

**Real Estate Price Indices & Price Dynamics:  
An Overview from an Investments Perspective**  
by Devid Geltner, MIT

**Sticky Rent and Housing Prices**  
by Chihiro Shimizu, Reitaku University and UBC

Discussant by Yongheng Deng  
National University of Singapore

Hitotsubashi-RIETI International Workshop on  
Real Estate Markets and the Macro Economy  
Tokyo, Japan      December 15, 2014



# Why do we need to continue to discover and improve real estate price indices & improve our understanding of price dynamics in real estate market?

**THE WALL STREET JOURNAL.**

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January 28, 2013, 5:40 PM HKT

## Study: China Underestimated House Price Growth in Beijing, Shanghai

It's clear Chinese property prices skyrocketed over the past decade. But for some key cities, they may have risen even faster than the Chinese's government's most liberal estimates.

That's the conclusion of economists Yongheng Deng, Joseph Gyourko and Jing Wu in a National Bureau of Economic Research working paper that analyzes Chinese housing and land prices.

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# Why do we need to improve our understanding in real estate price indices & price dynamics?

参 政 通 息

参考天下网  
www.cktxw.com

2013年1月30日

## 美报告称京沪房价涨幅被低估

【美国《华尔街日报》网站1月28日报道】题：研究表明中国低估了北京上海房价涨幅

过去十年来中国房地产价格的火速上涨是有目共睹的，但在某些主要城市，房价上涨的速度可能比政府最大胆的估计还要夸张。

这是经济学家邓永恒、约瑟夫·吉尤科和吴璟在美国全国经济研究所的一份工作报告中得出的结论，这份报告对中国的住房和土地价

一项名为“商品房平均销售价格指数”的政府房地产指数显示，北京房价在2006年至2010年期间上涨不到50%。

另一项名为“70个大中城市新建住宅价格指数”的官方指标显示同期北京房价上涨120%左右。而经济学家认为，北京房价在这一时期的实际涨幅接近250%。

要准确计算中国的平均房价并不是一件容易的事，因为中国有太多的新建住

模型法，将房地产的价格因素分解成例如楼层朝向、与周边小区的距离和小区所在位置的优劣等变量。

经济学家根据这一模型对8个城市的房价进行了分析，与政府数据一样，其考察范围也是新建住宅。

分析结果显示，并非所有城市的房价涨幅都被官方统计所低估。例如，政府公布的成都市房地产价格就高于经济学家报告所反映的价格。而政府关于西安房价的统计结果

# Real Estate Markets and the Macro Economy

## — The Collateral Channel Effect

**Property price can amplify business cycles through the collateral channel effect.**

**Bernanke and Gertler (1989); Kiyotaki and Moore (1997).**

If firms are otherwise financially constrained,

*Increased property values can enable firms to provide more collateral and enlarge their borrowings and investments, which fuels economic prosperity.*

*Business downturns will depress property values, thereby reducing firms' debt capacity and depressing investment, which deepens downturns.*

### **Empirical evidences:**

**Japan: Gan (2007).**

(The burst of the land price bubble in late 1980s seriously hit Japan's economy via the collateral channel effect.)

**US: Chaney, Sraer and Thesmar (2011); Cvijanovic (2011).**

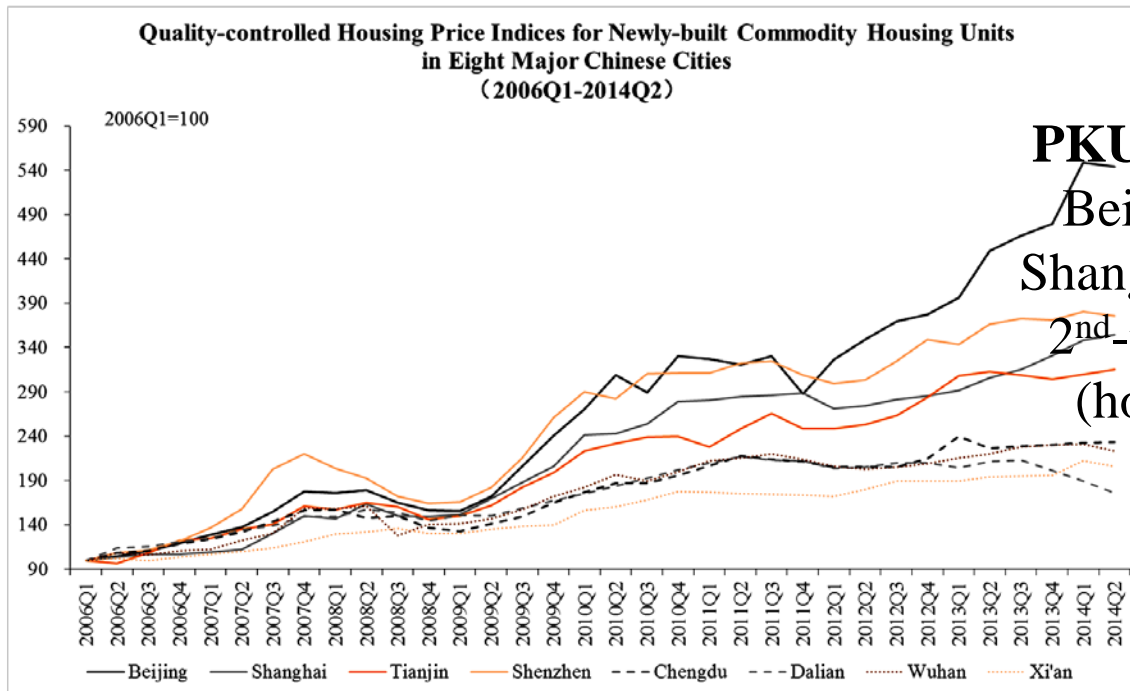
(A \$1 increase in collateral value leads a representative US firm to raise its debts by \$0.038 and PPE investments by \$0.060.

**China: Wu, Gyourko and Deng (2014).**

# Challenges and opportunities in constructing and estimating real property indices

## 1. Real Property (especially commercial property)

Characterized by **Heterogeneity**: in **Assets**, in **Markets**, in **Data Sources**: Makes studying of pricing very challenging.



**PKU-THU Housing Price Index:**  
Beijing up over 5-fold since '06  
Shanghai, Shenzhen, Tianjin 3-fold,  
2<sup>nd</sup>-tier cities only doubled prices  
(holding quality, size constant)



# Challenges and opportunities in constructing and estimating real property indices

1. Real Property (especially commercial property)  
Characterized by **Heterogeneity**: in **Assets**, in **Markets**, in **Data Sources**: Makes studying of pricing very challenging.
2. Urban Economists & Econometricians have Pioneered New **Price Indexing Methodologies**, Combined with New **Data Sources**: → Shed New Light on Commercial Property Price Dynamics.

# Challenges of Indexing Transaction Prices in the Private Property Market:

Two Major Approaches to Rigorous Transaction Price Indexing (controlling for heterogeneity – “apples vs oranges” – problem):

## 1) Hedonic Value Modelling:

- Regress property prices on property characteristics (hedonic variables), Hold characteristics constant in index.
- Two methods: Pooled (time-dummies) & Chained (imputed). Latter better in theory but more data intensive.

## 2) Repeat-Sales Indices:

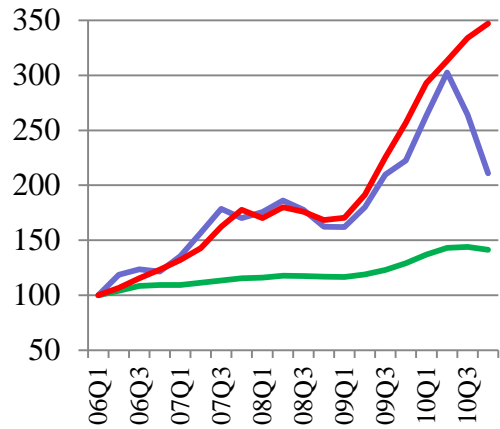
- Based on same-property price changes (properties sold more than once).
- Models actual price-change experience of property owners.

# Questions?

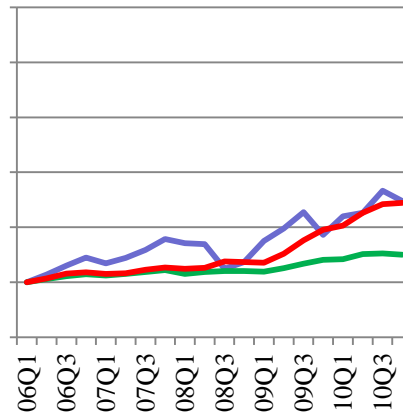
- Q1: Do the different methods suggested in the Eurostat Handbook (and in section 2 above) lead to different estimates of housing price changes?
- Q2: If the methods do generate different results, which method should be chosen.
- Q3: Which data source should be used for housing information?



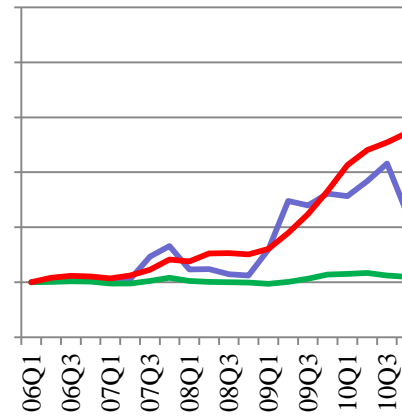
# Comparison of House Price Indices



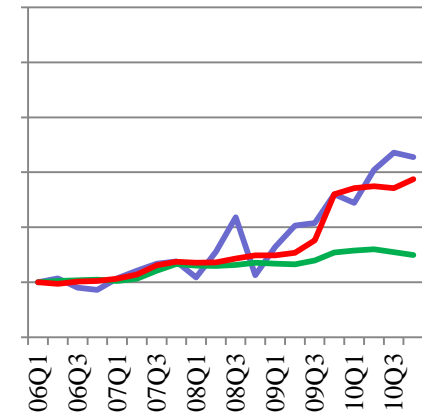
**Beijing**



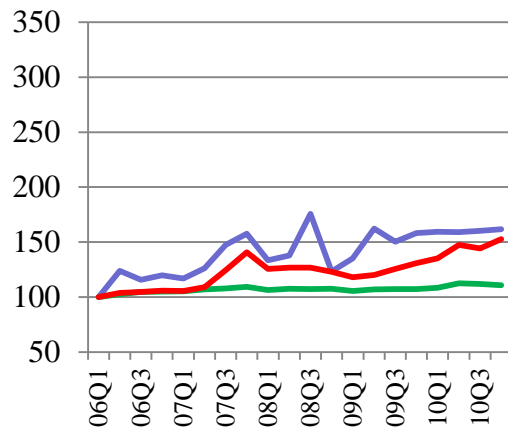
**Tianjin**



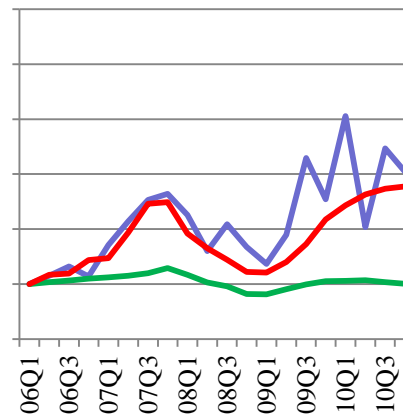
**Shanghai**



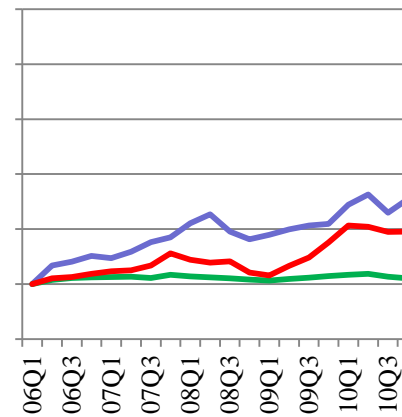
**Hangzhou**



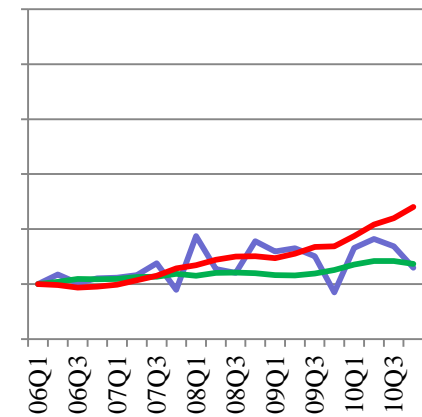
**Wuhan**



**Shenzhen**



**Chengdu**



**Xian**

— : Average Price Index. — : 70 Cities Index. — : (New) Hedonic Price Index.

Source: Deng, Gyourko and Wu (2012); and National Bureau of Statistics of China.

# Comparison of House Price Indices

Average Real Compound Quarterly House Price Growth Rates (2003-2010)

City	“Average Index”	“70 Cities Index”	Hedonic Index
Beijing	4.00%	1.83%	6.77%
Tianjin	2.95%	1.18%	2.90%
Shanghai	2.63%	0.25%	4.61%
Hangzhou	4.08%	1.17%	3.54%
Wuhan	2.56%	0.54%	2.25%
Shenzhen	3.78%	0.01%	3.40%
Chengdu	3.06%	0.27%	2.08%
Xian	0.73%	0.89%	2.84%

Source: Deng, Gyourko and Wu (2012); ; and National Bureau of Statistics of China.

# Problems with the repeat sales method

- (i) there is *sample selection bias* (Clapp and Giaccotto 1992);
- (ii) the assumption that there are *no changes in property characteristics* and their parameters during the transaction period is unrealistic (Case and Shiller, 1987, 1989; Clapp and Giaccotto, 1992, 1998, 1999; Goodman and Thibodeau, 1998; Case et al. 1991).
- → **Depreciation and renovation problems.**

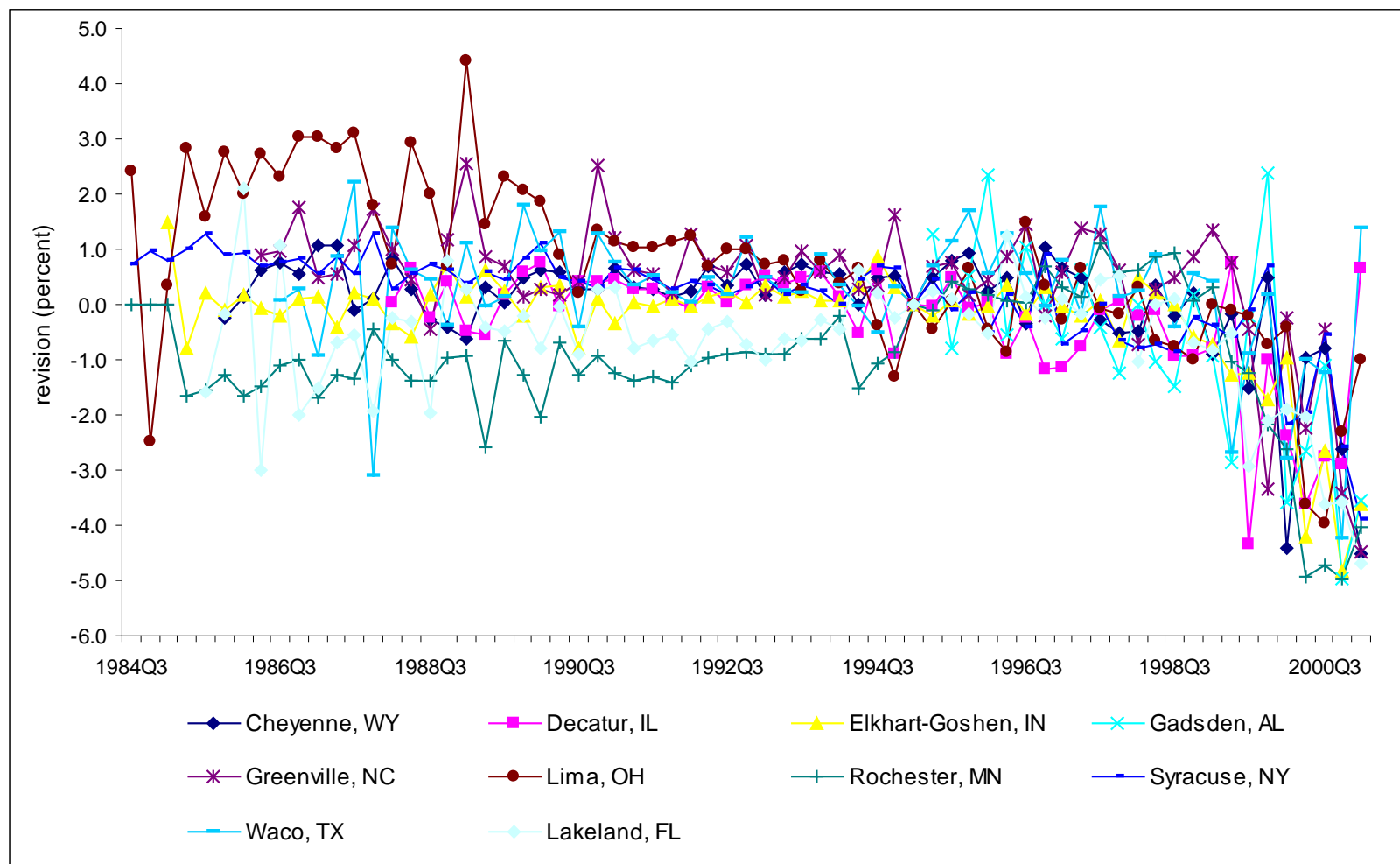
# Problems with the repeat sales method

- (i) there is an *omitted variable bias* (Case and Quigley 1991; Ekeland, Heckman and Nesheim 2004; Shimizu 2009);
- (ii) the assumption of *no structural change* is unrealistic (Case et al. 1991; Clapp et al. 1991; Clapp and Giaccotto 1992, 1998; Shimizu and Nishimura 2006, 2007, Shimizu, Takatsuji, Ono, and Nishimura 2007).

# Repeat-Sale-Indices are subject to significant revision problem (Deng and Quigley, 2008)

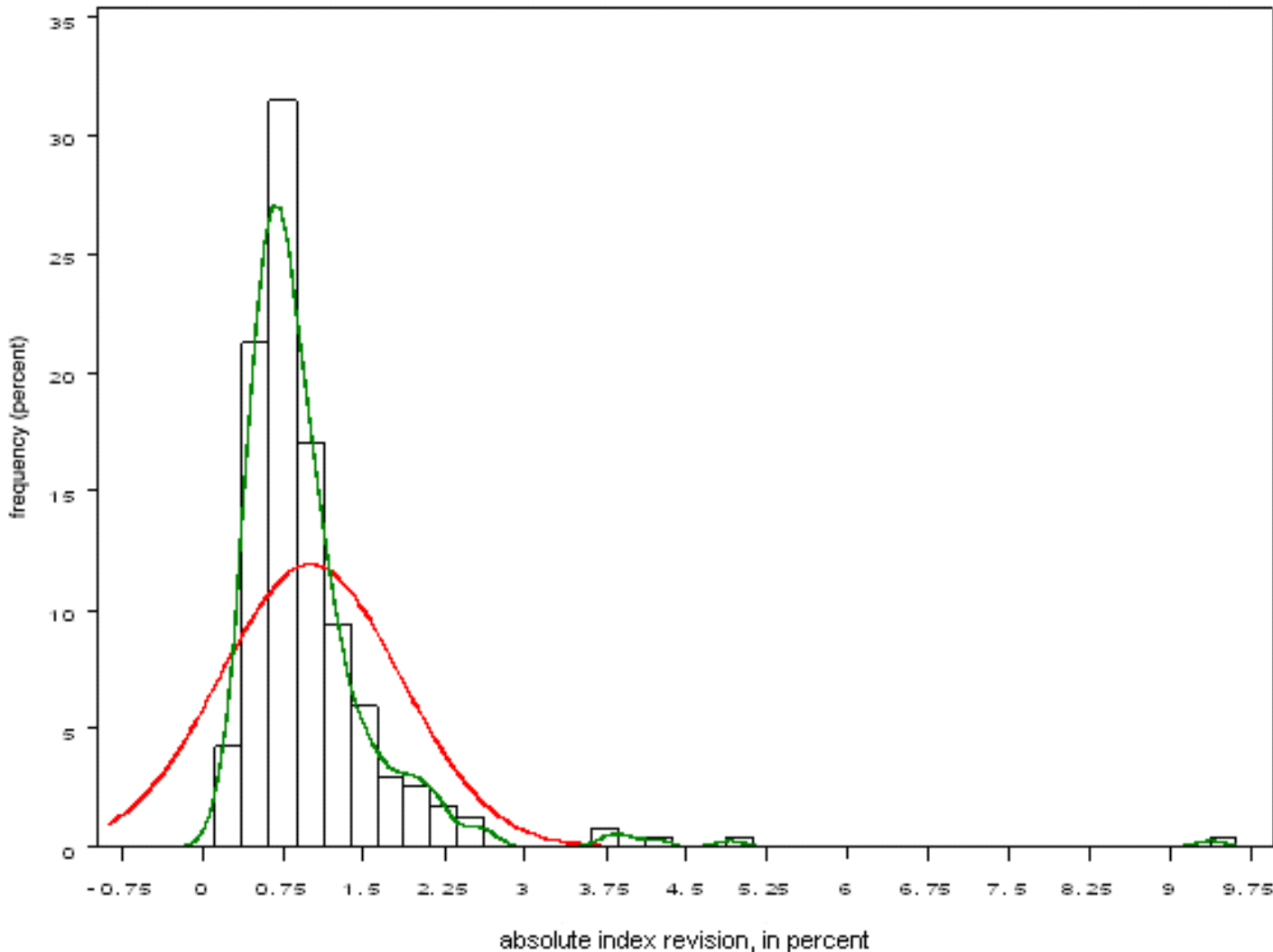
- Changing geography
  - Not an insurmountable problem, but certainly messy
- Possibly large revisions
  - In one quarter of MSAs, average absolute revision exceeds 1.5%
  - In about 15% of MSAs, average absolute revision exceeds 2%
  - Revisions much larger and more volatile in recent past
- Volatility in revisions varies by market
- Little evidence of predictability in revisions
- The property of index revision makes the settlement of futures contracts less precise, but not subject to systematic biases
- The magnitude of the arbitrary revisions to price estimates suggests a limitation in the efficiency gains from trading in housing price futures

# House Price Index Revisions for Selected MSAs with the Median Average Absolute Revision, 2007Q1 vs. 2001Q1 (Deng and Quigley, 2008)

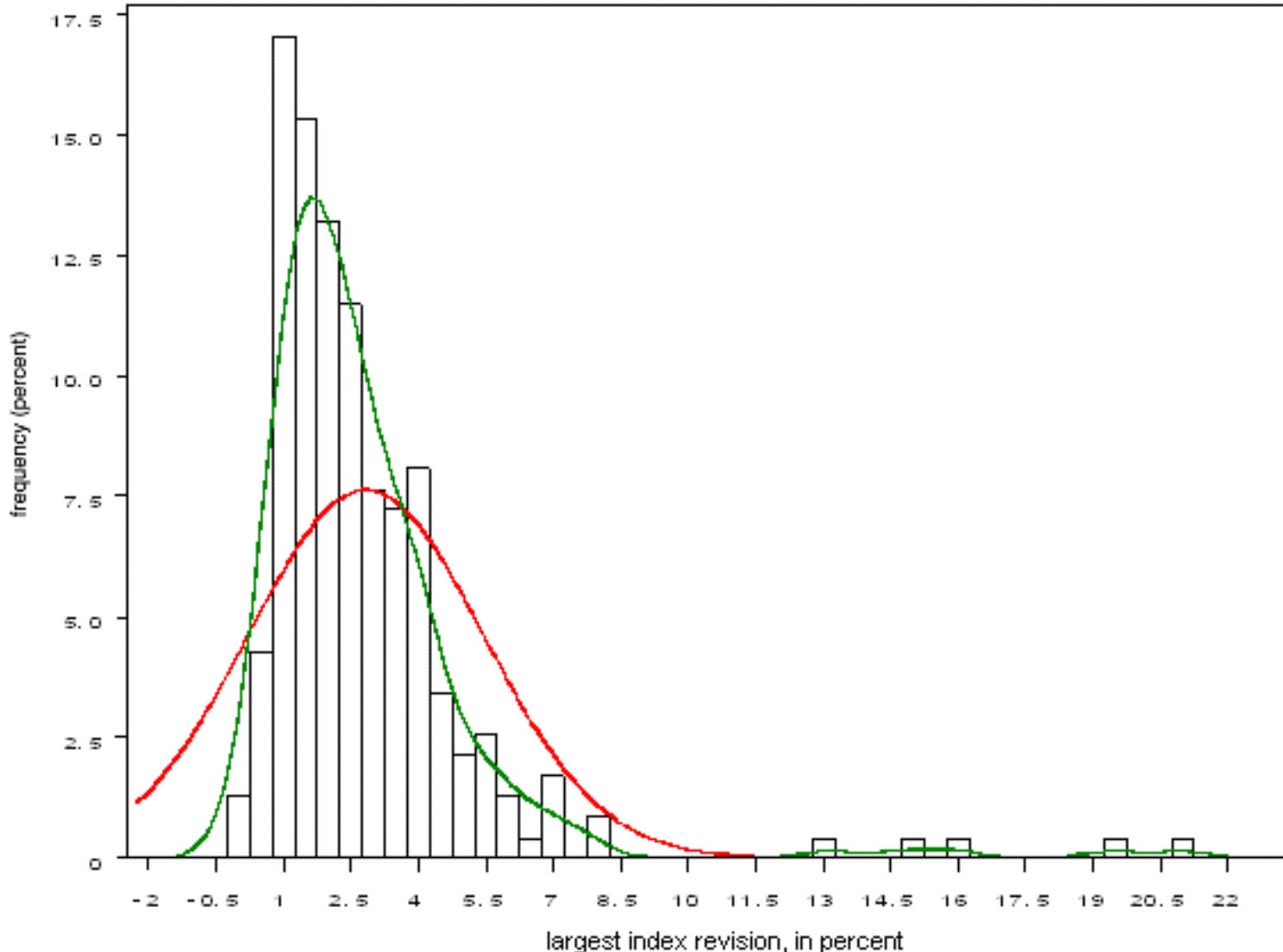




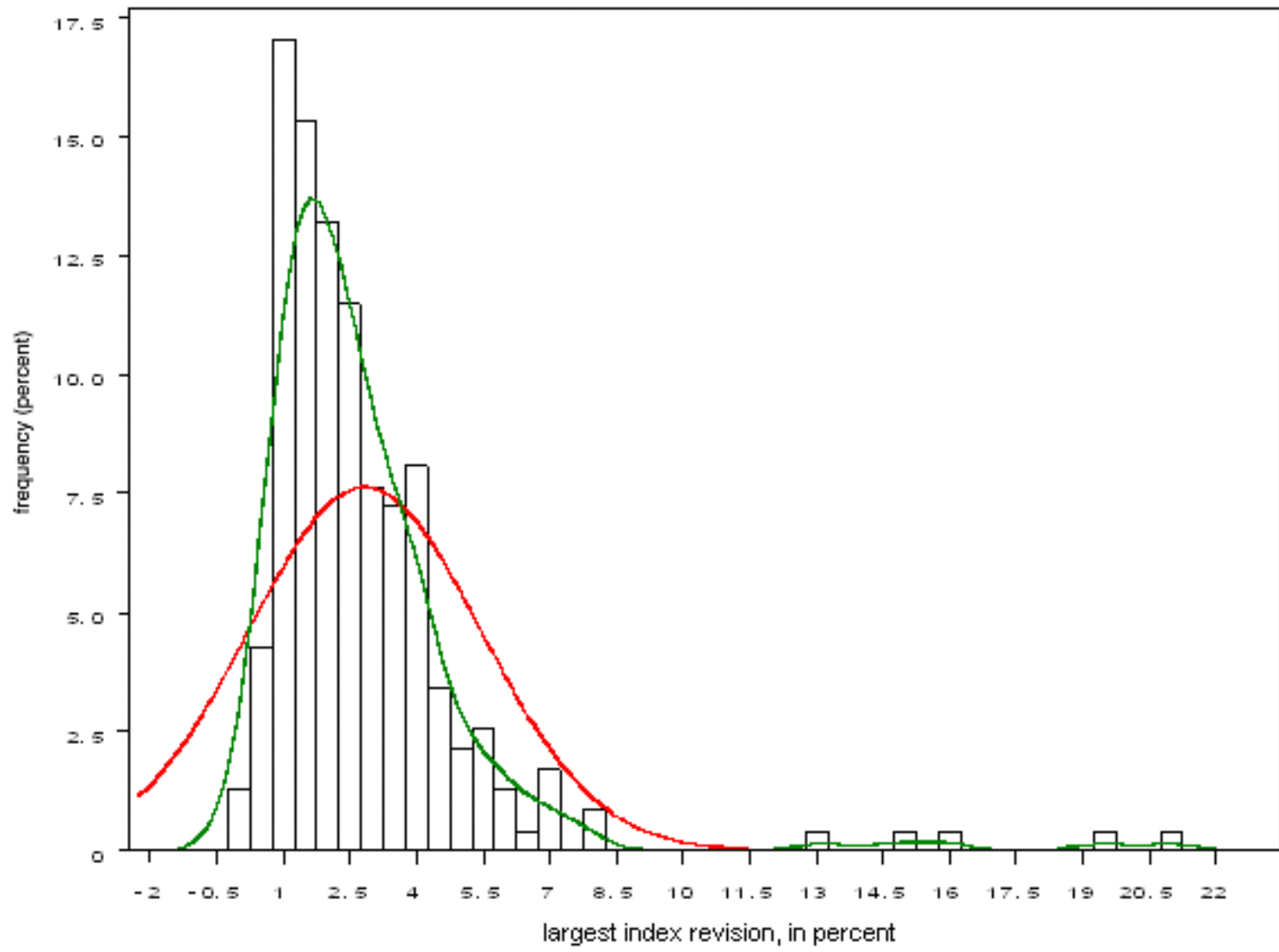
# Frequency Distribution of Mean Absolute Revision in House Price Index, in percent, 238 MSAs (Deng and Quigley, 2008)



# Frequency Distribution of Largest Quarterly Revision in House Price Index, in percent, 238 MSAs (Deng and Quigley, 2008)



# Frequency Distribution of Largest Absolute Quarterly Revision in House Price Index, in percent, 238 MSAs (Deng and Quigley, 2008)



# Challenges of Indexing Transaction Prices in the Private Property Market:

**Most fundamental price index is based on consummated transaction prices in private property market. But...**

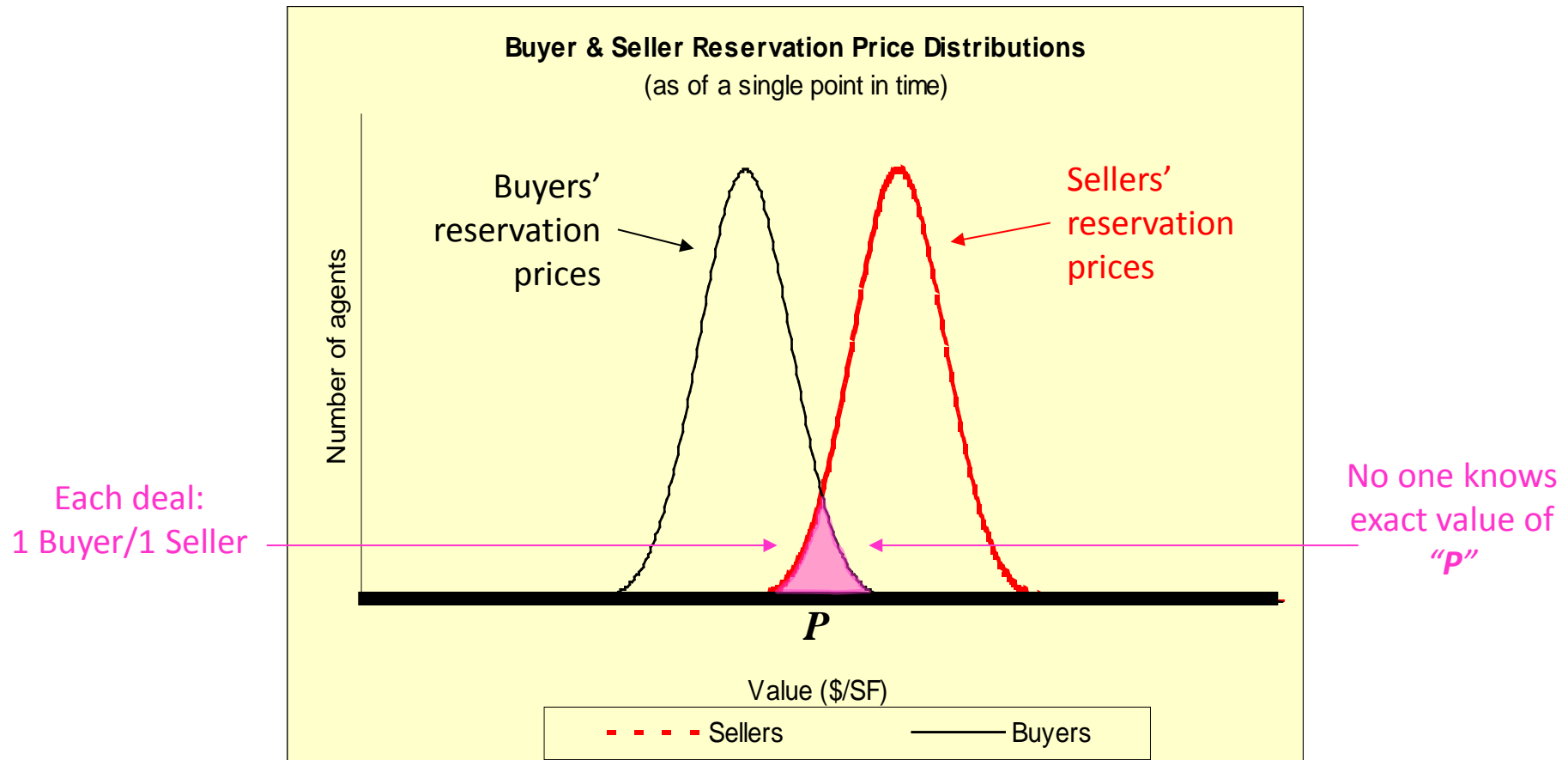
- Traded good is **heterogeneous**, each one unique.
- Individual assets are **traded rarely & irregularly** in time: No naturally occurring matched sample panel.
- Transactions are relatively **sparse** (small samples).
- Especially at market-segment level (“**granular indices**”).
- Prices are “**noisy**” (heterogeneous agents: price dispersion).

## **Two Major Problems:**

- **Noise** in the index (statistical estimation “error”).
- **Bias** in the index (omitted variables, non-representative samples)

# 1. Real Estate Asset Markets

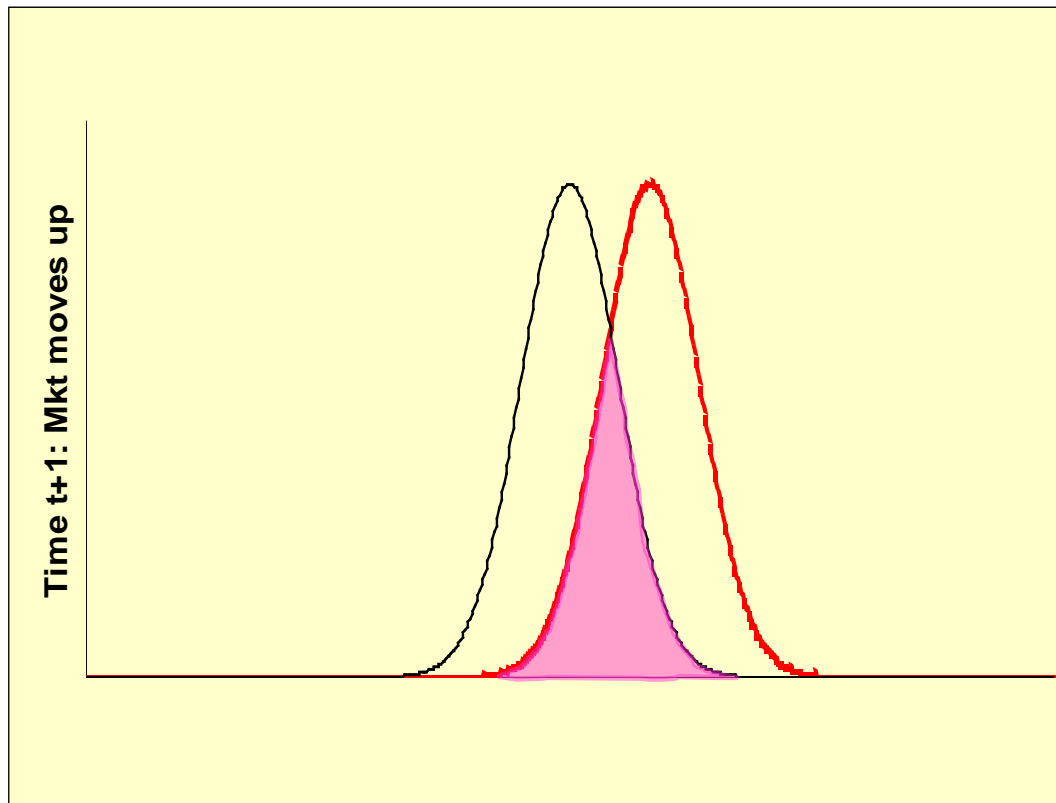
Volume of transactions (liquidity in period  $t$ ) is proportional to *area* of “**overlap region**” (intersection of buyers’ & sellers’ distributions):



**Heterogeneous Traders → Observed Prices Dispersed Around “P”.**

# 1. Real Estate Asset Markets

## Evolution of Buyer & Seller Reservation Price Distributions Reflecting Variable Liquidity

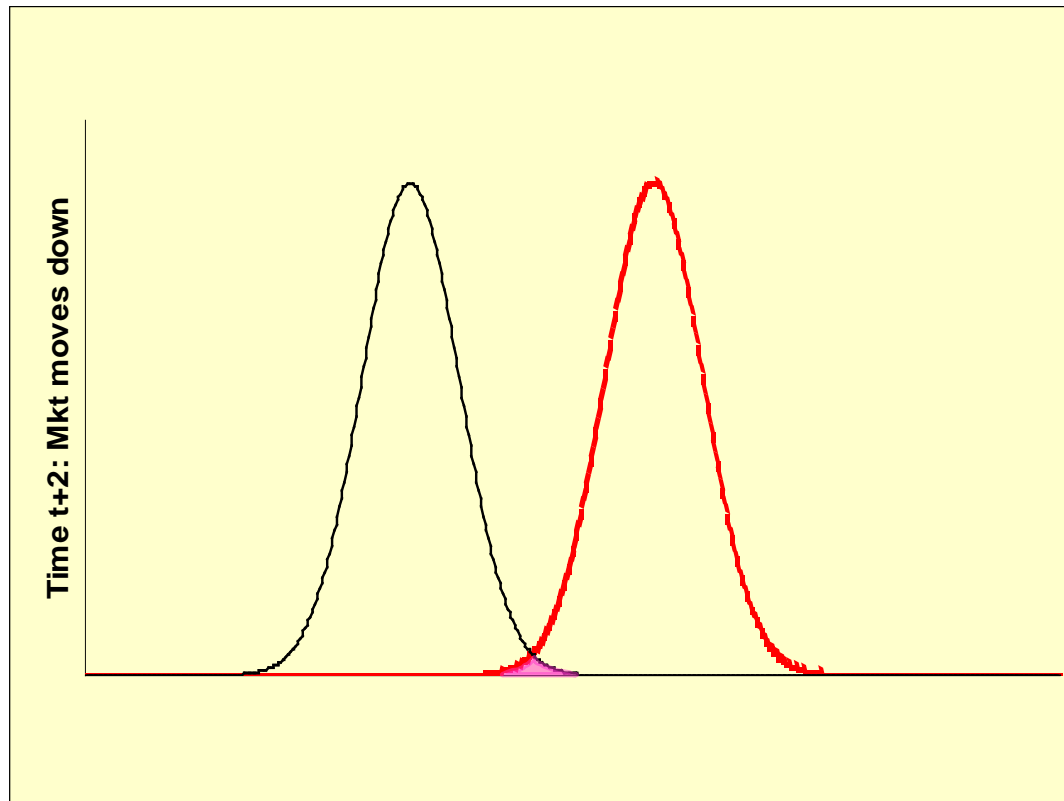


Up Market



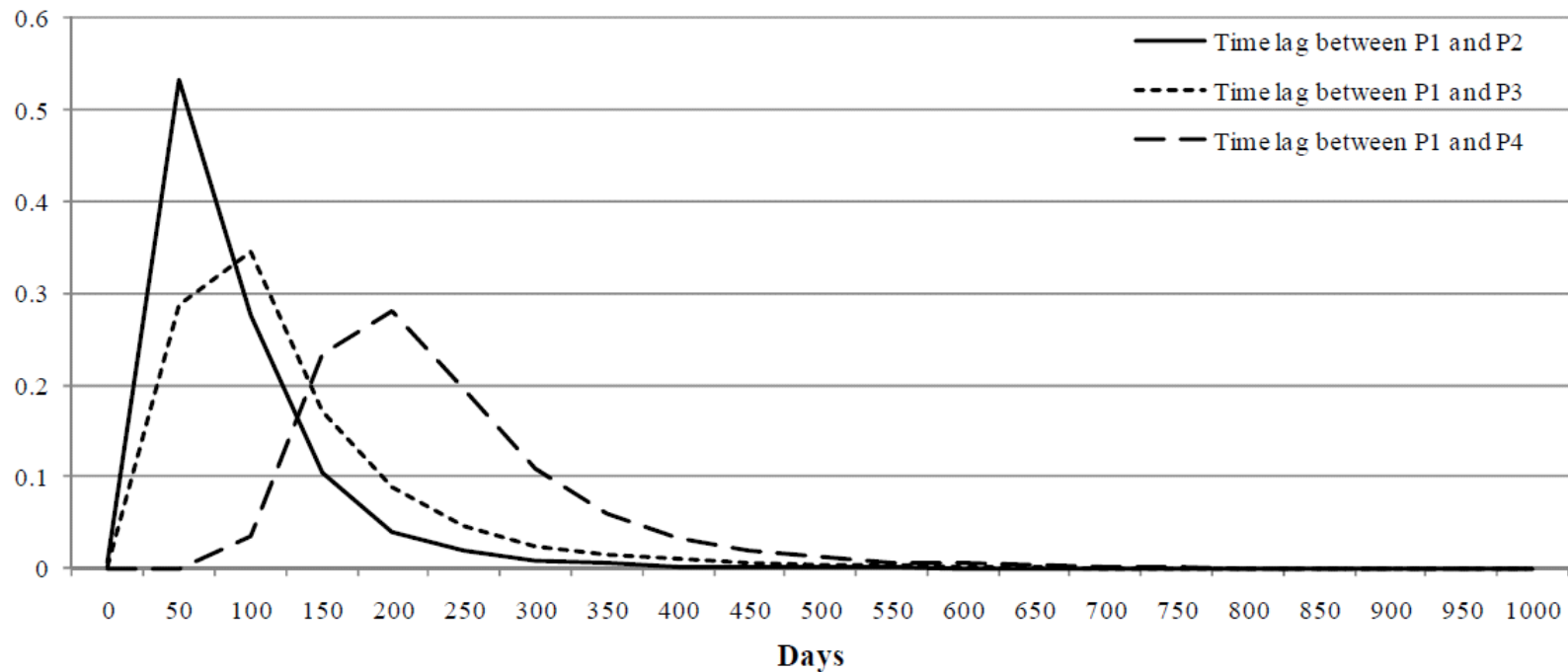
# 1. Real Estate Asset Markets

## Evolution of Buyer & Seller Reservation Price Distributions Reflecting Variable Liquidity

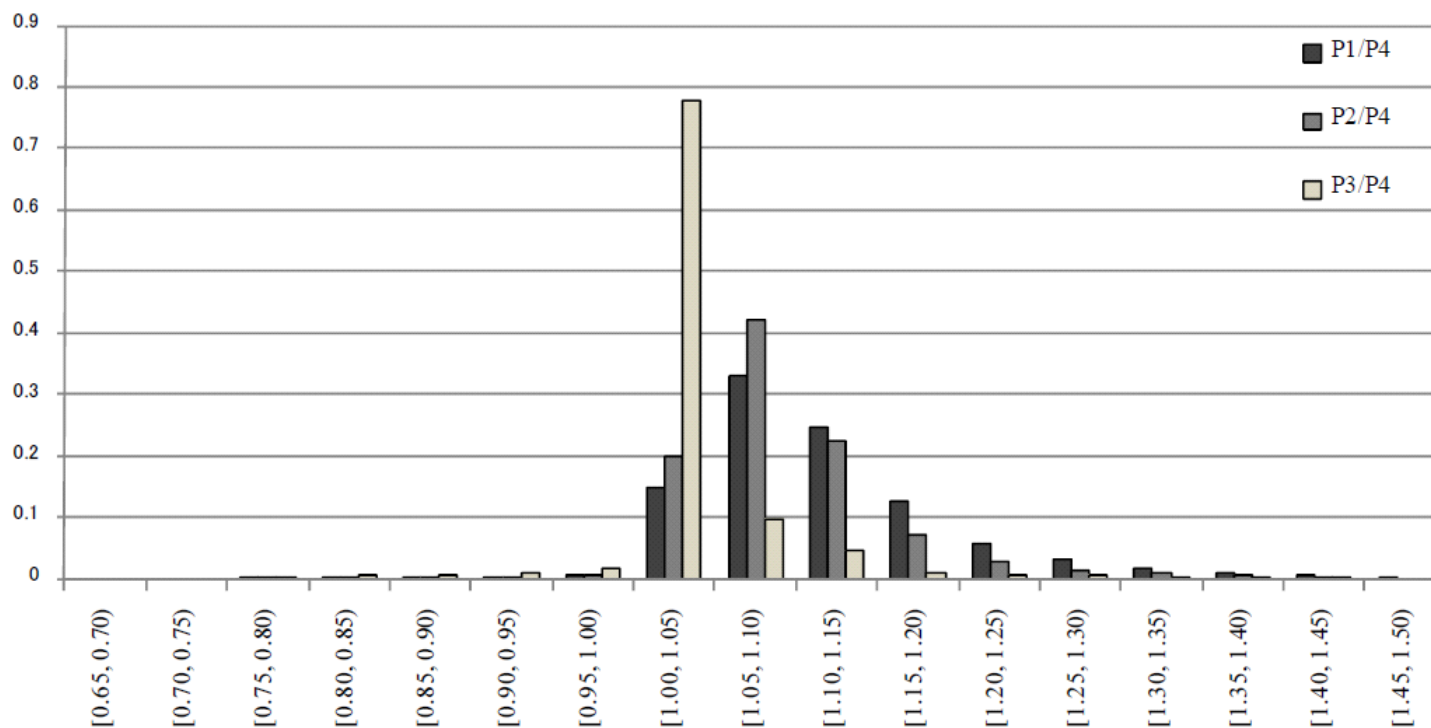


**Down Market**

# Intervals between events in the house buying/selling process



# Densities for relative prices



# Matching Methodology in thinly traded CRE markets (Deng, McMillen and Sing, 2014)

- Matching pairs of CRE transactions based on characteristics of location and structure of properties that are sold in the based (control) period and later (treatment) time
- RSR indices are an extreme form of matching in which each observation is paired with its closest neighbor – itself
- Matching estimator overcomes technical constraints in illiquid markets
  - It is not restricted to a small number of non-random repeat transaction
  - It is less sensitive to changes in sample composition across transaction periods
  - It could explicitly account for variations across different price quantiles over time

# RSR Models

- Hedonic price function for CRE, where  $y_{it}$  is the natural log-sale price of property is defined as

$$y_{it} = \sum_{t=1}^T \delta_t D_{it} + \beta'_t X_{it} + \lambda'_t Z_{it} + u_{it}$$

- Repeat sale price function by (Bailey, Muth and Nourse, 1963; Case and Shiller, 1987, 1989) defines price growth (first order difference in log-price) as

$$y_{it} - y_{is} = (\delta_t D_{it} - \delta_s D_{is}) + (u_{it} - u_{is})$$

# Matching Strategy (Deng, McMillen and Sing, 2014)

- Matching strategy is a two-period RSR model with constant coefficient, which is defined as

$$y_{i,2} - y_{i,1} = (\delta_2 - \delta_1)D_{i,2} + u_{i,2} - u_{i,1}$$

- The time dummy  $D_{i,2}$  estimates the differences in average log-sale prices between control and treatment periods
- The average treatment effect (ATE) is defined as

$$ATE(t_j) = \frac{1}{n_j} \sum_{i=1}^{n_j} D_{ij} E[y_i(t_j) - y_i(t_1)]$$

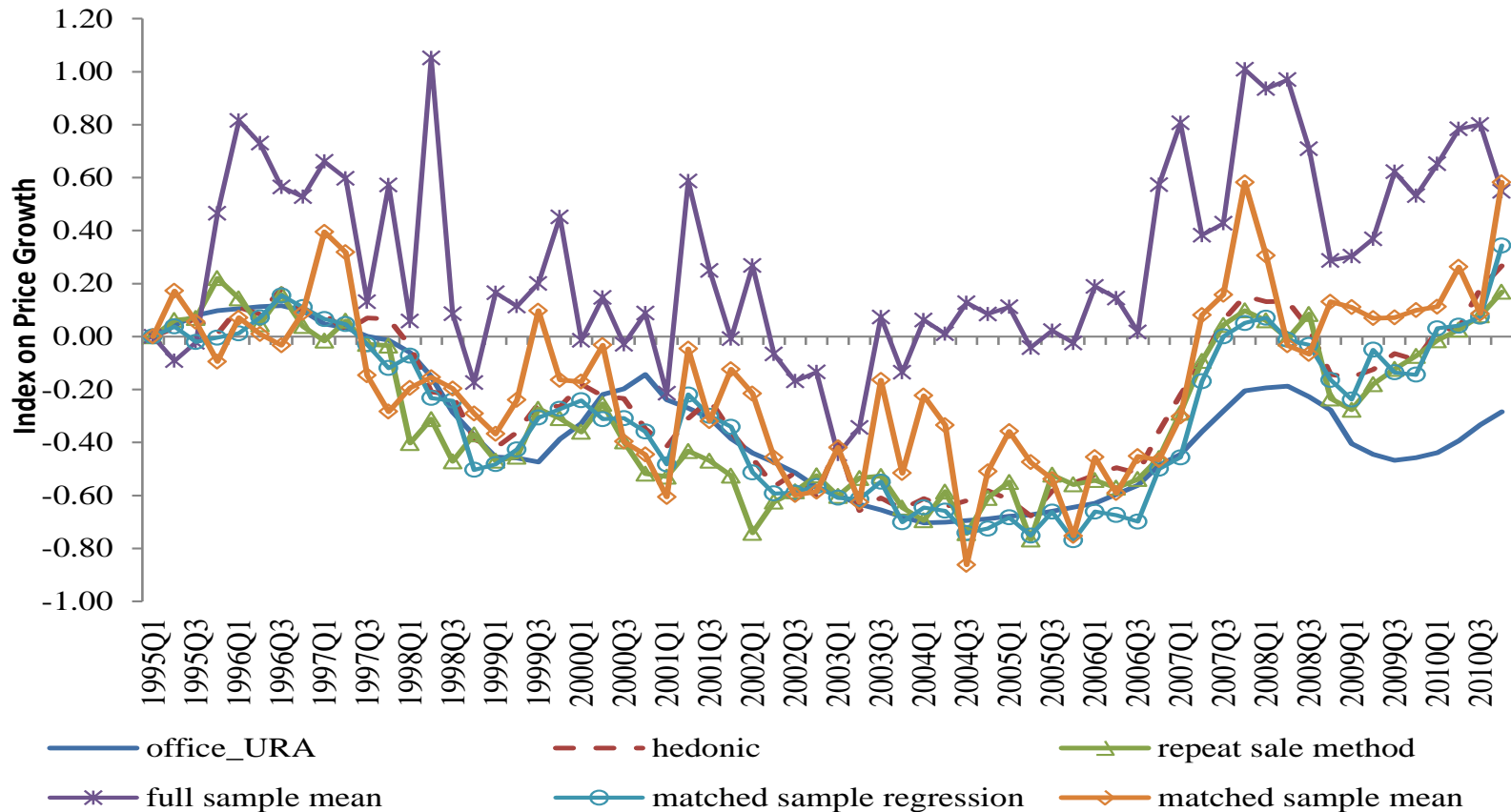
- Based on propensity score approach, the “treatment” is a sale at time  $t$  and the “control” is a sale at time 1, and the predicted value from a Probit model of sale time is used to construct the matches.



# Matching indices for Singapore's CRE markets (Deng, McMillen and Sing, 2014)

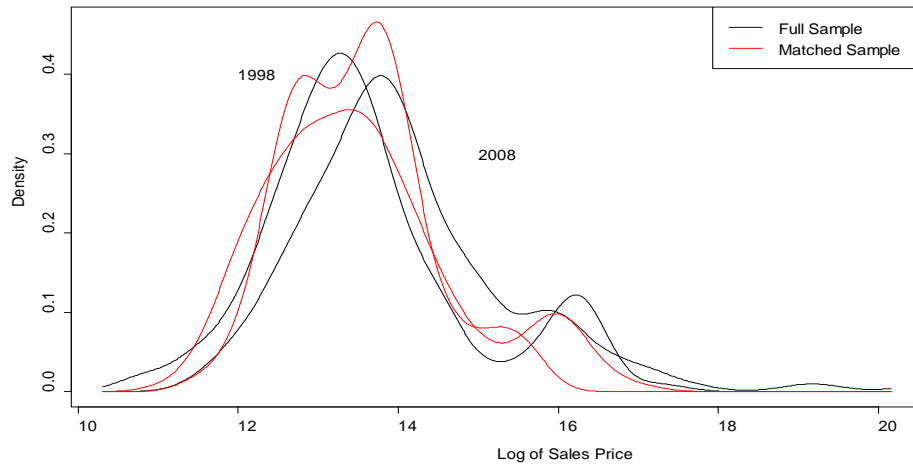
- We estimate the hedonic, repeat sale sample and matched sample price indices
- We plot the indices alongside with the full-sample and matched-sample means and URA CRE indices (see figures)
- The indices are much more volatile than URA CRE indices but they closely track the long-term movements
- We recovered the unmatched samples and compare the indices estimated using matched and unmatched samples (see figures)
- We plot the kernel density of log-price distributions the two periods in 1998 and 2008 (figures)
- The quantile distributions are also analyzed (figures)

# Matched CRE indices and other indices (1)

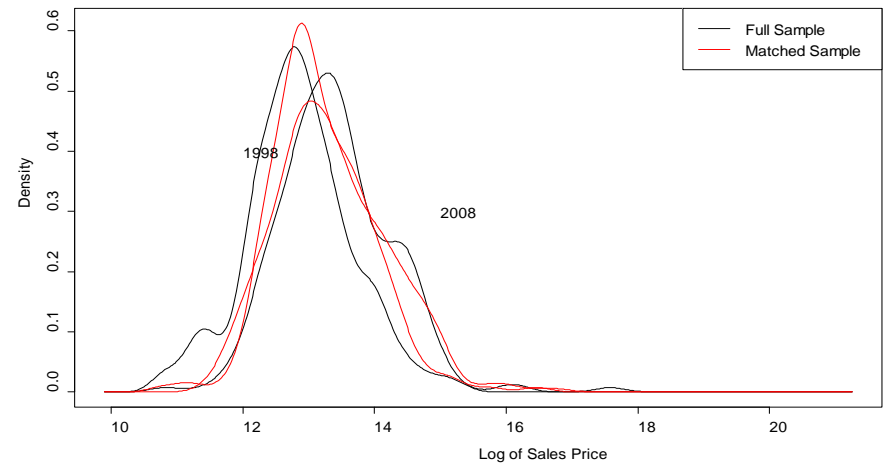


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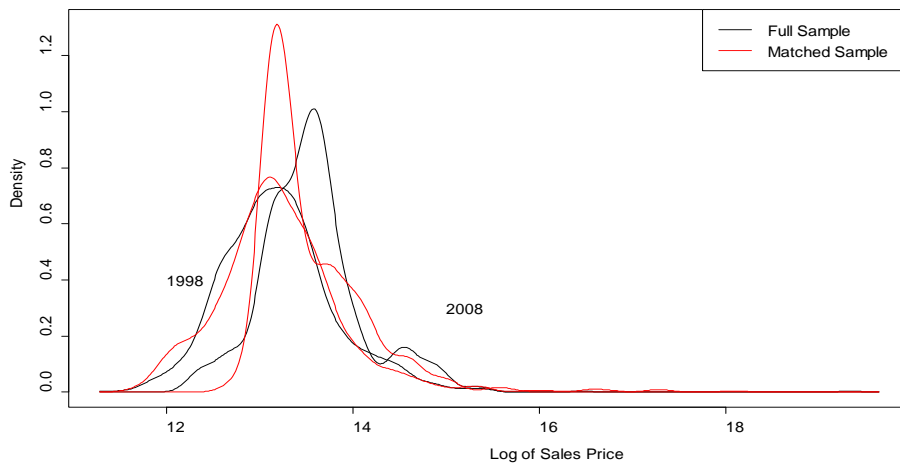
# Sale Price Density



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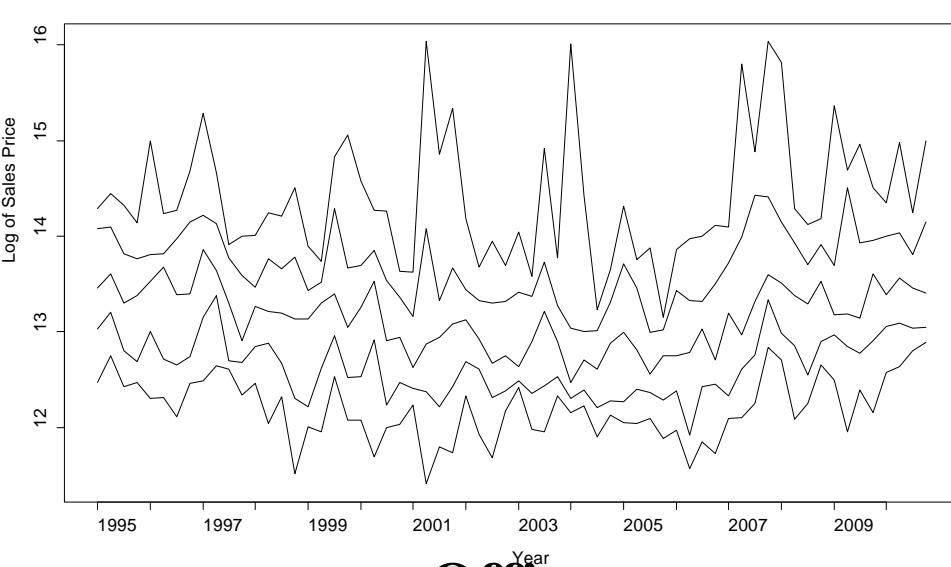


**Shop**

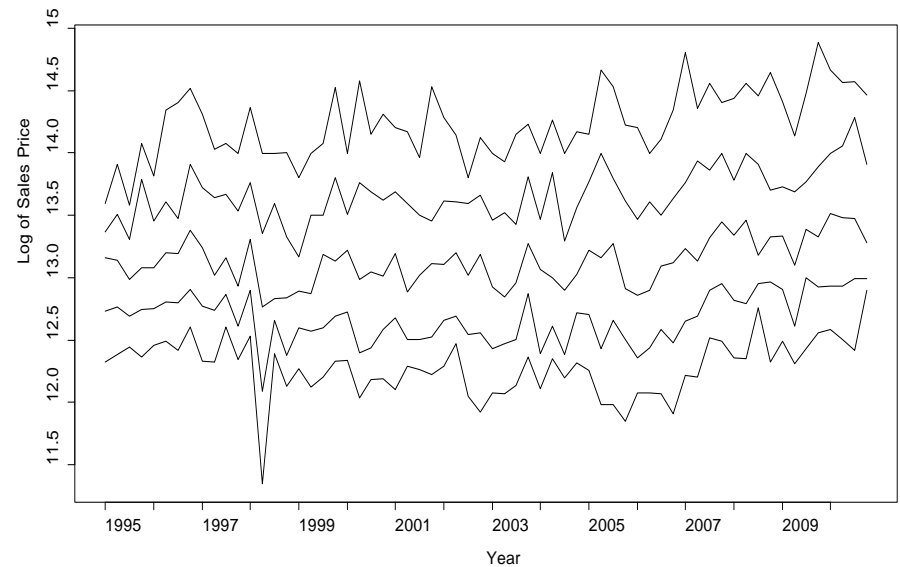


**Multiple-user factory**

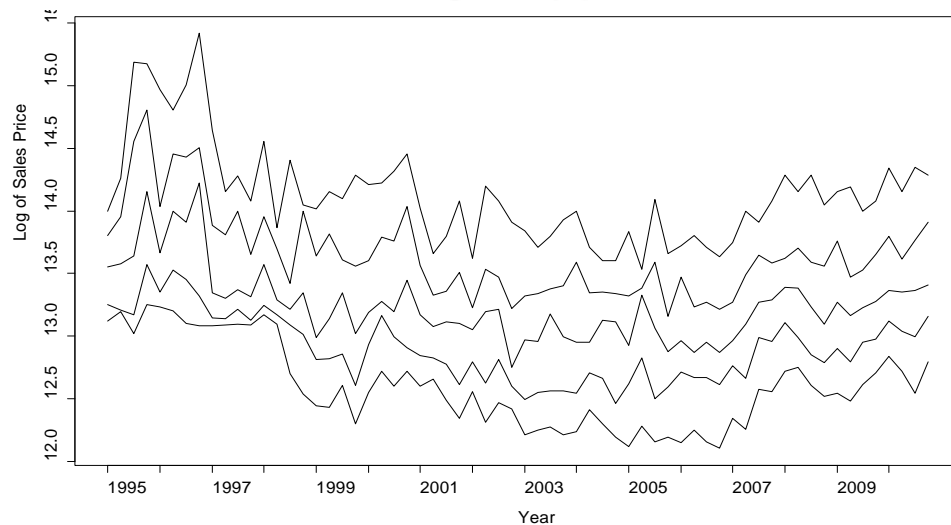
# Price Quantiles for Matched Sample



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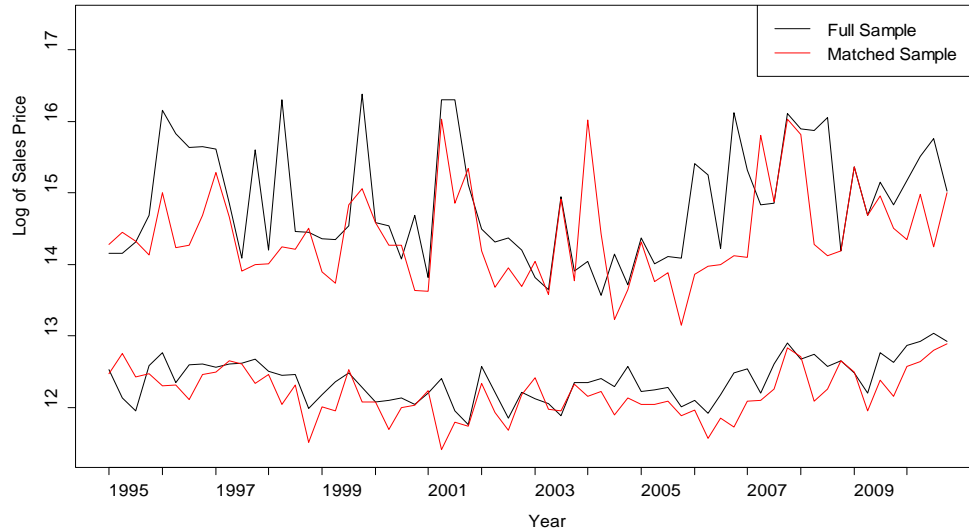


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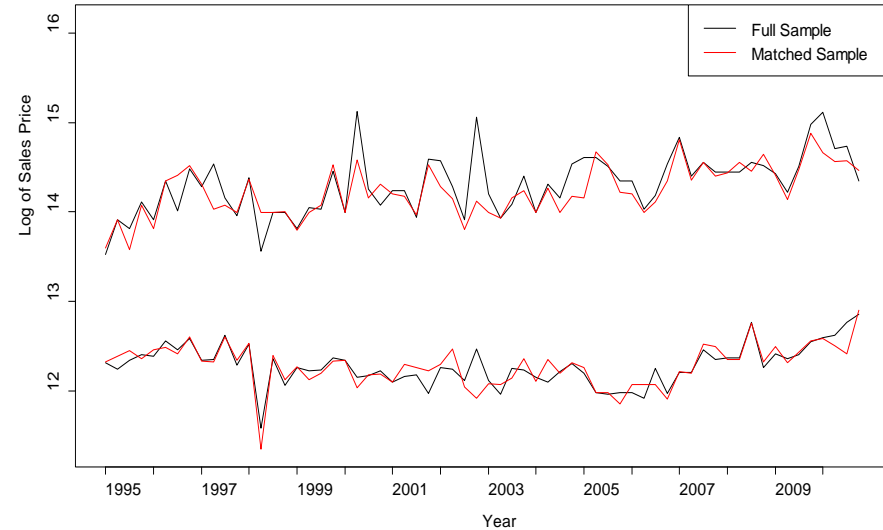


**Multiple-user factory**

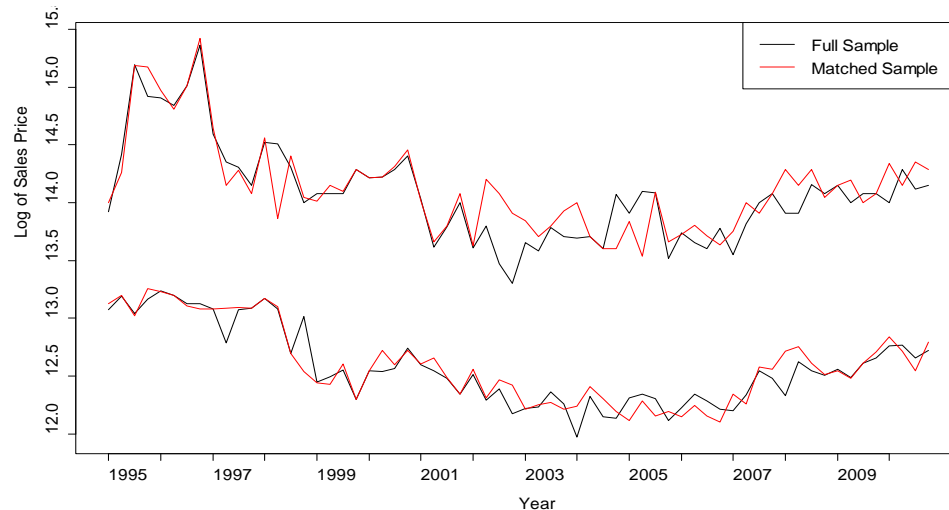
# 10<sup>th</sup> and 90<sup>th</sup> Percentiles of Log Sale Prices



**Office**



**Shop**



**Multiple-user factory**

# Summary on matching indices

- Non-random and thin transactions in CRE markets have been challenging for researchers of CRE indices
- RSR methodology that restricts the samples to pairs of identical properties sold at least twice over time could be restrictive in an illiquid CRE market
- Matching procedure offers an alternative way of dealing with the non-random and thin transactions in CRE markets
- The conventional RSR could be a special case of matching
- Matched indices are less sensitive to small number of unrepresentative repeat sales
- Percentile distributions generated by matched samples add further information on time variations in CRE prices