Commercial Property Price in Tokyo

Commercial Property Price Indexes for Tokyo

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Chihiro Shimizu
(Reitaku University & The University of British Columbia)
with
W. Erwin Diewert (The University of British Columbia),
Kiyohiko G. Nishimura (The University of Tokyo),
Tsutomu Watanabe (The University of Tokyo)
Commercial Property Price Indexes for Tokyo

Ⅰ. Lessons of Japanese experience in Bubble period

Paper 1: Biases in commercial appraisal-based property price indexes in Tokyo
Chihiro Shimizu, Kiyohiko.G. Nishimura, Tsutomu Watanabe

Ⅱ. How should we estimate the CPPI?

Chihiro Shimizu, W. Erwin Diewert, Kiyohiko.G. Nishimura, Tsutomu Watanabe

Paper 3: Notes on a Framework for Commercial Property Price Indexes
W. Erwin Diewert
Urban Land Price Index: 1955-2012

1960-: Industrial Property Bubble

1970-: Residential Property Bubble

1980-: Commercial Property Bubble

1995-: Lost Decade

2005-: Fund Bubble or Mini Bubble

Source: Japan Real Estate Institute
Lessons from Japanese experience in Bubble period.

- What happened during “Collapse of Bubble” in Japan:
  - The most typical problem was the one surrounding financial institutions disposal of bad loans.

- Since no property price index/property price information existed that made it possible to capture property market conditions, it was not possible to calculate accurate bad loan debt amounts, and it took a long time until policy measures were implemented, including the injection of public funds.

- This was a major factor leading to the prolonged economic stagnation known as the “lost decades.”
# Commercial Property Price Information in Japan.

<table>
<thead>
<tr>
<th>Survey</th>
<th>Organisation</th>
<th>Type1</th>
<th>Type2</th>
<th>Frequency</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Published Land Price Survey</td>
<td>The Ministry of Land, Infrastructure, Transport and Turism</td>
<td>Appraisal</td>
<td>Price &amp; Index</td>
<td>Annually</td>
<td>1970</td>
</tr>
<tr>
<td>Urban Land Index</td>
<td>Japan Real Estate Association</td>
<td>Appraisal</td>
<td>Index</td>
<td>Bi-annually</td>
<td>1955</td>
</tr>
<tr>
<td>IPD Property Index</td>
<td>IPD: Investment Property Databank</td>
<td>Appraisal</td>
<td>Index</td>
<td>Monthly</td>
<td>2001</td>
</tr>
<tr>
<td>ARES JREIT Property Index</td>
<td>The Association for Real Estate Securitization</td>
<td>Appraisal</td>
<td>Index</td>
<td>Quarterly</td>
<td>2001</td>
</tr>
<tr>
<td>MUTB-CBRE Real Estate Investment Index</td>
<td>Mitsubishi-UFJ Trust Bank &amp; CB Richard Ellis</td>
<td>Appraisal</td>
<td>Index</td>
<td>Yearly</td>
<td>1968</td>
</tr>
</tbody>
</table>
Why J-CPPI were not effective in policy management?

- The question of why these property price indexes were not effective in policy management during the bubble era and the subsequent collapse process is a vital one.

- One cause suggested during the series of policy-related discussions following the bubble’s collapse was that there were significant errors in the property appraisal prices forming the raw data for creating the indexes.


- (Nishimura and Shimizu (2003), Shimizu and Nishimura (2006), (2007)
Transaction price-based index and Appraisal value based index in Tokyo.

Market Price

Appraisal Price

Index: 1975 = 1

Calendar Year

annual change rate (%)
**Appraisal Value to Market Price ratio:** Appraisal value / estimated transaction price

<table>
<thead>
<tr>
<th>ID</th>
<th>Neighbourhood</th>
<th>Area</th>
<th>Land Value (Yen/m²) at 1975</th>
<th>Lot size</th>
<th>Road Width</th>
<th>Nearest Station</th>
<th>Distance to NS</th>
<th>FLR</th>
<th>Value / Estimate Ratio at 1975</th>
<th>Value / Estimate Ratio at 1987</th>
<th>Value / Estimate Ratio at 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point 1</td>
<td>Small-sized retails and financial offices mixed use</td>
<td>Chiyoda Ward</td>
<td>1,250,000</td>
<td>163m²</td>
<td>27m</td>
<td>Kanda</td>
<td>150m</td>
<td>800%</td>
<td>75.98%</td>
<td>58.63%</td>
<td>126.01%</td>
</tr>
<tr>
<td>Point 2</td>
<td>Retails and offices mixed use</td>
<td>Minato Ward</td>
<td>1,270,000</td>
<td>133m²</td>
<td>10m</td>
<td>Omotesando</td>
<td>60m</td>
<td>700%</td>
<td>71.02%</td>
<td>63.14%</td>
<td>115.56%</td>
</tr>
</tbody>
</table>
2. Data sources and quality adjustments of commercial property price indexes

Table 1: Commercial property price indexes

<table>
<thead>
<tr>
<th>Name</th>
<th>Price data</th>
<th>Estimation method</th>
<th>Frequency</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Land Price Index</td>
<td>Appraisal prices</td>
<td>Mean</td>
<td>Bi-annually</td>
<td>Japan</td>
</tr>
<tr>
<td>IPD Property Index</td>
<td>Appraisal prices</td>
<td>Mean</td>
<td>Monthly</td>
<td>25 countries</td>
</tr>
<tr>
<td>NCRIEF Property Index</td>
<td>Appraisal prices</td>
<td>Mean</td>
<td>Quarterly</td>
<td>U.S.</td>
</tr>
<tr>
<td>MIT/CRE TBI</td>
<td>Transaction prices</td>
<td>Hedonic</td>
<td>Quarterly</td>
<td>U.S.</td>
</tr>
<tr>
<td>Moody’s/RCA CPPI</td>
<td>Transaction prices</td>
<td>Repeat sales</td>
<td>Monthly</td>
<td>U.S.</td>
</tr>
<tr>
<td>FTSE NAREIT PureProperty Index</td>
<td>REIT returns</td>
<td>De-levered regression</td>
<td>Daily</td>
<td>U.S.</td>
</tr>
</tbody>
</table>
How should we estimate CPPI?
The Relationship Between Rents and Asset Prices
Data Source Options: Transaction or Appraisal Prices (Left) or Present Value (Right)

\[
P_{0t} = R_{0t} + \left[\frac{1+i_{1t}}{1+r_{1t}}\right] R_{1t} + \left[\frac{(1+i_{1t})(1+i_{2t})}{(1+r_{1t})(1+r_{2t})}\right] R_{2t} + \ldots
\]

- \(P_{0t}\): stock value of a new asset at the beginning of period t
- \(R_{0t}\): income corresponding to \(P_{0t}\)
- \(i_{nt}\): expected rent inflation rates for used assets of varying ages \(n\)
- \(r_{nt}\): discount factor, term structure of interest rates

Several methods of CPPI estimation.

- **Academics:**
  - Repeat sales price method:
    - The depreciation problem and renovation problem
  - Hedonic price method: The hedonic price method, it is necessary to collect considerable property price-related attribute data.

- **Appraisal Practice:**
  - Present value method or DCF:
    - In the appraisal practice, appraiser usually uses Discounted Cash Flow approach or Income approach (not use comparable approach using transaction prices).
Empirical Model of **Present Value**: Hedonic model for rent, price and discount rate using Appraisal data in REIT

**Rent Model**
\[
\ln y_{it} = \sum_j \alpha_j Z_{ij} + f_t, \quad \text{eq (1)}
\]

**Gordon Model (1959)**

- **Price Model**
\[
v_{it} = E_t \sum_{\tau=0}^{\infty} \frac{y_{it+\tau}}{\exp\left(\sum_{s=0}^{\tau-1} r_{t+s}\right)} = y_{it} \phi_t, \quad \text{eq (2)}
\]

- **Discount rate**
\[
\phi_t \equiv E_t \sum_{t=0}^{\infty} \frac{\exp(f_{t+\tau} - f_t)}{\exp\left(\sum_{s=0}^{\tau-1} r_{t+s}\right)} \cdot \text{Quality adjusted Price Indexes.} \quad \text{eq (3)}
\]

- **Price Model**
\[
\ln v_{it} = \sum_j \alpha_j Z_{ij} + f_t + \ln \phi_t, \quad \text{eq (4)}
\]

\( y \): eq (1)
REIT Data ≠ IPD data and NCRIEF data
: 2001-2010 Tokyo Special District

### Appraisal price

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std.Dev</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appraisal price (4,993 Observations)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V^A$: Appraisal price (million yen)</td>
<td>8,428.35</td>
<td>11,767.37</td>
<td>323.00</td>
<td>138,000.00</td>
</tr>
</tbody>
</table>

### Transaction price

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std.Dev</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transaction data (559 Observations)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V^T$: Transaction price (million yen)</td>
<td>7,229.37</td>
<td>11,110.93</td>
<td>324.00</td>
<td>110,000.00</td>
</tr>
</tbody>
</table>

### Rent, Price & Rent-Price ratio

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std.Dev</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOI, Appraisal price and NOI Price ratio (4,926 Observations)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$y^A$: Net Operating Income (Rent - Operating)</td>
<td>413.06</td>
<td>501.45</td>
<td>15.68</td>
<td>5,268.89</td>
</tr>
</tbody>
</table>
**Empirical Model:** Hedonic model for rent, price and discount rate

**Rent Model**
\[
\ln y_{it} = \alpha_0 + \sum_{j} \alpha_j Z_{ijt} + \sum_{t} \nu_t D_t + \epsilon_{yit},
\]

**Price Model**
\[
\ln v^A_{it} = \beta_0 + \sum_{j} \beta_j Z_{ijt} + \sum_{t} \xi_t D_t + \epsilon_{vit},
\]

**Discount rate Model**
\[
\ln c^A_{it} = (\alpha_0 - \beta_0) + \sum_{j} (\alpha_j - \beta_j) Z_{ijt} + \sum_{t} (\nu_t - \xi_t) D_t + (\epsilon_{yit} - \epsilon_{vit})
\]

**Z:** Characteristics of property  
**D:** Time Dummy

The quality-adjusted value for Price, Income, and the Cap rate
\[
\hat{y}_t = \exp(\nu_t); \quad \hat{v}^A_t = \exp(\xi_t); \quad \hat{c}^A_t = \exp(\nu_t - \xi_t).
\]
## Estimation result of hedonic equation: Income, Price and Discount rate

<table>
<thead>
<tr>
<th></th>
<th>Model,$y_A$</th>
<th>Model,$V_{A3}$</th>
<th>Model,$r_A$</th>
<th>$\alpha - \beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>$\beta$</td>
<td>$\alpha$</td>
<td>$\beta$</td>
<td>$\alpha - \beta$</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>11.057 0.130 ***</td>
<td>13.614 0.117 ***</td>
<td>2.557 0.078 ***</td>
<td>2.557</td>
</tr>
<tr>
<td>$S$: Floor space (m$^2$)</td>
<td>0.006 0.003 *</td>
<td>0.002 0.003</td>
<td>0.005 0.002 **</td>
<td>0.005</td>
</tr>
<tr>
<td>$A$: Age of Building (years)</td>
<td>-0.006 0.001 ***</td>
<td>-0.009 0.001 ***</td>
<td>0.003 0.001 ***</td>
<td>0.003</td>
</tr>
<tr>
<td>$H$: Number of stories (stories)</td>
<td>-0.001 0.002</td>
<td>0.006 0.002 ***</td>
<td>-0.007 0.001 ***</td>
<td>-0.007</td>
</tr>
<tr>
<td>$TS$: Time to the nearest station: (minutes)</td>
<td>-0.004 0.005</td>
<td>-0.018 0.004 ***</td>
<td>0.014 0.003</td>
<td>0.014</td>
</tr>
<tr>
<td>$TT$: Travel Time to Central Business District (minutes)</td>
<td>-0.015 0.006 ***</td>
<td>-0.023 0.005 ***</td>
<td>0.008 0.003 ***</td>
<td>0.008</td>
</tr>
<tr>
<td>$LD_k (k=0,\ldots,K)$</td>
<td>Yes: Census</td>
<td>Yes: Census</td>
<td>Yes: Census</td>
<td>-</td>
</tr>
<tr>
<td>$TD_q (q=0,\ldots,Q)$</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>0.773</td>
<td>0.889</td>
<td>0.672</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.926</td>
<td>4.926</td>
<td>4.926</td>
<td></td>
</tr>
</tbody>
</table>

*P<.01, **P<.0.05, ***<.0.01

Note: The dependent variable in each case is the log of the price.
Hedonic Price, Rent and Discount Rate

\[ \hat{V}_t^A = \exp(\xi_t) \]
\[ \hat{y}_t = \exp(v_t) \]
\[ \hat{r}_t^A = \exp(v_t - \xi_t) \]
**Stickiness (Rigidity) of Appraisal Value = Smoothing**

\[ V = \frac{y}{r} \]

- **Rigidity of Discount Rate**\( (r) \).
- **Rigidity of Rent**\( (y) \).

Present value approach based on the share prices of REITs

\[
Y_{rt} \equiv \sum_{i \in A_{rt}} y_{it} : \text{Net Operating Income}
\]

\[
\phi_t = \frac{\sum_{i \in A_{rt}} v_{it}}{\sum_{i \in A_{rt}} v_{it}}
\]

Property Market

Stock Market

Real Estate Asset
(Appraisal)

\[
V_{rt} \equiv \sum_{i \in A_{rt}} v_{it}.
\]

Share rt
(Stock)

Liability rt

Tobin's Q

\[
\ln v_{it} = \sum_j \alpha_j Z_{ij} + f_t + \ln \varphi_t
\]

(eq4)

\[
\ln V_{rt} = f_t + \ln \varphi_t + \ln \left[ \sum_{i \in A_{rt}} \exp \left( \sum_j \alpha_j Z_{ij} \right) \right].
\]

(eq9)
Trend of Rent / Price ratio: %

Appraisal Based Discount Rate

rA: Madel.rA

Share Price ased Discount Rate

rM: NOI/Enterprise ratio
Discount Rate and **Risk Premium**: %

Gordon (1959), Diewert (2013):

\[ r = i + \rho - \delta \]

- \( i \) discount factor, term structure of interest rates,
- \( \rho \) risk premium with respect to property investments,
- \( \delta \) expected rent inflation rates of \((y)\).

- **Risk premium**: \( \rho = r + \delta - i \)

\[ \text{JGB (10 year)} \]

\[ \text{Discount Rate} \]

\[ \text{Geometric Mean of income} \]
Trend of Risk Premium: %

Appraisal Based Risk Premium

Stock Based Risk Premium

pA: risk A

pM: risk M
Why Tobin’s q is not unity?

• Such an arbitrage transaction may not take place for some (unknown) reasons.

• As discussed in Lamont and Thaler (2003), the lack of price arbitrage is sometimes observed in financial markets; for example, the price of a close-end mutual fund sometimes deviates from the underlying value of the asset it owns.

• We cannot rule out the possibility that such “mispricing” occurred in J-REIT market during this period.
Tobin’s q relative to the average
Trend of Market Rent and Appraisal Rent Indexes

New contract rent

YitN: New contract rent

Y: Paying rent

2001.2nd quarter = 1

Paying rent
Calvo (1983) Parameter : $\lambda$ (New Keynesian Style) :

$$\sum_i \ln y_{it} = (1 - \lambda) \sum_i \ln y_{it}^N + \lambda \sum_i \ln y_{it-1}$$

$$\sum_i \ln y_{it} = (1 - \lambda) \sum_{\tau=0}^{\infty} \lambda^\tau \left( \sum_i \ln y_{it-\tau}^N \right)$$

$$1 \div 0.124 \div 8$$

$$0.124 = 1 - \lambda (=0.874)$$

$\lambda = 0.874, s.e. = 0.050$
State-Dependent or Time-Dependent Pricing:

Caballero-Engel’s definition of price flexibility:

Shimizu, Watanabe and Nishimura(2010)

\[ \Delta \log R_{it}^* = \Delta \xi_i + \nu_{it} \]

\[ X_{it} \equiv \log R_{it-1} - \log R_{it}^* \]

\[ \Lambda(x) \equiv \Pr(\Delta R_{it} \neq 0 | X_{it} = x) \]

Caballero-Engel(1993)

:Adjustment Hazard

\[ \lim_{\Delta \xi_i \to 0} \frac{\Delta \log R_i}{\Delta \xi_i} = \int \Lambda(x) h(x) dx + \int x \Lambda'(x) h(x) dx \]

Caballero-Engel’s measure of price flexibility

Intensive margin

Extensive margin

Caballero-Engel(2007)

\[ \Lambda(x) = \Pr(\Delta R_{it} \neq 0 | I_{it}^N = 1, X_{it} = x) \Pr(I_{it}^N = 1 | X_{it} = x) \]

\[ + \Pr(\Delta R_{it} \neq 0 | I_{it}^R = 1, X_{it} = x) \Pr(I_{it}^R = 1 | X_{it} = x) \]
Trend of New Present Value & Appraisal Indexes

Market Rent ÷ Stock based DR

Appraisal Rent ÷ Stock based DR

PV(M,M): YM / rM
PV(A,M): YA / rM
PV(A,A): YA / rA
Daily CPPI, $PV_{(M,M)}$, $PV_{(A,M)}$: 2003.1.4 – 2012.11.16
Conclusion: Issues in conducting of Commercial Property Price Indexes

- Setting of discount rate for property appraisals must be performed in light of market data. In terms of the reasons that smoothing and lags occur with property prices determined using the capitalization method, it has become clear there are problems in the setting of discount rate (or risk premiums).

- Price indexes must be explicitly defined: do they measure investor-observed market values ($PV(A,M)$), or do they measure potential market values ($PV(M,M)$)?
Chihiro Shimizu
(Reitaku University & University of British Columbia)

- My presentation slides and papers are available at: