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The Estimation of Owner Occupied Housing Indexes using the RPPI: The Case of Tokyo

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Chihiro Shimizu

(Reitaku University & University of British Columbia).

with

W.Erwin Diewert (University of British Columbia).

Kiyohiko.G. Nishimura (The Deputy Governor of Bank of Japan).

Tsutomu Watanabe (University of Tokyo).

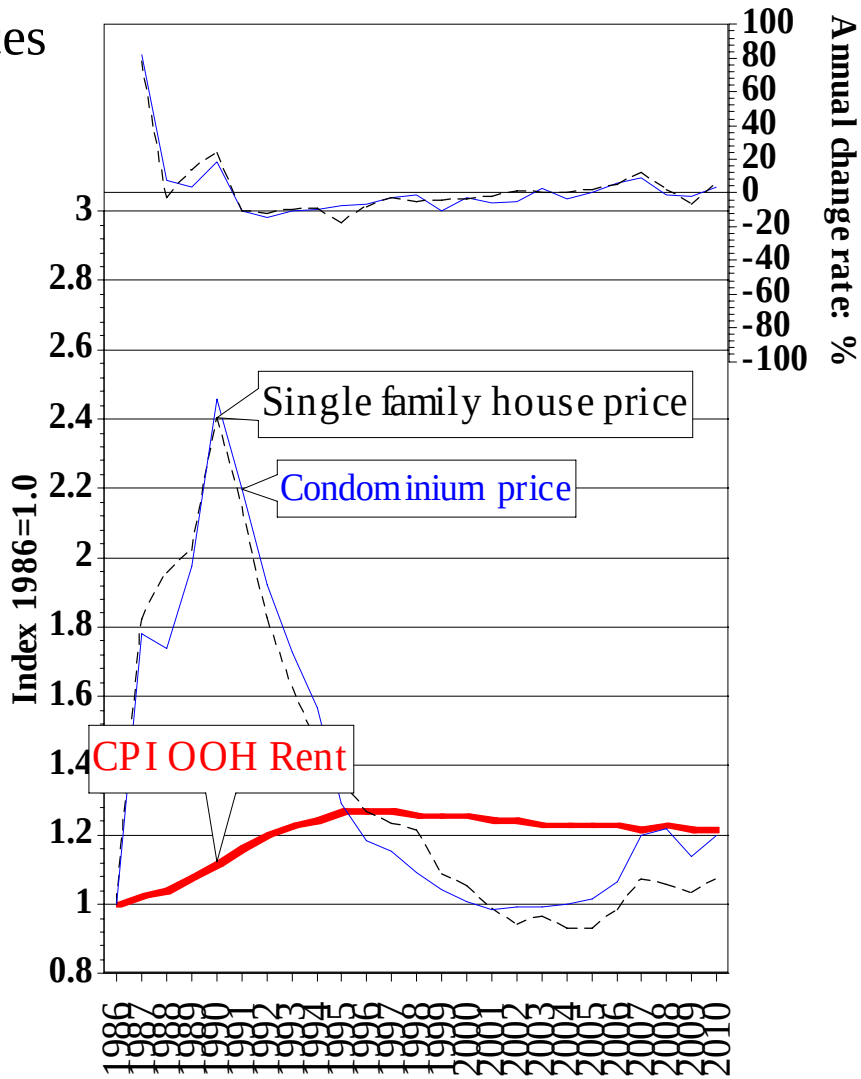
Ⅰ. Housing prices and OOH rent for CPI.

The most important link between asset prices and goods & services prices is the one through housing rents **(Diewert and Nakamura 2011, Goodhart 2001)**

1. Housing rents account for **more than one fourth of personal spending.**

2. Imputed Rent for OOH also represents a weight of approximately 10% in the SNA

2009= 10.1%, 2010 =9.85%



cshimizu@reitaku-u.ac.jp

Ⅱ. How should we estimate OOH Imputed rent?.

The User Cost Approach

The Equivalent Rent Approach

$$V_v^t = \frac{y_v^t}{1+r^t} + \frac{y_{v+1}^{t+1}}{(1+r^t)(1+r^{t+1})} + \cdots + \frac{y_{m-1}^{t+m-v-1}}{\prod_{i=t}^{t+m-v-1}(1+r^i)} - \frac{O_v^t}{1+r^t} - \frac{O_{v+1}^{t+1}}{(1+r^t)(1+r^{t+1})} - \cdots - \frac{O_{m-1}^{t+m-v-1}}{\prod_{i=t}^{t+m-v-1}(1+r^i)}$$

- V_v^t : the initial asset value for the period *t*.
- y_v^t : the income corresponding to V_v^t .
- O_v^t : the operating income to be paid at the end of the period *t*.
- r^t : the expected nominal discount (interest) rate for period *t*.

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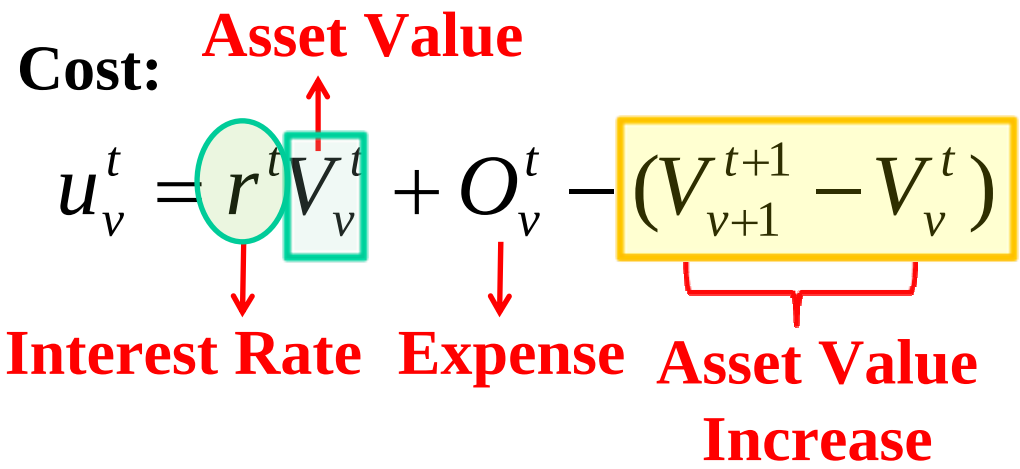
Estimation Problems in the User Cost Approach.

Basic User Cost:



- **Estimation Method:**
- The estimation method is complicated.
- **Negative problem:**
- The value becoming negative during periods of dramatic price increases.
- **Volatility problem:**
- Housing price volatility becoming greater than what it is perceived by market players.

Estimation Problems in the Equivalent Rent Approach.

- **1. Market structure disparities between the owner-occupied housing and the rental housing.**
- The average floor space (size) of housing in Tokyo: **Housing and Land Survey 2008.**
- **Single-family houses:**
- **110.71 square meters** for owner-occupied housing and **79.36 square meters** for rental housing
- **Condominiums:**
- **65.84 square meters** for owner-occupied housing and **36.06 square meters** for rental housing
- **2. Problem in Rent Survey.**
- The rent surveyed via consumer price statistics is the household's paying rent, there is a strong possibility that there is a major discrepancy with the rent determined by the current market. **Paying rent not opportunity cost.**

cshimizu@reitaku-u.ac.jp

Ⅲ. Diewert's OOH Opportunity Cost Approach.

- **Diewert(2006):**
- "Perhaps the correct opportunity cost of housing for an owner occupier is not his or her internal user cost but the ***maximum of the internal user cost***, *which is the* financial opportunity cost of housing, and what the property could rent for on the rental market. After all, the concept of opportunity cost is supposed to represent the ***maximum sacrifice that one makes in order to consume or use some object***."

- **Diewert's OOH Opportunity Cost Approach:**
- (Financial) User Cost > or < Equivalent rent

cshimizu@reitaku-u.ac.jp

Diewert's Financial User Cost.

Generalized Case: **Type B. Homeowner do not fully own their homes, but have positive home equity:**

Asset Value Expense

$$u^t\Big|_{typeB} \equiv r_D^t D^t + r^t (V^t - D^t) + O^t - (V^{t+1} - V^t).$$

Interest Rate for Mortgage Interest Rate for Investment Debt Expected Capital Gain

Type A. Homeowner owns their home (full equity):

$$u^t\Big|_{typeA} \equiv r^t V^t + O^t - (V^{t+1} - V^t).$$

Type C. Homeowner have zero home equity:

$$u^t\Big|_{typeC} \equiv r_D^t D^r + O^t - (V^{t+1} - V^t).$$

cshimizu@reitaku-u.ac.jp

Diewert's OOH Opportunity Cost Approach.

- The term opportunity cost refers to the cost of the best alternative that must ***be forgone in taking the option chosen.***
- **Option0**:Homeowner continue to live the home.
- →***Opportunity Cost*** associated with **Option0.**

- **Option1**: Selling at the beginning of period *t* and buy back at the *t*+1 .→ **User Cost.**
- **Option2**: Renting out from *t* to *t*+1. →**Equivalent Rent.**

- ***t*+0, Option1 (User Cost) > Option2 (E. Rent) = Option1**
- ***t*+1, Option1 (User Cost) < Option2 (E. Rent) = Option2**

cshimizu@reitaku-u.ac.jp

Estimated Result of Hedonic Equations.

$$\mu_{ijt} = X_{it}\beta_t + \upsilon_{it}$$

Housing rent: For Equivalent Rent.

Single family house price, Condominium price, and land price: For User Cost.

Single family house price model

Year	Intercept	logS	logW	logA	logTS	logTT	Number	Adj.R^2
1990	6.10	-0.08	0.25	-0.02	-0.07	-0.28	2,414	0.54
1991	6.02	-0.05	0.20	-0.03	-0.09	-0.27	2,430	0.52
1992	5.82	-0.03	0.14	-0.05	-0.10	-0.23	2,586	0.52
1993	5.46	-0.06	0.14	-0.04	-0.07	-0.18	2,747	0.51
1994	5.16	-0.08	0.12	-0.03	-0.04	-0.13	3,775	0.49
[illegible]								
2006	4.82	-0.04	0.01	-0.04	-0.05	-0.15	20,805	0.58
2007	5.06	-0.07	0.00	-0.03	-0.04	-0.17	19,208	0.62
2008	5.36	-0.08	0.02	-0.04	-0.07	-0.19	16,177	0.61
2009	5.70	-0.20	0.01	-0.04	-0.06	-0.17	14,429	0.63
2010	5.86	-0.22	0.03	-0.04	-0.06	-0.19	14,620	0.63

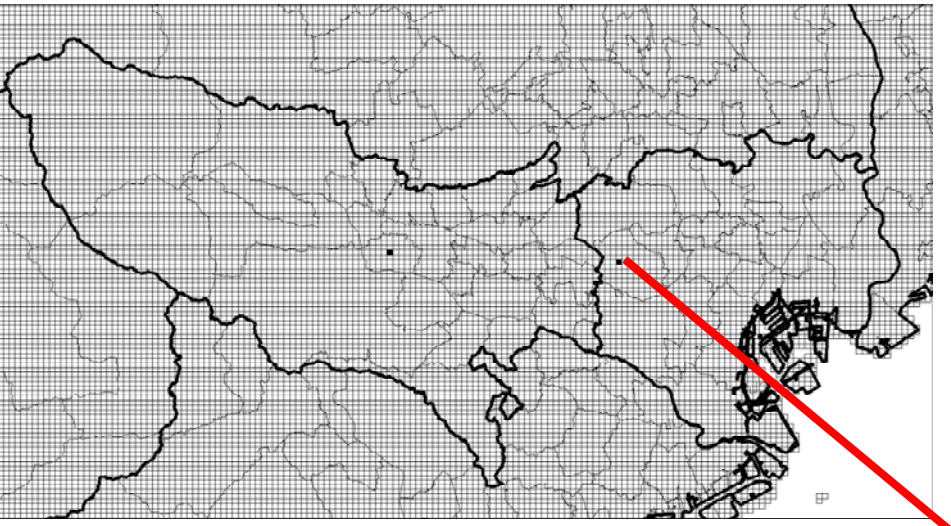
*The dependent variable in each case is the log price per square meter.

**The table indicate the coefficient of main variables which a part of hedonic estimation results per year.

***Estimation Method: Robust Regression

cshimizu@reitaku-u.ac.jp

Tokyo Prefecture:2010.



Building Survey

	Single family house		Condominium	
	e)Total*	(units)**	f)Total*	(units)***
1990	148,834,033	1,857,722	107,274,134	367,734
1995	160,654,688	1,854,315	135,778,868	374,807
2000	174,379,864	1,897,345	161,698,203	381,216
2005	181,977,956	2,011,068	186,759,564	417,872

*unit: square meter

**Number of single family houses

***Number of condominium buildings(not unit)

Tokyo:

-Population: **13,161,751**

-Households: **6,403,219**

-SNA: **71.181 trillion JPY**

All Japan:

-Population: **128,057,352**

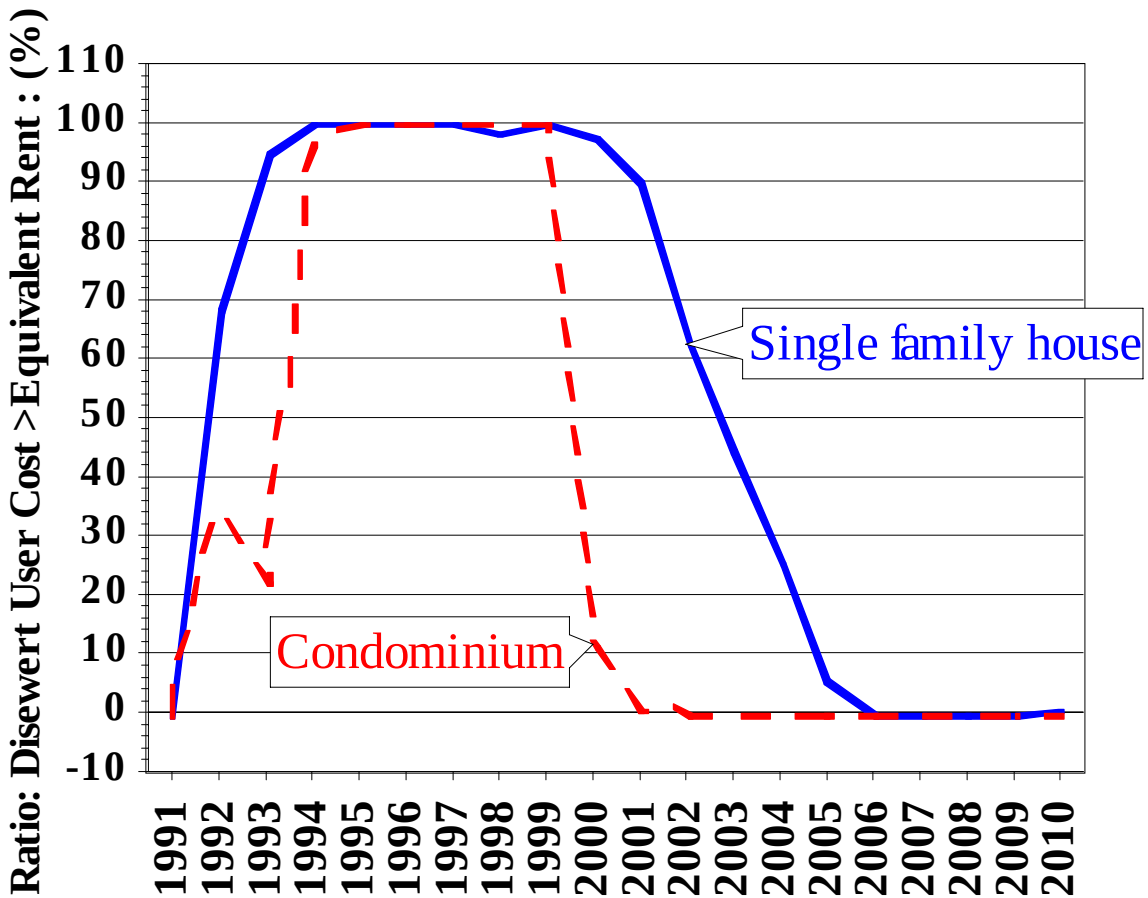
-Households: **51,950,504**

-SNA: **490.647 trillion JPY**

cshimizu@reitaku-u.ac.jp

Ratio: Diewert User Cost >Equivalent Rent: (%)

Ratio: Option1 (User Cost) > Option2 (E. Rent) = Option1



cshimizu@reitaku-u.ac.jp

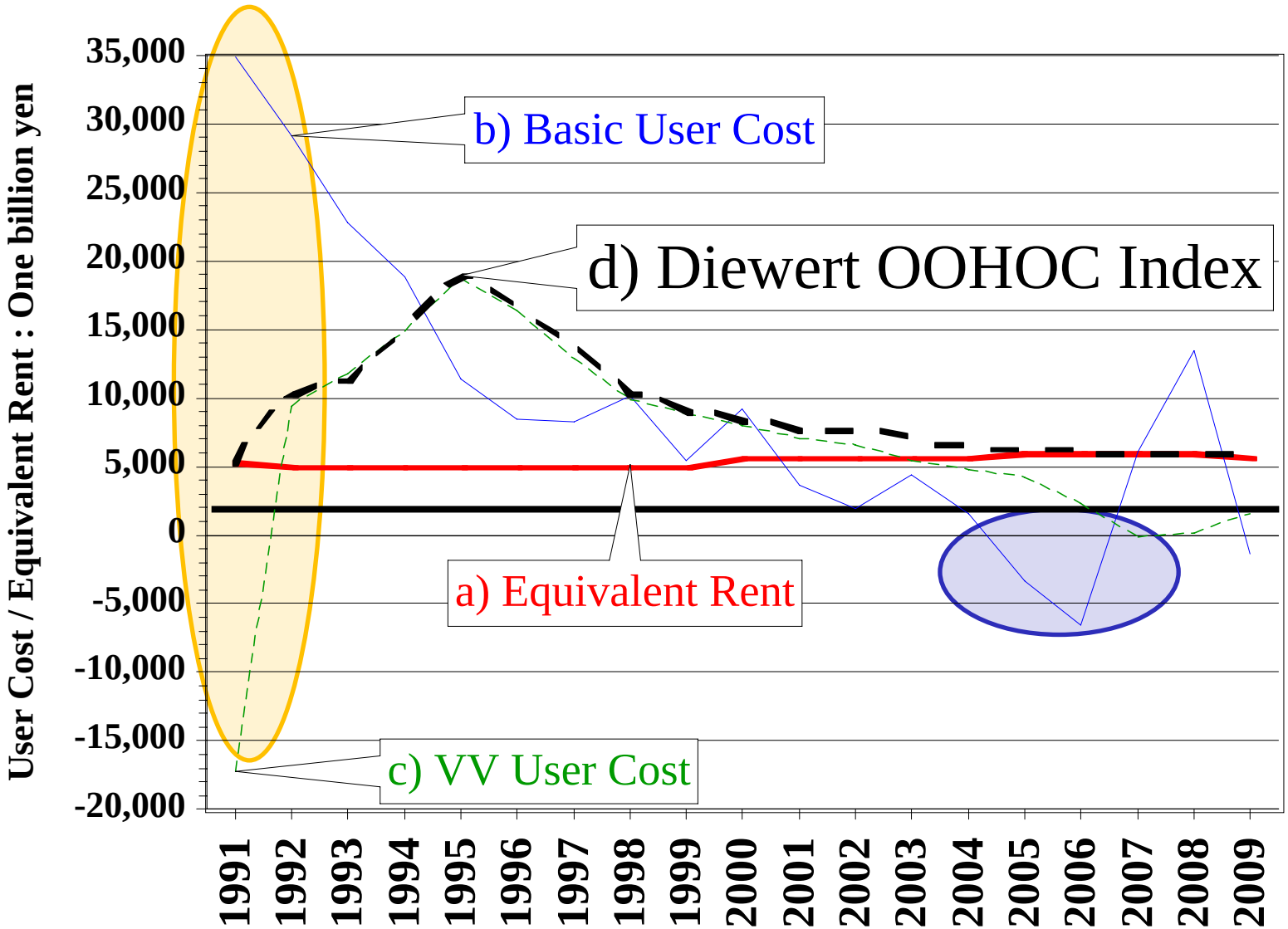
Estimation results of User Costs.

Year	a) Equivalent Rent*	b) Basic User Cost*	c) VV User Cost*	d) Diewert Financial User Cost*	e) Diewert OOHOC Index*	d) -b)*	d) - c)*	e) - a)*
1991	5,381.91	34,917.15	-17,249.25	-16,969.24	5,381.91	-51,886.39	280.01	0.00
1992	5,283.60	29,172.85	9,414.64	9,141.06	10,419.92	-20,031.78	-273.58	5,136.32
1993	5,021.95	22,840.21	11,742.15	11,524.01	11,589.21	-11,316.20	-218.14	6,567.26
1994	4,933.06	18,828.92	14,916.87	14,639.22	14,639.23	-4,189.69	-277.64	9,706.16
1995	5,268.97	11,404.91	18,786.03	18,624.62	18,886.70	7,219.71	-161.42	13,617.73
1996	5,256.77	8,446.97	16,425.49	16,498.50	16,498.50	8,051.53	73.01	11,241.73
1997	5,219.79	8,231.11	12,849.09	13,223.56	13,223.57	4,992.45	374.47	8,003.78
1998	5,155.46	10,184.68	9,831.25	10,367.09	10,368.52	182.41	535.84	5,213.06
1999	5,157.14	5,429.53	8,858.19	9,112.25	9,127.37	3,682.72	254.06	3,970.22
2000	5,864.61	9,214.74	7,984.24	8,189.68	8,494.76	-1,025.07	205.43	2,630.15
2001	5,831.36	3,620.13	7,063.19	7,673.58	7,729.83	4,053.45	610.39	1,898.46
2002	5,925.69	1,923.76	6,600.24	7,223.75	7,427.48	5,299.99	623.51	1,501.79
2003	5,818.97	4,383.36	5,395.85	6,012.84	6,714.04	1,629.48	617.00	895.07
2004	5,782.20	1,577.33	4,767.56	5,376.14	6,331.98	3,798.81	608.58	549.78
2005	6,001.29	-3,359.14	4,168.27	5,011.60	6,446.76	8,370.73	843.33	445.47
2006	6,062.71	-6,546.35	2,303.28	3,323.47	6,082.47	9,869.83	1,020.20	19.76
2007	6,113.83	6,050.27	-111.39	1,053.99	6,114.15	-4,996.28	1,165.38	0.32
2008	5,951.92	13,441.22	129.20	1,376.28	5,952.16	-12,064.94	1,247.07	0.24
2009	5,815.37	-1,388.15	1,594.28	2,877.89	5,817.18	4,266.04	1,283.61	1.80

*One billion yen

cshimizu@reitaku-u.ac.jp

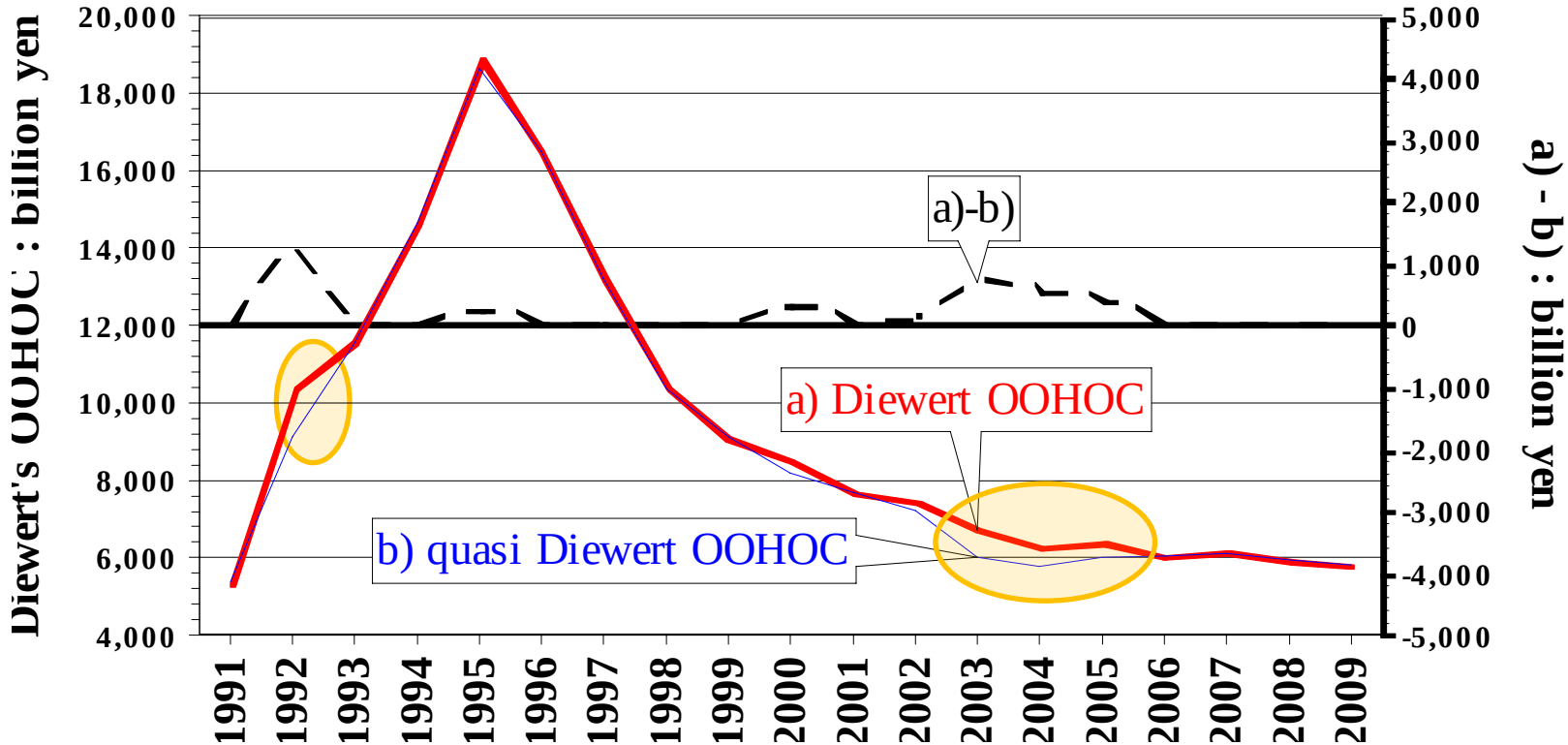
Diewert's OOHOC Index and User Cost Indexes.



Quasi Diewert's OOHOC Index.

$$Diewert \quad OOHOC_t = \sum_I Max\{UC_{it}, ER_{it}\}$$

$$Quasi \quad OOHOC_t = Max\left\{\sum_I UC_{it}, \sum_I ER_{it}\right\}$$



Ⅳ. Conclusions:

- Having an extremely large weight in national accounting and consumer price statistics, **imputed rent for owner-occupied housing plays an important role.**
- Traditional **equivalent approach** and **user cost approach** have a several problem in estimating it.
- **Diewert's OOH Opportunity Cost Approach** is one of the a powerful estimation method for imputed rent of OOH.
- ***Quasi*** Diewert's OOH Opportunity Cost Index ***can be approximated*** with ***true*** Diewert's OOH Opportunity Cost.
- **In the coming new RPPI**, we should consider **to improve the estimation of the OOH imputed rent** in National Account and CPI.

cshimizu@reitaku-u.ac.jp

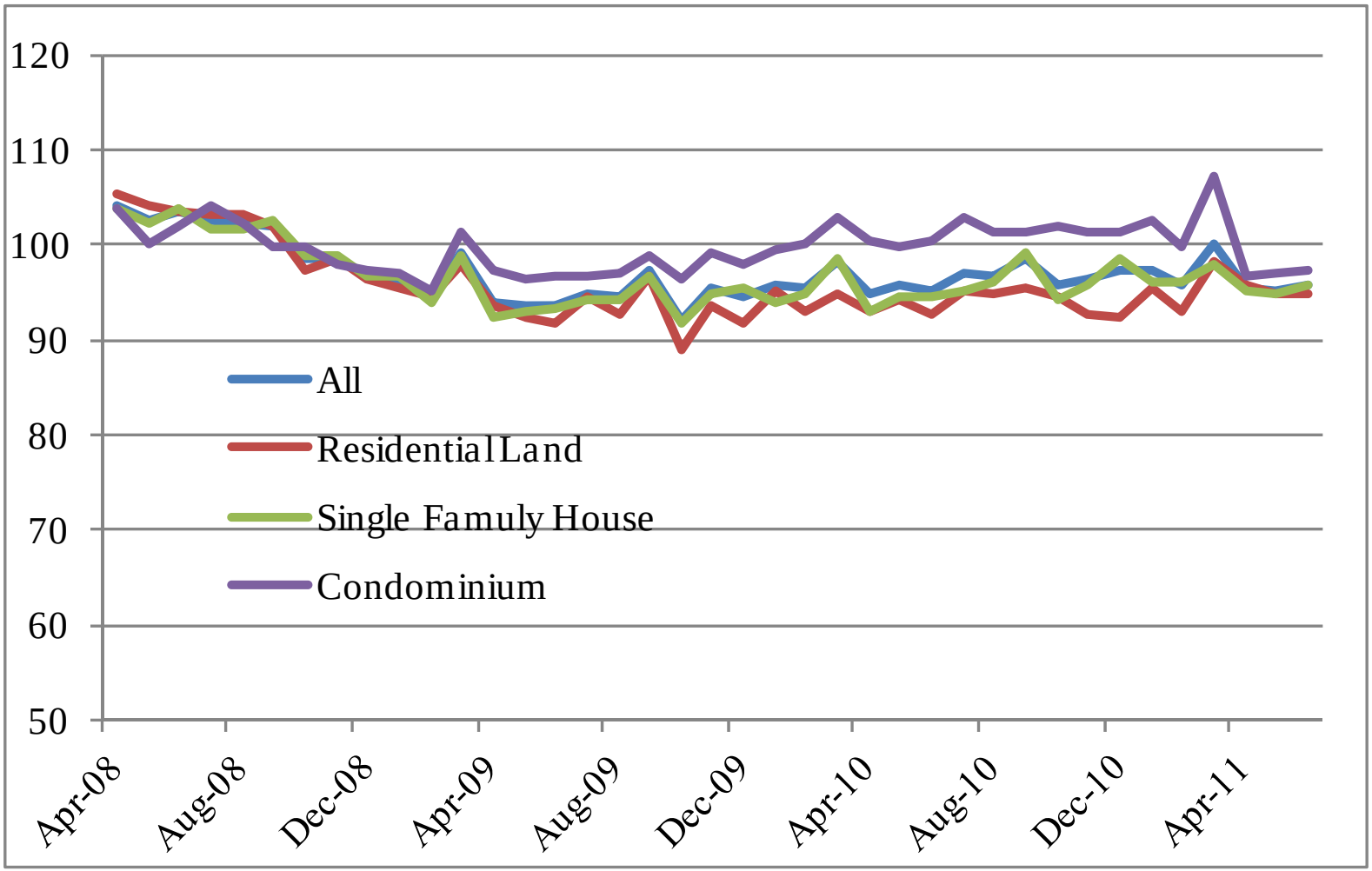
Contact:

- Chihiro Shimizu (Reitaku University& University of British Columbia)
- W.Erwin Diewert (University of British Columbia),
- Kiyohiko.G. Nishimura (The Deputy Governor of Bank of Japan),
- Tsutomu Watanabe (University of Tokyo)

- Our paper and presentation slides are available at:

- **http://www.cs.reitaku-u.ac.jp/sm/shimizu/English.html**

New Japanese Residential Property Price Indexes

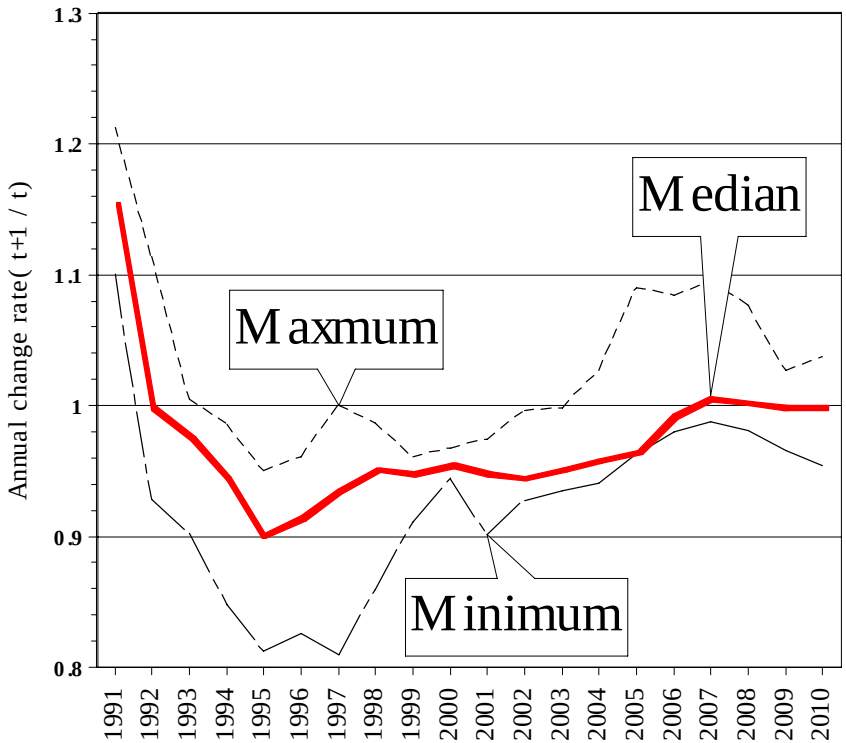


The Verbrugge Variant (VV) of the User Cost Approach

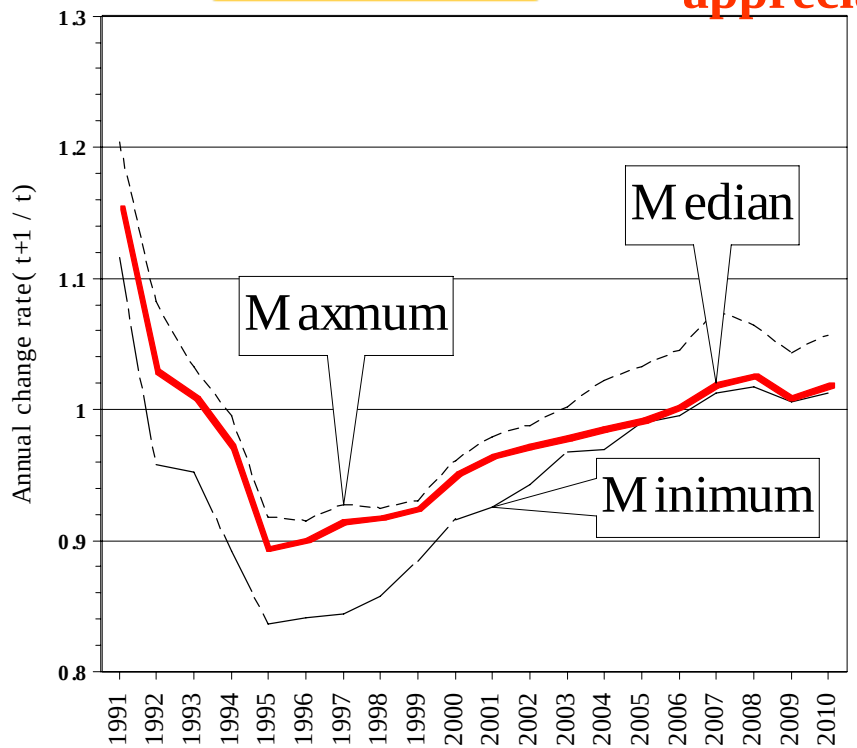
Poole, Ptacek and Verbrugge (2005) , Verbrugge (2008), Diewert (1974)

$$u^t = r^t V^t + \gamma_H^t V^t - E[\pi]V^t$$

⇨ **The rate of expected house price appreciation**



Single family house



Condominium

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