BANK OF JAPAN

Progress in Quality Adjustments for Office Rents: A New Approach to Aging-Related Depreciation

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Introduction

- In Japan's SPPI, subgroup "Office space rental" consists of four regional office rent indexes: the Tokyo area, Nagoya area, Osaka area, and other areas.
- In the price survey, we collect the average rent per unit area for a predetermined sample of buildings on a monthly basis.

Structure of Japan's Services Producer Price Index

	Weights	Number of Items
Overall Average	1,000	146
Finance and insurance	46.4	12
Real estate services	89.9	11
Transportation and postal activities	161.7	36
Information and communications	230.8	23
Leasing and rental	57.8	15
Advertising services	41.7	11
Other services	371.7	38

Structure of the Group "Real estate rental"

Group	Subgroup	Item	Weights
Real estate rental	Office space rental	Office space rental (Tokyo area)	22.8
		Office space rental (Nagoya area)	1.1
		Office space rental (Osaka area)	3.4
		Office space rental (other areas)	2.0
	Other space rental	Sales space rental	22.9
		Warehouse space rental	9.2
		Hotel rental	5.1
		Conference rooms rental	0.1
		Parking space rental (monthly)	1.2

Introduction (cont.)

Determinants of Office Quality

(i) Location
(ii) Scale
(iii) Facilities

⇒ Rents of the same sample of office buildings are surveyed, keeping attributes (i)-(iii) generally fixed.

Quality remains constant in the short term

(iv) Building age

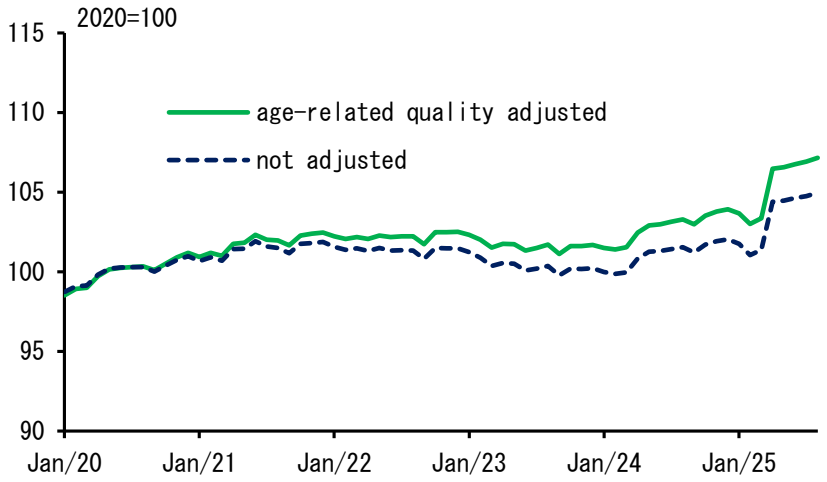
⇒ Quality deterioration over time

Quality bias
(Downward bias in the index)

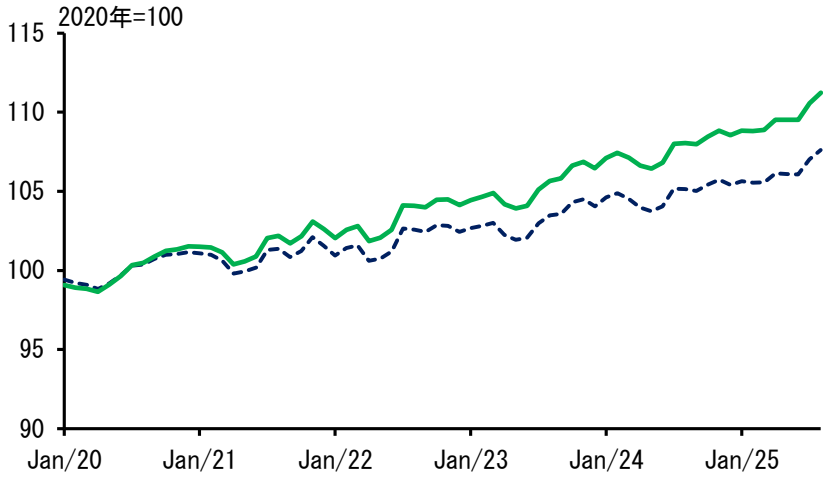
Since the adoption of the 2010 base SPPI, we have applied age-related quality adjustments to remove the downward bias.

Age-related quality-adjusted rent indexes derived using the current methodology

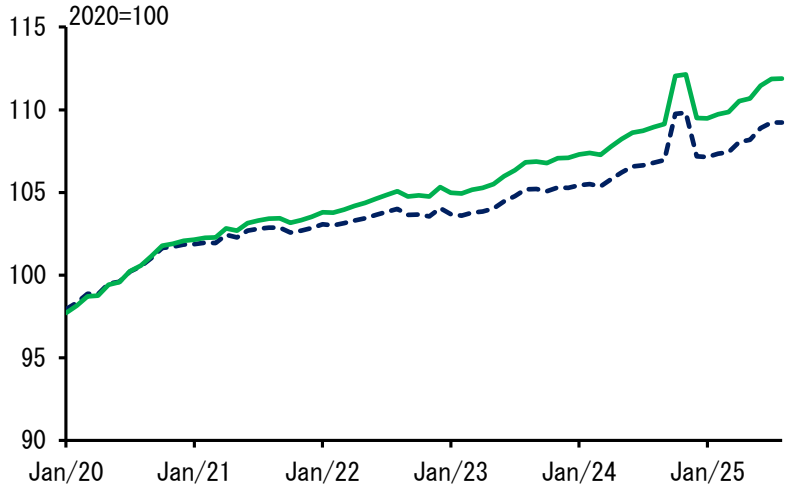
Tokyo area



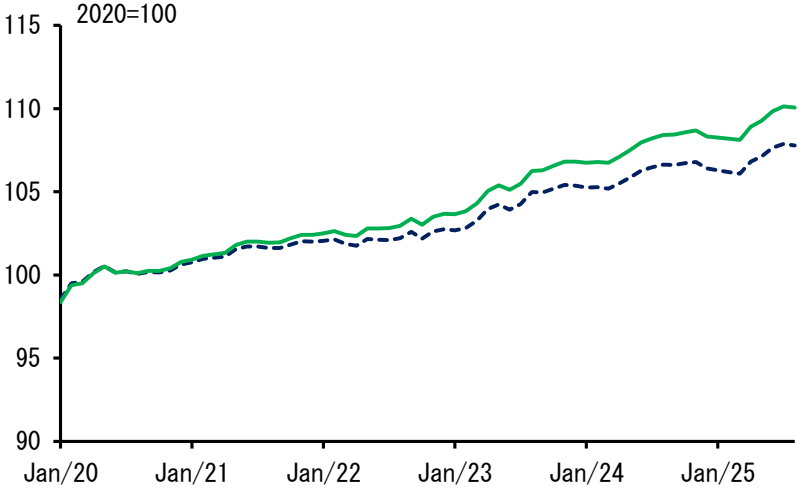
Nagoya area



Osaka area



Other areas



Current Methodology and Revision Approach

How to calculate the age-related quality adjustment factor

Estimate the cumulative age-related rent depreciation curve

↓

Take a weighted average of annual depreciation rates by building age, using the age distribution of the survey sample

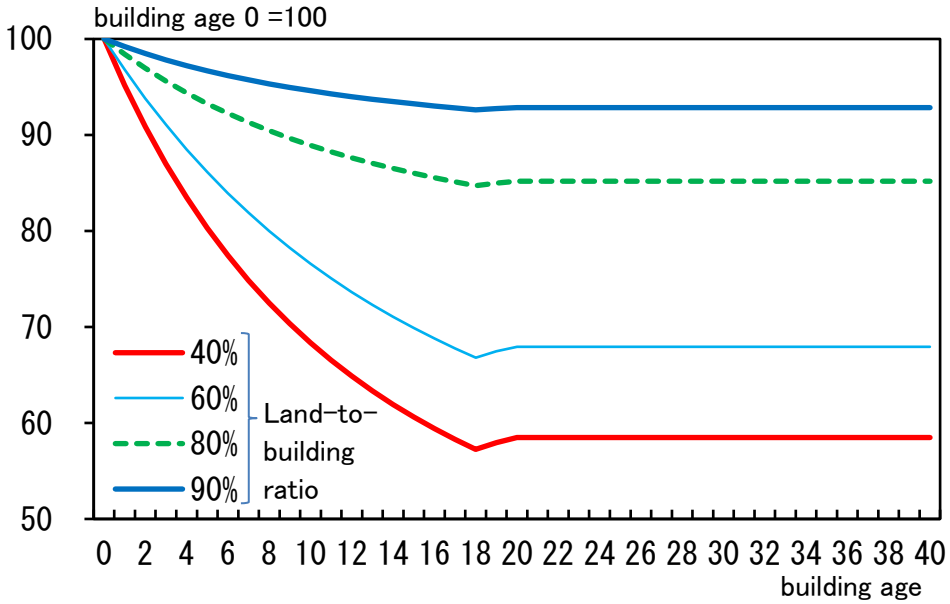
↓

Age-related quality adjustment factor (per annum)

Estimating the cumulative age-related rent depreciation curve

- The cumulative age-related rent depreciation curve reflects the relationship between building age and rent decline.
- The curve is estimated using parameters such as the depreciation rates of the building's structure and its facilities.

Cumulative age-related rent depreciation curve



Parameters and sources

- ✓ Deterioration rates:
  - Land: No aging deterioration
  - Building's structure: 5% p.a. deterioration → Saita&Higo (2010)
  - Building's facilities: 14.2% p.a. deterioration
- ✓ Building Structure-to-Facilities Ratio: 67:33
- ✓ Impact of Renewal Investments
  No deterioration in buildings > 20 years old

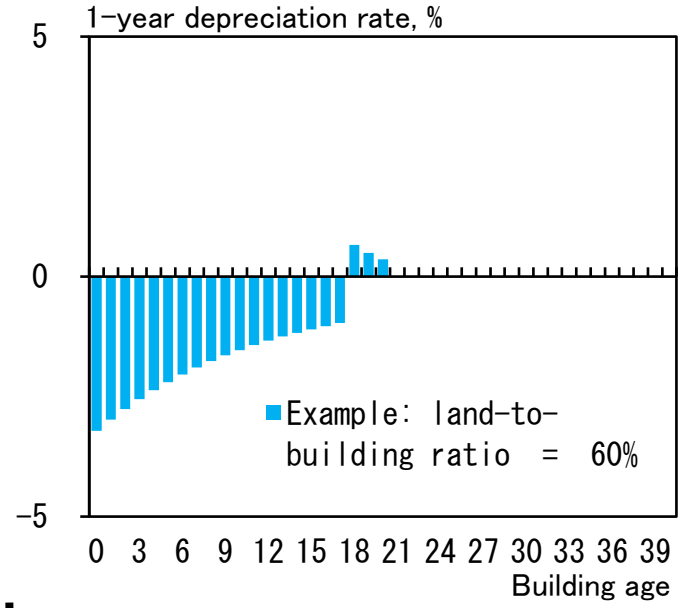
  (Building Structure-to-Facilities Ratio, Impact of Renewal Investments → An industry publication issued in 2000)
- ✓ Land-to-Building Ratio → Official Land Prices, Construction Cost Deflators, etc.

- However, some of these parameters may be outdated…

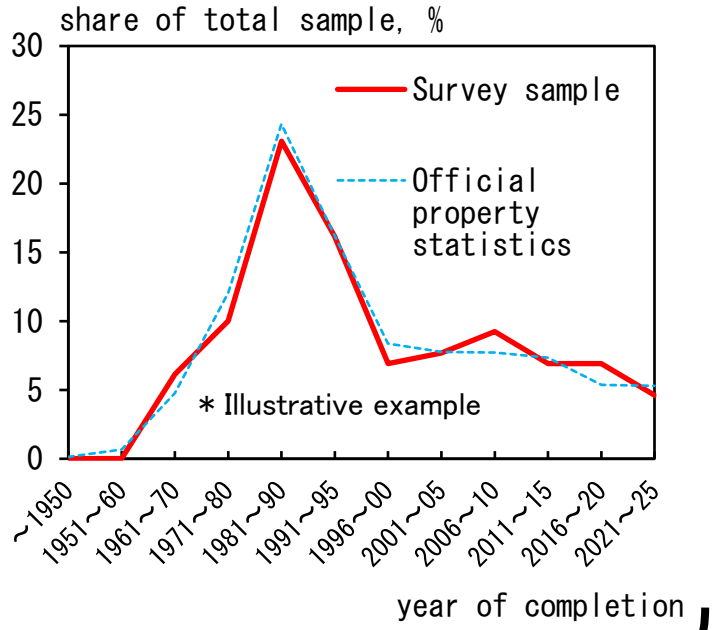
Age-related quality adjustment factor (per annum)

- A weighted average of the annual depreciation rates for a building aged *n* years is taken, using the age distribution of the survey sample as weights (office buildings are sampled to match the age distribution of official property statistics).
- The adjustment factor is annually revised following changes in the age distribution of the survey sample and the land-to-building ratio for each region.

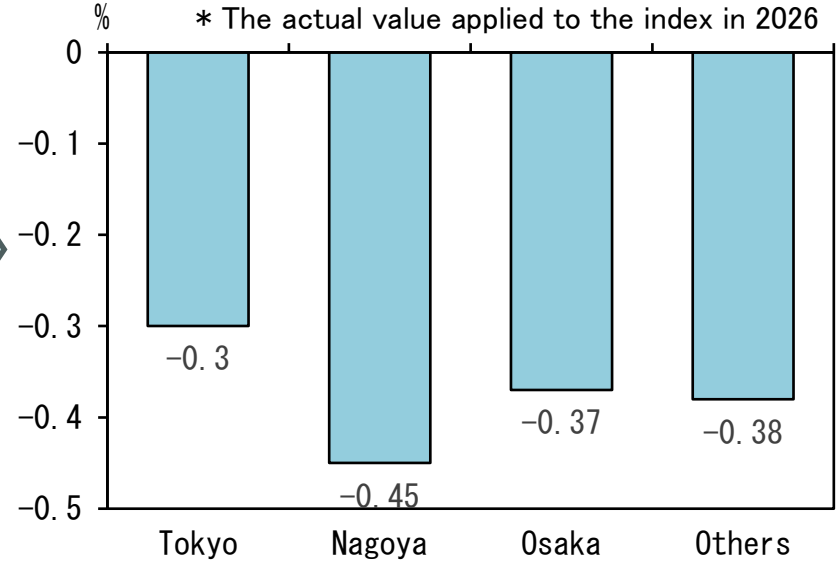
1-year depreciation rates by building age



Age distribution of the survey sample



Adjustment factor (annual rate)



Weighted Average

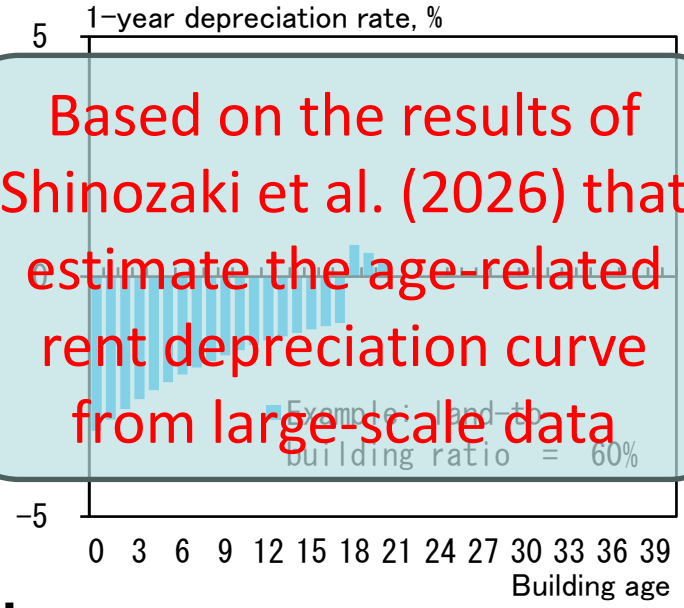
Revision approach for calculating age-related quality adjustment factor

- The adjustment factor is revised using a cumulative age-related rent depreciation curve estimated by Shinozaki et al. (2026) based on large-scale office rental data.

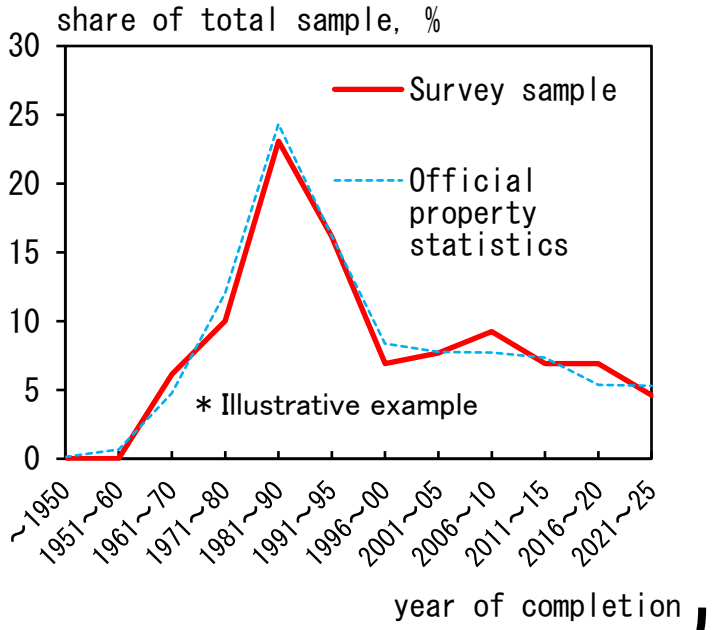
Revision approach

Based on the results of Shinozaki et al. (2026) that estimate the age-related rent depreciation curve from large-scale data

1-year depreciation rates by building age

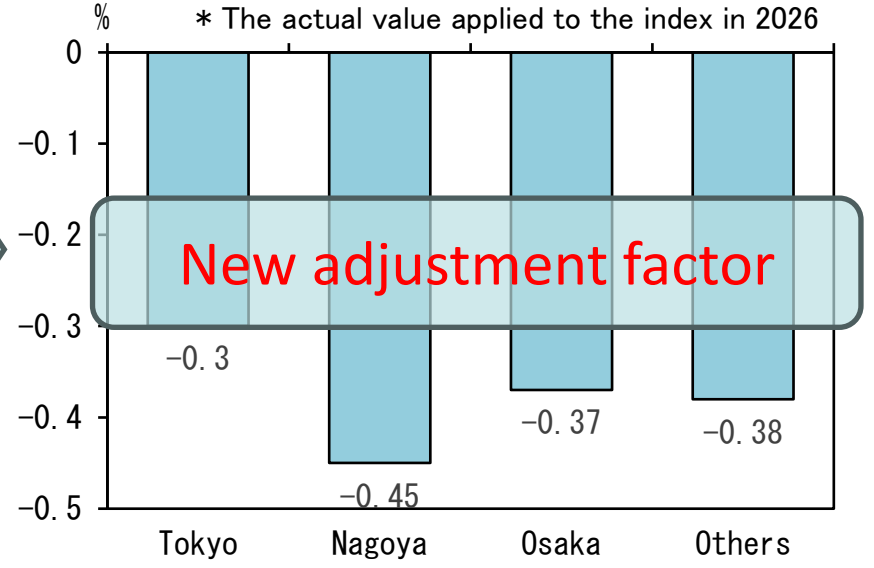


Age distribution of the survey sample



Weighted Average

Adjustment factor (annual rate)



New adjustment factor

Revised Cumulative Age-Related Rent Depreciation Curve

— Empirical Results by Shinozaki et al. (2026) —

Shinozaki et al. (2026): Overview of the data

- The dataset contains rent and property characteristics data for tenants who signed new leases between 2000-2024 in properties located within Tokyo's 23 wards and Osaka City, comprising a total of 80,057 observations.

Data description

Variables	Definitions	Min.	Ave.	Med.	Max.	S.D.	Outlier
$rent_t^{(i)}$	The rent for tenant *i* at the time of the contract (JPY per *tsubo*)	6003	184740	17000	94025	7522.7	6,000 JPY or less, exceeding 100,000 JPY
$age_t^{(i)}$	The age (years) of the property to which tenant *i* belongs at the time of the contract	0.0	22.3	22.0	60.0	12.2	More than 60 years
$GFA_t^{(i)}$	The total floor area (*tsubo*) of the property to which tenant *i* belongs	300.3	7242.8	2200.0	139685.4	12895	300 *tsubo* or less
$min_t^{(i)}$	The required walking time (minutes) from the nearest station to tenant *i*	0.0	3.1	3.0	19.0	2.1	—
$story_t^{(i)}$	The number of floors above ground of the property to which tenant *i* belongs	2.0	13.3	10.0	64.0	8.8	—
$D\_center_t^{(i)}$	1 if the property to which tenant *i* belongs is located in one of the five central wards (*Chiyoda*, *Chuo*, *Minato*, *Shibuya*, and *Shinjuku*)	0.00	0.41	0.00	1.00	—	—
$D\_area_t^{(i)}$	The area where the property to which tenant *i* belongs is located	—	—	—	—	—	—
$D\_RF_t^{(i)}$	1 if the property to which tenant *i* belongs has a raised-floor structure	0.00	0.83	1.00	1.00	—	—
$D\_AC_t^{(i)}$	1 if the property to which tenant *i* belongs has individual air conditioning	0.00	0.82	1.00	1.00	—	—
$D\_machine_t^{(i)}$	1 if the property to which tenant *i* belongs is equipped with mechanical security systems	0.00	0.96	1.00	1.00	—	—
$D\_large_t^{(i)}$	1 if the property to which tenant *i* belongs is large-scale (5,000 *tsubo* or more)	0.00	0.31	0.00	1.00	—	—
$D\_Osaka_t^{(i)}$	1 if the property to which tenant i belongs is located in Osaka City	0.00	0.25	0.00	1.00	—	—
$D\_reno_t^{(i)}$	1 if the property to which tenant *i* belongs has undergone renovations at the time of the contract	0.00	0.20	0.00	1.00	—	—
$age\_r_t^{(i)}$	The number of years since renovations were made to the property to which tenant *i* belongs at the time of the contract	0.0	8.6	7.0	57.0	7.1	—

(Note) *Tsubo* is a traditional unit of area used in Japan, where 1 *tsubo* is equivalent to 3.30578 square meters.

Shinozaki et al. (2026): Estimation model

- A hedonic model with the building age term, controlling for variables that influence rents.

Rent at time t | Building age | Property characteristics

$$\ln rent_t^{(i)} = f\left(age_t^{(i)}\right) + \alpha + \sum_{k=1}^{l} \gamma_k X_{k,t}^{(i)} + u_t^{(i)}.$$

Relationship between the building age and rent

- Assumes several functional form of f(age), with reference to previous studies.

Age-dummy variables

$$f\left(age_t^{(i)}\right) = \sum_{k=1}^{60} \delta_k \mathbf{1}_{\{age_t^{(i)}=k\}}.$$

$\mathbf{1}_{\{n\}}$: A function that takes the value 1 when condition n is satisfied, and 0 otherwise.

Two linear functions (kinked function model)

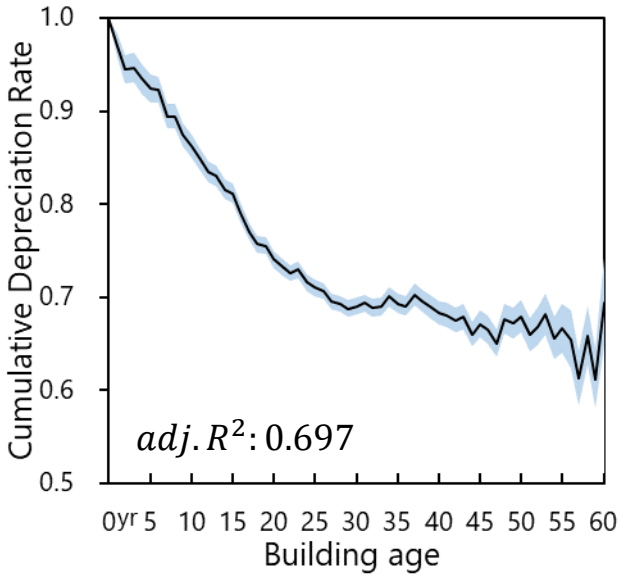
$$f\left(age_t^{(i)}\right) = \left(\mathbf{1}_{\left\{0 \le age_t^{(i)} \le T\right\}} \frac{1}{T} age_t^{(i)} + \mathbf{1}_{\left\{T < age_t^{(i)}\right\}}\right)\delta_2 + \delta_3 age_t^{(i)}.$$

T : The connection point between two linear functions.

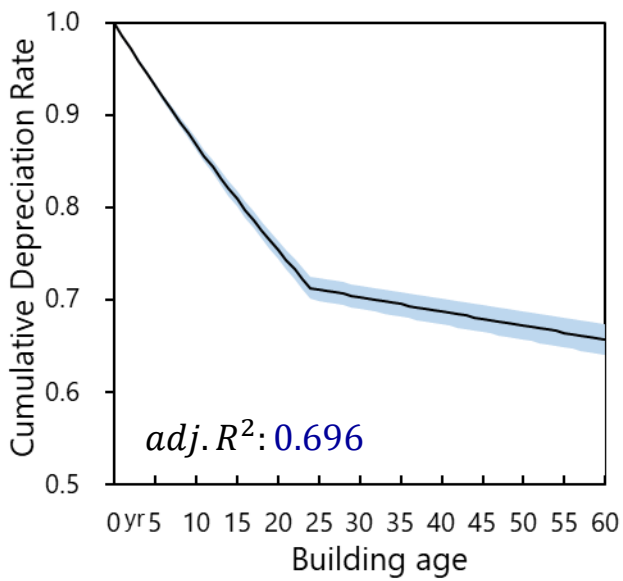
Shinozaki et al. (2026): Estimated cumulative age-related rent depreciation curve

- For the age-dummy variables model, the curve shows a generally linear decline up to around the age of 25 years, followed by a period of stability. This aligns with the kinked function model.
- For index compilation, we use the kinked function model to ensure stable adjustments for quality depreciation.

Age-dummy Variables



Kinked function model



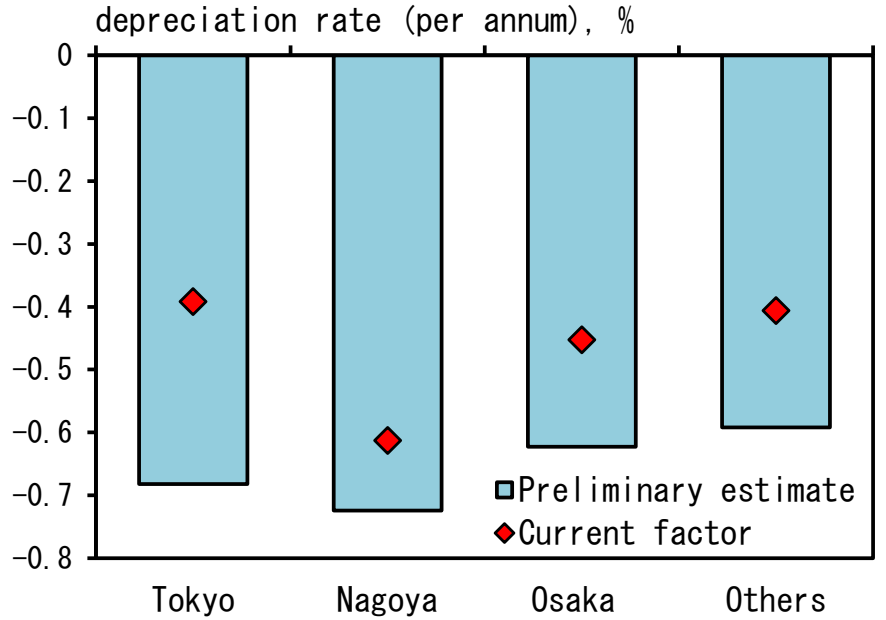
(Note) The shaded area indicates ±2 standard deviations. The same applies hereafter.

Preliminary Estimation of New Age-Related Quality Adjustment Factor

Preliminary estimation of new age-related quality adjustment factor

- The weighted-average 1-year age-related rent depreciation rate, based on Shinozaki et al. (2026), is calculated using the building age distribution as weights.
- The impacts of the new adjustment factor showed increases compared to the current factor across all regions.

New age-related quality adjustment factor (preliminary estimates)
(annual Rate, average for 2020-2026)



(Note) Estimates based on the building ages of the survey samples in each year. For 2025-base index, to which this revision is planned to be applied, the actual results may not necessarily match these estimates due to changes in the survey sample, including sample replacement.

Background to changes in the impacts of adjustment factors

- While the specific reasons for the difference between the newly estimated value and the current value of the macro-level age-related rent depreciation rate cannot be directly identified, the following hypotheses can be considered based on related research:

(Hypothesis 1)

- ✓ Saita and Higo (2010), which estimated building depreciation rates used for the current compilation, conducted their analysis using data from a single point in time: the end of April 2007.
- ✓ At that time, the office market was under strain due to an economic expansion, which may have led to an underestimation of building depreciation rates especially for older properties.

Background to changes in the impacts of adjustment factors (cont.)

(Hypothesis 2)

- ✓ In addition, Saita and Higo (2010) used “asking rents” rather than “contract rents” as their price data. While discounts were more likely to be applied during the contract stage for older properties, asking rents may have tended to be less likely to decline flexibly.

(Hypothesis 3)

- ✓ XYMAX RESEARCH INSTITUTE (2026) analyzed contract rents from 2013 to 2024 and found that the price competitiveness of older properties declined following the onset of moves toward work-style reform in both the public and private sectors in Q4 2016.
- ✓ The Institute pointed to the possibility of an emergence of new evaluation criteria for property quality, such as employee-friendly office environments and environmental sustainability.

Implementation issues and future challenges

- Timing for revising the quality adjustment method

  The revision approach for calculating the adjustment factor is planned to be implemented along with the next SPPI base-year revision rebasing from the 2020 base to the 2025 base. The validity of this revision approach will be confirmed through public comments and discussions with companies, aiming to adjust the composition of survey samples.

- Re-estimation of the quality deterioration function

  We plan to re-estimate the hedonic model periodically during base year revisions to address model obsolescence. While internally re-estimating the model each year using new data, we verify whether the model updates materially affect the index level, and implement revisions if necessary.

Thank you