Purchasing Power Parities between Japan and China by Industry

Dai, Yanjuan
Guangdong University of Foreign Studies, School of International Trade Economics
Waihuan Donglu 178, Xiaoguwei Island,Panyu District,Guangzhou, Guangdong Province, 510006, China
E-mail:daiyanjuan@gmail.com
Li, Jie
Saitama University, Faculty of Economics
Simo-Okubo 255 Saitama-City 338-8570, Japan
E-mail: lij@mail.saitama-u.ac.jp
Izumi, Hiroshi
Osaka University of Economics, Faculty of Economics
Osumi 2 Higashi-Yodogawa-Ku Osaka, 533-8533, Japan
E-mail: izumi@osaka-ue.ac.jp

Introduction

A considerable number of estimations concerning the purchasing power parities (PPPs) of Chinese RMB have been made from the 1950s until now. The results of them are considerably different. The International Comparison Program (ICP) round 2005 published the estimation result of PPPs of RMB for the first time. It may be now the most authoritative estimation of the PPPs of RMB. It is the most widely used at present. The estimation of PPPs of RMB is very difficult in both theory and data. So the result of ICP is also not fully satisfied.

We estimate PPPs by industry in our own way in order to convert GDP and input-output tables of Japan and China into common currency unit and prices. Because no basic survey for necessary data such as price and quantity has done by governmental institutions in China, there are many difficulties in estimating China's PPPs. We tried our best to make use of existing data and to supplement some data through our own surveys, and got one more China's PPP estimation result.

1. Aim of the Estimation of PPPs between China and Japan in 2005

With the development of Chinese economy, a lot of people have paid attention to the real scale of Chinese economy. We are very interested in comparison of real total GDP and real per capita GDP between China and Japan. After ICP round 2005 published, real GDPs of China in World development indicators by World Bank have become considerably smaller comparing before version. We want to know how accurate ICP result of concerning RMB is.

One of major uses of PPP which estimated by ICP is estimation of widely used "dollar-a-day" i.e. international poverty line. According to the result of ICP round 2005, the ratio of people below the poverty line in China is very high. But it does not tally with the Chinese actual situation and our actual feelings. Also in this point, we think results of ICP around 2005 have some questions.

We are researching on international comparisons of labor productivities and energy efficiencies by industry too. For this purpose, we need not only nominal input-output tables but also real input-put tables. National input-output tables are defined as the tables in national currencies at national price levels. Nominal input-out tables are defined as the tables in a common currency at national price levels, which are converted from national input-out tables using official exchange rates. Real input-output tables are defined as the tables in a common currency at a uniform price level, which are converted from national input-put tables using PPPs by industry.

2. Data used in the PPPs Estimation between China and Japan in 2005

For calculating PPPs by sectors, at first, we collected as many price data available in both China and Japan as possible. This time we used mainly the following data, China: ①Data of the Prices Observation Center of National Development and Reform Commission; ②Chinese Trade Statistics of 2005. ③Chinese price data through Prof. Kiji. Japan: ①Retail Price Survey, ②The supporting table on domestic products by sector and commodity in Japan's 2005 Input-Output table. ③Japanese Trade Statistics of 2005. We also used the basic heading data of ICP.

Samples need to satisfy two requirements, comparability (type and quality of the product are the same in the two countries) and representativeness (price level of the product is close to the average for all products within the sector).

From table 1, we can see that if we use the data ① of China, which are the domestic retail prices, PPPs of Yuan to Yen in most of sectors are higher than those of ICP except Chemical Industry, Metal Products, Coking, Gas and Petroleum Refining and Other Manufacturing (See Column b of table 1). If we use the data ③ of China, which is also the domestic retail price (provided by Prof. Kiji), PPPs of Yuan to Yen in almost all sectors are higher than those of ICP except Chemical Industry and Coking, Gas and Petroleum Refining (See Column c of table 1). The data of ① and ③ are the products which are widely used in China, and the products satisfied the representativeness. But there is no information of detailed type and gauge for these products, so we can't judge if the quality of these products is the same with Japanese products. If we use the data ② of China and data ③ of Japan, which is the export data of the two countries, we found, the PPPs of Yuan to Yen in most of sectors except agriculture, foodstuff, Coking, Gas and Petroleum Refining are higher than the ICP's. We also compare the products of the import, and we found the PPPs by import data is close to the official exchange rate. At last we compare the Chinese export products with the Japanese domestic products in the supporting data of IO table, and saw the PPPs of Yuan to Yen in Foodstuff, Textile, Sewing, Leather and Furs Products and Machinery and Equipment are higher than ICP's.

Roughly speaking, if we lay more stress on representativeness, PPPs of Yuan to Yen are estimated higher, and if we lay more stress on comparability, they are estimated lower. We think ICP round 2005 concerning China laid not so strong stress on representativeness, therefore PPPs of Yuan in ICP were estimated a little lower than the real state.

3. Methods used in the PPPs estimation between China and Japan in 2005

We calculated PPPs of sectors from PPPs of products through fisher method (partially through simple geometric mean: See note of Table.1.) and calculated PPPs of GDP from the PPPs of sectors not only through Fisher method and Geary-Khamis (GK) method but also through our original method (Total labor method).

When we calculated PPPs of GDP from the PPPs of sectors, we used domestic final use of domestic products and imports and net export in IO tables as weight.

3.1 Fisher method

In the Fisher method, PPPs between Japan and China are geometric mean of results calculated by using Japan weight and China weight.

Fisher method satisfies base country invariance but does not satisfy additivity. Geary-Khamis method and total labor method satisfies not only base country invariance but also additivity.

Table.1

Purchasing Power Parities by Industry between China and Japan from various sources

Unit : Yen / Yuan Ofiicial Exchange Rate: 13.46

sector ＼ data source	a Aggregated from ICP Basic Heading Data	b CHN The Prices Observation Center's Data ： JPN Retail Price Survey, IO ten digit Data	c CHN Prof.Kiji's Data ： JPN Retail Price Survey	d Both Export Data	e Both Import Data	f CHN Export Data ： JPN IO ten digit Data
1 Agriculture	**59.28**	97.71	107.86	42.28	16.30	
2 Mining and Quarrying		22.55		**37.51**	13.15	9.18
3 Foodstuff	35.84	57.61	50.10	33.47	18.32	**49.22**
4 Textile, Sewing, Leather and Furs Products	26.74	77.61	53.46	81.32	21.91	**55.59**
5 Other Manufacturing	**29.86**	10.95	85.33	50.08	16.00	25.38
6 Production and Supply of Electric Power, Heat Power and Water	**30.98**	41.21	37.41			
7 Coking, Gas and Petroleum Refining	**43.68**	27.97	42.74	15.68	14.31	16.01
8 Chemical Industry	42.70	29.73	28.29	**43.11**	14.85	26.64
9 Building Materials and Non-metal Mineral Products	19.28	24.99	93.36	**44.99**	14.02	24.8
10 Metal Products	17.58	16.15	83.31	**29.24**	15.64	15.55
11 Machinery and Equipment	**20.77**	39.19	79.64	40.94	9.98	28.14
12 Construction	**62.29**	134.82*				
13 Transportation, Postal and Telecommunication Services	**40.37**	205.04	100.00			
14 Wholesale and Retail Trades, Hotels and Catering	**26.99**					
15 Real Estate, Leasing and Business Services	**39.34**					
16 Banking and Insurance	**33.83**					
17 Other Services	46.98	98.60	**56.07**	101.70	21.43	

Note:

a. ICP Data are in purchaser price. These data are aggregated from 130 basic heading items to 17 sectors by using Fisher method with weight of Basic Headings Nominal Expenditures.

b. CHN The Prices Observation Center's Data and JPN Retail Price Survey are in purchaser price.
JPN IO ten digit Data are in producer price.
They are converted into purchaser prices by multiplying purchaser price / producer price in 7 digit data.
PPPs of items are aggregated to 17sectors by simple geometric mean.
* China statistical yearbook on investment in fixed assets:Japan IO ten digit data

c. Prof.Kiji's data are in purchaser price.
These PPPs are also aggregated to 17 sectors by simple geometric mean.

d. Export data are in FOB price.
PPPs of items are aggregated to 17sectors by using Fisher method with weight of export value.

e. Import data are in CIF price.
PPPs of items are aggregated to 17sectors by using Fisher method with weight of import value.

f. Export data are in FOB price.
JPN IO ten digit Data are in producer price.
They are converted into purchaser prices by multiplying purchaser price / producer price in 7 digit data.
PPPs of items are aggregated to 17sectors by using Fisher method with weight of export value and domestic production value..

3.2 Geary-Khamis method (GK method)

In Geary-Khamis method, GDPs in expenditure side of the two countries are indicated at weighted averages of actual prices. These prices are shown in International GK Yen.

GK method is expressed by following equations, as well known.

$$\boldsymbol{\pi_i = \sum_{j=1}^{n} \frac{p_{ij}}{ppp_j}\left[\frac{q_{ij}}{\sum_{j=1}^{n} q_{ij}}\right] \quad (i = 1, \ldots, m)} \qquad \textbf{(1)}$$

$$\boldsymbol{\sum_{i=1}^{m} \pi_i q_{ib} = \sum_{i=1}^{m} p_{ib} q_{ib} \quad (b = base - country)} \qquad \textbf{(2)}$$

$$\boldsymbol{ppp_j = \frac{\sum_{i=1}^{m} p_{ij} q_{ij}}{\sum_{i=1}^{m} \pi_i q_{ij}} \quad (j = 1, \ldots, n)} \qquad \textbf{(3)}$$

$\pi_{i:}$ international average price of i-th commodity (unkown)

ppp_j: purchasing power parity of j-th country (unkown)

p_{ij}: price of i-th commodity in j-th country (price in each currency for the volume in a unit of base-country-currency)

q_{ij} : quantity of i-th commodity in j-th country (domestic and import product in base-country-currency)

i: commodity (17 domestic sectors and 17 import sectors)

j: country (Japan, China)

3.3 Total labor method

In Total labor method, GDPs in expenditure side of two countries are indicated at weighted averages of prices in proportion to total labor quantity inputted in the commodity. These prices are shown in International Labor Yen.

The total labor method is shown by the following equations.

$$\boldsymbol{t_i = \sum_{j=1}^{n} t_{ij}\left[\frac{q_{ij}}{\sum_{j=1}^{n} q_{ij}}\right] \quad (i = 1, \ldots, m)} \qquad \textbf{(4)}$$

$$\boldsymbol{\pi_i^* = t_i\left[\frac{\sum_{i}^{m} p_{ib} q_{ib}}{\sum_{i=1}^{m} \tau_i q_{ib}}\right] \quad (i = 1, \ldots, m)(b = base - country)} \qquad \textbf{(5)}$$

$$\boldsymbol{ppp_j^* = \frac{\sum_{i=1}^{m} p_{ij} q_{ij}}{\sum_{i=1}^{m} \pi_i^* q_{ij}} \quad (j = 1, \ldots, n)} \qquad (6)$$

τ_i: international average total labor quantity inputted in i-th commodity for the volume in a unit of base-country-currency

t_{ij}: total labor quantity inputted in i-th commodity in j-th country for the volume in a unit of base-country-currency

q_{ij} : quantity of i-th commodity in j-th country (domestic product and import in base-country-currency)

π_i^*: price in proportion to international average total labor quantity inputted in i-th commodity

p_{ij}: price of i-th commodity in j-th country (price in each currency for the volume in a unit of base-country-currency)

ppp_j^*: purchasing power parity of j-th country

Table.2

Purchasing Power Parities by Industry between China and Japan by some different methods

Unit : Yen / Yuan Ofiicial Exchange Rate: 13.46

		a Fisher method	b GK method		c Total Labor method	
	sector ＼unit	CH Yuan/ JP Yen	JP Yen / INTL GK Yen	CH Yuan / INTL GK Yen	JP Yen / INTL Labor Yen	CH Yuan / INTL Labor Yen
Domestic	1 Agriculture	0.0169	1.4935	0.0252	0.3414	0.0058
	2 Mining and Quarrying	0.0267	0.9725	0.0259	0.8449	0.0225
	3 Foodstuff	0.0203	1.1833	0.0240	0.6509	0.0132
	4 Textile, Sewing, Leather and Furs Products	0.0180	1.4160	0.0255	0.6626	0.0119
	5 Other Manufacturing	0.0335	0.8513	0.0285	0.6790	0.0227
	6 Production and Supply of Electric Power, Heat Power and Water	0.0323	0.9042	0.0292	1.2424	0.0401
	7 Coking, Gas and Petroleum Refining	0.0229	1.0364	0.0237	2.2578	0.0517
	8 Chemical Industry	0.0232	1.0637	0.0247	1.1970	0.0278
	9 Building Materials and Non-metal Mineral Products	0.0222	1.1570	0.0257	0.6792	0.0151
	10 Metal Products	0.0342	0.8000	0.0274	0.6960	0.0238
	11 Machinery and Equipment	0.0481	0.7069	0.0340	0.7005	0.0337
	12 Construction	0.0161	1.4594	0.0234	1.0836	0.0174
	13 Transportation, Postal and Telecommunication Services	0.0248	1.0213	0.0253	1.3552	0.0336
	14 Wholesale and Retail Trades, Hotels and Catering Services	0.0371	0.9035	0.0335	1.0570	0.0392
	15 Real Estate, Leasing and Business Services	0.0254	1.0076	0.0256	1.6811	0.0427
	16 Banking and Insurance	0.0296	0.9365	0.0277	1.9267	0.0570
	17 Other Services	0.0178	1.2271	0.0219	1.3101	0.0234
Import	1 Agriculture	0.0614	0.5026	0.0308		
	2 Mining and Quarrying	0.0761	0.5956	0.0453		
	3 Foodstuff	0.0546	0.7771	0.0424		
	4 Textile, Sewing, Leather and Furs Products	0.0456	0.8438	0.0385		
	5 Other Manufacturing	0.0625	0.7612	0.0476		
	6 Production and Supply of Electric Power, Heat Power and Water	0.0743	0.4423	0.0329		
	7 Coking, Gas and Petroleum Refining	0.0699	0.7816	0.0546		
	8 Chemical Industry	0.0673	0.6477	0.0436		
	9 Building Materials and Non-metal Mineral Products	0.0713	0.6444	0.0460	0.3583	0.0292
	10 Metal Products	0.0639	0.5999	0.0384		
	11 Machinery and Equipment	0.1002	0.3658	0.0366		
	12 Construction			0.0259		
	13 Transportation, Postal and Telecommunication Services	0.0743	0.7644	0.0568		
	14 Wholesale and Retail Trades, Hotels and Catering Services	0.0743	0.7595	0.0564		
	15 Real Estate, Leasing and Business Services	0.0743	0.3847	0.0286		
	16 Banking and Insurance	0.0743	0.3528	0.0262		
	17 Other Services	0.0467	0.5812	0.0271		
Net Export		0.0492	0.5437	0.0268	0.3336	0.01642
Average		0.0255	1.0000	0.0259	1.0000	0.0188

Note

a. Domestic PPPs are calculated by using the underlined data in Table.1.

b. Import PPPs are calculated by using the data in column e of Table.1 (Both Import Data) and exchage rate.

c. Average is calculated by using final uses in domestic and net export of IO tables as weight.

4. Comparisons of GDP between China and Japan in 2005

At last we will use different PPPs to compare GDP between China and Japan in 2005 and analyze the reasons of their differences.

Table 3 shows that if we use the official Exchange rate, the China's GDP is 0.4958 times as large as Japan's GDP, but if we use the PPPs that estimated by ICP (EKS method), China's GDP is 1.381 times of Japan's GDP, the Chinese economic scale is already in 2005 much larger than Japan. If we use our PPPs to compare the GDPs, by the Fisher method, the China's GDP is 1.4441 times of Japan's; by the GK method, the China's GDP is 1.4206 times of Japan's. The results by the Fisher method and GK method are not so different. The main reason why CHN/JPN we calculated by Fisher and Gk is larger than the one by ICP is that we use price data put more stress on representativeness comparing ICP.

If we use PPPs by total labor method, the China's GDP is 1.9606 times of Japan's. According to total labor method, the China's GDP is much larger than Japan's GDP. The main reason is, we think, as follows. The prices of product of agriculture and light industries in China are much lower than those in Japan, and prices of product of heavy chemical industries in China are not so much lower. Therefore ratios (=weight in the calculation) of agriculture and light industries in our total labor model are larger than those in the other methods, and this made Chinese GDP much larger than other methods.

Table.3

GDP Comparison between China and Japan in 2005

	Official Exchange Rate	ICP	Our Calculation		
			Fisher PPP	GK PPP	Total Labor PPP
unit	US Million Dollar	INTL Million Dollar	JPN Billion Yen	INTL GK Billion Yen	INTL Labor Billion Yen
China	2256903	5364252	724531	712756	983677
Japan	4552200	3872843	501734	501734	501734
CHN/JPN	0.4958	1.3851	1.4441	1.4206	1.9606

REFERENCES

Izumi Hiroshi, Li Jie, Yang Hyun-Ok (2007) 'Purchasing Power Parities and Multilateral Comparison of Input-output Tables concerning Japan, China and The Republic of Korea in 2000' "Input-output Analysis" Vol. 15, No. 1, in Japanese