

Change in the Distribution of Sale/Rental Prices: Comparison of Beijing and Tokyo

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Cross-country comparison

Introduction

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- Knoll et al. (2017) No price like home *AER*
 - 17 advanced countries' annual house prices indices
 - Rose strongly and with substantial cross-country variation after 1950s
- Gyourko et al. (2006) Superstar Cities *AEJ*
 - "Superstar": inelasticity of housing supply and growth in aggregate demand
 - High house prices and price-to-rent ratios crowd out lower-income households
- Only mean or median based Indices used

Japanese Housing market

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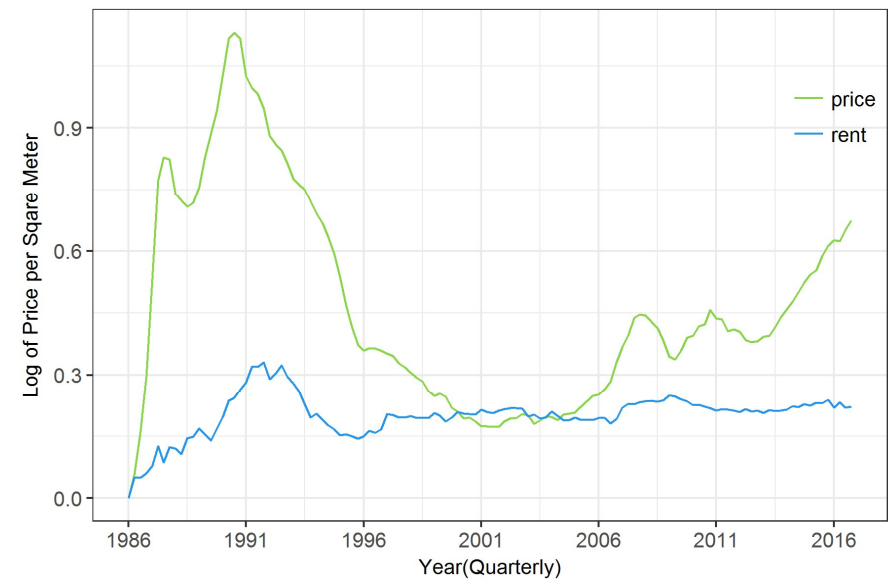
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- Housing market cycle in Japan
 - Boom in late 1980s
 - Recovery after 2000
- Sale and Rental market
 - Prices have larger variation
 - Rents stable after 1997
 - Quality differ across market
 - Spatial variance



Price Index of Tokyo

Chinese Housing Market

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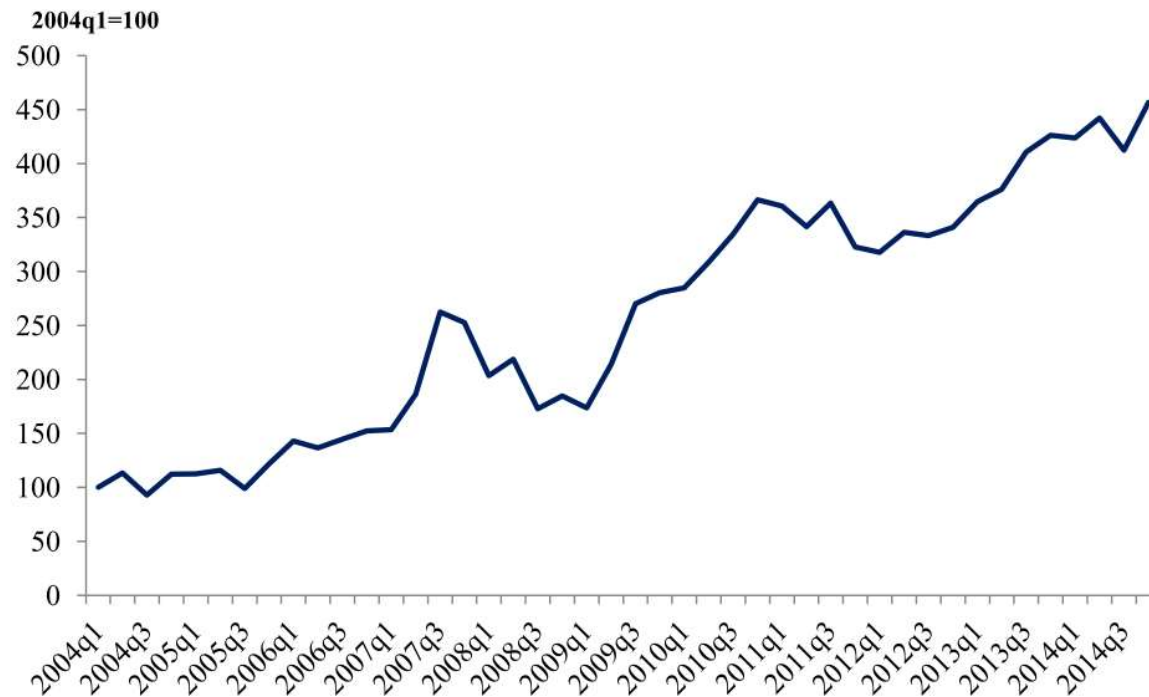
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- Start late as land reform after 1988
- Keep Booming for last 20 years
- Beijing is the most typical “superstar” city in China

Figure 2: Chinese National Real Residential Land Price Index, 35 Markets, Constant Quality Series (Quarterly: 2004q1 – 2014q4)



Source: Wu, Gyourko, Deng (2016)

Price-to-rent Ratio

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- Stiglitz (1990): “If the reason that the price is high today is only because investors believe that the selling price will be high tomorrow—when ‘fundamental’ factors do not seem to justify such a price—then a bubble exists.”
- In a branch of the literature, house sale and rental prices lie at the heart of examining house price bubbles and disorders in the housing markets
 - e.g., McCarthy and Peach, 2004; Himmelberg et al., 2005; Campbell and Shiller, 1988, 2005; Brunnermeier and Julliard, 2008; Campbell et al., 2009; Wu et al., 2012; and Ambrose et al, 2015.

User Cost Framework

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- Porterba (1984) and Himmelberg et al. (2005)
- $u_t = r_t^{rf} + \omega_t + \delta_t + \gamma_t - g_{t+1}$ ($R_t = u_t P_t$)
 - r_t^{rf} is risk-free interest rate,
 - ω_t denotes transaction costs and property taxes,
 - δ_t reflects maintenance costs and depreciation rate,
 - γ_t is the risk premium associated with housing,
 - g_{t+1} is the expected capital gain.

Estimate Price-to-rent ratio

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● Previous Studies

- Compare Price Indices with rental indices (Fu and Ng, 2001; Gallin, 2008; and Campbell et al., 2009)
- Matching approach (Smith and Smith, 2006; Waihl, forthcoming)
- “Repeat-sales” style price-to-rent ratio (Bracke, 2015)

● This Paper

- Locally weighted regression
- Conditional Quantile Decomposition

Decomposition

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- Mean decomposition

- Oaxaca (1973) and Blinder (1973)

- $$\hat{y}_1 - \hat{y}_2 = X_1' \hat{\beta}_1 - X_2' \hat{\beta}_2 = \underbrace{(X_1 - X_2)}_{\text{Variable}} \hat{\beta}_1 + \underbrace{\bar{X}_2}_{\text{Coefficient}} (\hat{\beta}_2 - \hat{\beta}_1)$$

- Distributional decomposition

- Conditional quantile regression (Machado and Mata, 2005)
- Distributional regression (Chernozhukov et al. 2013)
- Unconditional quantile regression, i.e. RIF-regression (Firpo et al., 2007 2009)

Decomposition

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- Spatial Extension of Machado and Mata (2005):

- (Total) $\hat{y}_1^m(\tau, \mathbf{z}_1) - \hat{y}_2^m(\tau, \mathbf{z}_2) = X_1^{m'} \hat{\beta}_1^m(\tau, \mathbf{z}_1) - X_2^{m'} \hat{\beta}_2^m(\tau, \mathbf{z}_2) =$

- (Variables) $X_1^{m'} \hat{\beta}_1^m(\tau, \mathbf{z}_1) - X_2^{m'} \hat{\beta}_1^m(\tau, \mathbf{z}_1) +$

- (Locations) $X_2^{m'} \hat{\beta}_1^m(\tau, \mathbf{z}_1) - X_2^{m'} \hat{\beta}_1^m(\tau, \mathbf{z}_2) +$

- (Coefficients) $X_2^{m'} \hat{\beta}_1^m(\tau, \mathbf{z}_2) - X_2^{m'} \hat{\beta}_2^m(\tau, \mathbf{z}_2)$

Sale and Rental Model

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● Locally Weighted Approach

- Estimate same locally quantile regression for sale and rental datasets
- $\widehat{y}_p = X_p' \widehat{\beta}_p(\tau, z_p)$ and $\widehat{y}_r = X_r' \widehat{\beta}_r(\tau, z_r)$,
- $\tau = 0.02, .04, \dots, .98$, in increments of 0.02, number of quantiles $B = 48$

● Decomposition

- (Total) $\widehat{y}_p - \widehat{y}_r = X_p' \widehat{\beta}_p(\tau, z_p) - X_r' \widehat{\beta}_r(\tau, z_r) = (\text{Variables}) + (\text{Locations}) +$
 (Coefficients) $X_p^{np'} \widehat{\beta}_p^{np}(\tau, z_p) - X_p^{np'} \widehat{\beta}_r^{np}(\tau, z_p)$

Method to calculate price-to-rent ratio

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Step 1. Estimate **locally weighted quantile regressions** in the set of target points of sale and rental datasets separately, $x(z)$, for each quantile range of $\tau = 0.02, 0.04, \dots, 0.98$, in increments of 0.02 , implies a number of quantile $B = 48$: $\arg \min_{\beta \in \mathbb{R}} \sum_i w_i(z) \rho_\tau(y_i - (x_i - x)' \beta)$. The estimate of target point in each τ -th quantile is $\hat{\beta}(\tau, z)$.

Step 2. Interpolate the quantile regression estimates $\hat{\beta}(\tau, z)$ of the set of target points to the full set of points represented in the data set. Then, I get n_p coefficient estimates $\hat{\beta}_p(\tau, z_p)$ and n_r coefficient estimates $\hat{\beta}_r(\tau, z_r)$ for each value of τ , one for each observation in sale sample and rental sample, where n_p and n_r are the numbers of observations in sale and rental datasets.

Step 3. Interpolate the coefficients in τ th quantile of **rental models**, $n_r \times k$ matrix $\hat{\beta}_r(\tau, z_r)$, to the location of **sales sample**, $n_p \times 1$ vector z_p , and get the $n_p \times k$ **counterfactual coefficients** matrix: $\hat{\beta}_r^c(\tau, z_p)$.

Step 4. Calculate the **spatial price-to-rent ratios** in τ th quantile for each observation in sale dataset $x_p(z_p)$: $ptr(\tau, z_p) = \exp(X_p \hat{\beta}_p(\tau, z_p) - X_p \hat{\beta}_r^c(\tau, z_p))$. The **kernel density** of $ptr(z_p)$ for each observation in sale dataset is estimated and **median** of $ptr(z_p)$ represent the spatial price-to-rent ratio.

Unconditional Quantile Regression

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- Firpo, Fortin, and Lemieux (2009) *Econometrica*
 - RIF (recentered influence function) regression
 - investigate the effect of changes in the explanatory variables on the marginal distribution of the dependent variable, instead of holding all other variables at their actual value.
- RIF Function
 - $\widehat{RIF}(Y, \widehat{q}_\tau) = \widehat{q}_\tau + \frac{\tau - 1(Y \leq \widehat{q}_\tau)}{f_Y(\widehat{q}_\tau)}$,
 - $\widehat{q}_\tau = \arg \min_q \sum_{i=1}^N (\tau - 1(Y_i \leq q)) \cdot (Y_i - q)$
 - $\widehat{f}_Y(y) = \frac{1}{N \cdot b_Y} \cdot \sum_{i=1}^N K_Y\left(\frac{Y_i - y}{b_Y}\right)$, Gaussian kernel with bandwidth (Firpo et al., 2009)

Unconditional Quantile Decomposition

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- Unconditional quantile decomposition

- $\hat{\gamma}_{g,\tau} = \left(\sum_{i \in G} X_i \cdot X_i^T \right)^{-1} \cdot \sum_{i \in G} \widehat{RIF}(Y_{gi}, q_{g,\tau}) \cdot X_i, \quad g = 1, 0$

- $\hat{q}_1^\tau - \hat{q}_0^\tau = \underbrace{(\bar{X}_1 - \bar{X}_0)}_{\text{Variable}} \hat{\gamma}_{0,\tau} + \underbrace{\bar{X}_1}_{\text{Coefficient}} (\hat{\gamma}_{1,\tau} - \hat{\gamma}_{0,\tau})$

- Beijing and Tokyo data

- Price, Rent, and Price-to-rent ratio
 - Beijing: 2005 and 2010
 - Tokyo: 2005 and 2010 (1986 and 1991)

Change of Distribution in Housing market

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● Literature

- McMillen (2008) MM approach, Housing price in Chicago 1995-2005
- Nicodem and Raya (2012), Fesselmeyer et al. (2013), Thomschke (2015), Qin et al. (2016)

● Contribution

- Compare two housing markets
- Use sale price, rental price and estimated individually price-to-rent ratio

Data and model specification

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- Comparable micro-level Resale and Rental Data

- Tokyo 23 Special Wards
 - From 1986 to 2016
 - Provided by Recruit Co., Ltd.
- Beijing
 - From 2005 to 2010
 - Provided by 5i5j and Century 21

- Model specification

- $$\ln P = \beta_0 + \beta_1 \ln(\text{Size}) + \beta_2 \text{Age} + \beta_3 d_{\text{station}} + \beta_4 d_{\text{center}} + D_{\text{qtr}}\gamma + D_{\text{district}}\delta + \varepsilon$$

Summary Statistics

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	(1)	(2)	(3)	(4)	(5)	(6)
	Beijing		Tokyo		Tokyo	
	2005	2010	2005	2010	1986	1991
	Sale					
Price per m ² (USD in 2010)	886.2	3231.9	5611.7	6258.8	6581.0	13098.8
Log Price per m ²	6.743	7.997	8.573	8.687	8.680	9.412
Floor Space (m ²)	79.42	81.23	61.98	60.75	48.28	51.45
Age (year)	10.17	11.14	15.90	17.05	8.022	11.27
Distance to Station	1.684	1.801	0.574	0.593	0.564	0.570
Distance to Center	13.35	14.74	8.782	9.138	8.642	9.068
Observations	2512	19294	4666	3982	4835	9584
	Rental					
Rent per m ² (USD in 2010)	54.90	81.97	407.4	438.5	411.7	524.1
Log Rent per m ²	3.933	4.317	5.979	6.056	5.966	6.214
Floor Space (m ²)	60.77	68.64	36.27	34.88	40.79	41.55
Age (year)	11.66	13.04	15.64	11.73	3.413	6.066
Distance to Station	1.382	1.589	0.593	0.547	0.527	0.583
Distance to Center	10.76	12.71	9.566	8.413	9.149	9.287
Observations	20965	82278	11088	271448	706	4517
Price-to-rent ratio	18.70	46.54	15.94	18.51	14.81	28.93

OLS : Beijing 2005-2010

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	(1) Price		(3) Rent		(5) Price-to-rent ratio	
	2005	2010	2005	2010	2005	2010
Log of floor area	-0.00521 (0.0220)	-0.116*** (0.00745)	-0.305*** (0.00680)	-0.373*** (0.00264)	3.637*** (0.155)	14.24*** (0.115)
Age	-0.00782*** (0.000956)	-0.00895*** (0.000358)	-0.0122*** (0.000377)	-0.0126*** (0.000164)	-0.102*** (0.0111)	-0.0386*** (0.00547)
Distance to Station	-0.0205*** (0.00368)	-0.0144*** (0.00191)	-0.0293*** (0.00256)	-0.0315*** (0.000959)	0.924*** (0.0577)	0.927*** (0.0400)
Distance to center	-0.0338*** (0.00140)	-0.0267*** (0.000749)	-0.0364*** (0.000936)	-0.0324*** (0.000407)	-0.0836*** (0.0169)	-0.127*** (0.0130)
Constant	39.87*** (11.44)	36.26*** (7.157)	2.803 (7.564)	35.64*** (3.593)	-13.76 (164.4)	486.5*** (141.1)
Observation	2512	19294	20965	82278	2512	19294
Adj R2	0.723	0.456	0.456	0.536	0.635	0.658

Note: dependent variable is log of sale price per square meter, log of rent per square meter and price-to-rent ratios. Quarterly control, district control, and geographic coordinates are added.

OLS : Tokyo 2005-2010

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	(1) Price		(3) Rent		(5) Price-to-rent ratio	
	2005	2010	2005	2010	2005	2010
Log of floor area	0.0633*** (0.00883)	0.0223** (0.0108)	-0.289*** (0.00349)	-0.235*** (0.000670)	4.655*** (0.0398)	3.881*** (0.234)
Age	-0.0176*** (0.000245)	-0.0157*** (0.000252)	-0.00869*** (0.000155)	-0.00842*** (0.0000259)	-0.139*** (0.00102)	-0.143*** (0.00716)
Distance to Station	-0.110*** (0.00732)	-0.126*** (0.00844)	-0.0635*** (0.00351)	-0.0678*** (0.000751)	-0.809*** (0.0326)	-0.571** (0.243)
Distance to center	-0.0423*** (0.00163)	-0.0348*** (0.00178)	-0.0232*** (0.000887)	-0.0295*** (0.000179)	-0.132*** (0.00671)	0.147*** (0.0537)
Constant	320.7*** (21.40)	173.4*** (21.36)	65.59*** (10.96)	109.5*** (2.397)	1681.1*** (93.64)	-4048.8*** (683.5)
Observation	4666	3982	11088	271448	4666	3982
Adj R2	0.814	0.798	0.749	0.751	0.932	0.430

Note: dependent variable is log of sale price per square meter, log of rent per square meter and price-to-rent ratios. Quarterly control, district control, and geographic coordinates are added.

OLS : Tokyo 1986-1991

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	(1)	(2)	(3)	(4)	(5)	(6)
	Price		Rent		Price-to-rent ratio	
	1986	1991	1986	1991	1986	1991
Log of floor area	0.00780 (0.0106)	-0.138*** (0.00630)	-0.203*** (0.0174)	-0.150*** (0.00637)	1.700*** (0.0967)	-0.0979** (0.0458)
Age	-0.0170*** (0.000823)	-0.0197*** (0.000398)	-0.00575** (0.00260)	-0.00973*** (0.000599)	-0.131*** (0.00817)	-0.212*** (0.00297)
Distance to Station	-0.118*** (0.00995)	-0.0792*** (0.00670)	-0.132*** (0.0243)	-0.0750*** (0.00889)	0.749*** (0.125)	-0.521*** (0.0461)
Distance to center	-0.0583*** (0.00243)	-0.0477*** (0.00149)	-0.0357*** (0.00659)	-0.0450*** (0.00225)	0.250*** (0.0326)	0.0465*** (0.0102)
Constant	468.0*** (32.73)	194.0*** (17.94)	-2.823 (81.77)	131.3*** (30.69)	-3107.7*** (484.8)	-439.1*** (124.4)
Observation	4835	9584	706	4517	4835	9584
Adj R2	0.751	0.717	0.725	0.634	0.682	0.706

Note: dependent variable is log of sale price per square meter, log of rent per square meter and price-to-rent ratios. Quarterly control, district control, and geographic coordinates are added.

Kernel Density: Price

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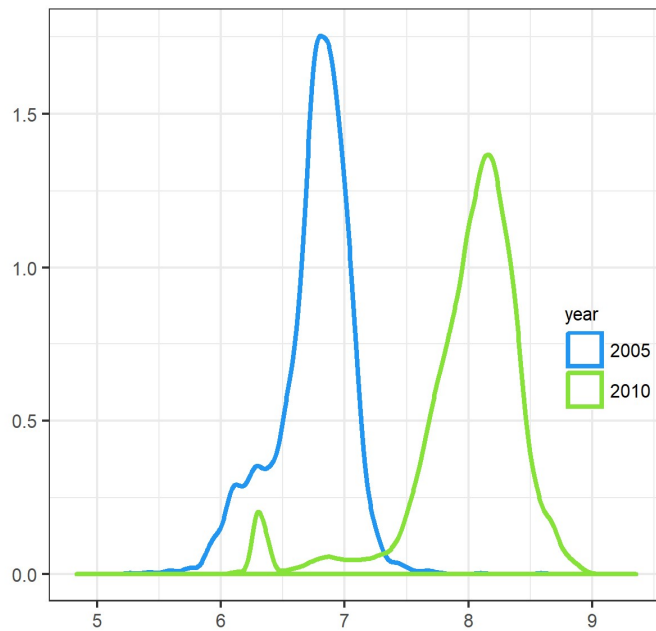
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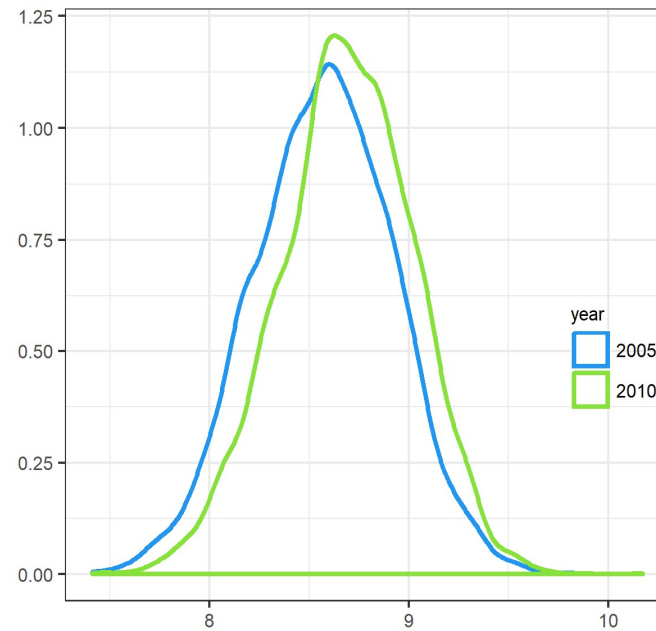
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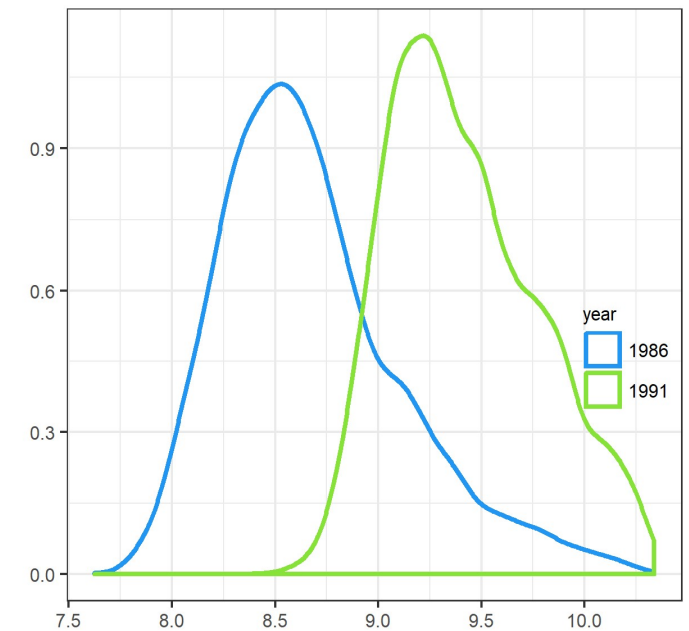
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Beijing 2005-2010



Tokyo 2005-2010



Tokyo 1986-1991

Kernel Density: Rent

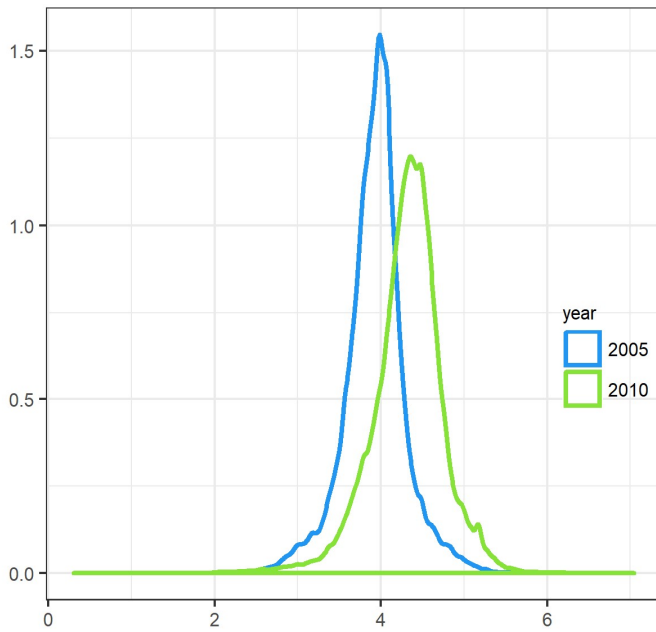
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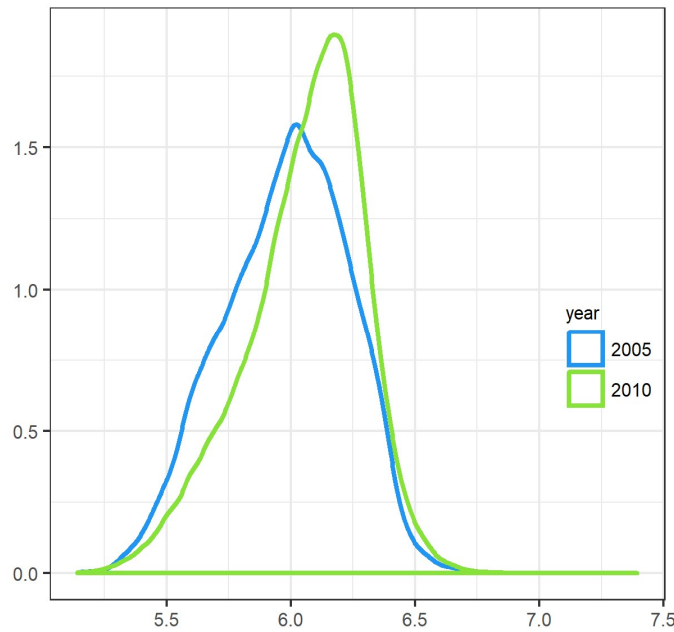
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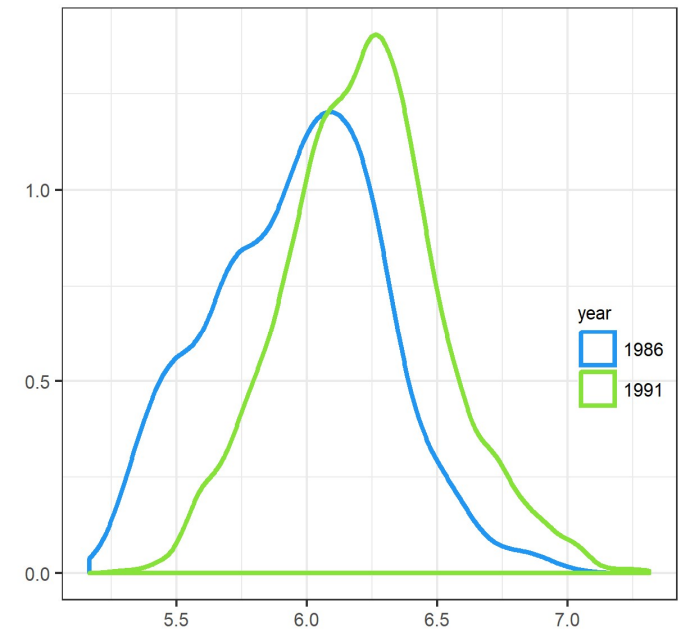
Conclusion



Beijing 2005-2010



Tokyo 2005-2010



Tokyo 1986-1991

Kernel Density: Price-to-rent Ratio

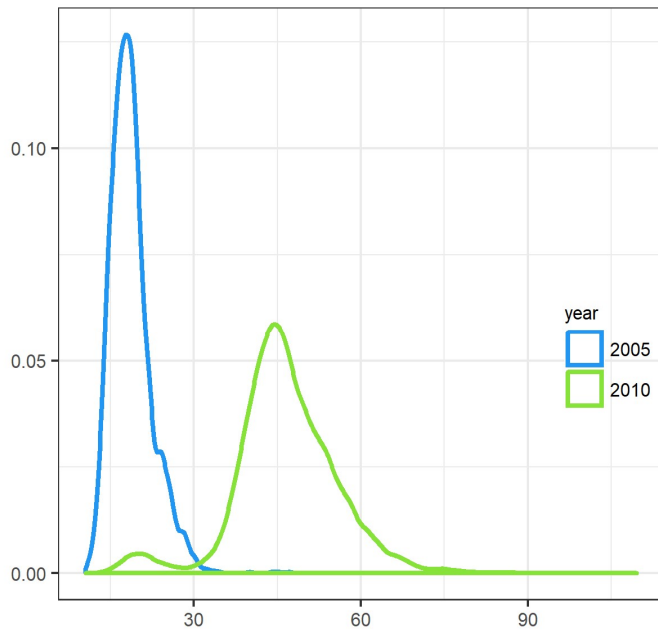
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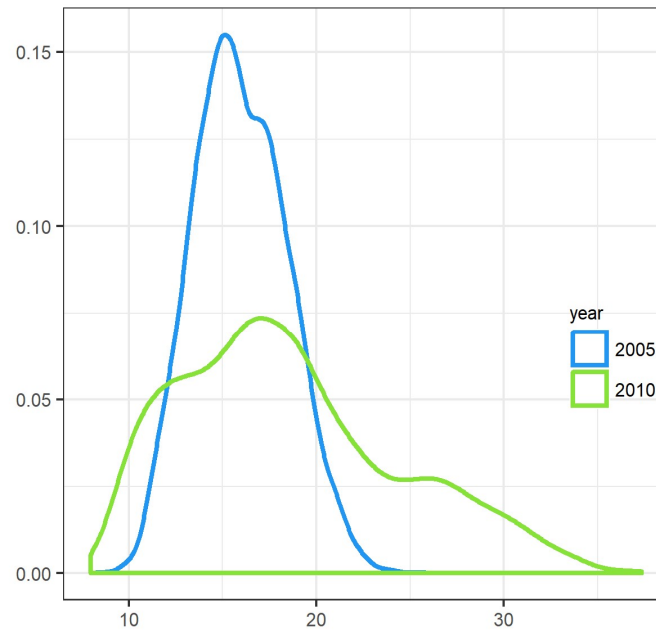
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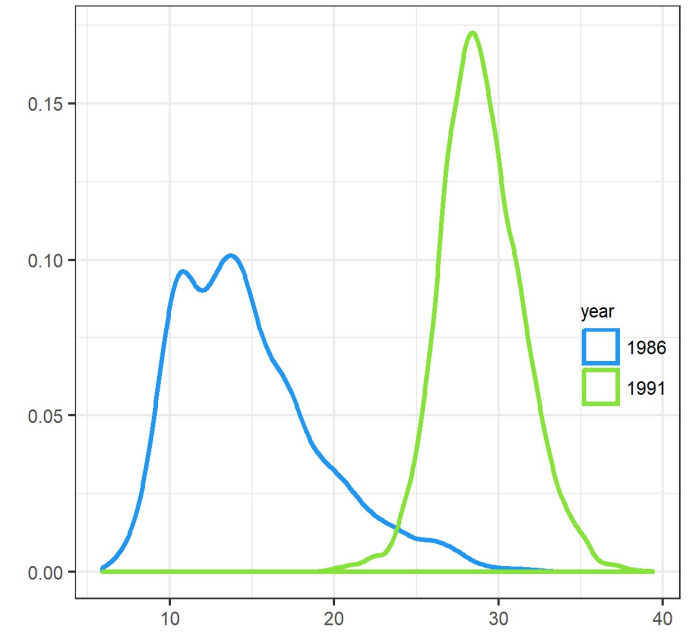
Conclusion



Beijing 2005-2010



Tokyo 2005-2010



Tokyo 1986-1991

Unconditional Quantile Regression: Beijing

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
	10th	50th	90th	10th	50th	90th	10th	50th	90th	
		Price			Rent			Price-to-rent ratio		
		50th	90th	10th	50th	90th	10th	50th	90th	
A. Beijing 2005										
Log of Floor Space(m ²)	-0.107***	0.00555	0.0802***	-0.228***	-0.194***	-0.628***	2.867***	3.388***	5.747***	
Age (year)	-0.0106***	-0.00180**	-0.0136***	-0.00219***	-0.00791***	-0.0362***	-0.0444***	-0.104***	-0.159***	
Distance to Station(km)	-0.0772***	-0.00192	-0.0110***	-0.0202***	-0.0247***	-0.0246***	0.289***	0.571***	2.548***	
Distance to CBD(km)	-0.0413***	-0.0320***	-0.0196***	-0.0746***	-0.0279***	-0.0257***	-0.0129	-0.0433*	-0.255***	
Constant	52.50	55.25***	8.946	-61.57***	21.95***	37.98**	251.9	-136.2	-338.8	
Observations	2512	2512	2512	20965	20965	20965	2512	2512	2512	
R ²	0.597	0.465	0.188	0.401	0.283	0.151	0.219	0.426	0.309	
B. Beijing 2010										
Log of Floor Space(m ²)	-0.338***	-0.0290***	0.0508***	-0.267***	-0.263***	-0.640***	8.876***	13.00***	20.50***	
Age (year)	-0.0135***	-0.00469***	-0.0111***	-0.00750***	-0.00993***	-0.0260***	0.226***	-0.101***	-0.114***	
Distance to Station(km)	-0.0521***	-0.00760***	-0.00636***	-0.0557***	-0.0241***	-0.0203***	0.438***	0.517***	1.634***	
Distance to CBD(km)	-0.0207***	-0.0328***	-0.0216***	-0.0325***	-0.0340***	-0.0286***	-0.114***	-0.0791***	-0.148***	
Constant	-21.00	59.12***	40.27***	14.57	31.46***	49.60***	1742.4***	108.8	243.4	
Observations	19294	19294	19294	82278	82278	82278	19294	19294	19294	
R ²	0.216	0.428	0.215	0.274	0.398	0.273	0.302	0.506	0.336	

Unconditional Quantile Regression: Tokyo 2005-2010

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Price			Rent			Price-to-rent ratio		
	10th	50th	90th	10th	50th	90th	10th	50th	90th
A. Tokyo 2005									
Log of Floor Space(m ²)	0.0416***	0.0620***	0.0775***	-0.268***	-0.347***	-0.177***	4.363***	5.071***	4.501***
Age (year)	-0.0136***	-0.0177***	-0.0178***	-0.00512***	-0.00992***	-0.00892***	-0.101***	-0.175***	-0.116***
Distance to Station(km)	-0.127***	-0.113***	-0.0713***	-0.134***	-0.0420***	-0.0313***	-0.613***	-0.934***	-0.575***
Distance to CBD(km)	-0.0482***	-0.0445***	-0.0294***	-0.0284***	-0.0202***	-0.0165***	-0.142***	-0.186***	-0.115***
Constant	586.6***	296.4***	38.59	134.7***	51.95***	13.1	1269.4***	1855.0***	1588.6***
Observations	4666	4666	4666	11088	11088	11088	4666	4666	4666
R ²	0.347	0.58	0.3	0.311	0.519	0.241	0.318	0.653	0.316
B. Tokyo 2010									
Log of Floor Space(m ²)	0.0199	-0.00311	0.0323	-0.404***	-0.243***	-0.0761***	3.363***	3.583***	3.791***
Age (year)	-0.0161***	-0.0147***	-0.0147***	-0.0111***	-0.00905***	-0.00472***	-0.146***	-0.153***	-0.227***
Distance to Station(km)	-0.138***	-0.114***	-0.0683***	-0.152***	-0.0399***	-0.0370***	-1.578***	-0.199	0.724
Distance to CBD(km)	-0.0428***	-0.0310***	-0.0283***	-0.0450***	-0.0298***	-0.0193***	0.0835	0.143**	0.325**
Constant	325.3***	167.4***	-27.9	236.0***	104.7***	23.15***	652.8	-3032.1***	-9342.4***
Observations	3982	3982	3982	271448	271448	271448	3982	3982	3982
R ²	0.342	0.578	0.29	0.403	0.495	0.227	0.259	0.218	0.264

RIF Decomposition: Beijing 2005-2010

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	(1) Price			(2) Rent			(3) Price-to-Rent Ratio		
	Total Difference	Variable Effect	Coefficient Effect	Total Difference	Variable Effect	Coefficient Effect	Total Difference	Variable Effect	Coefficient Effect
10th	1.275*** (0.0187)	-0.119*** (0.0104)	1.394*** (0.0159)	0.291*** (0.00655)	-0.176*** (0.00327)	0.467*** (0.00579)	22.87*** (0.123)	0.213 (0.141)	22.66*** (0.161)
20th	1.237*** (0.0142)	-0.116*** (0.00724)	1.352*** (0.0104)	0.337*** (0.00435)	-0.186*** (0.00292)	0.523*** (0.00374)	24.81*** (0.103)	0.199* (0.105)	24.61*** (0.115)
30th	1.231*** (0.00895)	-0.114*** (0.00679)	1.345*** (0.00652)	0.360*** (0.00333)	-0.155*** (0.00232)	0.514*** (0.00285)	25.94*** (0.0987)	0.154 (0.105)	25.79*** (0.108)
40th	1.261*** (0.00685)	-0.101*** (0.00579)	1.362*** (0.00534)	0.395*** (0.00306)	-0.139*** (0.00204)	0.534*** (0.00264)	26.89*** (0.0985)	0.0892 (0.111)	26.80*** (0.106)
50th	1.290*** (0.00636)	-0.0933*** (0.00518)	1.383*** (0.00510)	0.397*** (0.00276)	-0.135*** (0.00193)	0.532*** (0.00246)	27.79*** (0.102)	0.00651 (0.125)	27.78*** (0.112)
60th	1.304*** (0.00620)	-0.0867*** (0.00477)	1.390*** (0.00515)	0.416*** (0.00269)	-0.135*** (0.00193)	0.551*** (0.00248)	28.96*** (0.111)	0.0128 (0.152)	28.95*** (0.132)
70th	1.323*** (0.00614)	-0.0833*** (0.00467)	1.406*** (0.00532)	0.427*** (0.00270)	-0.127*** (0.00183)	0.553*** (0.00253)	30.51*** (0.129)	-0.0104 (0.178)	30.52*** (0.157)
80th	1.343*** (0.00635)	-0.0790*** (0.00466)	1.422*** (0.00591)	0.452*** (0.00342)	-0.135*** (0.00205)	0.586*** (0.00325)	32.19*** (0.166)	-0.0731 (0.184)	32.27*** (0.181)
90th	1.365*** (0.00705)	-0.0754*** (0.00486)	1.440*** (0.00709)	0.447*** (0.00617)	-0.164*** (0.00288)	0.610*** (0.00585)	33.93*** (0.244)	-0.0280 (0.203)	33.96*** (0.249)

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	(1) Price			(2) Rent			(3) Price-to-Rent Ratio		
	Total Difference	Variable Effect	Coefficient Effect	Total Difference	Variable Effect	Coefficient Effect	Total Difference	Variable Effect	Coefficient Effect
10th	0.125*** (0.0122)	-0.0967*** (0.00744)	0.221*** (0.0104)	0.0862*** (0.00418)	0.109*** (0.00360)	-0.0227*** (0.00375)	-1.477*** (0.108)	0.230*** (0.0736)	-1.707*** (0.108)
20th	0.132*** (0.0118)	-0.104*** (0.00809)	0.237*** (0.00905)	0.107*** (0.00413)	0.110*** (0.00318)	-0.00276 (0.00314)	-0.607*** (0.121)	0.389*** (0.0859)	-0.997*** (0.122)
30th	0.136*** (0.00981)	-0.0865*** (0.00676)	0.222*** (0.00708)	0.108*** (0.00389)	0.0947*** (0.00256)	0.0133*** (0.00280)	0.386*** (0.125)	0.402*** (0.0808)	-0.0166 (0.125)
40th	0.118*** (0.00943)	-0.0810*** (0.00659)	0.199*** (0.00658)	0.0963*** (0.00346)	0.0853*** (0.00221)	0.0111*** (0.00247)	1.245*** (0.117)	0.263*** (0.0750)	0.982*** (0.115)
50th	0.110*** (0.00930)	-0.0831*** (0.00695)	0.193*** (0.00637)	0.0915*** (0.00311)	0.0743*** (0.00190)	0.0172*** (0.00226)	1.875*** (0.120)	0.283*** (0.0786)	1.592*** (0.118)
60th	0.111*** (0.00952)	-0.0819*** (0.00715)	0.193*** (0.00669)	0.0847*** (0.00309)	0.0627*** (0.00161)	0.0220*** (0.00234)	2.506*** (0.130)	0.432*** (0.0868)	2.074*** (0.128)
70th	0.104*** (0.00966)	-0.0771*** (0.00690)	0.181*** (0.00709)	0.0650*** (0.00310)	0.0518*** (0.00136)	0.0133*** (0.00246)	3.541*** (0.163)	0.692*** (0.118)	2.850*** (0.166)
80th	0.100*** (0.0102)	-0.0780*** (0.00709)	0.178*** (0.00812)	0.0497*** (0.00316)	0.0447*** (0.00123)	0.00498* (0.00269)	5.532*** (0.231)	0.855*** (0.177)	4.677*** (0.237)
90th	0.0901*** (0.0112)	-0.0682*** (0.00656)	0.158*** (0.00982)	0.0285*** (0.00333)	0.0413*** (0.00124)	-0.0128*** (0.00301)	8.160*** (0.200)	0.458*** (0.143)	7.702*** (0.202)

RIF Decomposition: Tokyo 1986-1991

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	(1) Price			(2) Rent			(3) Price-to-Rent Ratio		
	Total Difference	Variable Effect	Coefficient Effect	Total Difference	Variable Effect	Coefficient Effect	Total Difference	Variable Effect	Coefficient Effect
10th	0.804*** (0.00828)	-0.108*** (0.00461)	0.912*** (0.00745)	0.324*** (0.0220)	-0.0415*** (0.0142)	0.365*** (0.0198)	16.03*** (0.0653)	-0.736*** (0.0455)	16.77*** (0.0670)
20th	0.779*** (0.00764)	-0.116*** (0.00479)	0.895*** (0.00627)	0.283*** (0.0212)	-0.0409*** (0.0133)	0.324*** (0.0168)	16.03*** (0.0672)	-0.820*** (0.0366)	16.85*** (0.0689)
30th	0.765*** (0.00789)	-0.133*** (0.00546)	0.898*** (0.00609)	0.277*** (0.0212)	-0.0449*** (0.0123)	0.322*** (0.0158)	15.60*** (0.0792)	-0.933*** (0.0373)	16.53*** (0.0823)
40th	0.753*** (0.00817)	-0.151*** (0.00614)	0.903*** (0.00617)	0.234*** (0.0201)	-0.0484*** (0.0125)	0.283*** (0.0145)	15.09*** (0.0775)	-0.983*** (0.0375)	16.08*** (0.0828)
50th	0.753*** (0.00881)	-0.180*** (0.00729)	0.932*** (0.00680)	0.219*** (0.0176)	-0.0423*** (0.0114)	0.261*** (0.0133)	14.72*** (0.0778)	-1.055*** (0.0397)	15.77*** (0.0861)
60th	0.759*** (0.00963)	-0.199*** (0.00806)	0.957*** (0.00767)	0.214*** (0.0164)	-0.0382*** (0.0106)	0.252*** (0.0129)	14.34*** (0.0881)	-1.158*** (0.0433)	15.50*** (0.0980)
70th	0.753*** (0.0116)	-0.232*** (0.00943)	0.985*** (0.00955)	0.203*** (0.0160)	-0.0347*** (0.0108)	0.238*** (0.0129)	13.65*** (0.106)	-1.258*** (0.0478)	14.91*** (0.118)
80th	0.724*** (0.0149)	-0.222*** (0.00967)	0.946*** (0.0126)	0.208*** (0.0165)	-0.0275** (0.0122)	0.236*** (0.0138)	12.84*** (0.129)	-1.285*** (0.0504)	14.13*** (0.142)
90th	0.635*** (0.0177)	-0.187*** (0.00953)	0.822*** (0.0161)	0.250*** (0.0210)	-0.0408** (0.0172)	0.290*** (0.0194)	11.13*** (0.172)	-1.380*** (0.0567)	12.51*** (0.186)

RIF Decomposition: Total Effect

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	10 th quantile	50 th quantile	90 th quantile
A. Beijing 2005-2010			
Price	0.202896	0.189846	0.193397
Rent	0.082953	0.100531	0.103115
Price-to-rent ratio	1.565366	1.526924	1.422639
B. Tokyo 2005-2010			
Price	0.007859	0.007529	0.008161
Rent	0.015309	0.015256	0.004524
Price-to-rent ratio	-0.11524	0.118783	0.424779
C. Tokyo 1986-1991			
Price	0.098348	0.087497	0.068287
Rent	0.058942	0.036519	0.039357
Price-to-rent ratio	1.612678	1.048433	0.528491

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- Beijing experience larger appreciation between 2005 and 2010 than Tokyo. The boom in Beijing 2005-2010 is similar with Tokyo 1989-1991.
- Appreciation of price-to-rent ratio is larger than price and rent during boom period in two economics.

The slide features several geometric shapes. In the top right, there is a large blue triangle pointing downwards, partially overlapping a larger red triangle pointing upwards. In the bottom left, there are two overlapping blue triangles, one larger and darker than the other. In the bottom right, there is a blue triangle pointing upwards.

Thanks!
Q&A