancy rate data [0, 100], we re-estimated our specification using a logit-transformed dependent variable. Although fractional response models are occasionally employed for bounded outcome variables, we did not adopt them in our analysis for two methodological reasons. First, the application of fractional response estimators within modern staggered DiD frameworks remains limited. Second, fitting a fractional logit model induces a quasi-complete separation problem that excludes properties that maintain a 0% vacancy rate throughout the observation period. Excluding these properties introduces a potential sample selection bias. Therefore, a logit transformation was applied to preserve the full sample. Although the estimated regression coefficients under the logit specification are expressed in log-odds and cannot be directly compared in magnitude with the linear regression coefficients, the overall dynamic trajectories of the event-study plots remained broadly consistent with our baseline results, as presented in Appendix D. This general consistency in event-study paths was similarly observed when applying the shock-excluded subsample established in Section 3.3.1. These results show that our findings are not overly sensitive to the functional form specifications.



Notes: The solid line connects the point estimates of average treatment effect on the treated (ATT), and the vertical bars represent the 95% confidence intervals. Standard errors are clustered at the building level. The horizontal axis denotes years relative to the time of "fake" treatment, with the year prior to the "fake" treatment ($\tau = -1$) serving as the reference period, normalized to zero. The estimates are based on 25 treatment events across six distinct treatment cohorts (ranging from 2018 to 2024).

Fig. 3. Event-study estimates of the in-time placebo test. *Source*: own study.

3.3.3. In-time placebo test

We performed an in-time placebo test to test for potential anticipation effects and pre-existing trends. We artificially shifted the treatment timing backward, assigning a "fake" treatment year that was two and three years prior to the actual installation of the shared tenant lounge for each treated building. The analysis yielded no statistically significant treatment effects across any pre-treatment period (Fig. 3). The estimated

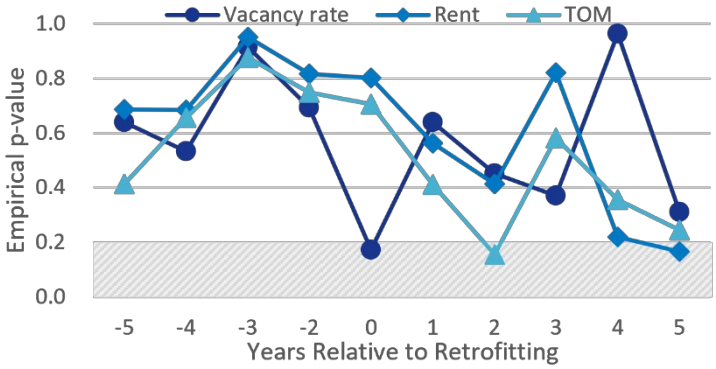
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coefficients remained statistically indistinguishable from zero, confirming that the buildings that eventually received modern refurbishment were not already on divergent upward trajectories in terms of rent or occupancy prior to the intervention. This null result supports the assumption of parallel trends used in our baseline models.

3.3.4. In-space placebo test

We conducted an in-space (permutation) placebo test to examine whether our baseline estimates are artifacts of spatial serial correlation, random data noise, or macroeconomic shocks specific to the observation period 2018–2024. In panel datasets with a small number of treated clusters, a common feature in micro-level commercial real estate studies, standard parametric inference can over-reject the null hypothesis because of understated standard errors (MacKinnon & Webb, 2020). The in-space placebo test addresses this issue by constructing a nonparametric reference distribution. Specifically, we iteratively and randomly assigned "fake" treatment status to untreated buildings within the control group—preserving the actual timing and cohort distribution of lounge installations—and re-estimated the staggered DiD specification across 1,000 iterations. This procedure allowed us to evaluate whether the magnitude of the observed treatment effect was truly significant compared with the pseudo-treatments assigned to non-retrofitted properties in the same spatial and temporal environment.

The empirical p-values from this test suggest, although inconclusive, evidence of the uniqueness of our findings. Given the small size of the treated building cohort, the permutation test had limited statistical power, preventing empirical p-values from reaching the conventional significance thresholds (e.g., $p < 0.05$). Rather than providing a definitive statistical rejection, the value of this test lies in the structural shift observed between the pre- and post-treatment periods. Quantitatively, the mean empirical p-value across the pre-treatment periods was 0.718 (median: 0.690), reflecting that prior to lounge installation, the target properties were indistinguishable from the randomly selected control properties. The mean empirical p-value decreased to 0.464 (median: 0.413) in the post-treatment periods (Appendix E). Although post-treatment p-values fluctuated across individual relative years, this downward shift in the overall distribution indicated a noticeable post-treatment structural departure (Fig. 4). The in-space placebo test should not be interpreted as confirmatory proof on its own; however, it provides complementary evidence, suggesting that the baseline estimates reflect meaningful market responses rather than pure underlying noise.



Notes: Empirical p-values were calculated based on 1,000 random reassignments (permutations) of the treatment status among the sample buildings. For each relative year ($\tau \in [-5,5]$), the datapoint values represent the proportion of placebo estimates whose absolute magnitude exceeded that of the actual estimated treatment effect ($|\hat{\beta}_\tau^{placebo}| \geq |\hat{\beta}_\tau^{actual}|$).

Fig. 4. Empirical p-value of the in-space placebo test. *Source*: own study.

Although these robustness checks may not provide a definitive statistical proof, the combined evidence from these tests—when contextualized within the practical realities of the commercial real estate market—supports the conclusion that the value enhancement observed in our primary analysis is unlikely to be a random artifact.

4. Discussion

4.1. Findings and underlying mechanisms

The empirical results demonstrated a substantial reduction in vacancy rates and TOM following the installation of shared tenant lounges, accompanied by a medium-term rental growth premium. To

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contextualize these findings, shared tenant lounges should not be viewed as a universal panacea or a standalone solution that single-handedly reverses asset obsolescence. Rather, they serve as a highly visible, representative proxy for "amenitization" - a core tactical component within broader asset repositioning strategies.

Our findings offer nuanced empirical backing for the prevailing "flight to quality" trend in the commercial real estate market (Gupta et al., 2026; Matsuo et al., 2024b). Although flight to quality is traditionally understood as a macro-level tenant migration toward newer Class A properties with superior physical specifications, our results reveal a complementary dimension of this phenomenon: a structural shift in tenant demand from purely private, rentable floor area toward shared, experience-driven spatial environments. Modern corporate tenants no longer evaluate office space solely as a physical "container" for desks; instead, they prioritize environments that actively foster employee collaboration, enhance well-being, and support modern hybrid work models (Fiorentino et al., 2022). By strategically converting underutilized areas into shared functional spaces, older or Class B properties can effectively enhance their "operational and functional quality." This enables them to participate in the flight to quality trend without undergoing capital-intensive total building redevelopment.

Furthermore, our analysis revealed a notable temporal divergence between occupancy gains and rental growth. While TOM declines significantly as early as year 1, and vacancy rates decline significantly starting in year 2, following retrofitting, the asking rent premium builds more gradually: a positive effect emerges early but does not reach statistical significance until year 5, culminating in an increase of approximately 7.5%. This time lag, or "gestation period," can be explained through the behavioral strategies of property owners. Following capital-intensive renovation, owners typically prioritize the rapid recovery of occupancy rates to fill immediate voids. Once the building's vibrancy is restored and its brand value is re-established in the market, thereby increasing the tenants' WTP, owners are positioned to aggressively raise rents during new leasing campaigns or lease renewals.

4.2. Practical implications

From a property management and investment perspective, the findings of this study directly address the strategic trilemma introduced in Section 1–whether to accept functional obsolescence, convert the property for alternative use, or undertake modern refurbishment. Our results demonstrate that targeted spatial repositioning, as exemplified by lounge retrofitting, offers a viable and highly rational pathway for aging assets to mitigate competitive displacement. By effectively halving the leasing downtime and generating a rent premium of over 7% in the medium to long term, the resulting stabilization of cash flows strongly justifies the required capital expenditure (CAPEX) for such functional upgrades.

This study highlights the critical consideration of the income approach in real estate appraisal and valuation. Traditional valuation methodologies heavily weight static physical attributes such as building age, location, and floor area. However, our findings underscore that "functional value"—driven by qualitative spatial enhancements and shared amenity features—exerts a substantial impact on cash flow forecasting. In an era in which tenant retention hinges increasingly on user experience rather than physical age alone, appraisers and market analysts must explicitly incorporate these qualitative factors and amenity premiums into their pricing models to accurately reflect a property's true market value.

4.3. Limitations and future research

Although this study provides valid evidence on the effects of installing shared tenant lounges, it had several limitations. First, as discussed in Section 3.3, the relatively small sample size of the treated cohort inherently constrained the statistical power of our in-space placebo tests (e.g., MacKinnon & Webb, 2020; Roth et al., 2023). Given that modern retrofitting of office buildings is a rapidly accelerating trend, we anticipate that the future expansion of these facilities will allow for larger datasets, thereby enabling even more refined and highly powered statistical analyses.

Second, although this study explicitly focused on the installation of shared tenant lounges, commercial real estate renovations are rarely executed in isolation. In practice, the introduction of a lounge is frequently bundled with broader capital improvements, such as upgrades to entrance lobbies, restrooms, HVAC systems, or elevator halls. The estimated premiums for rent and occupancy should not be interpreted strictly as an isolated causal effect of the lounge. Rather, lounge installation serves as a highly visible proxy for comprehensive asset repositioning, and our findings must be understood as capturing the broader

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aggregate impact of "office building modernization."

Third, the geographical and physical scope of this study was explicitly confined to large-scale office buildings located in Tokyo's five central wards. Consequently, the generalizability of these findings to other market segments remains unclear. Future research should investigate the extent to which these value-added strategies impact small-to-medium-sized office buildings, and comparative studies involving international markets are necessary to determine whether these behaviors remain consistent across different cultural contexts.

Finally, the analytical framework employed in this study shares significant conceptual and structural parallels with the extensive research on green building premiums. Similar to green building research, our approach opens several promising avenues for future empirical investigation. For example, exploring how the magnitude of this amenity premium fluctuates across market cycles (Das & Wiley, 2014; Reichardt et al., 2012)—and how it evolves as the overall market penetration rate of such amenities increases (Chegut et al., 2014; Costa et al., 2017)—remains a critical theme. Evaluating the heterogeneity of these effects across different property characteristics such as building size and age (Holtermans & Kok, 2019; Robinson & McAllister, 2015), as well as investigating the broader impacts on other outcomes, including tenant productivity (Miller et al., 2009; Newsham et al., 2018), operational costs (Pivo & Fisher, 2010; Reichardt, 2014; Szumilo & Fuerst, 2013), and ultimate cash flows (Leskinen et al., 2020), are highly promising avenues for future empirical research. Furthermore, directly comparing the dynamics of the "modernization premium" identified in this study with the well-documented "green premium" can provide vital insights for both academic inquiry and practical real estate investment strategies.

5. Conclusions

This study empirically investigated the causal impact of modern office building refurbishment, specifically the installation of shared tenant lounges as a key proxy for comprehensive building modernization, on the economic performance of office properties. Focusing on the high-grade assets in Tokyo's five central wards and employing a staggered DiD framework, we successfully isolated the dynamic effects of these value-added upgrades.

Our findings provide compelling evidence that broad repositioning strategies generate significant market premiums in the context of post-pandemic "flight to quality." Modern retrofitting drastically reduces leasing downtime and mitigate vacancy risks in the short term. Furthermore, following the necessary gestation period to re-establish the market positioning of a property, these modernizations deliver a statistically significant rent premium of approximately 7.5% over a five-year period.

These results have important implications for real-estate practitioners. For property owners and investors, our empirical evidence offers a robust quantitative justification for the CAPEX required to combat functional obsolescence through modern retrofitting. For the appraisal profession, this research underscores a critical paradigm shift: traditional valuation methodologies must move beyond static physical metrics to explicitly incorporate qualitative "functional value" and amenity premiums.

Two key caveats frame the interpretation of our findings. First, practitioners must recognize that the observed performance gains reflect an aggregate modernization effect—combining lounge installations with broader mechanical, aesthetic, and operational upgrades - rather than an isolated "lounge effect." Providing a shared lounge without addressing the overall building standards and age-related decline is unlikely to serve as a panacea. Second, given our sample constraints, our findings pertain specifically to large-scale prime commercial assets in core metropolitan markets and may not be directly generalizable to smaller or peripheral office properties.

As work styles continue to evolve and tenant preferences favor superior overall building standards, the strategic provision of value-added modern communal spaces, as part of a broader asset upgrade strategy, will remain a fundamental prerequisite for sustaining the economic viability, tenant retention, and market competitiveness of office assets in the modern era.

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Data availability statement

The data used in this study were provided by a private commercial real estate company (Sanko Estate Co., Ltd.) specifically for the purposes of this research. As these data are proprietary and confidential, the authors do not have permission to share or make them publicly available.

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Appendix A

Table A.1.

Description of variables.

Variable	Unit	Details
Vacancy rate	%	Percentage of total rentable area that is currently unoccupied.
Asking rent	$Yen/Tsubos\ (log)$	Initial rental price requested by the landlord for the rentable space.
Time-on-market	$Day\ (log)$	Total duration of rentable space remains actively listed for rent before a lease is signed.
Area per floor	m^2	Total rentable floor space of a single standard level within the building.
Number of floors	$Floors$	Total number of floors in the building situated above ground level.
Age	$Year$	Number of years since the building completion.
Neighborhood rentable space	$m^2(log)$	Total rentable floor area within 400 m (logarithm and tsubo).
Area of available space	m^2	Specific floor area of the individual rental unit.

Source: own study.

Appendix B

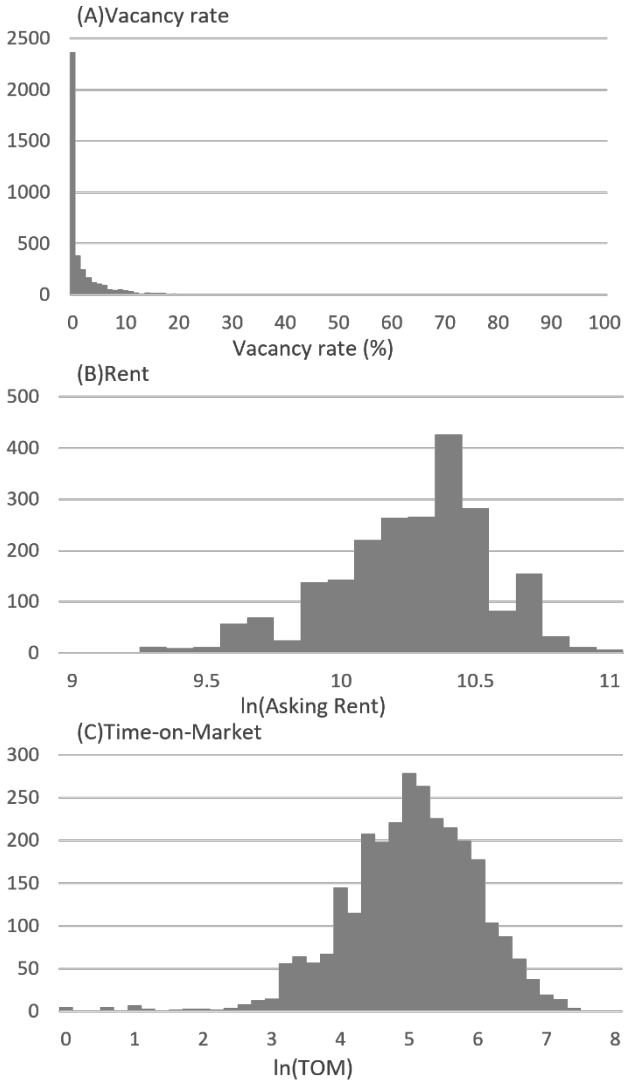


Fig. B.1. Histograms of (A) vacancy rate, (B) rent, and (C) TOM. *Source*: own study.

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Appendix C

Table C.1.

Regression results for vacancy rate, rent, and time-on-market (TOM) models.

		Vacancy rate				Rent				Time-on-Market			
		Estimate	Std. Error	p-value		Estimate	Std. Error	p-value		Estimate	Std. Error	p-value	
Years Relative to Retrofitted	-5	-0.664	1.626	0.683		-0.016	0.020	0.412		0.448	0.282	0.113	
	-4	-0.795	1.436	0.580		-0.014	0.016	0.387		0.203	0.293	0.489	
	-3	-0.138	1.227	0.911		0.002	0.020	0.941		0.063	0.214	0.769	
	-2	0.329	0.795	0.679		0.005	0.014	0.708		-0.117	0.240	0.627	
	0	1.149	0.843	0.174		0.006	0.015	0.673		-0.159	0.200	0.427	
	1	0.566	1.935	0.770		0.016	0.015	0.278		-0.358	0.100	0.000	***
	2	-1.243	0.522	0.018	*	0.028	0.023	0.213		-0.721	0.105	0.000	***
	3	-1.619	0.670	0.016	*	0.010	0.020	0.632		-0.278	0.121	0.023	*
	4	-0.084	1.511	0.956		0.056	0.029	0.053	.	-0.538	0.279	0.055	.
	5	-1.832	0.591	0.002	**	0.073	0.018	0.000	***	-0.845	0.275	0.002	**
Age		-8.442	1.809	0.000	***	-0.007	0.013	0.589		-0.268	0.218	0.220	
Neighborhood rentable space		1.688	1.267	0.183		-0.029	0.036	0.421		-0.259	0.325	0.426	
Area of available space										0.032	0.024	0.196	
Vacancy rate										-0.013	0.004	0.000	***
Aggregated ATT		-0.057	0.824	0.945		0.024	0.012	0.053	.	-0.383	0.116	0.001	**
N			3,957				2,218				2,893		
Adj. R2			0.367				0.937				0.140		
Joint Wald test (pre-treatment = 0)		3.008		0.556		0.689		0.953		12.691		0.013	*

*Note: ***, **, *, and . denote statistical significance at 0.1, 1, 5, and 10% levels, respectively. The estimates are based on 25 treatment events across six distinct treatment cohorts (ranging from 2018 to 2024). The estimates reported for the joint Wald test represent the Wald F-statistic, testing the null hypothesis—related to the parallel trends assumption—that all pre-treatment period ATT coefficients are jointly zero.*

Source: own study.

Appendix D

Table D.1.

Regression results of sub sample analysis in vacancy rate.

		Full sample				Sub sample			
		Estimate	Std. Error	p-value		Estimate	Std. Error	p-value	
Years Relative to Retrofitted	-5	-0.312	0.359	0.385		0.183	0.284	0.520	
	-4	-0.319	0.279	0.253		0.139	0.186	0.454	
	-3	-0.157	0.275	0.567		-0.033	0.246	0.893	
	-2	0.194	0.174	0.266		0.270	0.155	0.083	.
	0	0.776	0.294	0.009	**	0.621	0.321	0.054	.
	1	-0.264	0.391	0.500		-0.618	0.302	0.042	*
	2	-0.368	0.253	0.147		-0.534	0.295	0.072	.
	3	-0.053	0.435	0.903		-0.408	0.505	0.419	
	4	0.345	0.284	0.225		0.051	0.250	0.840	
	5	0.025	0.601	0.967		0.465	0.655	0.478	
Age		-1.361	0.258	0.000	***	-1.357	0.258	0.000	***
Neighborhood rentable space		1.065	0.439	0.016	*	1.091	0.439	0.013	*
Aggregated ATT		0.107	0.234	0.649		-0.097	0.263	0.712	
N			3,956				3,900		
Adj. R2			0.405				0.401		

*Note: ***, **, *, and . denote statistical significance at 0.1, 1, 5, and 10% levels, respectively. The estimates are based on 25 treatment events (18 in the subsample) across six distinct treatment cohorts (ranging from 2018 to 2024).*

Source: own study.

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Appendix E

Table E.1.

Empirical p-value of in-space placebo test.

			Vacancy rate	Rent	Time-on-Market	ALL
Years Relative to Retrofitted		-5	0.640	0.687	0.414	
		-4	0.533	0.685	0.657	
		-3	0.916	0.952	0.876	
		-2	0.693	0.817	0.748	
		0	0.172	0.802	0.707	
		1	0.640	0.562	0.411	
		2	0.451	0.414	0.155	
		3	0.371	0.822	0.583	
		4	0.964	0.219	0.355	
		5	0.310	0.167	0.244	
Pre-treatment	Average		0.696	0.785	0.674	0.718
	Median		0.667	0.752	0.703	0.690
Post-treatment	Average		0.411	0.488	0.383	0.464
	Median		0.485	0.498	0.409	0.413

Note: Empirical p-values are calculated by randomly assigning "fake" treatment status to buildings in the control group only, replicating the actual structure of 25 treatment events across six distinct treatment cohorts (ranging from 2018 to 2024), and re-estimating the 1,000 iterations.

Source: own study.

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