Housing Rent and Japanese CPI

Chihiro Shimizu
(National University of Singapore and University of British Columbia)

Satoshi Imai
(Statistics Bureau of Japan)

Erwin Diewert
(University of British Columbia and New South Wales University)

Tsutomu Watanabe
(University of Tokyo)

14th Ottawa Group Meeting (Chiba, Japan)
21. May. 2015
2007-2009: the Financial Crisis

2013-: Abenomics

2011.3.11: Earthquake

Hedonic estimate $R_t^*$, Actual CPI Rent and Residential Property Prices
1. Introduction

Outline or Questions

Â Why do goods and services prices not fluctuate significantly even if asset prices fluctuate?

Â How should we estimate the housing rent in CPI?

Expenditures for housing services: 26.4%

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing rents</td>
<td>4.9%</td>
</tr>
<tr>
<td>Imputed rents from owner occupied housing</td>
<td>19.4%</td>
</tr>
<tr>
<td>Housing maintenance and others</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

“Consumer Price Index (CPI) in Tokyo, 2010”

Â In estimating rental costs for durable goods, statistical agencies usually use the acquisition approach. It will be useful to many users if, in addition to the acquisitions approach, the statistical agency would implement a variant of either the rental equivalence approach or the user cost approach for long lived consumer durables. Users can then decide which approach best suits their purposes. Any one of the three main approaches could be chosen as the approach that would be used in the “headline” CPI. (Diewert (2015))
Disadvantages of the rental equivalence approach

Â Homeowners may not be able to provide very accurate estimates for the rental value of their dwelling unit.

Â On the other hand, if the statistical agency tries to match the characteristics of an owned dwelling unit with a comparable unit that is rented in order to obtain the imputed rent for the owned unit, there may be difficulties in finding such comparable units. (Quality adjustment bias)

Â The statistical agency should make an adjustment to these estimated rents over time in order to take into account the effects of depreciation. (Depreciation bias)

Â Care must be taken to determine exactly what extra services are included in the homeowner's estimated rent.
Rent Control Bias: ñMarket Rentò and ñContract rentò

Â In addition to the above possible biases in using the rental equivalence approach to the valuation of the services of OOH, there are differences between ñcontract rentò and ñmarket rentò.

Â “Contract rent” refers to the rent paid by a renter who has a long term rental contract with the owner of the dwelling unit and “market rent” is the rent paid by the renter in the first period after a rental contract has been negotiated.

Â If we value the services of an owner occupied dwelling at its current opportunity cost on the rental market, we should be using market rent rather than contract rent.
2. Macro-Analysis of Housing Rent
Panel data of rental prices
## Summary Statistics of Housing Rent

<table>
<thead>
<tr>
<th></th>
<th>Sample period</th>
<th>Coverage</th>
<th>Provided by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>January 2010 - July 2014</td>
<td>Monthly</td>
<td>Recruit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tokyo’s wards</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paid rent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>New and rollover contracts</td>
<td></td>
</tr>
<tr>
<td>Sample period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coverage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of samples</td>
<td>All samples</td>
<td>New contracts</td>
<td>Rollover contracts</td>
</tr>
<tr>
<td></td>
<td>1,529,485</td>
<td>36,832</td>
<td>41,117</td>
</tr>
<tr>
<td>Monthly rent</td>
<td>mean: 101,721.2 s.d.: 46,209.7</td>
<td>mean: 100,423.7 s.d.: 45,271.9</td>
<td>mean: 102,094.6 s.d.: 46,480.0</td>
</tr>
<tr>
<td>Floor space (m²)</td>
<td>mean: 32.4 s.d.: 15.6</td>
<td>mean: 32.2 s.d.: 15.6</td>
<td>mean: 32.5 s.d.: 15.7</td>
</tr>
<tr>
<td>Price per m²</td>
<td>mean: 3,293.3 s.d.: 788.3</td>
<td>mean: 3,271.9 s.d.: 756.8</td>
<td>mean: 3,292.8 s.d.: 798.1</td>
</tr>
<tr>
<td>Age of unit (years)</td>
<td>mean: 13.0 s.d.: 9.9</td>
<td>mean: 12.3 s.d.: 10.1</td>
<td>mean: 13.4 s.d.: 9.8</td>
</tr>
<tr>
<td>Time to nearest station (min)</td>
<td>mean: 5.1 s.d.: 3.8</td>
<td>mean: 5.0 s.d.: 3.7</td>
<td>mean: 5.2 s.d.: 3.9</td>
</tr>
<tr>
<td>Time to central business district (min)</td>
<td>mean: 12.4 s.d.: 6.4</td>
<td>mean: 12.1 s.d.: 6.3</td>
<td>mean: 12.5 s.d.: 6.4</td>
</tr>
</tbody>
</table>
Official Residential Rent Index or CPI Rent

- CPI rent survey districts are selected from enumeration districts of the Population Census by probability sampling. The number of house rent survey districts is 1,221.
- Statistics Bureau of Japan says that about 28,000 households are surveyed (see Annual report on the Retail Price Survey 2013).
- The survey districts are allocated according to scale of sample cities, the Tokyo metropolitan area is allocated 54 districts.
- The survey districts are grouped to three groups and one group is surveyed every 3 months.
- Rent index is calculated separately by 4 classification. - Wooden small house, wooden medium house, non-wooden small house and non-wooden medium house.
Figure 1: Comparison of Tokyo Ward Area Rent Indices

Abenomics

Paying Rent and CPI
Hedonic estimation for housing rent

We have the price and property-characteristics data of houses, pooled for all periods $t=1, 2, ..., T$, and that the number of data samples in period $t$ is $n_t$.

A standard hedonic price index is produced from the following house-price estimation model:

$$\ln R_{it} = \beta_t x_{it} + \epsilon_{it}$$  \hspace{1cm} (1)

where $R_{it}$ is the rent of house $i$ in period $t$,

$\beta_t$ is a vector of parameters associated with residential property characteristics,

$x_{it}$ is a vector of property characteristic for house $i$ in period $t$,

and $\epsilon_{it}$ is an error term.
Hedonic estimation for housing rent

We run rolling regression using new housing rent with $T = 12$.

<table>
<thead>
<tr>
<th>Estimation Window</th>
<th>Floor space</th>
<th>Age of building</th>
<th>Time to nearest station</th>
<th>Commuting time to CBD</th>
<th>Adjusted $R^2$</th>
<th>Number of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>201001 - 201012</td>
<td>0.0188</td>
<td>-0.0109</td>
<td>-0.0087</td>
<td>-0.0058</td>
<td>0.917</td>
<td>17,697</td>
</tr>
<tr>
<td>201002 - 201101</td>
<td>0.0188</td>
<td>-0.0109</td>
<td>-0.0088</td>
<td>-0.0058</td>
<td>0.916</td>
<td>16,707</td>
</tr>
<tr>
<td>201003 - 201102</td>
<td>0.0188</td>
<td>-0.0109</td>
<td>-0.0089</td>
<td>-0.0059</td>
<td>0.917</td>
<td>15,670</td>
</tr>
<tr>
<td>201004 - 201103</td>
<td>0.0188</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>14,504</td>
</tr>
<tr>
<td>201005 - 201104</td>
<td>0.0188</td>
<td>-0.0110</td>
<td>-0.0092</td>
<td>-0.0058</td>
<td>0.916</td>
<td>13,303</td>
</tr>
<tr>
<td>201006 - 201105</td>
<td>0.0187</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>12,106</td>
</tr>
<tr>
<td>201007 - 201106</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>11,086</td>
</tr>
<tr>
<td>201008 - 201107</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>10,068</td>
</tr>
<tr>
<td>201009 - 201108</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>9,096</td>
</tr>
<tr>
<td>201010 - 201109</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>8,128</td>
</tr>
<tr>
<td>201011 - 201110</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>7,160</td>
</tr>
<tr>
<td>201012 - 201111</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>6,242</td>
</tr>
<tr>
<td>201101 - 201112</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>5,322</td>
</tr>
<tr>
<td>201102 - 201201</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>4,401</td>
</tr>
<tr>
<td>201103 - 201202</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>3,524</td>
</tr>
<tr>
<td>201104 - 201203</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>2,667</td>
</tr>
<tr>
<td>201105 - 201204</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>1,827</td>
</tr>
<tr>
<td>201106 - 201205</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>1,019</td>
</tr>
<tr>
<td>201107 - 201206</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>568</td>
</tr>
<tr>
<td>201108 - 201207</td>
<td>0.0186</td>
<td>-0.0110</td>
<td>-0.0090</td>
<td>-0.0059</td>
<td>0.917</td>
<td>276</td>
</tr>
<tr>
<td>Average</td>
<td>0.0190</td>
<td>-0.0110</td>
<td>-0.0099</td>
<td>-0.0070</td>
<td>0.9196</td>
<td>7,863</td>
</tr>
</tbody>
</table>
Figure 2: Comparison of actual CPI and estimated indices

Hedonic New Rent Quality Adjusted Index

Paying Rent and CPI
3. Micro-Analysis of Rent

Frequency of Rent Adjustments

\[ \Delta R_{it} \equiv R_{it} - R_{it-1} \]

Price Change

Probability of event on New Contract \((I^N)\) and Renewed Contract \((I^R)\)

\[ \Pr(\Delta R_{it} = 0) = \left[ 1 - \Pr(I^N = 1) - \Pr(I^R = 1) \right] \]

\[ \Pr(\Delta R_{it} = 0 | I^N = 1) \Pr(I^N = 1) \]

\[ \Pr(\Delta R_{it} = 0 | I^R = 1) \Pr(I^R = 1) \]
### Table 4: Nominal Rigidity of Rent

<table>
<thead>
<tr>
<th></th>
<th>Rent decreased</th>
<th>Rent unchanged</th>
<th>Rent increased</th>
<th>Total</th>
<th>(Rent change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes accompanying new contracts</td>
<td>4,181 (0.114)</td>
<td>31,737 (0.862)</td>
<td>914 (0.025)</td>
<td>36,832</td>
<td>5,095 (0.138)</td>
</tr>
<tr>
<td>Changes accompanying rollover contracts</td>
<td>641 (0.016)</td>
<td>40,284 (0.980)</td>
<td>192 (0.005)</td>
<td>41,117</td>
<td>833 (0.020)</td>
</tr>
<tr>
<td>Total contract changes</td>
<td>4,822 (0.029)</td>
<td>72,021 (0.938)</td>
<td>1,106 (0.007)</td>
<td>164,356</td>
<td>5,928 (0.036)</td>
</tr>
</tbody>
</table>

### Fraction of housing units without no rent change per year

<table>
<thead>
<tr>
<th>Country</th>
<th>Fraction</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>78%</td>
<td>Estimated by Kurz-Kim (2006)</td>
</tr>
<tr>
<td>Japan</td>
<td>90%</td>
<td>Estimated by this research</td>
</tr>
</tbody>
</table>
Probability of No Rent Adjustments in New Contracts: 2010-2014

Figure 3: Monthly Changes in Nominal Rigidity of Rent
Probability of No Rent Adjustments in Rollover Contracts: 2010-2014

Figure 3: Monthly Changes in Nominal Rigidity of Rent

cshimizu@nus.edu.sg
Monthly rent change distribution in Turnover Contracts

\[ \Delta R_{it} = \frac{R_t}{R_{t-1}} | I_{it}^N = 1 \]

n=5,440

Figure 4: Rent Revision Range Density Distribution
Monthly rent change distribution in Rollover Contracts

\[ \Delta R_{it} = \frac{R_t}{R_{t-1}} \mid I_{it}^R = 1 \]

n=18,582,863

**Figure 4: Rent Revision Range Density Distribution**
State-Dependent or Time-Dependent Pricing: Caballero-Engel’s definition of price flexibility

Target Rent Level

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

Price Gap

\[ X_{it} = \log R_{it-1} - \log R_{it} \]

Probability of rent adjustments

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

Caballero-Engel’s measure of price flexibility

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

Intensive margin

Extensive margin

Caballero-Engel(1993)

Caballero-Engel(2007)

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

\[ + \Pr(\Delta R_{it} \neq 0 \mid I_{it}^R = 1, X_{it} = x) \Pr(I_{it}^R = 1 \mid X_{it} = x) \]

c shimizu@nus.edu.sg

2015/5/21
Distribution of Price Gap in New Contract

Figure 5: Price Gap Distribution
Distribution of Price Gap in Renewed Contract

Figure 5: Price Gap Distribution
Adjustment Hazard Function for *Turnover Units*: Probability of Unit Turnover

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

Figure 5: State-Dependency
Adjustment Hazard Function for *Turnover Units*

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

*Figure 5: State-Dependency*
Adjustment Hazard Function for *Rollover Units*

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

*Figure 5: State-Dependency*
Adjustment Hazard Function for *Rollover Units*

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

*Figure 5: State-Dependency*
Adjustment Hazard Functions

Table 5: Summary of Estimation Results

<table>
<thead>
<tr>
<th></th>
<th>$\epsilon = 0.4, 0.2$</th>
<th>$\epsilon = 0.2,0.0$</th>
<th>$\epsilon = 0.0,0.2$</th>
<th>$\epsilon = 0.2,0.4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Pr(I_t^N = 1</td>
<td>X_{it} = x)$</td>
<td>0.035</td>
<td>0.029</td>
<td>0.023</td>
</tr>
<tr>
<td>$\Pr(I_t^R = 1</td>
<td>X_{it} = x)$</td>
<td>0.006</td>
<td>0.026</td>
<td>0.028</td>
</tr>
<tr>
<td>$\Pr(\Delta R_{it} \neq 0</td>
<td>I_t^N = 1, X_{it} = x)$</td>
<td>0.131</td>
<td>0.134</td>
<td>0.138</td>
</tr>
<tr>
<td>$\Pr(\Delta R_{it} \neq 0</td>
<td>I_t^R = 1, X_{it} = x)$</td>
<td>0.015</td>
<td>0.022</td>
<td>0.020</td>
</tr>
<tr>
<td>$\Lambda(x)$</td>
<td>0.005</td>
<td>0.004</td>
<td>0.004</td>
<td>0.003</td>
</tr>
<tr>
<td>$h(x)$</td>
<td>0.039</td>
<td>0.569</td>
<td>0.337</td>
<td>0.047</td>
</tr>
</tbody>
</table>

Intensive margin:
$$\int \Lambda(x)h(x)dx =$$

Extensive margin:
$$\int x\Lambda'(x)h(x)dx =$$

Caballero-Engel’s measure of price flexibility
$$\lim_{\Delta \xi_t \to 0} \frac{\Delta \log R_t}{\Delta \xi_t} =$$

cshimizu@nus.edu.sg
Summary in “Sticky Housing Rent”

1. About ninety percent of the units in our dataset had no change in rents per year, indicating that rent stickiness is three times as high as in the US.

2. The probability of rent adjustment depends little on the deviation of the actual rent from its target level, suggesting that rent adjustments are not state dependent but time dependent.

3. These two results indicate that both intensive and extensive margins of rent adjustments are small, resulting in a slow response of the CPI rent to aggregate shocks.
4. Re-estimation of CPI

How should we estimate CPI more linked to asset price developments?

Â We have seen in the previous sections that the probability of individual rent adjustments is very low and that it depends little on price imbalances.

Â These two facts imply that price flexibility in terms of the impulse response function is low, thus causing the CPI for rent to respond only slowly to aggregate shocks.

Â We simplify the model.

Â We replace the imputed rent for owner-occupied housing in the CPI by our estimate of the market rent $R^*$. 

Â We also replace the imputed rent for OOH by our estimate of the depreciation adjusted rent R-age.
2007-2009: the Financial Crisis

2013-: Abenomics

Figure 7: Hedonic estimate Rt*, R-age and Actual CPI

cshimizu@nus.edu.sg
Figure 8: Reestimates of CPI inflation under Rent for OOH replaced by Rt* and R-age

2007-2009: the Financial Crisis

2013-: Abenomics
5. Conclusions:

Â Goods and services prices, as represented by consumer price indexes and the like, have not changed all that much in response to fluctuations in asset prices.

Â In particular, there was no major change in goods and services prices even during the significant rise in asset prices that was one of the factors leading to the global financial crisis and subsequent decline in such prices. This lack of correlation means that business cycle management via financial policy is difficult.

Â Focusing on rents, which are an important connecting point between asset market and goods and services market, we attempted to measure housing rent for Japan.
5. Conclusions:

- **Depreciation Bias:**
  - The Japanese rent index has a downward bias due to the neglect of depreciation. In other words, the actual CPI holds a strong downward bias due to the neglect of this "aging depreciation": approximately 1.1 percent per year.

- **Strong rigidity of price changes bias:**
  - While rents based on new contracts change in an elastic manner, actual paid rents change only gradually, even when market shocks occur.
  - Average market rents, which are representative of consumer prices, **have a strong tendency to change in a random manner**, independently of changes in rents determined freely by the market.

---

cshimizu@nus.edu.sg
5. Conclusions:

• the United Nations, IMF, OECD, BIS, and ILO have jointly put together international handbook on residential property price indices (RPPI).

• RPPI will be new important indicators for policy makers.

• Going forward, it will likely be necessary to clarify the relationship between asset price fluctuations and rent (or good and services) fluctuations.
### Population decline and Vacant rate bias

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>14.1%</td>
<td>13.9%</td>
<td>13.0%</td>
<td>12.6%</td>
</tr>
<tr>
<td><strong>Owner Occupied Housing</strong></td>
<td>9.8%</td>
<td>9.1%</td>
<td>7.8%</td>
<td>6.0%</td>
</tr>
<tr>
<td>(on Sale)</td>
<td>0.9%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>-</td>
</tr>
<tr>
<td>(others)</td>
<td>8.9%</td>
<td>8.0%</td>
<td>6.8%</td>
<td>6.0%</td>
</tr>
<tr>
<td><strong>Rental Housing</strong></td>
<td>18.8%</td>
<td>18.8%</td>
<td>17.6%</td>
<td>17.0%</td>
</tr>
</tbody>
</table>