Session II: CPPI Data Sources and Transaction/Appraisal Based Indices

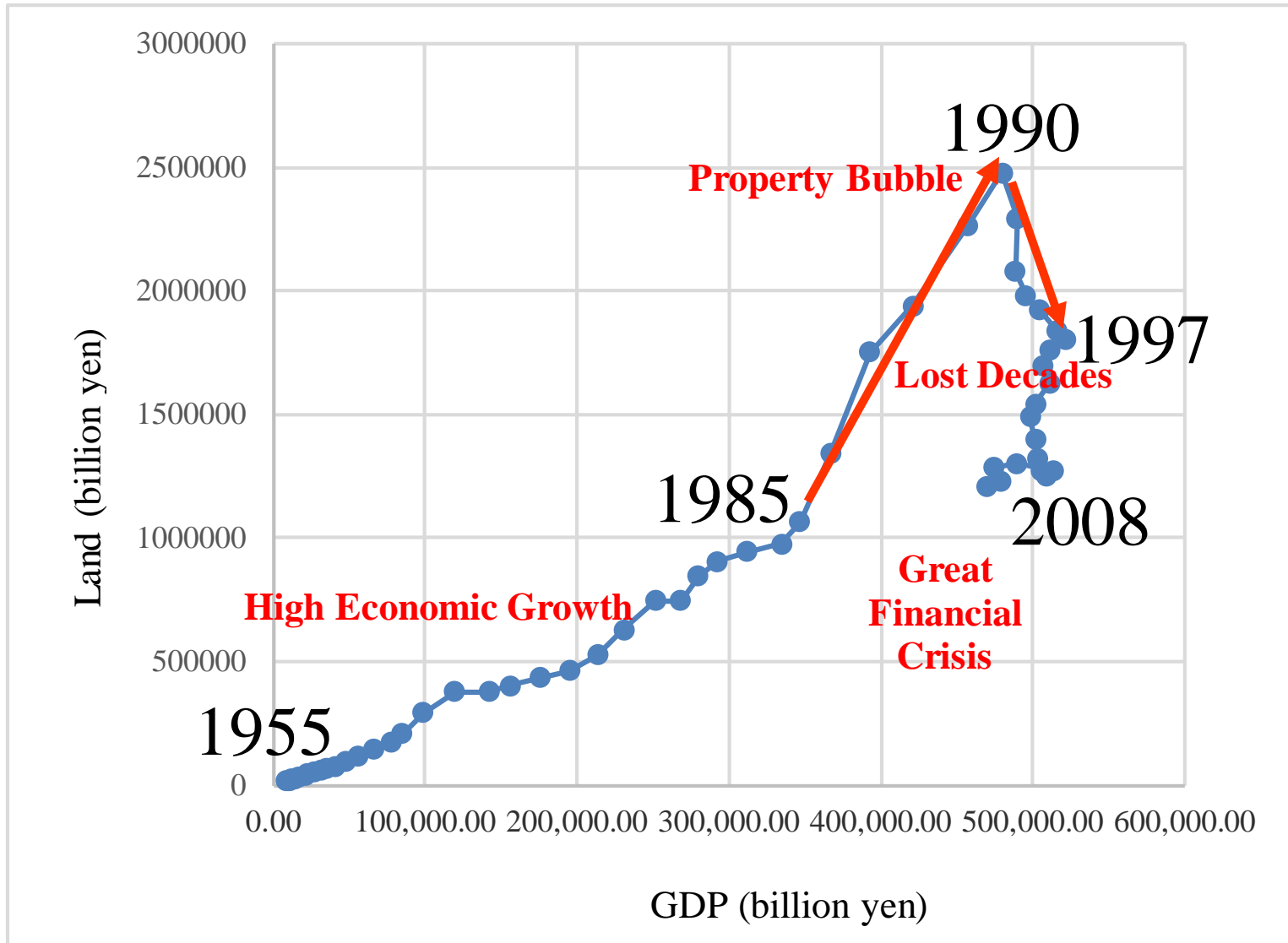# Biases in Commercial Property Price Indexes

Cappadocia, Turkey

Central Bank of the Republic of Turkey

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&

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LEVERAGING SCIENCE, DEVELOPING INNOVATION

I. Lessons from Japanese 20th century Property Bubbles.

Lessons from Japanese experience in Bubble period.

- **Why didn't BOJ change their policy?**
  - BOJ was largely delayed in policy enforcement.(1990)

- **Why did we need long time for disposal bad loan in financial sector?**
  - It was not possible to calculate **correct bad loan debt amounts**, and it took a long time until policy measures were implemented, **including the injection of public funds**.

- **→"Lost decades."**

- **How much did property prices rise in bubble period and drop after the collapse of bubble?**

Commercial Property Price Indices in Japan.

| Survey	Organisation	Use	Source	Data	Frequency	Availability*
Japan Commercial Property Price Index	Ministry of Land, Infrastructure, Transport and Tourism	Office, Retail, Logistics, Hotel and Land	Transaction price	Index	Quarterly	**2008 (Tokyo, Osaka, Nagoya1985)**
Land Market Value Publication (Published Land Price: PLP)	Ministry of Land, Infrastructure, Transport and Tourism	Land for commercial, residential and industrial real estate	**Assessment value**	Appraisal value per unit and average change rate	Annual	1970
Urban Land Price Index	Japan Real Estate Institute	Land for commercial, residential and industrial real estate	**Assessment value**	Average change rate	Biannual	1955
ARES Japan Property Index	THE ASSOCIATION FOR REAL ESTATE SECURITIZATION	Office, Residential, Retail, Logistics, Hotel and others	**Appraisal value**	Return	Monthly	2001
MSCI-IPD Japan Monthly Property Index	IPD: Investment Property Databank	Office, Residential, Retail, Logistics, Hotel and others	**Appraisal value**	Return	Monthly	2001

*Availability means that the data is available from this year.

Why J-CPPI were **not effective** in policy management?

- The question of **why these real estate 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 real estate assessment / appraisal prices** forming the raw data for creating the indexes. ***PLP, ULPI.***

Lessons from Japanese experience.

- 1. Appraisal/Assessment based information has **systematic problem.**
  - Smoothing problem, **Valuation error problem**, Lagging problem, Client influence problem.   (Nishimura and Shimizu(2003), Shimizu and Nishimura(2006), (2007)
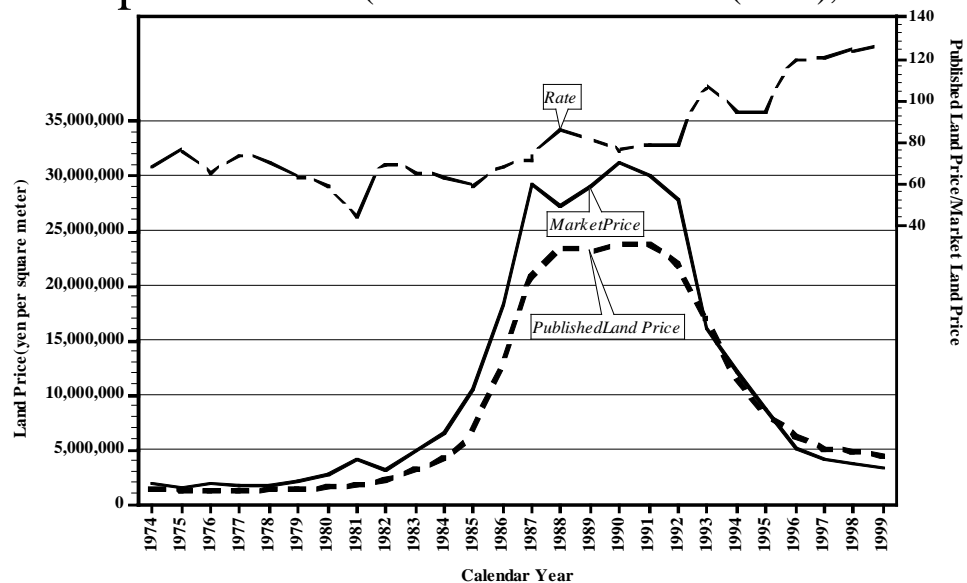
- 2. This kind of problem was a major factor in the delay in disposing of bad loans at financial institutions and **one of the factors leading to the subsequent stagnation of the economy.**

II. Official Property Price Indices in Japan.

- Jun 2006 OECD-IMF Real Estate Price Index Workshop , in Paris

- **2008   Financial crisis, Prof.Erwin Diewert visited to J-Cabinet Office and BOJ.**

- **May. 2009   Ottawa Group Meeting in Switzerland**

- **Dec. 2009   Started Official PPI project at MLIT**

- May 2011   Release "Handbook on Residential Property Prices Indices"

- Aug. 2012   Release Japanese Residential Property Price Index (JRPPI)
    as experimental series MLIT.

- Mar. 2015   Switch JRPPI as official series

- Mar. 2016   Release Japanese Commercial Property Price Index (JCPPI)
    as experimental series by MLIT

- 2018?   Switch JCPPI as official series.

Discussion 1. Methodology.

- **Hedonic Model（pooling data）**

$$\ln P_{it} = \alpha + \ln \boldsymbol{x}_i' \boldsymbol{\beta} + \boldsymbol{d}_i' \boldsymbol{\delta} + \upsilon_{it}$$

$$\boldsymbol{d}_i = \{d_{i2}, d_{i3}, \cdots, d_{it}, \cdots\} \quad \text{Time dummy variable}$$

$$\boldsymbol{\delta} = \{\delta_2, \delta_3, \cdots, \delta_t, \cdots\} \quad \text{Time effect}$$

- **Repeat Sales Model**

- （Bailey, Muth and Nourse1963 A.S.A.J: RS$_{\text{BMN}}$） $\rightarrow$ Log difference of 2nd sale prices and 1st sale prices

$$d_{iu} = \begin{cases} 1 & u = t \\ 0 & u \neq t \end{cases} \qquad \upsilon_{it} \sim NID(0, \sigma_\upsilon^2)$$

$$\ln(P_{it}/P_{is}) = \Delta_{ts} \ln P_i = \boldsymbol{D}_i' \boldsymbol{\delta} + \nu_{its}$$

$$D_{iu} = \begin{cases} -1 & u = s \quad \text{1st sale} \\ 1 & u = t \quad \text{2nd sale} \\ 0 & \text{otherwise} \end{cases} \qquad \nu_{its} = \upsilon_{it} - \upsilon_{is}$$

Disadvantages: Repeat Sales Method and Hedonic Method

- ## Hedonic Method:

- -not all the information that make up property prices is observable; as a result, it has been noted that **"*omitted variable bias*"** occurs.

- ## Repeat Sales Method:

- - there is sample selection bias (Clapp and Giaccotto 1992);

- - 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 Problem***

- **→*Renovation Problem***

- By Diewert, W. Erwin E.(2007), "The Paris OECD-IMF Workshop on Real Estate Price Indexes: Conclusions and Future Directions," The University of British Columbia, Department of Economics, Discussion Paper 07-01.

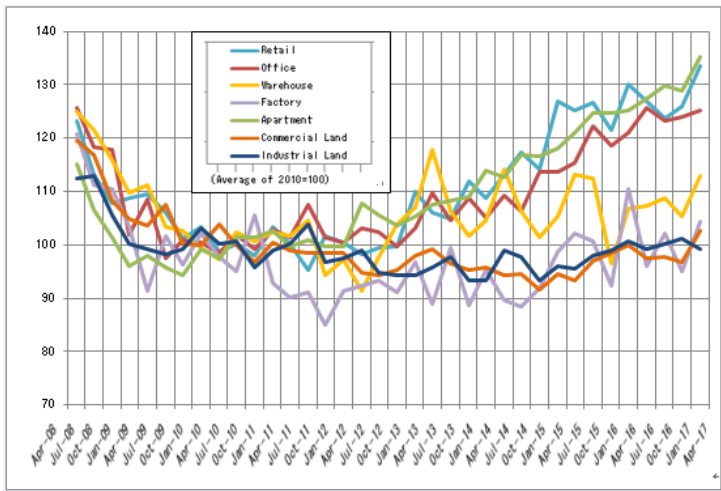# Empirical test in RPPI: Hedonic vs. Repeat Sales Index.
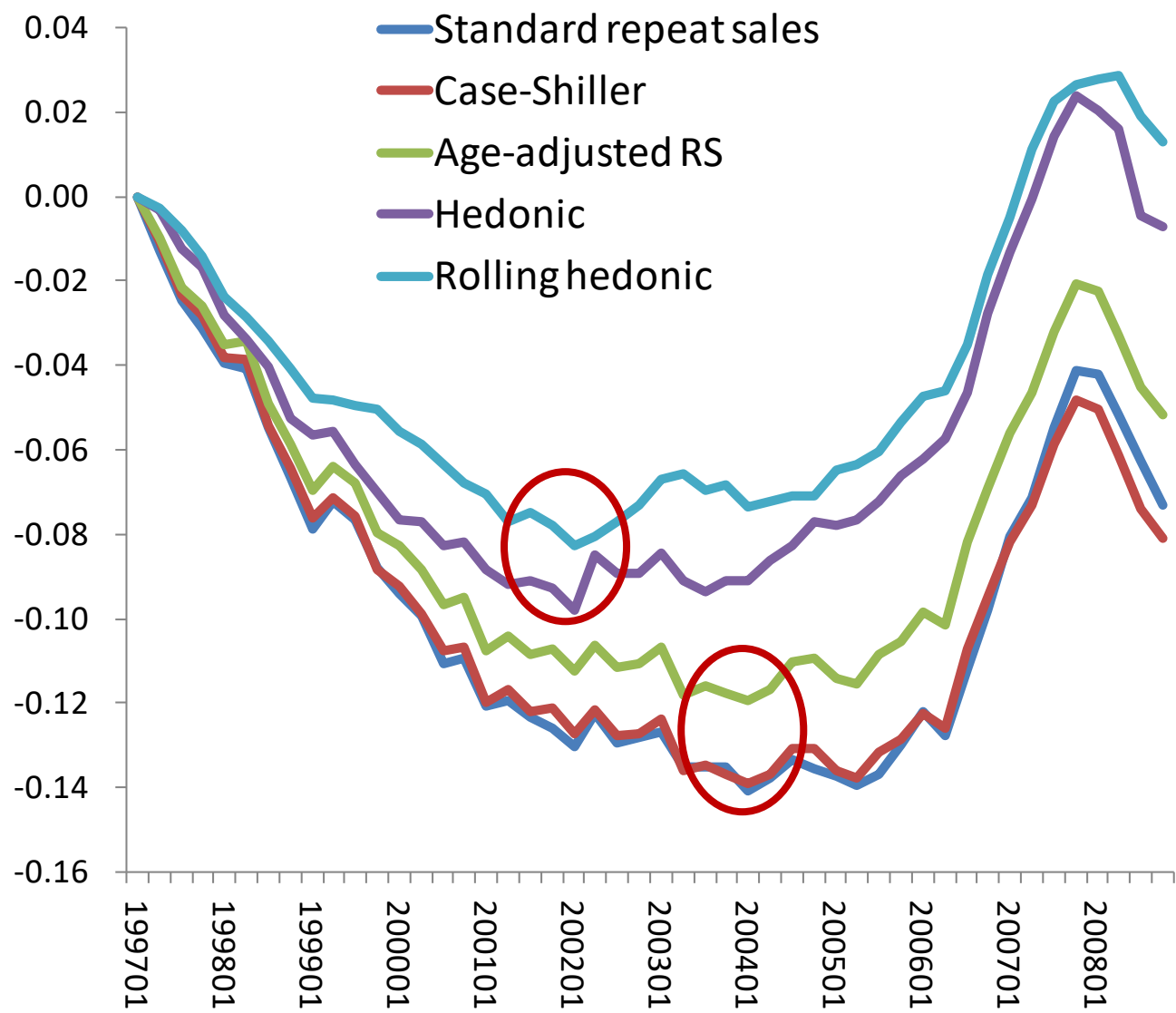
Discussion 2. Data Sources for *RPPI* and *CPPI*.

- Advantages and Disadvantages in 3 Data Sources.

- **a) <u>Transaction prices;</u>**

- b) **<u>Appraisal prices</u>** compiled by real estate markets, e.g.
        the REIT market; and

- c) **<u>Assessment prices</u>** for property tax purposes.
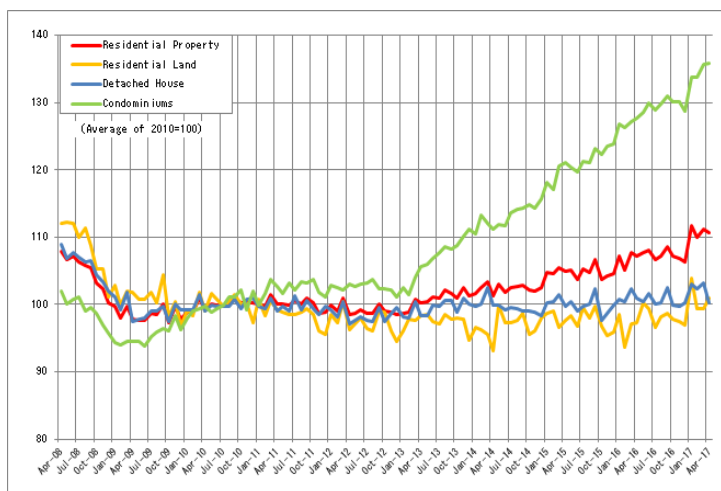
Figures of JRPPI and JCPPI

JCPPI

JRPPI
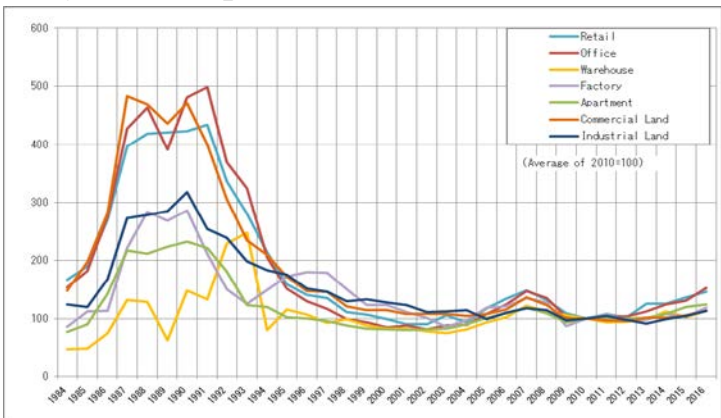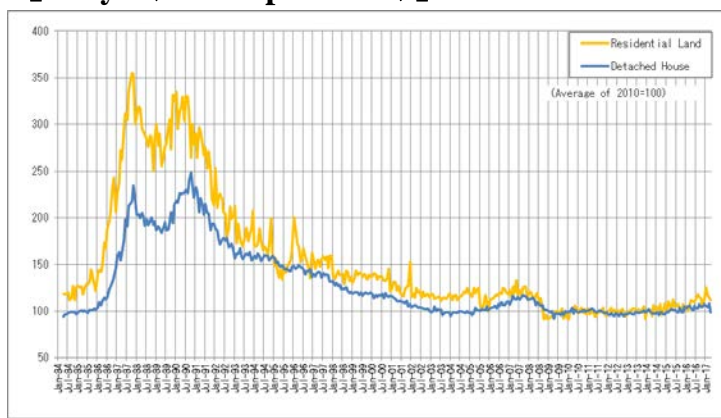
【**Nationwide（since April 2008）**】

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【**Tokyo (since April 1984)**】（※）

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（※）Figures of JCPPI and JRPPI before March 2008 are calculated in cooperation with Tokyo Association of Real Estate Appraisers.

III. Challenges to new methodology

- 1. Applies the ***Builder's Model*** to the Tokyo office market.
  - **Motivation1. SNA requires** ***Balance Sheet Accounts*** of the country; **the stock of** ***Land*** **and** ***Structure***.
  - **Motivation2.** We need "**early warning signal**" for financial policy. "***Land Price Index***" **leads "*Total Value Index*".**

- 2. Compare commercial property price indexes according to the ***different data source*** used.
- a) **Transaction prices**;
- b) **Appraisal prices** compiled by real estate markets, e.g. the REIT market; and
- c) **Assessment prices** for property tax purposes.

Challenge with Builder's Model

- This is not an easy task. **When a commercial property is sold, the selling price values the sum of the structure and land components** and so a structure-land decomposition must be obtained by a modeling exercise.

- The problem of obtaining ***constant quality*** price components for the land and structure components of a commercial property is further complicated by ***heterogeneity***.

- **The transactions in commercial property market is *sparse*.**

- We compared 3 sources for CPPI: Transaction prices, Appraisal prices and Assessment Prices.

# Summary Statistics in three data sources:2005-2015

	MLIT	REIT	PLP
V：Selling Price of Office Building	419.26	6686.60	416.88
	(368.75)	(4055.60)	(1036.40)
P: Unit Price	1.75	4.58	1.26
	(1.33)	(2.26)	(1.30)
S：Structure Floor Area (square metre)	903.30	8509.70	-
	(681.68)	(5463.90)	
L：Land Area (m^2)	254.24	1802.10	229.94
	(160.72)	(1580.20)	(217.18)
H：Total Number of Stories	5.79	10.12	-
	(2.17)	(3.30)	
A：Age (year)	24.32	19.14	-
	(10.67)	(6.80)	
DS：Distance to Nearest Station	387.61	308.29	347.24
	(237.73)	(170.04)	(254.79)
TT：Time to Tokyo	19.65	15.88	21.74
	(8.24)	(5.10)	(8.54)
PS：Construction Structure Price	23.47	23.59	-
	(1.03)	(1.02)	
Number of Observations	1,968	1,804	6,242

( ): Standard deviation

Estimated results in Hedonic equation in MLIT and REIT

Estimation Method	OLS	
DataSet	MLIT	REIT
Number of Observations	1,968	1,804
Dependent Variable	V	V
L : Land area	0.0019	0.0001
	(18.960)	(12.100)
S : Structure floor area	0.0003	0.0001
	(12.160)	(32.630)
A : Depreciation rate	-0.0089	-0.0356
	-(9.177)	-(19.770)
H : Total number of stories	0.1067	-0.0014
	(15.760)	-(0.430)
DS: Distance to the nearest station	-0.0003	-0.0013
	-(6.192)	-(17.960)
TT :Time to the Tokyo station	-0.0074	0.0036
	-(3.830)	(1.271)
WD_k(Location dummy)	Yes	
Dt (Time dummy)	Yes	
R-SQUARE	0.744	0.736

( ): t-Value

Comparison of Standard hedonic indices : Office use
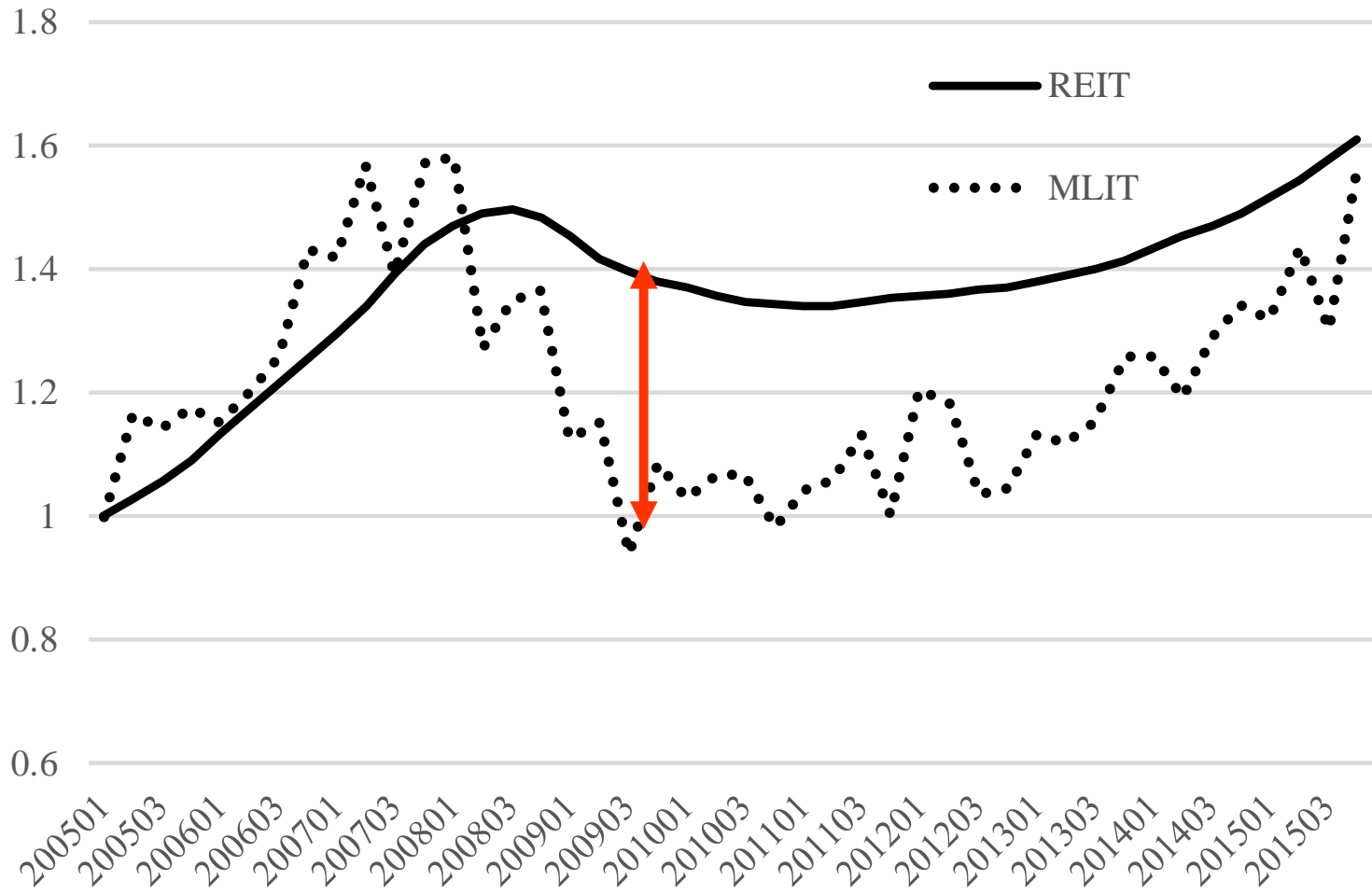
The Builder's Model

- (1) $V_{tn} = \alpha_t L_{tn} + \beta_t S_{tn} + \varepsilon_{tn}$; $t = 1,...,44; n = 1,...,N(t)$.

- The *builder's model* for valuing a commercial property postulates that the value of a commercial property is the sum of two components:

- *the value of the land* which the structure sits on **plus** *the value of the commercial structure*.

- The total cost of the property after the structure is completed will be equal to **the floor space area of the structure**, say $\underline{S}$ square meters, times the **building cost** per square meter, $\underline{\beta}$ say, plus **the cost of the land**, which will be equal to the cost per square meter, $\underline{\alpha}$ say, times **the area of the land site, $\underline{L}$**.

The Builder's Model

- **For older structures, we modify eq (1) and allow for *geometric depreciation* of the structure:**

(2) $V_{tn} = \alpha_t L_{tn} + \beta_t (1 - \delta_t)^{A(t,n)} S_{tn} + \varepsilon_{tn}$;

  where the parameter δ_t reflects the ***net depreciation***

 *rate* as the structure ages one additional period and

- L_{tn} is **the unit's share of the total land plot area of the structure,** α_t is the price of land (per meter squared), β_t is the price of commercial space (per meter squared), **A(t,n) is the age** of the structure in years and S_{tn} is the floor space of the unit (in square meters).

- δ_t is regarded as a ***net depreciation rate*** because it is equal to a "true" gross structure depreciation rate less an average renovations appreciation rate.

Estimated Results of Builder's Model

Estimation Method	NL				
Number of Observations	1,968				
Dependent Variable	**PL**				**V**
Model	Model.1	Model.2	Model.3	Model.4	Model.5
A：Depreciation rate	-	-	-	-	0.065 (6.739)
DS:Distance to the nearest station (metre)	-	-	-	-0.0003 (-5.197)	-0.0002 (-4.972)
TT:Time to the Tokyo station (minutes)	-	-	-	-0.003 (-1.192)	-0.004 (-1.619)
WD$_k$(Location dummy)	Yes				
Dt (Time dummy)	Yes				
R-SQUARE	0.640	0.659	0.730	0.733	0.734
LOG-LIKELIHOOD FUNCTION	-13421.67	-13373.05	-13136.04	-13373.05	-13122.71

( ): t-Value

# Comparison with V(Value of Property), PL(Land) and PS(Structure).
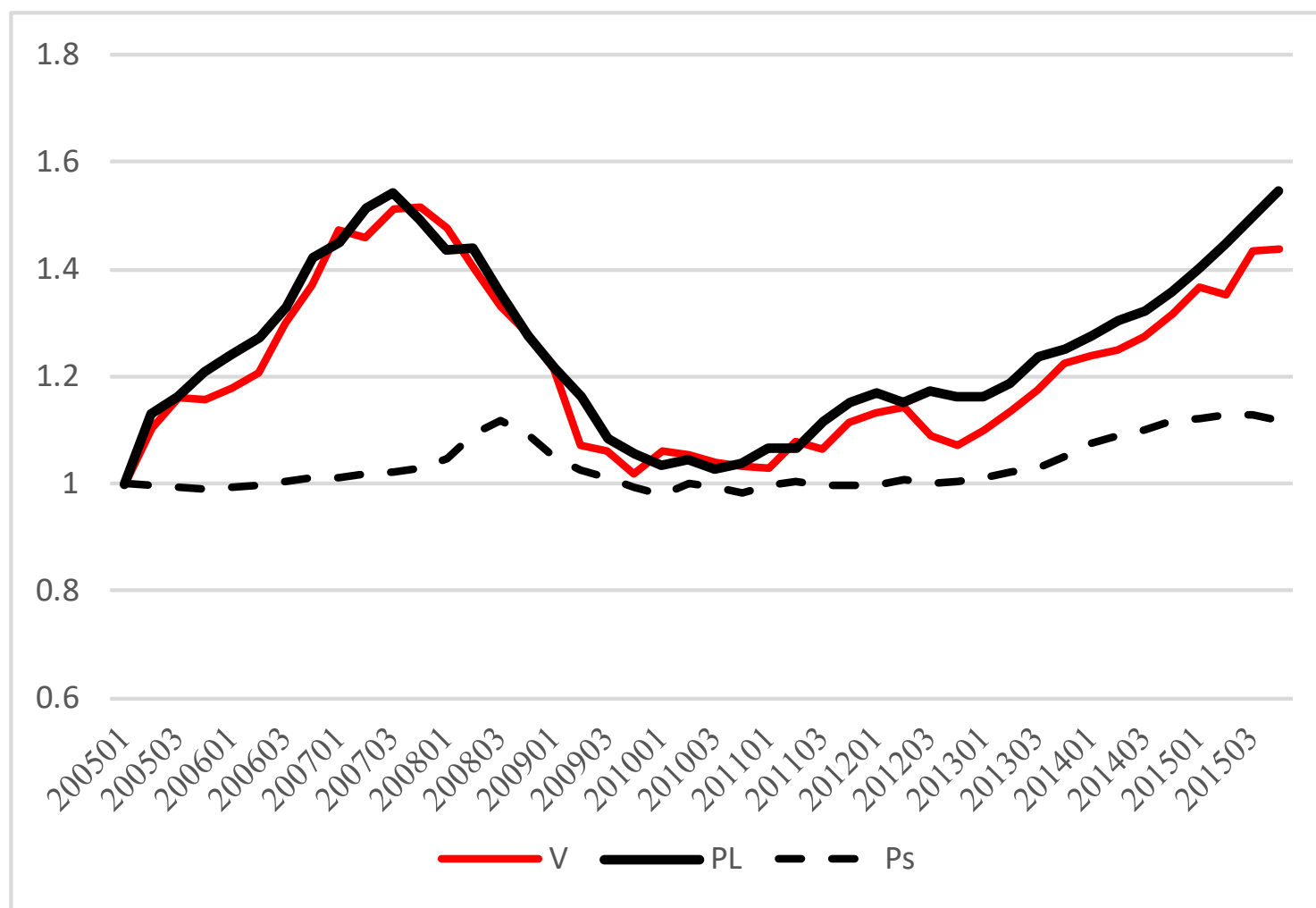
Comparison with Appraisal Prices and Assessment Prices

Table4. Estimated Results with Three Data Source in Tokyo

Estimation Method	NL		
DataSet	MLIT	REIT	PLP
Number of Observations	1,968	1,804	6,242
Dependent Variable	V	V	PL
A : Depreciation rate	0.067	0.036	
	(7.388)	(0.005)	
DS: Distance to the nearest station	-0.0002	0.0000	-0.0009
	-(5.689)	(0.000)	(0.000)
TT :Time to the Tokyo station	-0.004	-0.005	-0.022408
	-(2.125)	(0.002)	(0.001)
WD_k(Location dummy)	Yes		
Dt (Time dummy)	Yes		
R-SQUARE	0.728	0.869	0.857

( ): t-Value

Comparison of PL's from Three Data Sources and PS
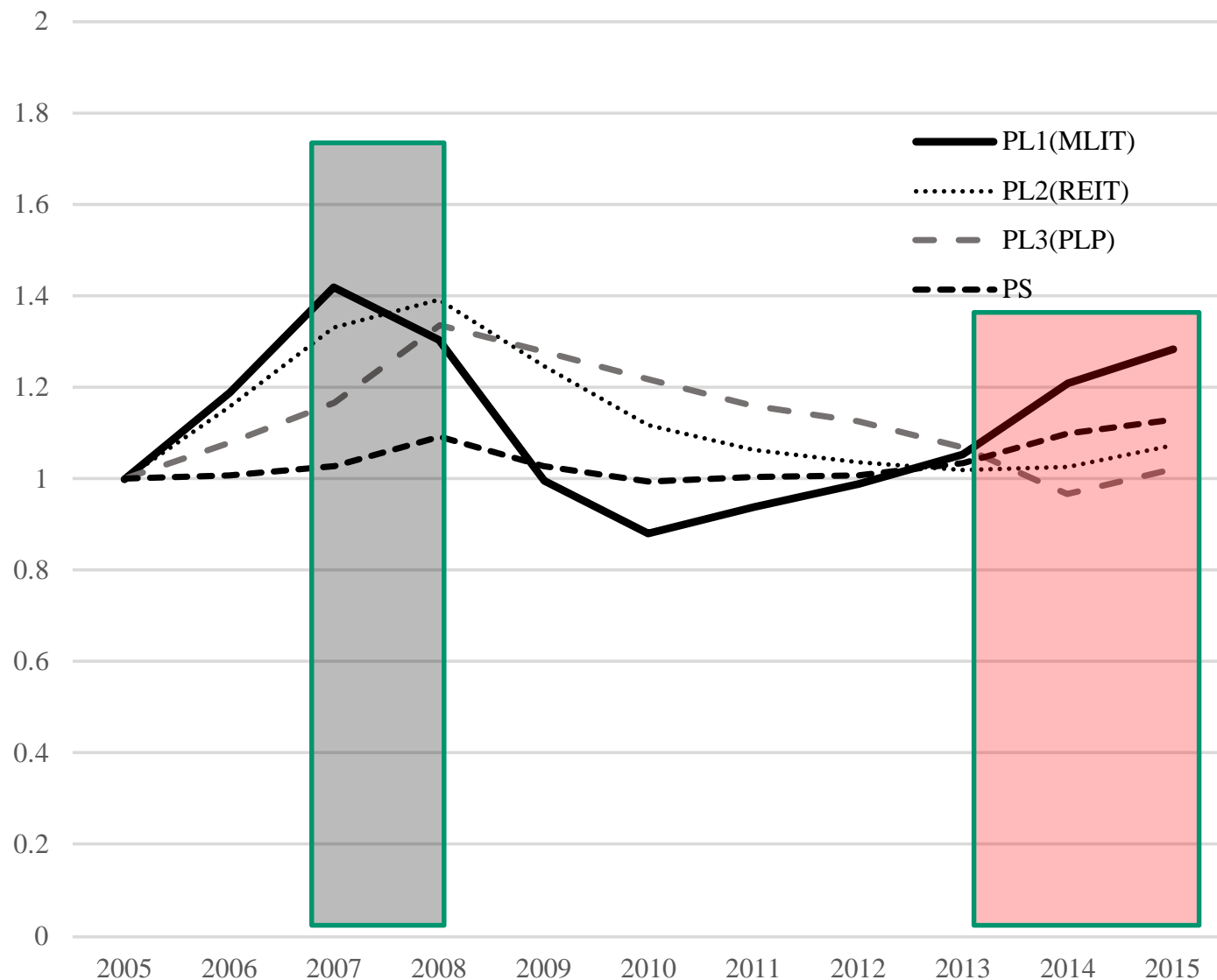
IV. Conclusions.

- When actually measuring property price indexes, **the problem of selecting the estimation method and the data sources** must be confronted.

- **Methodology:** J-Official CPPI decided to use hedonic measure because the **repeat sales measure tends to exhibit a delayed turn** compared with the hedonic measure.→**Hedonic measurement.**

- **Data Source:** Aside from transaction prices, the data source options used are: appraisal prices obtained from the REIT market and assessment prices for property tax purposes. However, it was established that compared to transaction price-based indexes, **those based on appraisal and assessment prices exhibit a certain degree of lagging.**→**Transaction prices**

Conclusions.

- **Economic Measurement: For the purpose of SNA, indexes that separate land from structure are necessary**. It was demonstrated that the Builder's Model proposed by Diewert and Shimizu (2005a), (2006a) as an estimation method **for a Commercial Property Price Index** that separates land from structure, can also be used with a certain level of precision in the office market, which is *highly heterogeneous* compared to the residential housing market.

- **Financial Policy:** We need **early warning signal** in property market for financial policy. **Constant quality " *land* " price index from Builder's model leads "*total*" value index**.

Conclusions.

- **Future Works:**

- Numerous problems still remain. In the realm of commercial properties, there are many other structures with **diverse uses, e.g. commercial facilities, factories, medical facilities, warehouses, or hotels.**

- In such markets, it is to be expected that transactions prices are even ***more scarce***, and properties, even more ***heterogeneous***, when compared to the office market.

- REIT Stock market Index for Public Pension Fund and FSA.

REIT stock based Daily CPPI, $PV(M,M)$, $PV(A,M)$
: 2003.1.4 – 2012.11.16
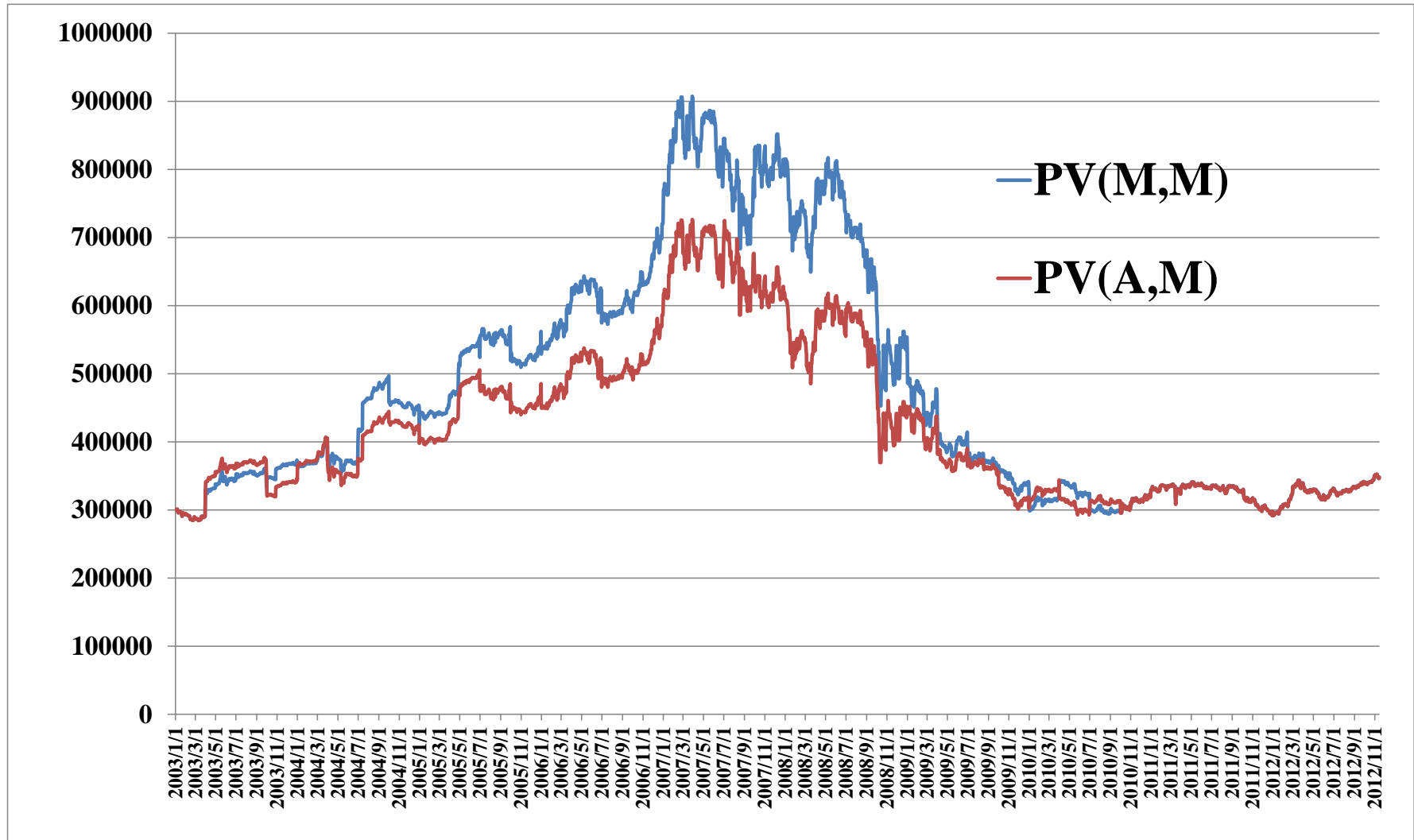
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