

International Comparison of Productivity among Asian Countries (ICPA) Project

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Research Institute of Economy, Trade and Industry¹

1. Scope and motivation

RIETI (Research Institute of Economy, Trade and Industry) has launched the ICPA project for an international comparison of productivity among Asian countries to undertake a broad examination of the sources of economic growth and competitiveness through large-scale, internationally comparable databases. This project is based on the KLEMS framework, i.e., industry level data on capital (K), labor (L), energy (E), material (M), service (S) as well as gross output to come up with TFP (Total Factor Productivity). This scope of this project is to develop comparable KLEMS datasets for China, Korea, Japan, Taiwan and the United States.

In this project, relative prices for each component of KLEM are also estimated. Industry level relative output price can be derived from expenditure side PPPs or unit price data from manufacturing census and other survey data. Relative wages and capital service prices can be used for input price for L and K, respectively. These relative prices data enable us to calculate the levels of TFP by industry for Asian countries as well as the United States.

The output of this project, i.e., industry level TFP growth and level among Asian countries can be used for assessing relative competitiveness of Japanese industry. In addition, comparable input and output tables, as well as labor and capital input data, can be served as basic database for Asian economies, which can be applied to economic modeling of structural changes, energy demand, environment impacts and so on. Studies on growth decomposition of Asian economies are available at macro level (Young, 1995) or at aggregated industry level (van Ark and Timmer, 2003). However, this project sheds a new light on East Asian economic developments by providing more detail information on the sources of economic growth at industry level.

2. Methodology

The methodology is based on the growth accounting framework, with internationally comparable measurements of the service flow of labor, capital, and other intermediate inputs; gross output; and productivity at economy-wide and industry levels.² This framework must

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² The analytical framework on international comparison of TFP growth and level is provided in Kuroda et. al. (1996). Empirical works of this framework include Kuroda and Numura (1999), Jorgenson et. al. (2002) and Keio University (1996).

be consistently related to national accounts statistics and input-output tables of each country.

Common industrial classification is provided in Table A of Appendix 1. Labor input and capital input are derived from quantity and price data by type, as are described in Table B and Table C, respectively. Proper aggregation of labor and capital inputs based on detail data by type allows us to make a distinction between quantity and quality improvement for each factor input. Divisia index of capital service (K^{PK}) is derived as follows,

$$\ln\left(\frac{K_t^{PK}}{K_{t-1}^{PK}}\right) = \sum_i \bar{v}_{i,t} \ln\left(\frac{K_{i,t}}{K_{i,t-1}}\right)$$

$$\text{where, } \bar{v}_{i,t} = \frac{1}{2}(v_{i,t-1} + v_{i,t}) \text{ and } v_{i,t} = \frac{P_{k,i,t} K_{i,t}}{\sum_i P_{k,i,t} K_{i,t}}$$

This capital service index is a weighted average of capital stock (K_i) for each type 'i' by the share of rental services from this type of capital stock ($\frac{P_{k,i,t} K_{i,t}}{\sum_i P_{k,i,t} K_{i,t}}$). Capital service price ($P_{k,i}$)

is based on the theory of rental service price, with asset price data, rate of depreciation, rate of return on asset and proper tax treatment in rental service equation. The growth rate of rental service index can be decomposed into the following two parts, i.e., quantity growth and quality growth.

$$\ln\left(\frac{K_t^{PK}}{K_{t-1}^{PK}}\right) = \underbrace{\ln\left(\frac{\sum_i K_{i,t}}{\sum_i K_{i,t-1}}\right)}_{\text{quantity growth}} + \underbrace{\left(\ln\left(\frac{K_t^{PK}}{K_{t-1}^{PK}}\right) - \ln\left(\frac{\sum_i K_{i,t}}{\sum_i K_{i,t-1}}\right)\right)}_{\text{quality growth}}$$

Labor input and intermediate input (energy, material and service) can be estimated in the same framework. Labor input is estimated as a weighted average of hours worked by hourly wage by type of labor, and divisia index of intermediate input (energy, material and service) can be derived from input output tables. Finally, growth accounting decomposition of output (Y) can be conducted as follows,

$$\ln\left(\frac{Y_t}{Y_{t-1}}\right) = s_k \ln\left(\frac{K_t^{PK}}{K_{t-1}^{PK}}\right) + s_l \ln\left(\frac{L_t}{L_{t-1}}\right) + s_{ems} \ln\left(\frac{EMS_t}{EMS_{t-1}}\right) + \ln\left(\frac{TFP_t}{TFP_{t-1}}\right)$$

where S^* is the share of each factor input '*'.

This framework can be applied to the level comparison across countries as well. Growth accounting decomposition of output Y in country 'j' as compared to country 'i' can be described as follows.

$$\ln\left(\frac{Y_j / P_{j/i}^y}{Y_i}\right) = s_k \ln\left(\frac{K_j^{PK} / P_{j/i}^k}{K_i^{PK}}\right) + s_l \ln\left(\frac{L_j / P_{j/i}^l}{L_i}\right) + s_{ems} \ln\left(\frac{EMS_j / P_{j/i}^{ems}}{EMS_i}\right) + \ln\left(\frac{TFP_j}{TFP_i}\right)$$

where $P_{j/i}^*$ is relative price of “*” in country ‘j’ as compared to country ‘i’.

3. Project Formation and schedule

This project has been conducted by a team of inside RIETI, as well as experts from participating countries, i.e., China, Korea, Taiwan and the United States, as is provided at Appendix 2. In addition, there are some experts from Europe in Appendix 2, since coordination efforts with European KLEM project, managed by GGDC (Groningen Growth Development Center) at University of Groningen, are underway.

This project started in 2001, and will be finalized by March 31, 2006, the end of Fiscal Year 2005. The whole project can be broken down into the following three stages.

- Stage 1 : Development of KLEMS data and the productivity growth rate
- Stage 2 : Construction of relative prices and the productivity level comparison
- Stage 3 : Analytical work by using KLEMS-PPP data for Japan’s international competitiveness.

The international conference was jointly organized with Keio University in May 2003, at the completion of stage 1 of this project, i.e., KLEM datasets and TFP comparison among participating countries. Details of this conference can be shown at the following RIETI web-site.

<http://www.rieti.go.jp/en/events/03053001/report.html>

As of March 2004, stage 2 has been almost finished, and the first results of both TFP growth and level comparison will be estimated by June 2004. The results will be discussed at the workshop, held by participating members, before summer 2004. Each country will improve its data based on the discussion at this workshop, and this data work will be finalized by the end of 2004. A final conference with analytical reports of ICPA projects will be held in the spring of 2005, and publication after the conference will be prepared toward the end of 2005.

References

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Appendix 1 : Sector Classification for ICPA Project

Table A Classification of Industry

1	Agriculture
2	Coal mining
3	Metal and non-metallic mining
4	Oil and gas extraction
5	Construction
6	Food and kindred products
7	Textile mill products
8	Apparel
9	Lumber and wood
10	Furniture and fixtures
11	Paper and allied
12	Printing, publishing and allied
13	Chemicals
14	Petroleum and coal products
15	Leather
16	Stone, clay, glass
17	Primary metal
18	Fabricated metal
19	Machinery, non-elect
20	Electrical machinery
21	Motor vehicles
22	Transportation equipment & ordnance
23	Instruments
24	Rubber and misc plastics
25	Misc. manufacturing
26	Transportation
27	.Communications
28	Electric utilities
29	Gas utilities
30	Trade
31	Finance Insurance and Real Estate
32	Other private service(*)
33	Public service(*)

* :The definition of 33 is government administration only and the rest of services should be put into 32

Table B Labor input
(cross classified as follows)

Industry	
	33 sectors in Table A
sex	
1	1.male
2	2.female
Age(*)	
1	16-34
2	35-54
3	55-
Education	
1	Junior high school or less
2	High school
3	College/University

*: A little modification can be made depending on data availability

Table C Capital input
(cross classified as follows)

Industry	
	33 sectors in Table A
asset type(*)	
1	structure
2	equipment
3	vehicles

*: Land and inventory should be estimated as well, if possible

Appendix 2: ICPA project participating members

Coordination Body at RIETI, Japan

Kuroda, Masahiro (Keio University): Leading Advisor

Kawai, Hiroki (Keio University and RIETI): Korea, Japanese data

Motohashi, Kazuyuki (Tokyo University and RIETI): Project Leader, China

Nomura, Koji (Keio University): Japanese Data

Shimpo, Kazushige (Keio University and RIETI): Taiwan, Japanese Data

International experts

Ho, Mun, (Harvard University and Resources for the Future): US

Jorgenson, Dale (Harvard University): US

Liang, Chi-Yuan, (Institute of Economics, Academia Sincia): Taiwan

Pyo, Hak K. (Seoul National University): Korea

Ruoan, Ren (Beijing University of Aeronautics and Astronautics): China

Timmer, Marcel (University of Groningen): PPPs, European KLEM project

Van Ark, Bart (University of Groningen): PPPs, European KLEM project

Ypma, Gerard (University of Groningen): European KLEM project