

# **Measurement of Deflators and Real Value Added in the Service Sector**

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# Motivation

- Numerous studies on Japan have shown that growth in service sector productivity has been sluggish and, moreover, that productivity is quite low compared to the United States and Europe (Inklaar and Timmer 2008, Fukao 2013, Jorgenson, Nomura and Samuels, forthcoming).
- Although a number of studies have sought to examine what is needed to raise Japan's service sector productivity (e.g., Fukao 2012, Morikawa 2014), **these studies have to contend with severe data constraints.**
- In recent years, initiatives to address measurement issues to examine service sector performance have sprung up in many advanced countries (Schreyer 2010, ONS 2007, OECD/Eurostat 2014). **In the UK, the ONS estimates and publishes direct and quality-adjusted output indexes for public sector activities.**
- In contrast, in Japan, there has been **little progress** in improving service sector statistics. In addition, in Japan, **documentation on how quantities and prices are estimated for GDP statistics is very limited.**

# Motivation (Contd.)

We focus on five sectors.

	Gross value added share in GDP			Man-hour input share in the total economy		
	US (2010)	UK (2010)	Japan (2012)	US (2010)	UK (2009)	Japan (2012)
Construction	3.6%	7.0%	6.1%	5.9%	8.2%	9.0%
Wholesale and retail	9.7%	10.8%	13.4%	13.5%	14.4%	14.4%
Education	5.9%	6.8%	3.5%	8.2%	6.9%	3.2%
Health care and social work	12.6%	8.1%	6.0%	17.9%	10.9%	10.6%
Public administration and defense, compulsory social security	4.2%	5.3%	9.3%	3.4%	5.7%	5.5%
Total	36.0%	37.9%	38.2%	48.9%	46.1%	42.7%

# Motivation (Contd.)

- In this paper, we compare Japan's methods of estimating service sector quantities and prices for GDP statistics with those employed in the United States and other developed countries.
- We also compare changes in total factor productivity (TFP) and gross output prices in the five sectors in Japan with those in the United States and the UK using standard KLEMS-type databases. Since these three datasets use the GDP of each country as the control total, we think that this comparison allows us to make conjectures about the extent to which measurement issues account for differences in estimated sectoral TFP growth across the three countries.
- We take a look at the new output indexes of the ONS in the UK. Moreover, we try to obtain rough estimates of the output and TFP of Japan's education and health care service sectors using the direct method and adjusting for quality changes.

# Construction

- In Japan's GDP statistics, real output of construction is obtained by using an input price index as the deflator. Under this convention, which essentially equates output with inputs, if the input price index covers all inputs, measured TFP growth will be close to zero.
- In Japan, there are no government statistics providing construction output prices.
- The “output=inputs” convention:

$$\frac{\frac{d(wL + rK + qM)}{dt}}{wL + rK + qM} = (s_L \hat{w} + s_K \hat{r} + s_M \hat{q}) + (s_L \hat{L} + s_K \hat{K} + s_M \hat{M})$$

Growth rate of  
nominal output

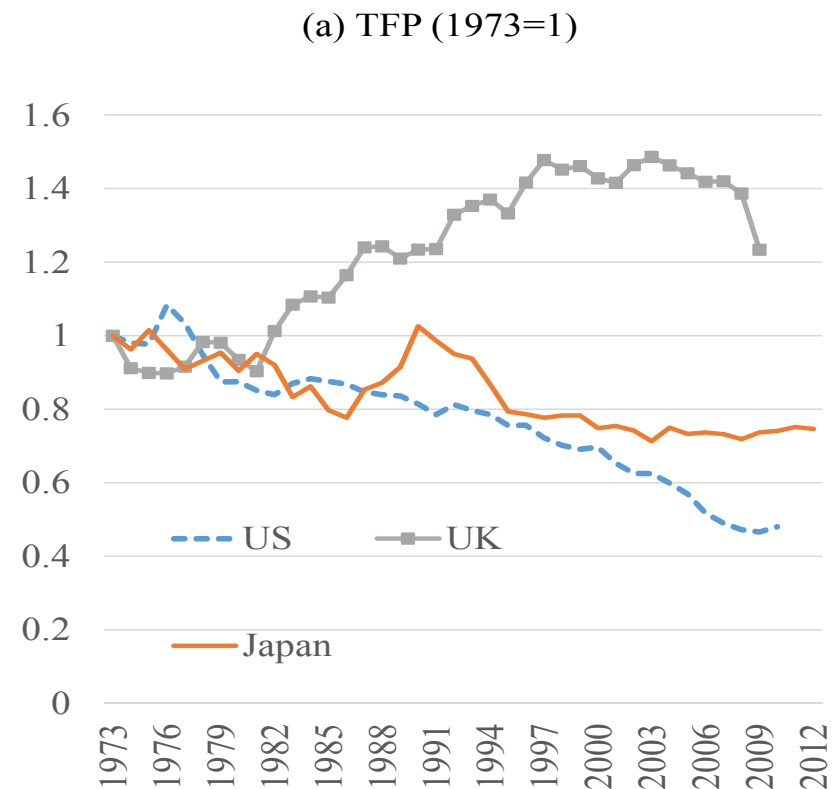
Growth rate of  
deflator

Growth rate of total  
inputs = growth rate  
of real output

# Construction (Contd.)

- First, the output measure does not entirely consist of information on factor inputs but also includes the operating surplus in nominal output.
- Second, Japan's deflator for the construction sector takes account only of intermediate input prices and wage rates and does not take capital service prices in account.
- Third, Japan's deflator for the construction sector does not take account of changes in labor quality.

Developments in TFP in the Construction Sector: Japan-US-UK Comparison

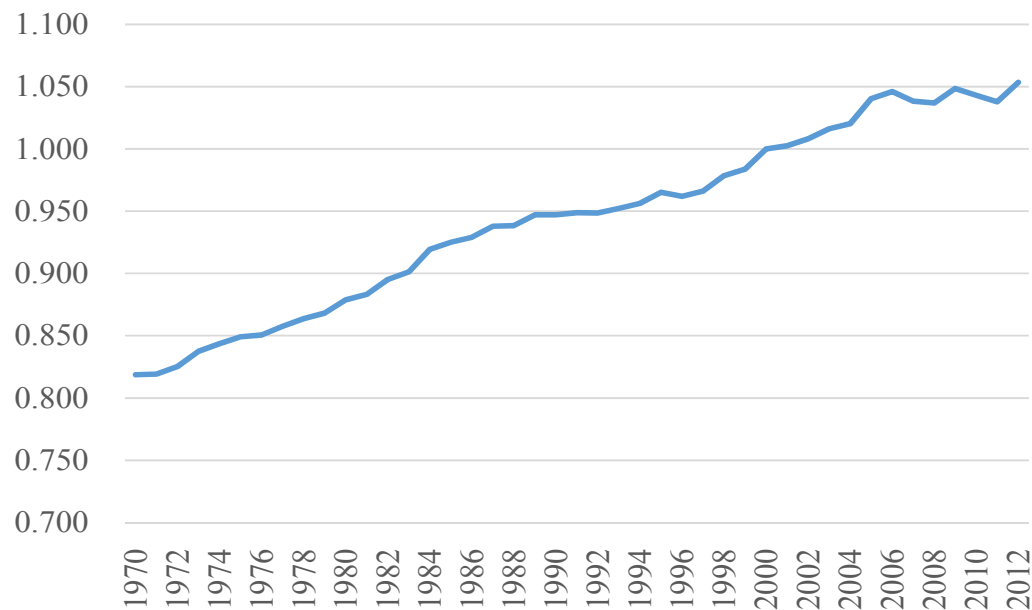


Sources: World KLEMS Data, EU KLEMS Data, and JIP Database 2015.

# Construction (Contd.)

- According to the JIP Database 2015, during the period 1970–2012 labor quality increased at an annual rate of 0.6%.
- Japan's GDP statistics underestimate real GDP growth by 1.7 percentage points for the period 1973–2012, and the JIP Database underestimates TFP growth in the economy as a whole by 1.7 percentage points for the same period.

Figure 2. Quality of Labor in the Construction Sector



# Wholesale and Retail

As OECD/Eurostat (2014) points out, if the quality of wholesale or retail services per unit of traded commodities does not change over time, the margin price per unit, i.e.,

Margin price per unit = Selling price per unit – Purchase price per unit

will be the appropriate measure of the price of services provided by wholesalers and retailers.

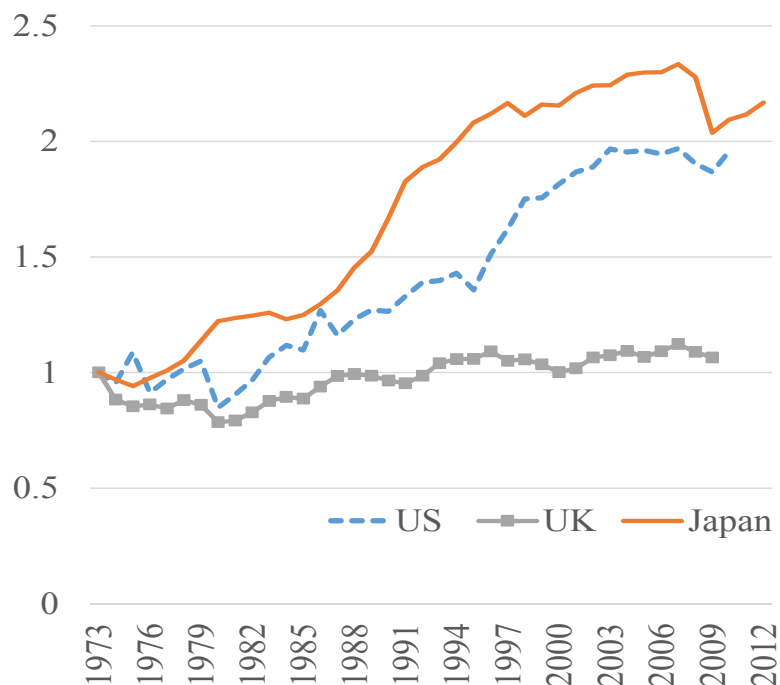
While the United States and Canada have started to use margin prices, most other countries, including Japan and the UK, still use the prices of traded commodities as deflators for the wholesale and retail sector.



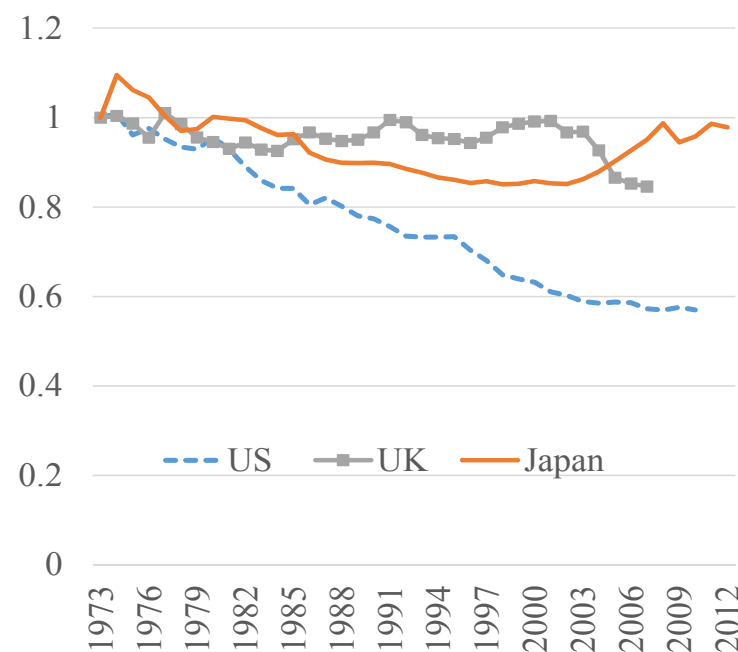
# Wholesale and Retail (Contd.)

Developments in TFP and the Gross Output Deflator in the Wholesale and Retail Sector:  
Japan-US-UK Comparison

(a) TFP (1973=1)



(b) Gross output deflator/GDP deflator (1973=1)

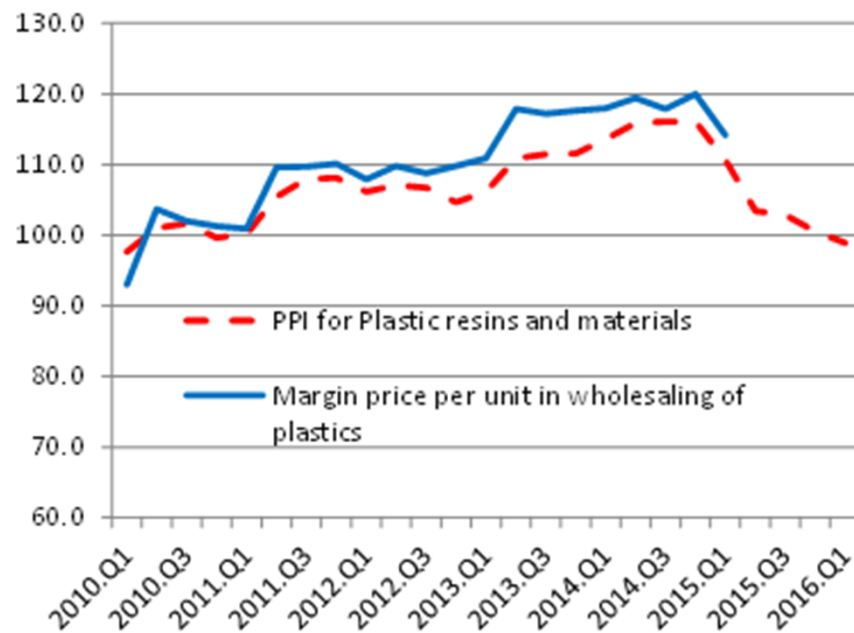


Probably reflecting the worldwide boom in natural resource prices in the 2000s, the gross output deflator-GDP deflator ratio in Japan increased substantially until the global financial crisis. Moreover, probably partly reflecting this increase in the gross output deflator-GDP deflator ratio, Japan's TFP growth in the sector slowed in the 2000s.

# Wholesale and Retail (Contd.)

The Bank of Japan (BOJ) recently started a [wholesale service price survey](#) and estimated the margin price per unit in domestic wholesale trade for three commodity categories – food and beverages, plastic resins and materials, and electric parts and devices – on a trial basis as part of its work on the Services Producer Price Index.

Comparison of the PPI for Plastic Resins and Materials and the Margin Price per Unit in Wholesaling of Plastic Resins and Materials: 2010=1 (Consumption Tax is Excluded)



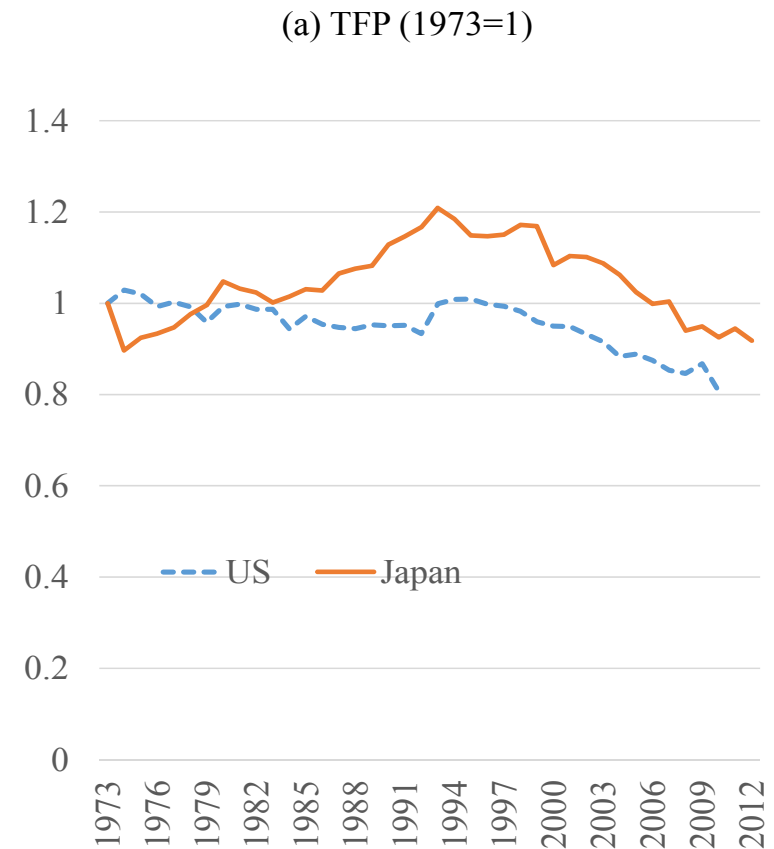
For the period after 2010, the figure indicates that the margin price per unit in the wholesaling of plastics increased more than the PPI for plastics. This means that, for this period, if we measure the TFP of wholesaling of plastics using the margin price per unit as deflator, the measured TFP growth rate will become lower than measured TFP growth based on the PPI.

# Education

In Japan and the United States, real output of most activities in the education sector is measured by the output=inputs approach.

In the case of Japan, the GDP statistics do not make adjustments for labor quality in the case of private schools (most of which are non-profit organizations) in the estimation process of input prices. This results in an underestimation of improvements in the quality of output and of TFP growth.

Developments in TFP in the Education Sector: Japan-US Comparison

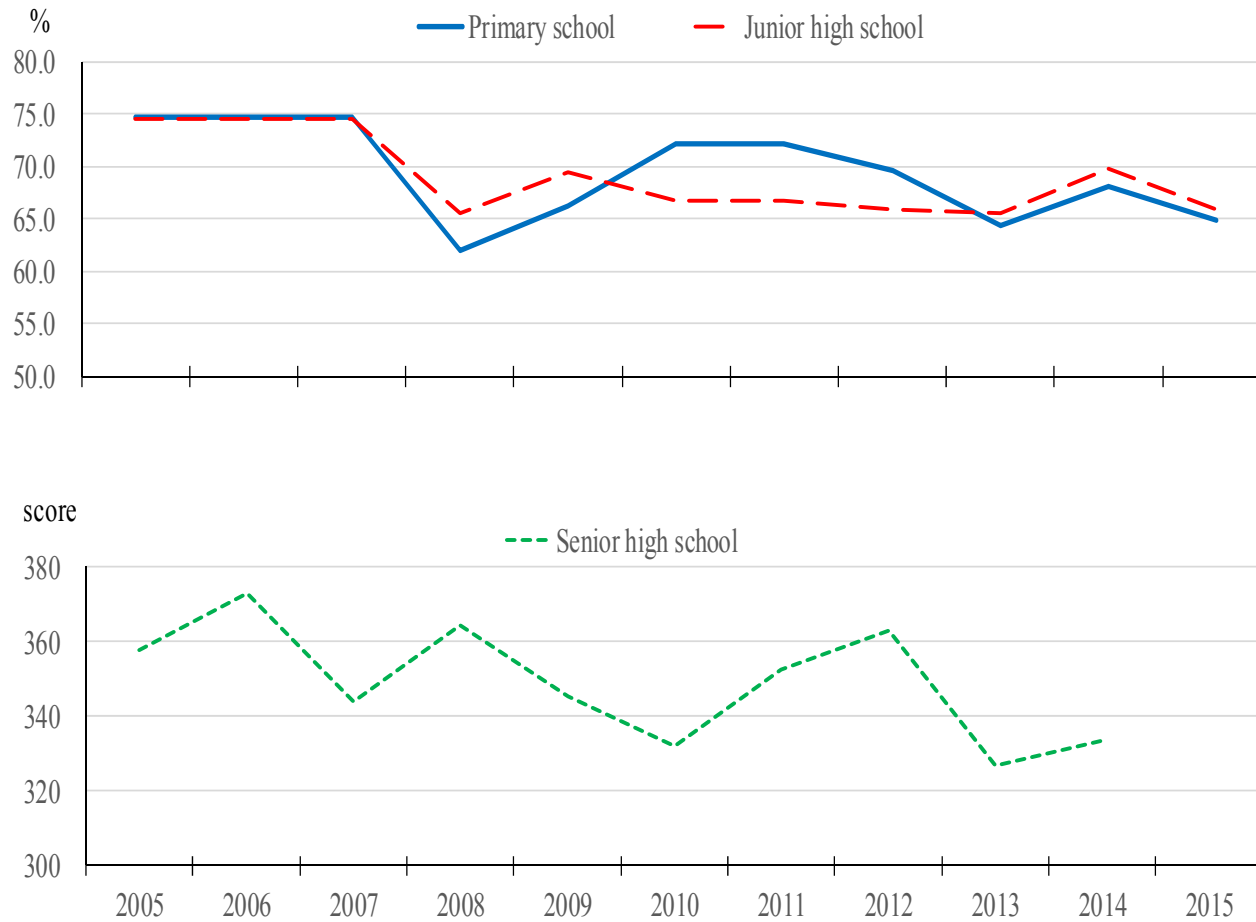


# Education (Contd.)

- We try to obtain rough estimates of the output and TFP of Japan's education and health care service sectors using the direct method and adjusting for quality changes.
- In the case of education, we use the number of students as the direct measure of output and employ test scores to measure the quality of education.
- The direct measure of output (number of students) is calculated for four school categories, namely, primary schools, junior high schools, senior high schools, and universities (both undergraduate and graduate schools). We then aggregate these four direct measures of output using the expenditure on each of the four school categories as weights.

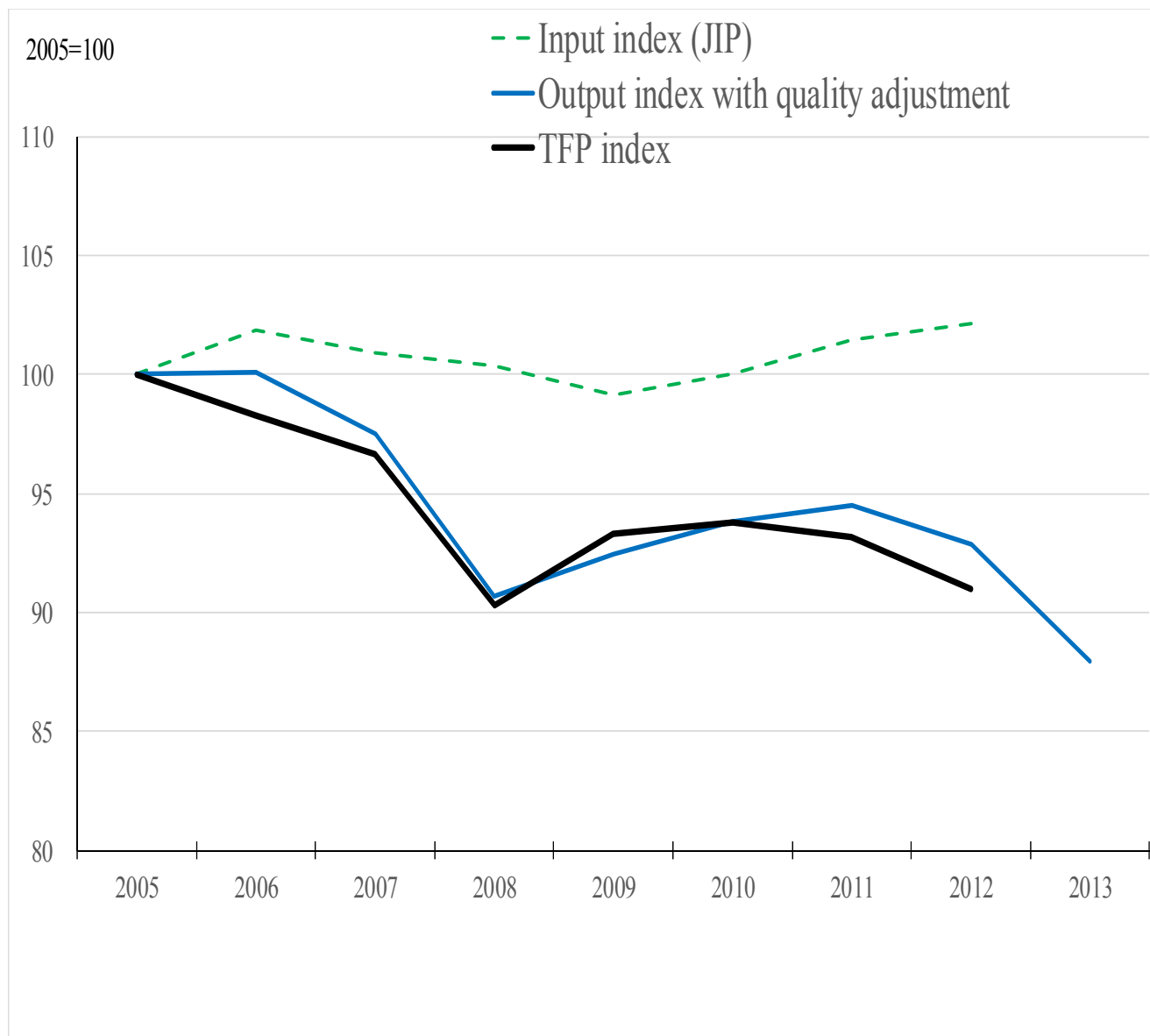
# Education (Contd.)

## Test Scores at Primary, Junior, and Senior High School Level in Japan



# Education (Contd.)

Developments in the Direct Measure of Output with Quality Adjustment, the Total Input Index, and TFP: Education Sector, Japan



# Conclusions

- Our analysis has shone some light on Japan's GDP statistics.
- There is a lot of room for improvement in Japan's GDP statistics.