
Yongheng Deng, National University of Singapore
Xiangyu Guo, National University of Singapore
Daniel McMillen, University of Illinois at Urbana - Champaign
Chihiro Shimizu, Nihon University

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Background

- Housing market cycle
  - Bubble in late 1980s
  - Long decline in 1990s
  - 2008 Global Financial Crisis

- Changes in the price distribution during the bubble, decline, rebound, and the 2008 crisis
  - Timing for different cities: Tokyo, Kawasaki, Kobe, Kyoto, Osaka, Yokohama
  - Changes in the distribution of prices for high-priced and low-priced homes

Condominium Prices in Tokyo
Objectives

- Describe changes in the full distribution of house prices
- Compare distributions across cities
- Changes in the distributions at different stages of the housing cycle
- Decomposition of the change in distributions: coefficients effect vs. variables
Background – Conventional Price Indices

- Medians or Means

- “Quality – Controlled” Indices
  - Hedonic model with controls for structural characteristics
  - Repeat Sales – Sample size, sample selection. Do characteristics or coefficients change over time?
  - Hybrid – Combines repeat sales with hedonic

All focus on a central tendency – mean or median.
Repeat Sales as a Matching Estimator

- Wang and Zorn, *Journal of Housing Economics* (1997): Repeat sales approach is identical to period by period means when the number of sales is the same for all periods in the repeat sales sample.

  - Series of matched samples based on propensity scores for probability of sale in time $t$ versus period.
  - Repeat sales approach is an extreme form of matching
  - Using a matching approach to trim sample of outliers produces a much larger sample than the repeat sales approach. Particularly useful when estimating price indices for relatively small geographic areas.
Quantile Price Indices

Introduction

Methods

Data

Results

Conclusion

- $Q_{lnP}(q|X_{it}, D_{it}) = X_i \beta(q) + \sum_{t=2}^{T} D_{it} \delta_t(q)$

- $q = .50$ is comparable to hedonic estimation. Also directly comparable to repeat sales estimator if the sample is restricted to properties that have sold at least twice.

- Can trace out the full distribution by estimating across many quantiles.
Predicted Densities

Introduction | Methods | Data | Results | Conclusion

- $Q_Y(q|X_i) = \alpha(q) + \beta(q)X_i$

- At a given value of $X = \delta$: $Q_Y(q|X = \delta) = \alpha(q) + \beta(q)\delta$

- Estimating at many values of $q$ implies a distribution of values at $X = \delta$

- Example: Estimate for $q = 0.02, 0.03, \ldots, 0.98$. (97 values of $q$)

- Calculate kernel density functions of predicted values at $X = \delta_1$ and $X = \delta_2$:
  - $\alpha(q) + \beta(q)\delta_1$ and $\alpha(q) + \beta(q)\delta_2$, where $q = 0.02, 0.03, \ldots, 0.98$

- Key simplification for experiments is that $X$ is discrete. Makes it possible to directly compare actual and predicted densities
Illustration for a Single Explanatory Variable:

\[ Q_Y(q | X_i ) = \alpha(q) + \beta(q)X_i \]
Estimated Coefficients across Quantiles

Introduction  Methods  Data  Results  Conclusion
Actual and Predicted Densities at $X = 3$ and $X = 7$
Sale Price Densities by Year, 10%, 50%, 90%: Chicago
Sale Price Densities

Kernel density estimates from quantile regressions, q\(=0.03, 0.05, \ldots, 0.97\) (\(B = 48\)). Pooled data from 2000, 2006, 2011.
Predictions using actual data with dummy variables set to counterfactual values.
Data

- Japan Condominium Listing Data
  - From 1986 to 2015
  - Provided by Recruit Co., Ltd.
  - Tokyo 241,702 observations
  - Six cities 482,677 observations
## Summary Statistics: Tokyo

### Introduction
- **Asset bubble**
  - **Boom**: 1986-1990
  - **Burst**: 1990-2000
- **Change in structures**
  - Properties in 1986, 1990 are new and small
  - Age increases

### Methods

<table>
<thead>
<tr>
<th>Data</th>
<th>Results</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Listing Price</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10,000 Yen)</td>
<td>3740.6</td>
<td>2568.9</td>
</tr>
<tr>
<td></td>
<td>(1824.6)</td>
<td>(1425.9)</td>
</tr>
<tr>
<td><strong>Unitprice</strong></td>
<td>68.22</td>
<td>56.60</td>
</tr>
<tr>
<td>(Price/Area)</td>
<td>(31.67)</td>
<td>(28.78)</td>
</tr>
<tr>
<td><strong>Floor Space</strong></td>
<td>56.82</td>
<td>47.93</td>
</tr>
<tr>
<td>(m^2)</td>
<td>(18.53)</td>
<td>(17.86)</td>
</tr>
<tr>
<td><strong>Age of building</strong></td>
<td>14.74</td>
<td>7.995</td>
</tr>
<tr>
<td><strong>Time to Nearest Station</strong></td>
<td>7.321</td>
<td>7.111</td>
</tr>
<tr>
<td><strong>SRC</strong></td>
<td>0.489</td>
<td>0.579</td>
</tr>
<tr>
<td>(dummy)</td>
<td>(0.500)</td>
<td>(0.494)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>241702</td>
<td>4942</td>
</tr>
</tbody>
</table>

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**Note**: The table includes data for various periods, including listing prices, unit prices, floor space, age of buildings, time to nearest station, time to Tokyo, and SRC (dummy) variables, along with their respective standard deviations.
Tokyo: Kernel Density of Floor Space and Age

Introduction

Methods

Data

Results

Conclusion
# Summary Statistics: Six Cities

<table>
<thead>
<tr>
<th>Introduction</th>
<th>Methods</th>
<th>Data</th>
<th>Results</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Tokyo</td>
<td></td>
<td>(2) Yokohama</td>
<td>(3) Kawasaki</td>
<td>(4) Kyoto</td>
</tr>
<tr>
<td>Listing Price (10,000 Yen)</td>
<td>5500.5 (1854.9)</td>
<td>3958.3 (1727.5)</td>
<td>4721.1 (1484.2)</td>
<td>2951.6 (989.1)</td>
</tr>
<tr>
<td>Unitprice (Price/Area)</td>
<td>119.2 (40.22)</td>
<td>65.42 (22.05)</td>
<td>83.05 (22.55)</td>
<td>42.33 (12.04)</td>
</tr>
<tr>
<td>Floor Space (m^2)</td>
<td>48.89 (16.39)</td>
<td>61.39 (18.06)</td>
<td>59.29 (17.90)</td>
<td>70.17 (14.78)</td>
</tr>
<tr>
<td>SRC (dummy)</td>
<td>0.540 (0.498)</td>
<td>0.310 (0.463)</td>
<td>0.227 (0.419)</td>
<td>0.150 (0.357)</td>
</tr>
<tr>
<td>Observations</td>
<td>8299</td>
<td>10918</td>
<td>4792</td>
<td>4069</td>
</tr>
</tbody>
</table>
Introduction

Methods

Data

Results

Conclusion

Note: Dependent variables is log(price); t statistics in parentheses; robust standard deviation are used

* p < 0.1, ** p < 0.05, *** p < 0.01
Hedonic, Mean and Median of Matched Sample

Introduction  Methods  Data  Results  Conclusion

Tokyo

Kawasaki

Yokohama

Osaka

Kobe

Kyoto

10%, 50% and 90% Percentile of Matched Sample

Introduction  Methods  Data  Results  Conclusion
Cities: Kernel Density of Price

Year: 1900

Year: 2000

Year: 2010

Year: 2015

Introduction
Methods
Data
Results
Conclusion
Tokyo: Quantile Regressions

Introduction

Methods

Data

Results

Conclusion

Tokyo: Quantile Regressions

**Introduction**

Methods

Data

Results

Conclusion

Graphs showing the coefficient of various factors (Intercept, Floor Space, Age of Building, Time to Tokyo Station, Time to Nearest Station, SRC Dummy) across different quantiles for the years 1990, 2000, and 2010.
Tokyo Quantile Regressions by district

10% Quantile Regression

50% Quantile Regression

90% Quantile Regression

Introduction

Methods

Data

Results

Conclusion
Quantile Regressions Index (Quarterly Time Dummy)

Introduction

Methods

Data

Results

Conclusion
Kernel Density: Financial Crisis 2008

Introduction

Methods

Data

Results

Conclusion
Difference with Tokyo
- City minus Tokyo
- Tokyo earlier in boom
- Tokyo later in burst than Kansai Area
- Difference notable in high-priced house
Distribution of House Prices in Japanese Cities

- Distribution Change is notable around 1990’s asset bubble period.
- In the bubble period, Tokyo area booms earlier than Kansai area. Tokyo area bursts later than Kansai area.