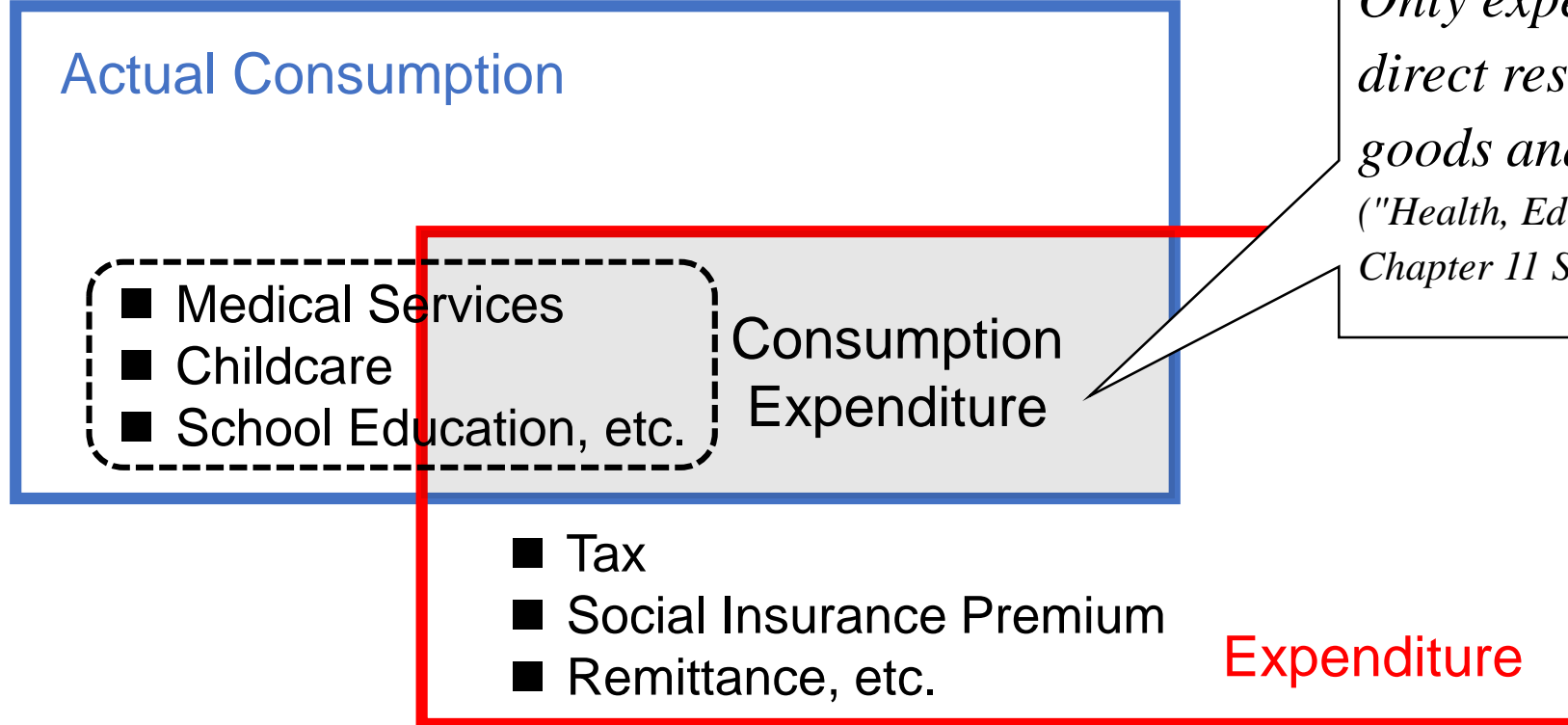


# Reevaluating Household Real Consumption through Attribute-Specific Price Indices and Actual Consumption

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Hitotsubashi Univ.

**Noriko INAKURA**  
Shikoku Univ.

## Focus of This Study



*Only expenditure by households that is a direct result of purchase of individual goods and services is the scope of CPI. ("Health, Education, and Social Protection Services," Chapter 11 Selected Special Cases, p274.)*

### When evaluating household welfare:

(1) It is necessary to clearly define the deflator and the coverage of consumption.

(2) The conventional method, which relies on expenditure records from household surveys and official CPI, faces significant problems.

## 1. Starting Point of This Study:

Household Final Consumption Expenditure and Actual Consumption in SNA

Real Consumption Expenditure Calculated from Official Statistics

## 2. A Household Attribute-Specific Price Index: *Inflation inequality*

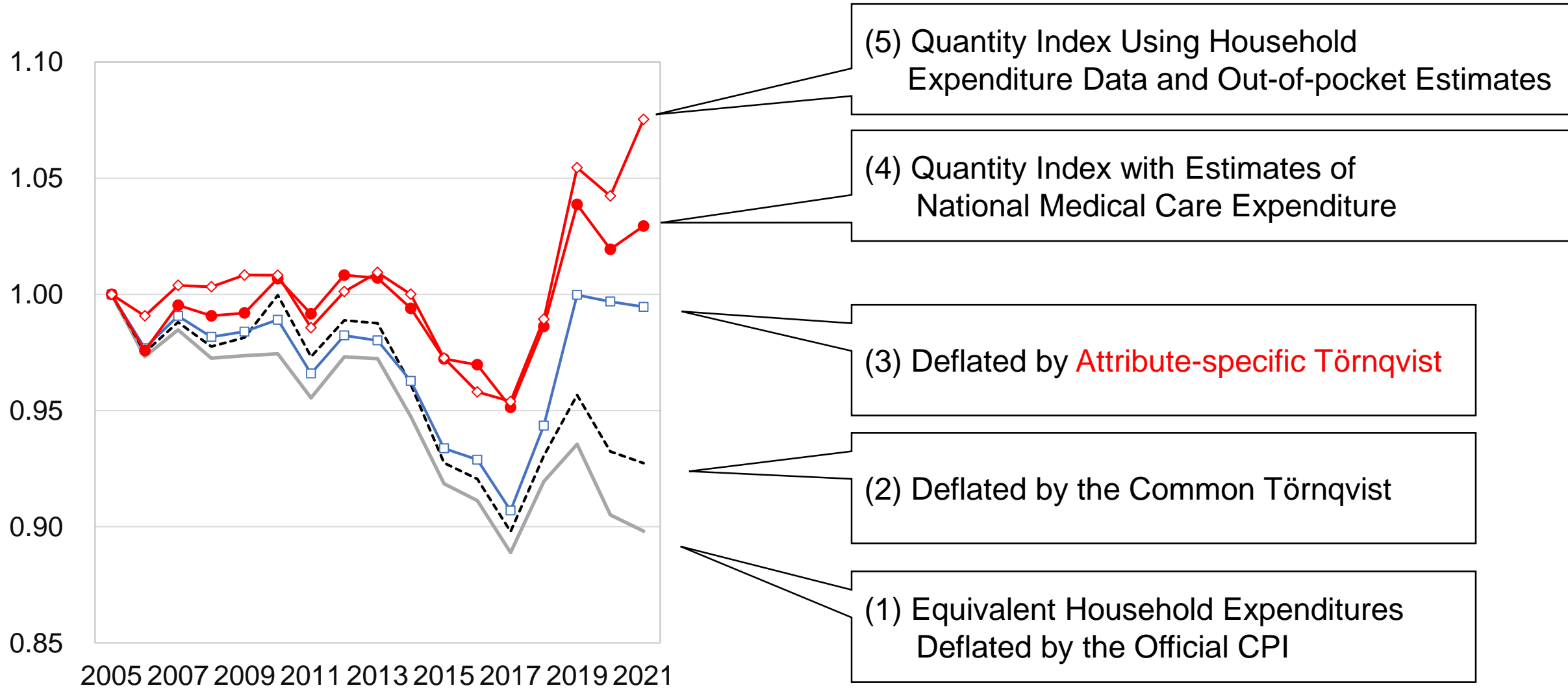
Description of the Data Used, Various Price Indices, **Attribute-Specific Törnqvist Index**

## 3. Incorporating Medical Services into a Quantity Index:

Long-Term Trends, Transition in Out-of-Pocket Share, Estimation of **Real Actual Consumption**

## 4. Household Real Consumption through Attribute-Specific Price Indices and Actual Consumption

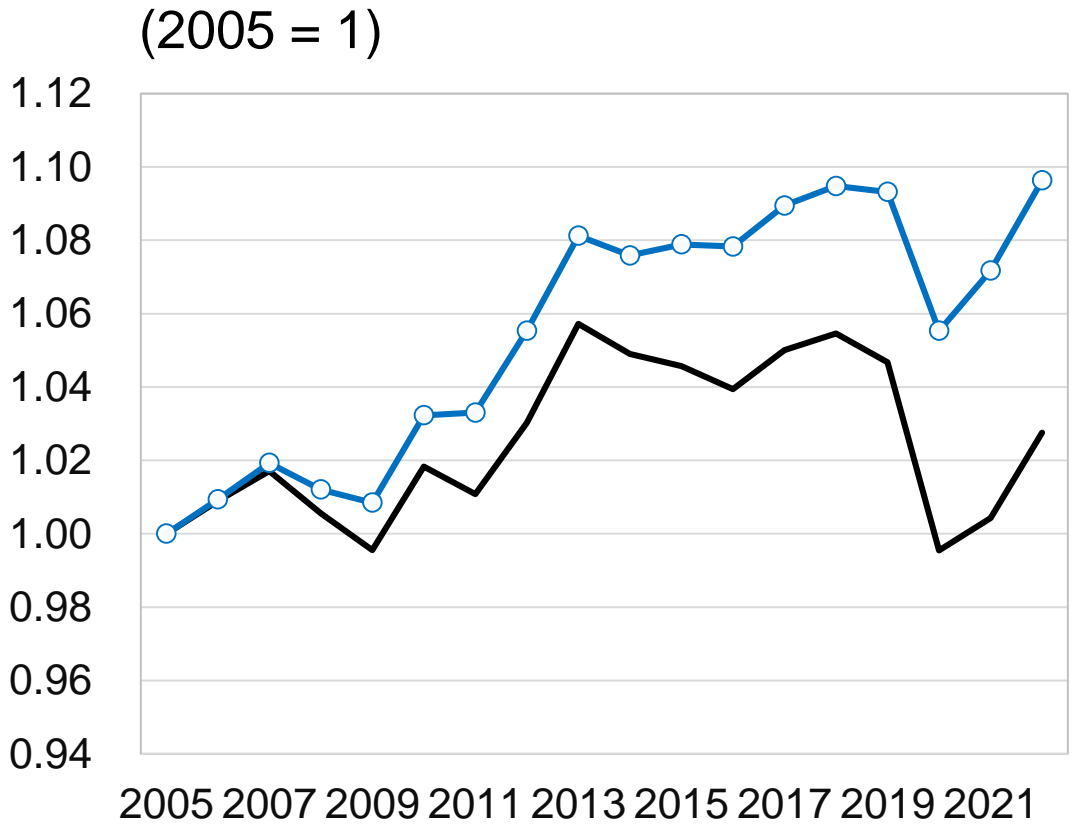
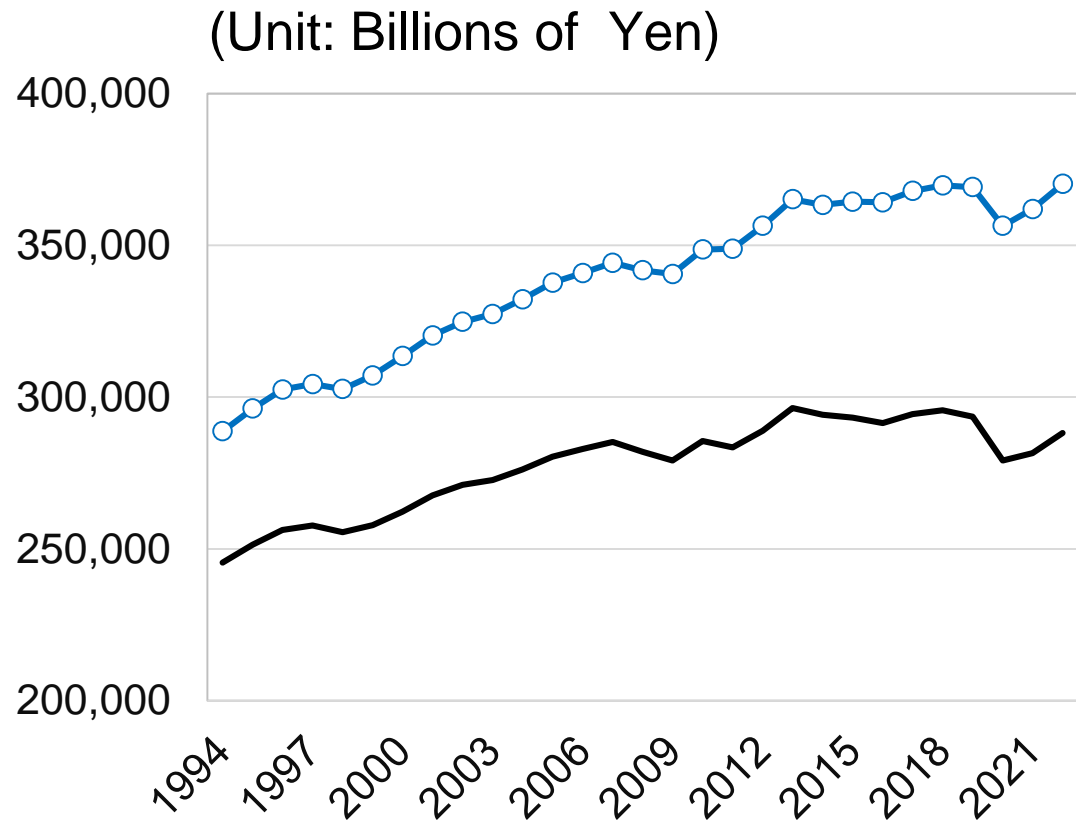
# Highlight: Evaluation of Equivalent Real Consumption Using Five Methods



Note: Households with Heads **Under 40 Years Old**

# 1. Starting Point of This Study

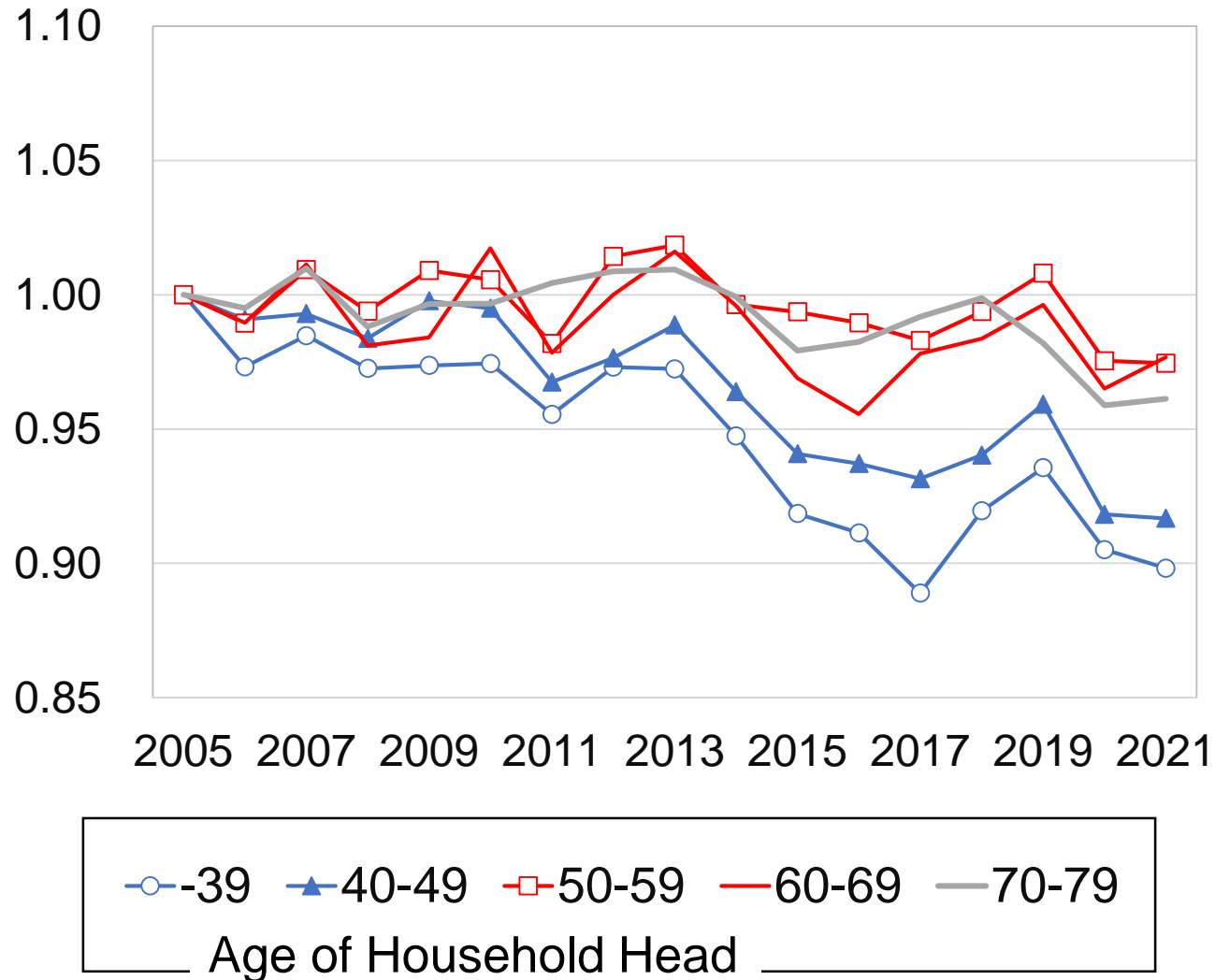
# Household Final Consumption vs. Actual Consumption



- Household final consumption expenditure
- Actual household final consumption

Data source: Compiled from "National Accounts," Cabinet Office, Government of Japan.  
Note: Based on chained year 2015 prices.

# Real Equivalent Consumption Expenditures by Age Category (2005 = 1)



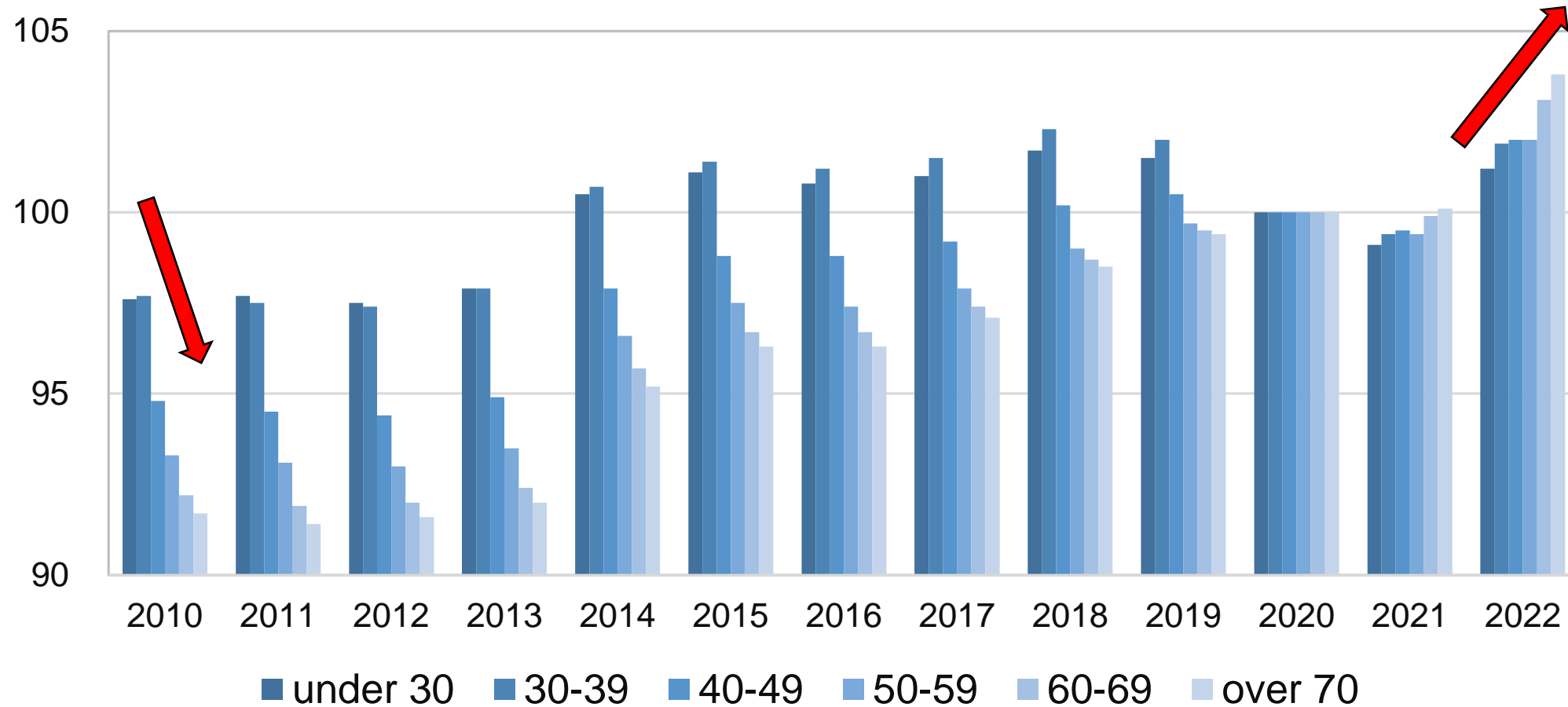
- Decline in Real Household Consumption Expenditure in Japan
- Notable Decreases Among Young and Middle-Aged Groups

Vihriälä (2017), Kitao & Yamada (2023), Murata & Hori (2023)

- The Japanese government's cabinet meeting in 2019 resolved to enhance economic support for young people.

Note: Expenditures adjusted using the OECD-modified equivalence scale.  
Data Source: Consumer Price Index and Family Income and Expenditure Survey conducted by the Ministry of Internal Affairs and Communications.

# Official CPI by Age Category



Data source: Created from the Ministry of Internal Affairs and Communications' "Consumer Price Index"



## 2. A Household Attribute-Specific Price Index:

### *Inflation inequality*

**Jaravel (2019, QJE) , Wimer & Collyer & Jaravel (2019, Policy Brief, Columbia Univ.)**

When using price indices by income-brackets, (compared to using the ordinal CPI)  
an additional 3.2 million individuals fall below the poverty line.

**Moretti (2013, Applied Econ.)**

Estimating CPI taking into account differences in housing prices by city

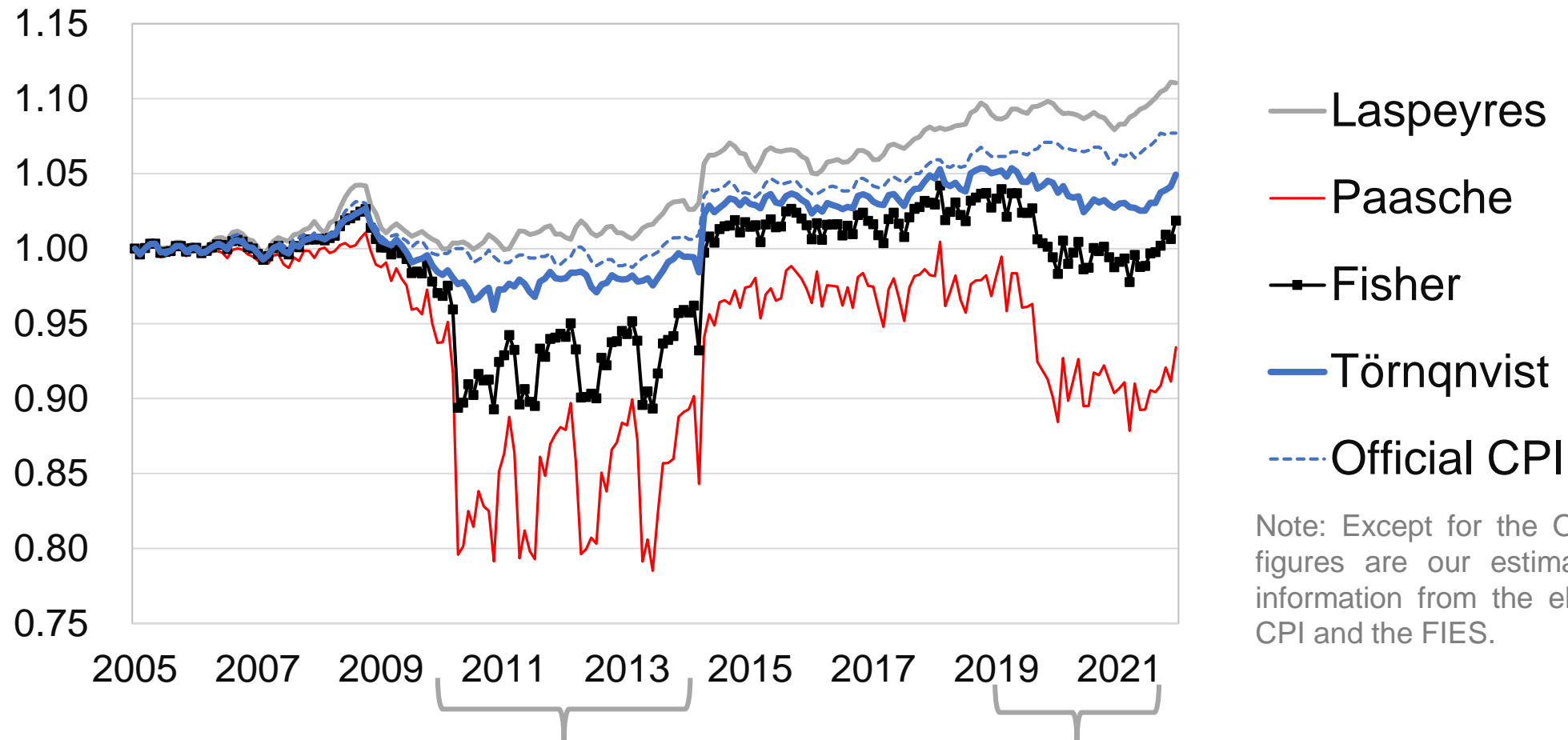
-> Nominal wage premium for college graduates (+20% in 2000) declined to +14%

# Data

Variable	Data source	Note
<b>Price</b>	Consumer Price Index	<ul style="list-style-type: none"><li>✓ by item (# of items: <b>499</b>)</li><li>✓ national average (prefecture-specific itemized CPI is <b>not</b> publicly available)</li></ul>
<b>Expenditure</b>	Family Income and Expenditure Survey ( <b>FIES</b> )	<ul style="list-style-type: none"><li>✓ utilizing <b>microdata</b> (# of households / month: about 8,000)</li><li>✓ households with <b>two or more members</b> (single-member households is to be added)</li><li>✓ analysis period: 2005M1-2021M12</li></ul>

Prices are assumed to be the same for all households, with only expenditure weights differing.

# Various Price Indices Common to Household Attributes



Note: Except for the Official CPI, the figures are our estimates based on information from the elementary level CPI and the FIES.

**Note1:** In July 2011, Japanese TV sets switched to digital broadcasting, and conventional TV sets could no longer receive the signals. Therefore, **many households purchased new TV sets** compatible with digital broadcasting around 2011.

**Note2:** In October 2019, free preschool and childcare were introduced for ages 3-5.

# Household characteristics used for index calculation

<b>Age</b> (of the head of household)
under 40
40-49
50-59
60-69
70-79

<b>Household income</b>
I
II
III
IV

<b>Region</b>
Hokkaido & Tohoku
Kanto
Hokuriku
Tokai
Kinki
Chugoku
Shikoku
Kyusyu & Okinawa

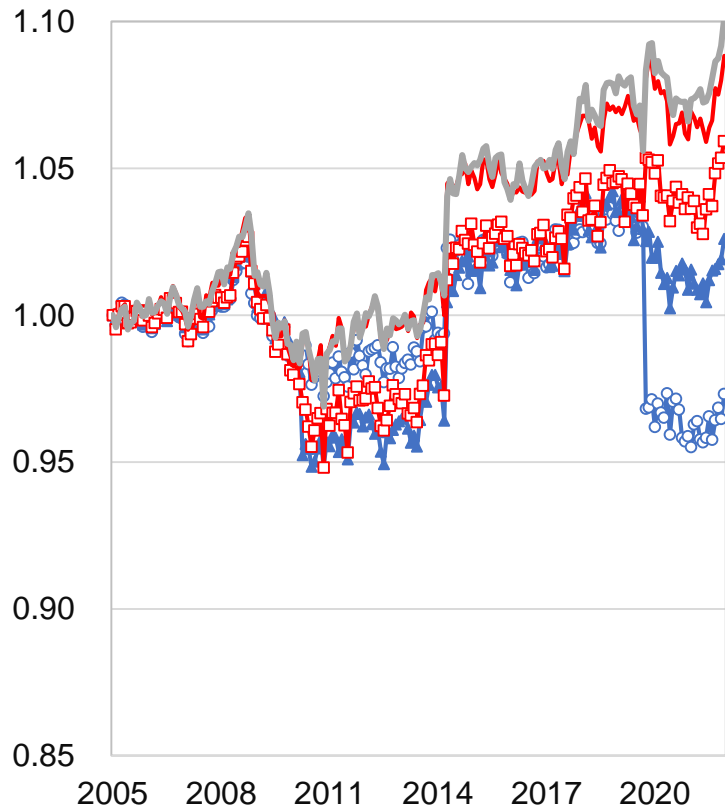
# Eight regions

Region
Hokkaido & Tohoku
Kanto
Hokuriku
Tokai
Kinki
Chugoku
Shikoku
Kyusyu & Okinawa



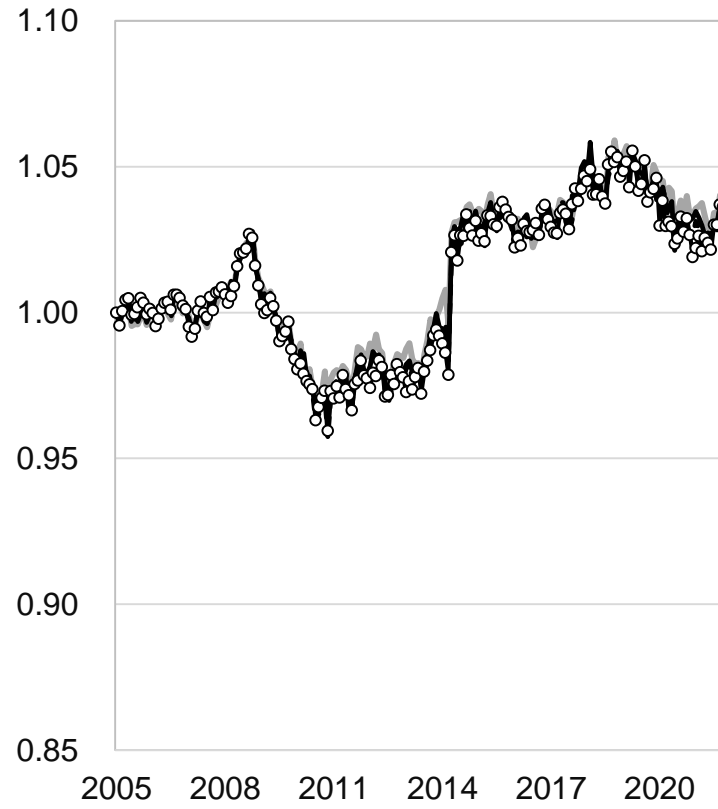
# Törnqvist Index Considering **Single** Attribute

## By Age Category



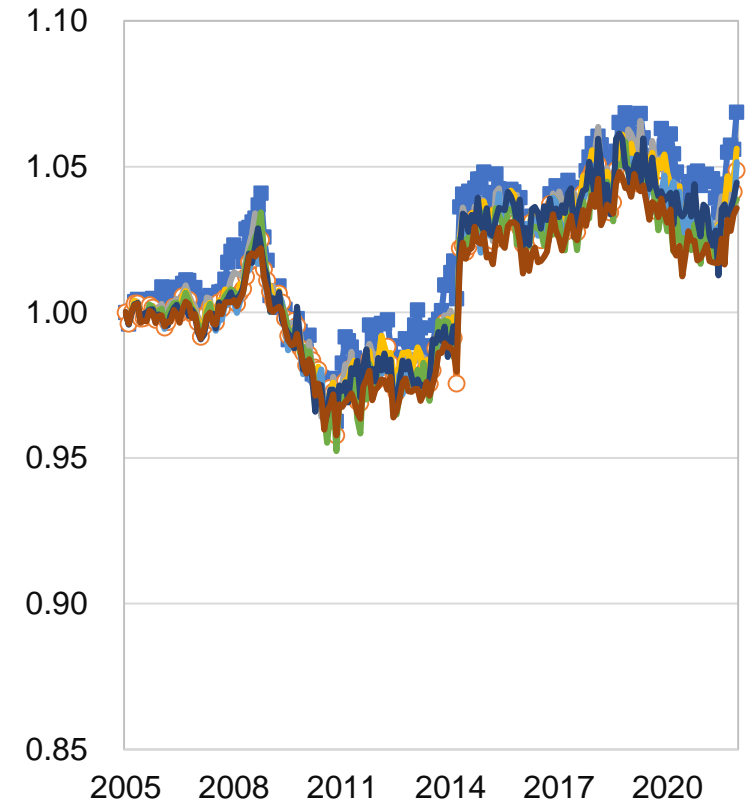
○ -39    ▲ 40-49    □ 50-59  
○ 60-69    ▲ 70-79

## By Income Category



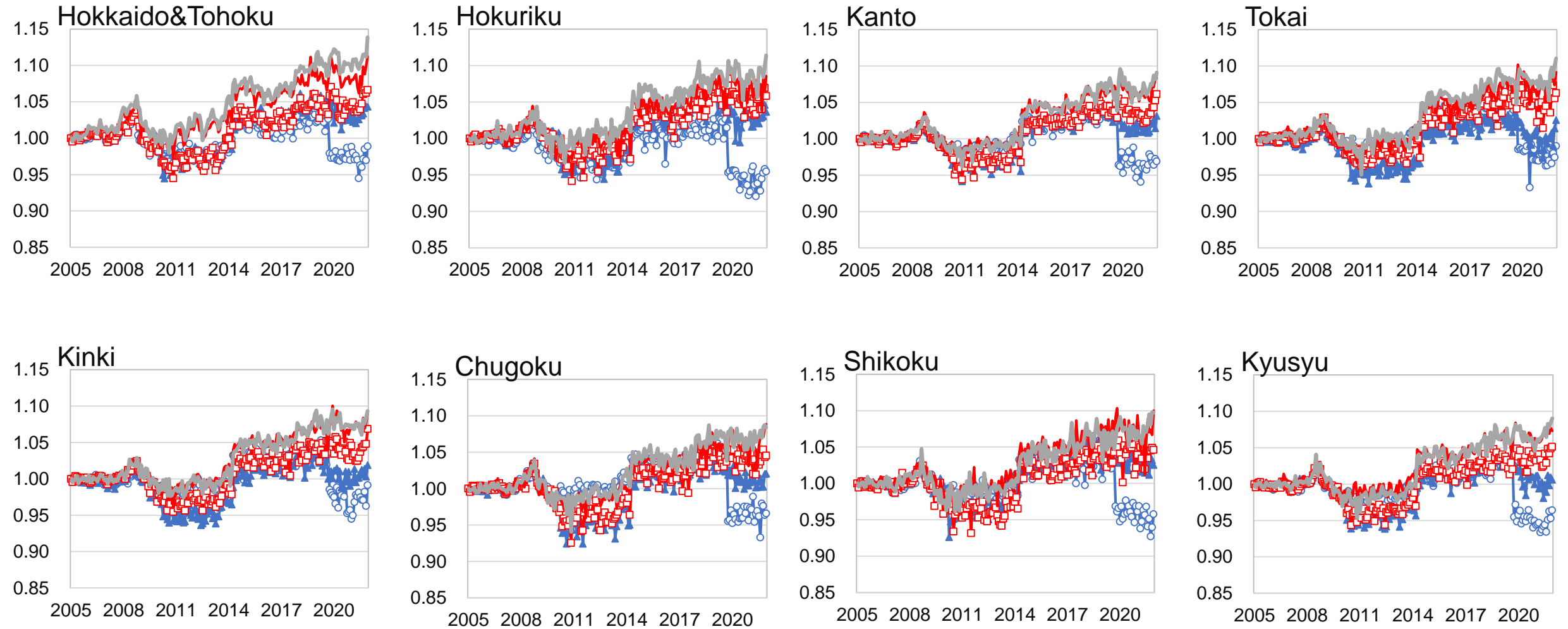
— I    - - - II    — III    ○ IV

## By Regional Block



■ Hokkaido&Tohoku    ○ Kanto  
▲ Hokuriku    ■ Tokai  
○ Kinki    ▲ Chugoku  
▲ Shikoku    ■ Kyusyu

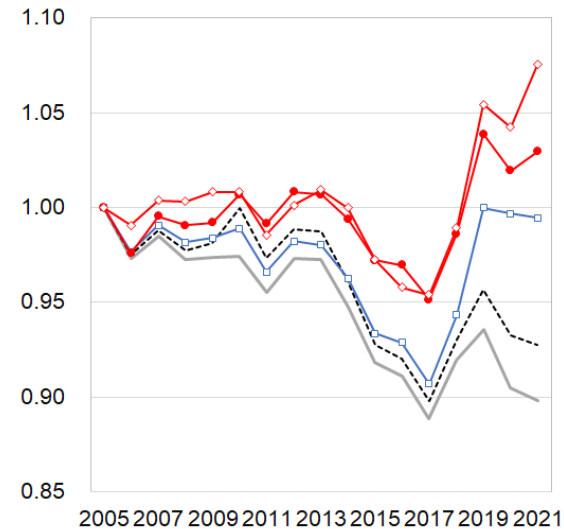
# Törnqvist Index Considering **Two** Attributes: Regional Block and Age Category



—○— -39 —▲— 40-49 —□— 50-59 — 60-69 — 70-79

# Real Consumption Expenditure: Implicit Quantity Index (1), (2), (3)

$QI_{i,t}^1 = \frac{E_{i,t}}{E_{i,s}} \bigg/ \frac{P_t^{CPI}}{P_s^{CPI}}$	(1)
$QI_{i,t}^2 = \frac{E_{i,t}}{E_{i,s}} \bigg/ \frac{P_t^{Tor}}{P_s^{Tor}}$	(2)
$QI_{i,t}^3 = \frac{E_{i,t}}{E_{i,s}} \bigg/ \frac{P_{i,t}^{Tor}}{P_{i,s}^{Tor}}$	(3)



- (3) Deflated by **Attribute-specific Törnqvist**
- (2) Deflated by the Common Törnqvist
- (1) Equivalent Household Expenditures Deflated by the Official CPI

## Price Indices: Published Data and Our Estimates

$P_t^{CPI}$	Official CPI excluding owner-occupied imputed rent
$P_t^{Tor}$	The Törnqvist index excluding owner-occupied imputed rent at time t, which is common across households.
$P_{i,t}^{Tor}$	The Törnqvist index of household i at time t, excluding owner-occupied imputed rent.

## Expenditure in FIES

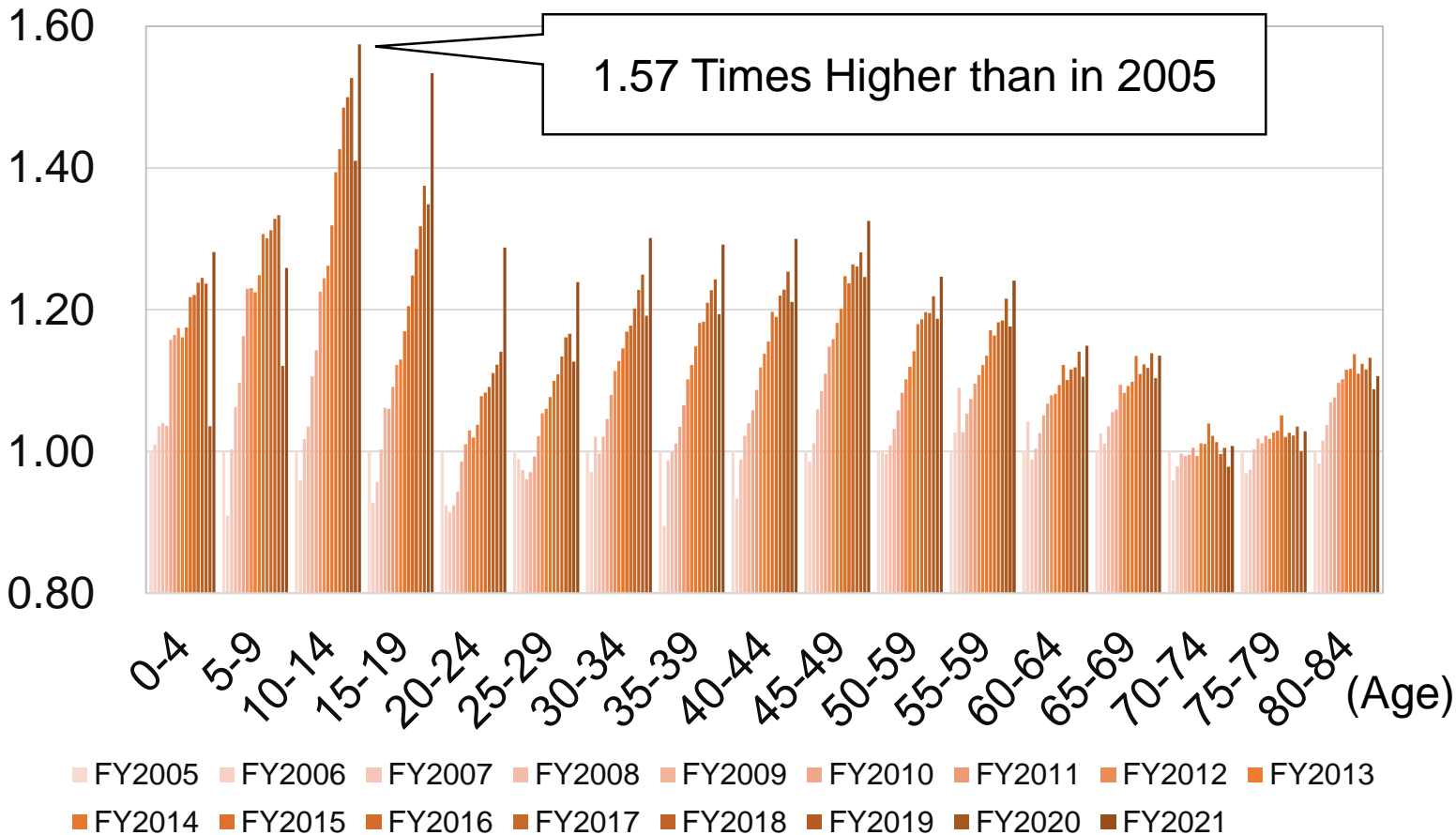
$E_{i,t}$	Equivalent nominal expenditure of household i at time t, excluding owner-occupied imputed rents.
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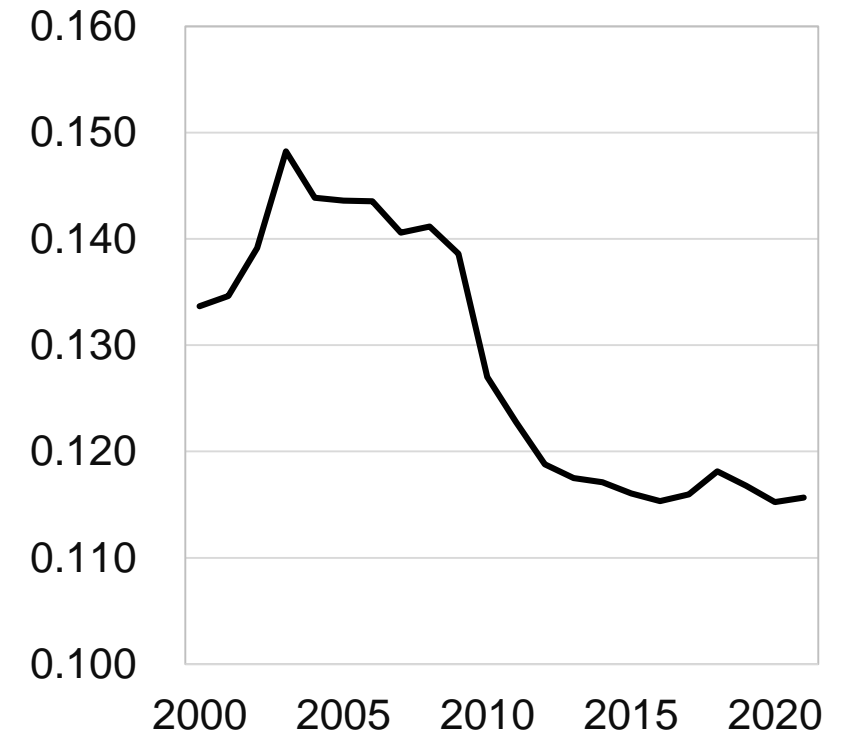
### 3. Incorporating Medical Services into a Quantity Index

# Medical Service Consumption in Japan

## National Health Care Expenditures by Age Category (Per Capita, Nominal Values, Year 2005=1)



## Share of Medical Expenses Borne by Patients



# Two Quantity Indices for Medical Services

$$QI_{i,t}^M = \left( \frac{C_{i,t}^M}{C_{i,s}^M} \right) / \left( \frac{P_t^{SNA,M}}{P_s^{SNA,M}} \right) \quad (4)$$

$$QI_{i,t}^{M'} = \left( \frac{E_{i,t}^M}{E_{i,s}^M} \right) / \left( \frac{P_t^{SNA,M} \overline{S}_{i,t}^M}{P_s^{SNA,M} \overline{S}_{i,s}^M} \right) \quad (5)$$

$\overline{S}_{i,t}^M$ : Estimated Self-Payment Ratios by Household Attributes. For details, refer to the paper.

Under 40: **0.566** in 2021 (2005 = 1)

70-79: **0.963** in 2021

## Price Indices: Published Data

$P_t^{SNA,M}$	GDP deflator for Health and Social Services published in SNA
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**Actual Medical Consumption:** Estimated from National Medical Care Expenditure and FIES Microdata

$C_{i,t}^M$	Nominal Equivalent Actual Medical Consumption
-------------	---

## Expenditure in FIES

$E_{i,t}^M$	Equivalent medical and health care nominal expenditure of household i at time t.
-------------	--

# Aggregate Quantity Index: Cobb-Douglas Type Composite Index

$$QI_{i,t}^4 = [QI_{i,t}^M]^\alpha [QI_{i,t}^O]^{(1-\alpha)},$$

$$\text{where } QI_{i,t}^M = \left( \frac{C_{i,t}^M}{C_{i,s}^M} \right) / \left( \frac{P_t^{SNA,M}}{P_s^{SNA,M}} \right).$$

(4)'

$$QI_{i,t}^5 = [QI_{i,t}^{M'}]^\alpha [QI_{i,t}^O]^{(1-\alpha)},$$

$$\text{where } QI_{i,t}^{M'} = \left( \frac{E_{i,t}^M}{E_{i,s}^M} \right) / \left( \frac{P_t^{SNA,M} S_{i,t}^M}{P_s^{SNA,M} S_{i,s}^M} \right).$$

(5)'

$\alpha$ : Represents the weights of actual medical consumption and real non-medical consumption in the quantity index calculation.

$\alpha = 0.132$ , derived using SNA data.  
For more details, please refer to the paper.

## Price Indices: Published Data and Our Estimates

$P_{i,t}^{Tor,O}$  The Törnqvist index of household  $i$  at time  $t$ ,  
**excluding** imputed rents, **medical, and health care.**

## Expenditure in FIES

$E_{i,t}^O$  Equivalent nominal expenditure of household  $i$  at time  $t$ ,  
**excluding** imputed rents, **medical, and health care.**

$$QI_{i,t}^O = \frac{E_{i,t}^O}{E_{i,s}^O} / \frac{P_{i,t}^{Tor}}{P_{i,s}^{Tor}}$$

## 4. Household Real Consumption through Attribute-Specific Price Indices and Actual Consumption

# Evaluation of Equivalent Real Consumption Using Five Methods

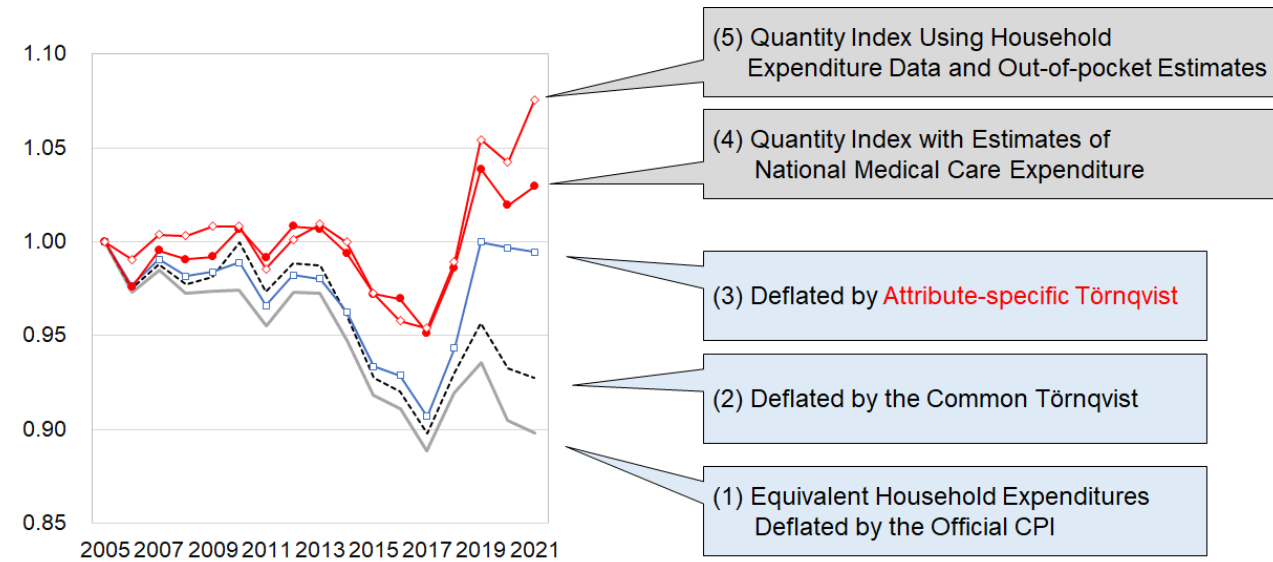
$$QI_{i,t}^1 = \frac{E_{i,t}}{E_{i,s}} \frac{P_t^{CPI}}{P_s^{CPI}} \quad (1)$$

$$QI_{i,t}^2 = \frac{E_{i,t}}{E_{i,s}} \frac{P_t^{Tor}}{P_s^{Tor}} \quad (2)$$

$$QI_{i,t}^3 = \frac{E_{i,t}}{E_{i,s}} \frac{P_{i,t}^{Tor}}{P_{i,s}^{Tor}} \quad (3)$$

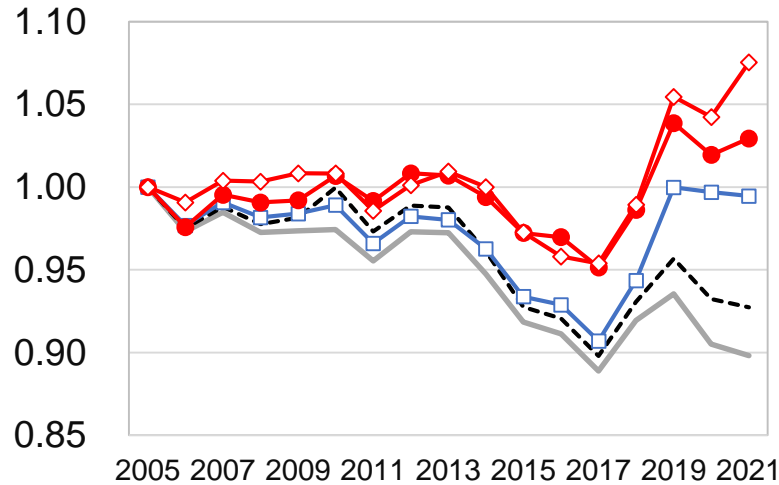
$$QI_{i,t}^4 = [QI_{i,t}^M]^\alpha [QI_{i,t}^O]^{(1-\alpha)} \quad (4)'$$

$$QI_{i,t}^5 = [QI_{i,t}^{M'}]^\alpha [QI_{i,t}^O]^{(1-\alpha)} \quad (5)'$$

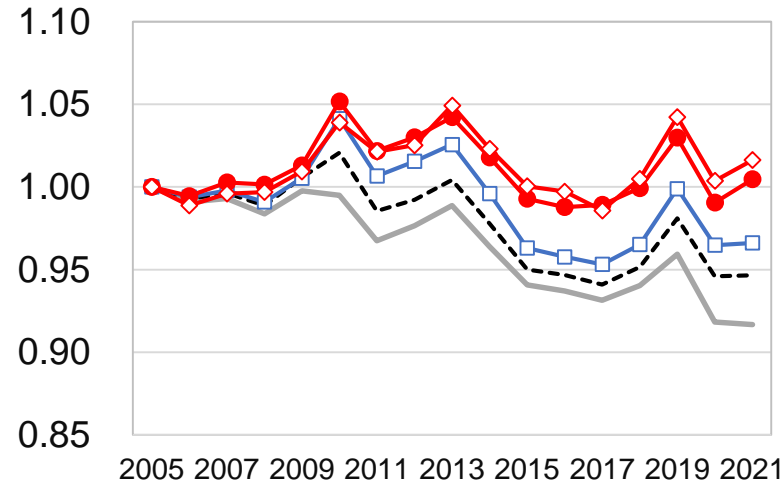


# Real Consumption Trends: by Age Category × Aggregation Method

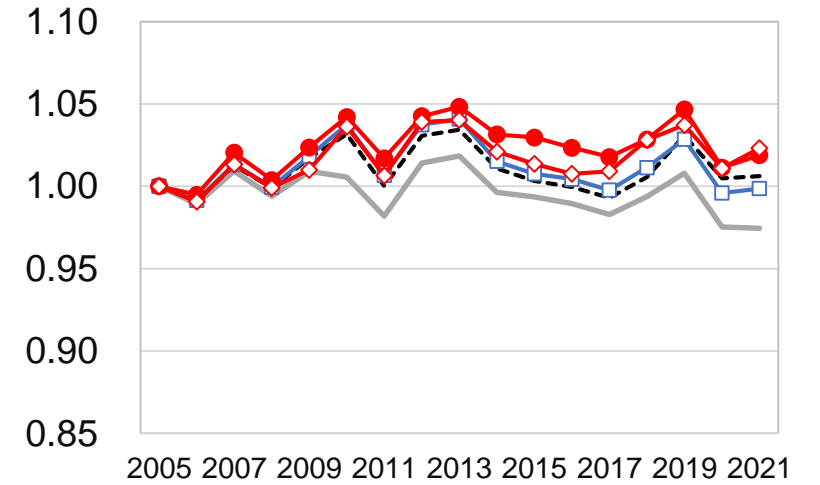
## Under 40



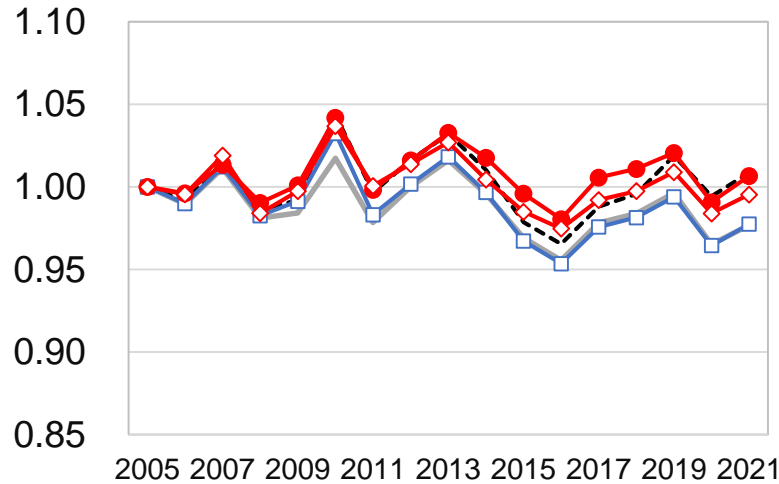
## 40-49



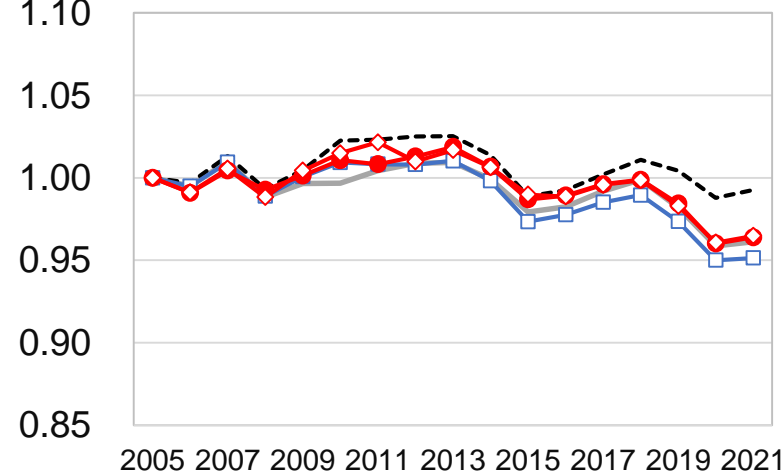
## 50-59



## 60-69



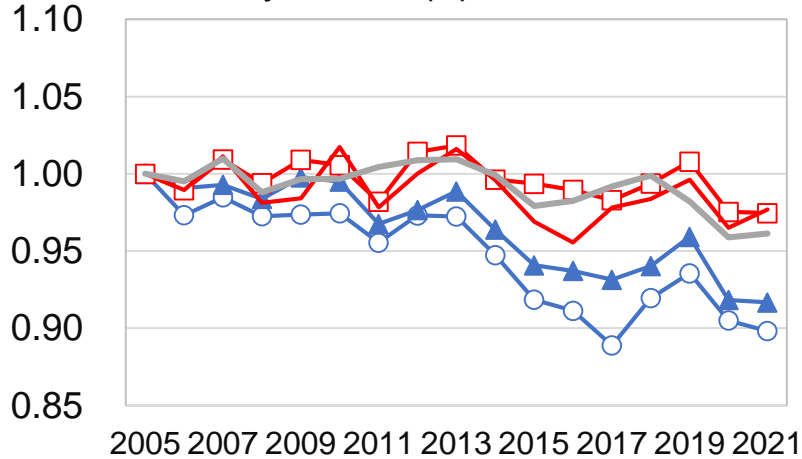
## 70-79



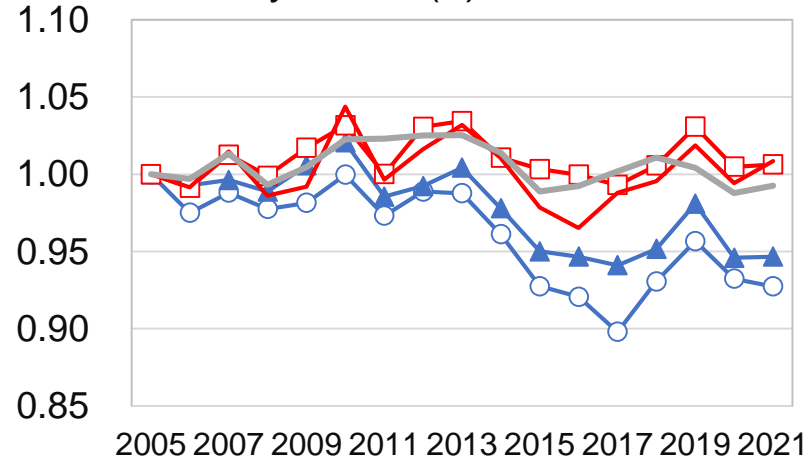
- (1) Equivalent Household Expenditures Deflated by the Official CPI
- (2) Deflated by the Common Törnqvist
- (3) Deflated by Attribute-specific Törnqvist
- (4) Quantity Index with Estimates of National Medical Care Expenditure
- ◇- (5) Quantity Index Using Household Expenditure Data and Out-of-pocket Estimates

# Real Consumption Trends: by Aggregation Method × Age Category

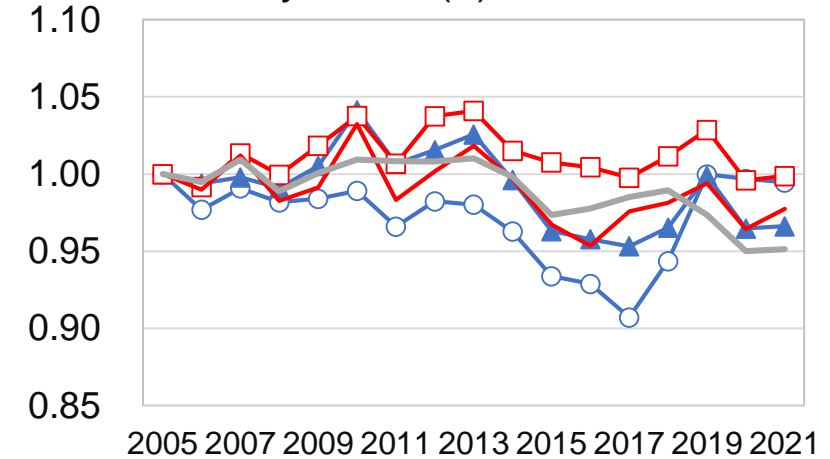
Quantity Index (1)



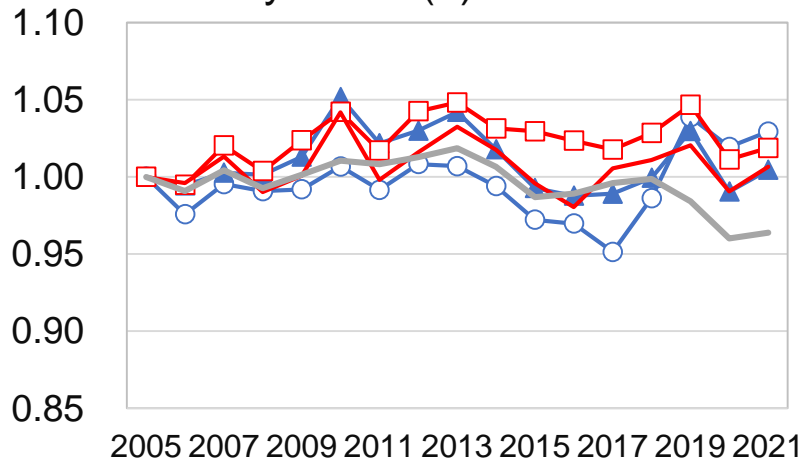
Quantity Index (2)



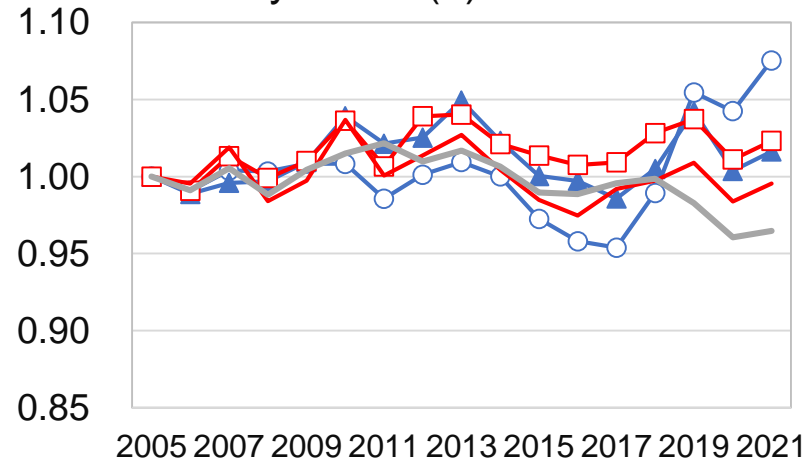
Quantity Index (3)



Quantity Index (4)



Quantity Index (5)



- (1) Equivalent Household Expenditures Deflated by the Official CPI
- (2) Deflated by the Common Törnqvist
- (3) Deflated by Attribute-specific Törnqvist
- (4) Quantity Index with Estimates of National Medical Care Expenditure
- (5) Quantity Index Using Household Expenditure Data and Out-of-pocket Estimates

—○— -39   —▲— 40-49   —□— 50-59   — 60-69   — 70-79



# Conclusion

The Törnqvist index by household attributes:

- Declined significantly for **younger** households after October 2019, when free childcare costs for infants began.
- When there are policy changes targeted at specific groups, **using a price index common to** all household attributes will lead to an **overestimate** (or underestimate) of the **real expenditures** of that particular group.

To measure economic welfare:

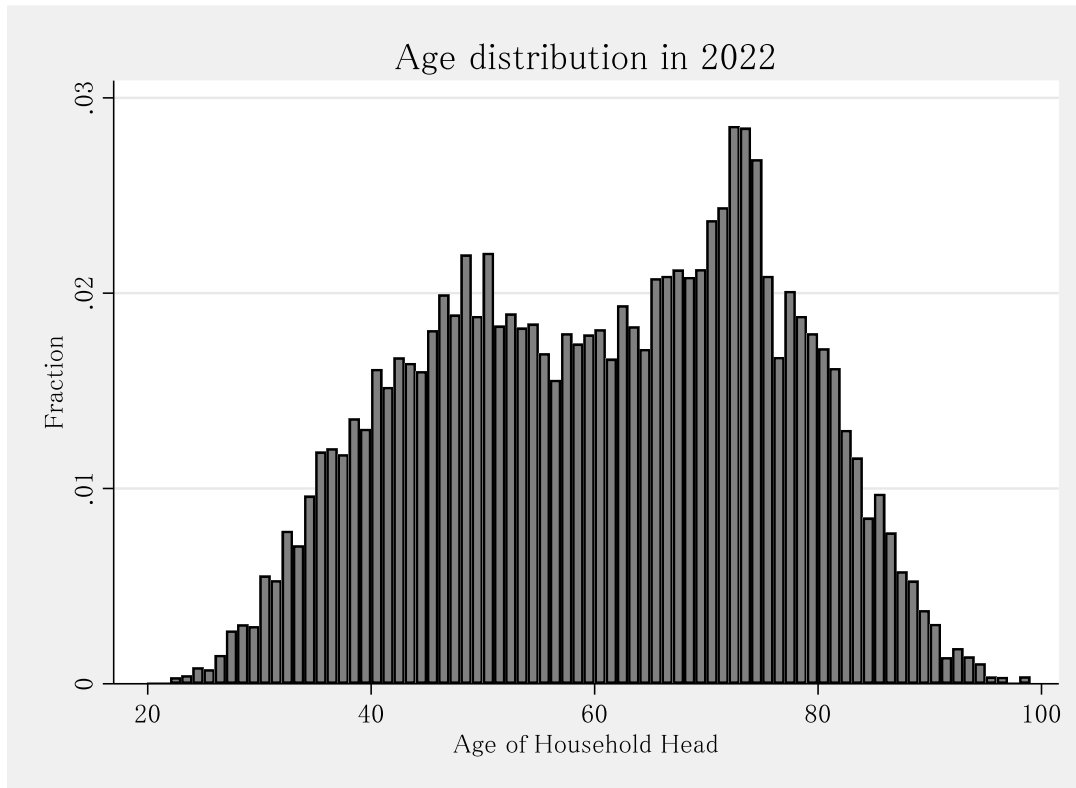
- Estimating household consumption of medical care based **solely on out-of-pocket costs** is likely to introduce significant measurement errors.

For consumption that has **statistically disappeared** from household expenditures due to **policy changes**, one method is to use external data to independently estimate the aggregate **quantity indices** for items where spending and consumption do not align.

# Appendix

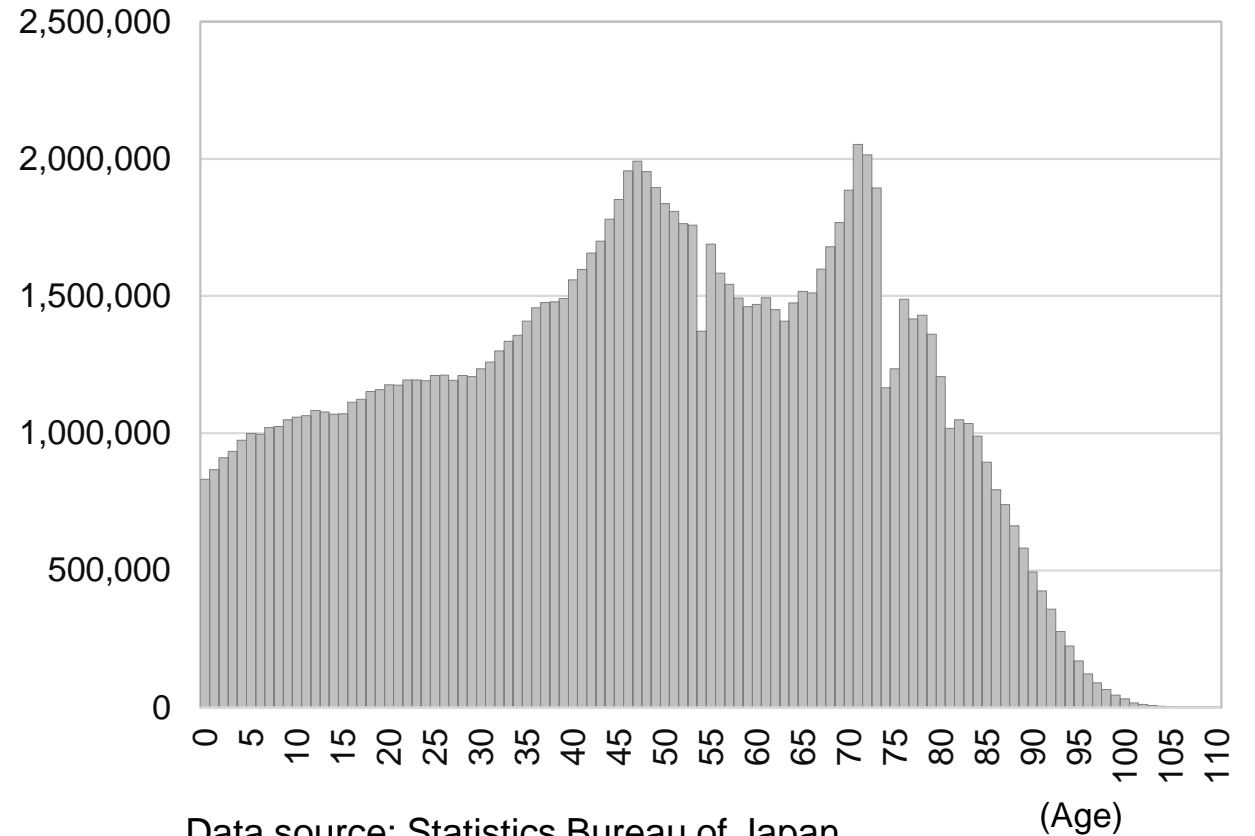
# Age Distribution in Japan

## Family Income and Expenditure



Note: Limited to households with two or more members.

## Census (2020)



Data source: Statistics Bureau of Japan,  
2020 Population Census.

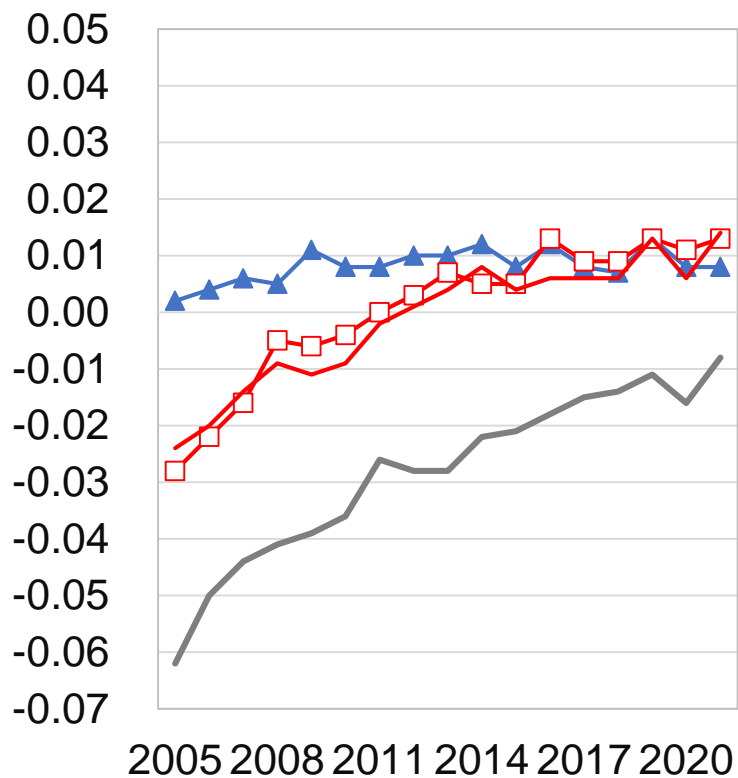
# Numerical Example Illustrating the Method for Estimating the Proportion of Out-of-Pocket Medical Expenses

Column 1	Column 2	Column 3	Column 4	Column 5
Family ID	Expenditure on Medical Services as Recorded in FIES (Unit: 1,000 Yen/Month) $E_{i,t}^M$	Age of Each Household Member	Monthly Medical Expenses for the Relevant Age Group, Estimated from the National Medical Care Expenditures $C_{i,t}^M$	Self-payment ratio $S_{i,t}^M$
1	3	0	20	$3/(20+10+10+10) = 0.06$
		5	10	
		30	10	
		40 (HH head)	10	
2	0	0	20	$0/((20+10+10+10)) = 0$
		5	10	
		30	10	
		40 (HH head)	10	
3	13	75	60	$13/(60+70) = 0.1$
		80 (HH head)	70	

# Coefficient Estimates

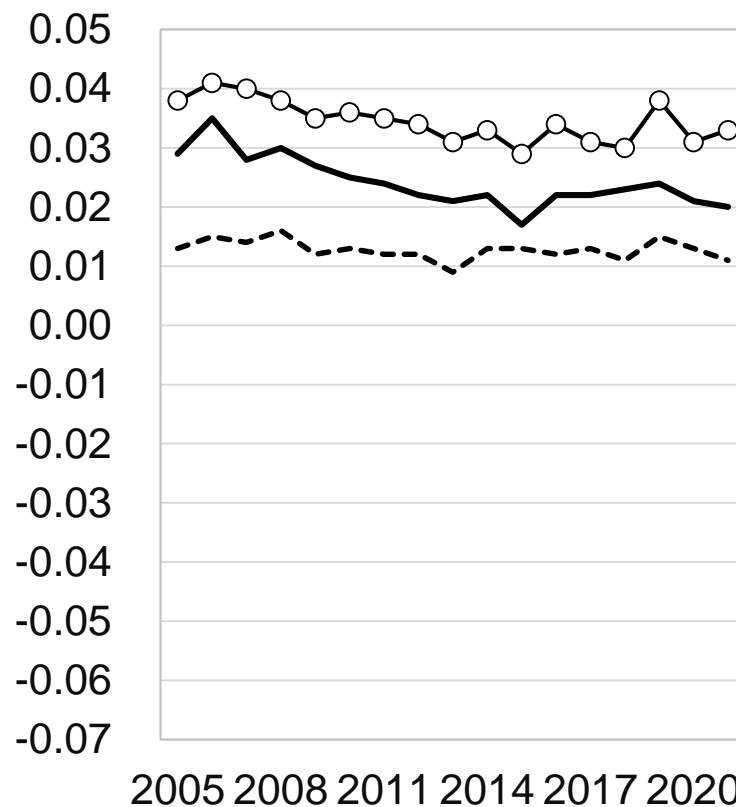
Dependent Variable: Proportion of Out-of-Pocket Medical Expenses

### Age Categories (Base Category: Under 40)



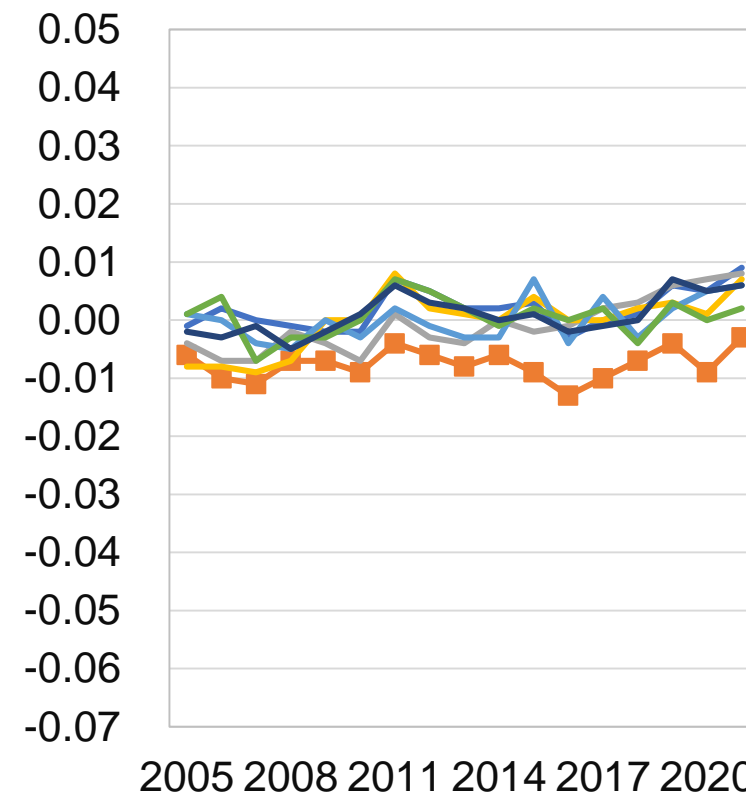
▲ age40      □ age50  
 — age60      — age70

### Annual Income Categories (BC: I)



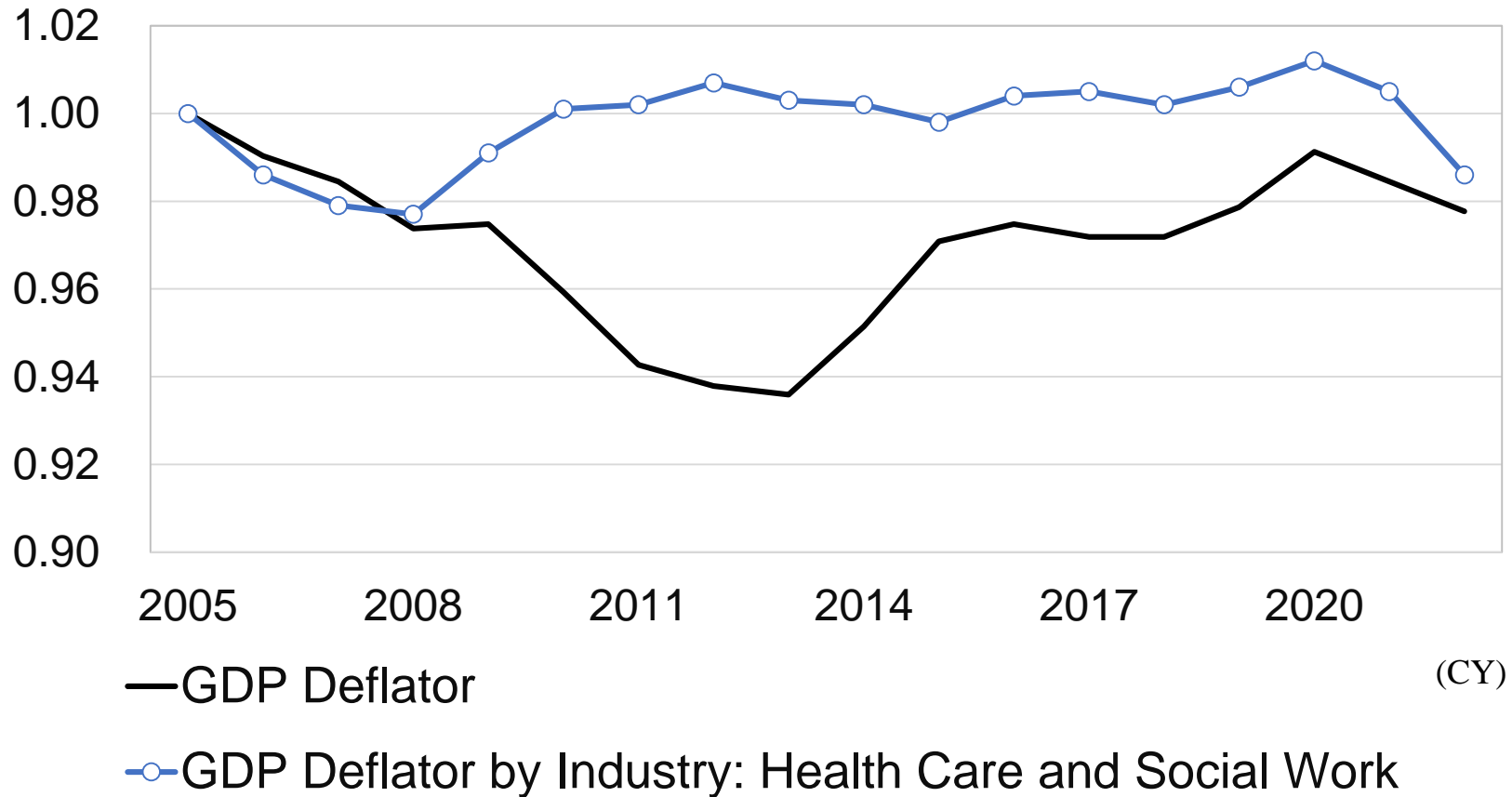
--- I    — II    —○— III

### Regional Blocks (BC: Hokkaido & Tohoku)



— Kanto      — Hokuriku      — Tokai  
 — Kinki      — Chugoku      — Shikoku  
 — Kyusyu

# GDP Deflator



Data source: Compiled from "National Accounts," Cabinet Office, Government of Japan.