1. Introduction

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The outstanding economic performance of East Asian countries has been investigated by numerous studies. Common factors behind high economic growth rates include stable macroeconomic conditions and active investment in human capital (World Bank, 1993). There are some studies touching upon the question of whether a high economic growth rate comes from factor inputs or total factor productivity growth. In general, growth accounting results at a macroeconomic level show that the Asian economic miracle has been achieved by factor accumulation rather than by productivity growth (Young, 1995; Kim and Lau, 1994; Bosworth and Collins, 1999). The factor accumulation theory is consistent with the human capital explanation of the economic growth of Asian countries, if labor quality upgrading is correctly measured.

However, all of these studies are conducted at a macro level, or fairly aggregated level, and the role of structural factors is ignored in the process of economic development. In the process of economic development, significant changes in industrial structure from agriculture to manufacturing can be found in Japan, Korea, China and other countries. Comparable industry-level data is needed to analyze such trends. In addition, the importance of export in economic development is sometimes stressed in literature (Motohashi, 2003). In this respect, industry-level productivity analysis is useful to assess the impact of exporting sectors on the aggregated economic growth of East Asian countries.

RIETI (Research Institute of Economy, Trade and Industry) has launched a research project for international comparison of productivity among Asian Countries at industry level to undertake a broad examination of the sources of economic growth and competitiveness through large-scale, internationally comparable databases. This project is called ICPA (International Comparison of Productivity among Asian Countries), consisting of a team of researchers from China, Korea, Japan, Taiwan and the United States. This book contains the results of this project, that is, the industry-level productivity comparison of these five countries.

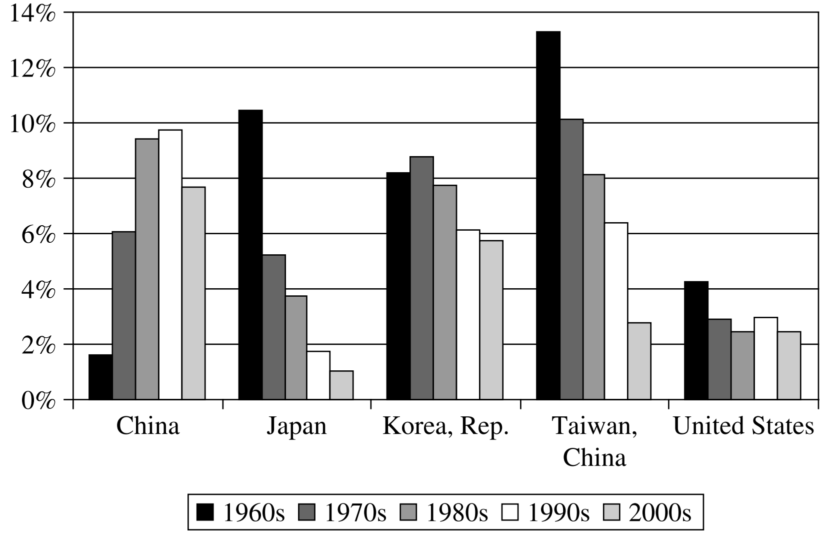

Figure 1.1 GDP growth rate by decade

The major objective of this project is to construct comparable datasets of productivity analysis, such as input–output tables, as well as labor and capital input data. This dataset is sometimes called 'KLEM' data, that is, industry-level data on capital (K), labor (L), energy (E) and material (M), as well as gross output, to come up with TFP (Total Factor Productivity) growth. An international productivity comparison based on this KLEM approach can be found in a previous Japan–US comparison (Jorgenson and Kuroda, 1995), and recently in an EU-wide research project called EU-KLEMS, initiated by an international consortium headed by the University of Groningen. However, the ICPA project is the first attempt to construct a comparable productivity dataset involving national statistical offices as well as productivity experts among Asian countries.

The period of coverage of this study is from 1980 to 2000. Due to data constraints, particularly in China, it is impossible to construct high quality comparable industry accounts before 1980. Therefore, the period of observation is relatively short. On the other hand, this study covers the data after the Asian crisis, which is not covered by most other productivity studies in Asian countries. As is shown in Figure 1.1, we can see a recent divergence of economic performance in the five countries. In Japan, a sharp slowdown of economic growth rate is found after the 1990s, while the growth rate in each decade is quite stable in the United States. Slowdown of growth rate can be seen in both Korea and Taiwan, but it is faster for Taiwan. Compared to these countries, the economic growth rate becomes faster after the 1970s in China. Finding whether these trends come from factor inputs or TFP sheds a new light on the different economic performances of these countries.

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 economy-wide and at industry levels. This framework is consistently related to the national accounts statistics and the input–output tables of each country. The analytical framework on international comparison of TFP growth and level is provided in Kuroda et al. (1996). Empirical works on this framework include Kuroda and Nomura (1999), Jorgenson et al. (2002) and Keio University (1996).

It is important to come up with a common industrial classification as well as classifications of types of capital and labor input. Proper aggregation of labor and capital inputs based on detailed data by type allows us to make a distinction between quantity and quality improvement for each factor input. In the case of capital inputs, the divisia index of capital service (K^{PK}) is derived as follows:

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

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

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 ($P_{k,i,t}K_{i,t}/\sum_i P_{k,i}K_i$). Capital service price ($P_{k,i}$) is based on the 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 the rental service index can be decomposed into the following two parts: quantity growth and quality growth.

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

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 the divisia index of energy and material inputs can be derived from input–output tables. Finally, growth accounting decomposition of output (Y) can be conducted as follows:

$$\ln\left(\frac{Y_t}{Y_{t-1}}\right) = s_k \ln\left(\frac{K_t^{PK}}{K_{t-1}^{PK}}\right) + s_l \ln\left(\frac{L_t}{L_{t-1}}\right) + s_e \ln\left(\frac{E_t}{E_{t-1}}\right)$$
$$+ s_m \ln\left(\frac{M_t}{M_{t-1}}\right) + \ln\left(\frac{TFP_t}{TFP_{t-1}}\right)$$

where S^* is an average share of each factor input '*' in a period '$t-1$' and 't'.

In the ICPA project, the productivity *level* is compared as well as the productivity *growth* of each industry, because 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:

$$\ln\left(\frac{Y_j/P^y_{j/i}}{Y_i}\right) = s_k \ln\left(\frac{K_j^{PK}/P^k_{j/i}}{K_i^{PK}}\right) + s_l \ln\left(\frac{L_j/P^l_{j/i}}{L_i}\right) + s_e \ln\left(\frac{E_j/P^e_{j/i}}{E_i}\right)$$
$$+ s_m \ln\left(\frac{M_j/P^m_{j/i}}{M_i}\right) + \ln\left(\frac{TFP_j}{TFP_i}\right)$$

where $P^*_{j/i}$ is relative price of '*' in country 'j' as compared to country 'i'.

The framework of international productivity level comparison under the KLEM dataset is presented in Kuroda et al. (1996), and empirical works of this framework include Jorgenson and Kuroda (1990), Kuroda and Nomura (1999), Jorgenson et al. (2002) and Keio University (1996).

This book consists of eight chapters including this introduction. From Chapter 2 to Chapter 6, a description of the data and TFP growth results for Japan, the US, China, Korea and Taiwan are each presented respectively. In Chapter 2, Masahiro Kuroda, Kazuyuki Motohashi and Kazushige Shimpo provide datasets for Japan, based on the Keio Economic Observatory (KEO) database, and also discuss the role of structural changes on productivity growth in the Japanese economy. The slowdown of total factor productivity growth in the 1990s is investigated from an industry-level growth accounting database, and it is shown that the aggregated productivity slowdown comes from non-ICT sectors. In Chapter 3, Dale Jorgenson, Mun Ho and Kevin Stiroh present the United States' results. In the United States, productivity resurgence can be seen in the 1990s, in contrast to Japan. It is found that the wholesale/retail sector as well as financial services contributed to this trend.

In Chapter 4, Ruoen Ren and Lin lin Sun provide the results for China. Due to the change from MPS to SNA for China's national account statistics in the mid-1980s, it was a major task for the Chinese team to construct time series input–output tables from 1981 to 2000. In China, the productivity growth rate becomes slower in the 1990s, and high economic growth has been achieved by factor accumulation, particularly by capital inputs. In Chapter 5, Hak K. Pyo, Keun-Hee Rhee and Bongchan Ha show the TFP trend of the Korean economy from 1984 to 2002. In this period, the Korean economy grew at 7.95%, but they found that TFP contribution was only 0.57%. In Chapter 6, the results for Taiwan are presented by Chi-Yuan Liang. He argues that the factor accumulation theory used by Krugman (1994), Kim and Lau (1994) and Young (1995) is invalidated because TFP growth rate in Taiwan in the 1980s and 1990s is higher than that of Japan or the United States. However, it is also found that a significant contribution to economic growth in Taiwan is, again, coming from capital inputs.

In Chapter 7 and Chapter 8, productivity levels among the five countries are compared. Chapter 7, by Marcel P. Timmer and Gerard Ypma, reports on relative producer price estimates for the five countries. Relative producer price is a key input to estimate international productivity level. Finally, Chapter 8, written by Kazuyuki Motohashi, shows the results of the comparison of the relative productivity of China, Korea, Taiwan and the United States to Japan. Japan is in second place among these countries, and due to the slow pace of TFP growth in the 1990s, the gap with other Asian countries has narrowed, while that with the United States has become wider.

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