Total factor productivity growth for 12 Asian economies: The past and the future[☆]

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A B S T R A C T

This study examines the importance of TFP growth in the long-term past and future economic growth of 12 Asian economies. We analyze the pattern of past growth based on a calculation of TFP growth, investigate the TFP dynamics by estimations of a TFP growth model, decompose the factors affecting TFP growth, and offer long-term projections of TFP growth. The main findings are as follows. First, results suggest that the growth accounting paradigm has shifted in the recent decade toward a productivity-based growth paradigm. Second, the catch-up effect is the major source of TFP growth in past decades, and the human capital contribution to TFP growth is gradually rising in Hong Kong, Korea, Singapore, and Taiwan in the most recent decade but is stagnated or weakened for other Asian economies. Third, the results project strong TFP growth for the two subperiods of 2010–2020 and 2020–2030 and thus suggest that the productivity-based growth will continue in the future long-term growth of the Asian economies.

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1. Introduction

Among the many countries of the world, the four East Asian economies of Hong Kong, Korea, Singapore, and Taiwan have shown phenomenal economic growth during the period from 1960 to 1990. Since the early 1990s, the eight other countries of Asia – China, India, Indonesia, Malaysia, Pakistan, Philippines, Thailand, and Vietnam – have also experienced persistent growth. The gross national income (in purchasing power parity; PPP) share of these 12 Asian economies in the world increased from 12% in 1995 to more than 20% in 2006 according to the World Bank's *World Development Indicators* and their share is continuing to expand rapidly. Between 1970 and 2007, these economies grew at an annual average rate of 6.09%, compared to OECD countries and other developing economies, which grew at a rate of 2.72% and 3.31%, respectively. Thus, contemplating about the future growth of the world economy, it seems natural to question whether the rapid growth of these economies will persist in the next few decades. Furthermore, in the aftermath of the financial crisis of 2008, the growth of these economies through the next decades will

likely have important implications on the pace of the world growth as well as the relative importance of markets around the world. Thus, the long-term economic forecast of these countries is of interest at various levels from designing public welfare policies, establishing strategies for industrial development and forecasting energy demands to making investment decisions at the firm level. These questions and issues call for a need to produce long-term growth projection of these economies.

From a production function approach, long-term growth depends primarily on the growth of inputs and total factor productivity (TFP). Because TFP growth is increasingly important for Asian economies, this study focuses on TFP growth within the previously mentioned 12 Asian economies. Specifically, we examine how much TFP contributed to the economic growth of these countries in both the past and in the recent periods, and provide a long-term projection of TFP for these economies for the period from 2010 to 2030.

Researchers disagree on the role played by TFP in the rapid and sustained economic growth of Asian economies. Assimilationists claim that the rapid growth is mainly attributable to increases in productivity (i.e. TFP), which result from the diffusion of technologies from the advanced economies. Accumulationists, however, claim that the growth can mostly be explained by the measured input growth in these economies. We review these issues and gauge how much the relative importance of TFP growth has changed over the years for the 12 Asian economies by providing TFP estimates for the past four decades and comparing these with

estimates from prior studies. The estimates include the values for the post-1997 currency crisis period, which is new to the literature. We also produce projections for future TFP growth. Although long-term projections of any kind, by their very nature, encounter numerous problems ranging from forecast model misspecification to inaccuracy and heroic assumptions, given the practical importance of the projection estimates, we hope to provide a feasible projection based on an empirical model of growth.

To develop a projection model, we first identify the main factors that influence TFP growth. To estimate an empirical model of TFP growth, we follow Bosworth and Collins (2003) but modify their model to incorporate intangible factors such as human capital and R&D capital in defining TFP dynamics. We estimate the empirical models of TFP growth based on a comprehensive international country-level panel data for the period from 1970 to 2007 and then use the estimation results to measure each determinant that influences TFP growth in each of the 12 Asian economies to characterize the growth experience of these economies. Finally, we use the empirical specifications obtained from the estimations as the baseline projection equation to forecast TFP growth for two subperiods: 2010–2020 and 2020–2030.

The remainder of the paper is organized as follows. Section 2 reviews the issues in the measurement of TFP growth and discusses the different approaches to measuring TFP. We also summarize the controversies in the growth literature regarding the TFP growth of Asian economies. Section 3 analyzes the trends and patterns of the Asian economies' TFP growth since the 1960s based on growth accounting method. Section 4 provides estimations of TFP growth using empirical models. Section 5 provides projections for the 2010–2030 period, and Section 6 concludes.

2. Issues and controversies regarding the TFP growth of Asian economies

2.1. Measurement of TFP growth: methodology

The literature provides very different pictures of TFP growth and TFP's impact on the growth of Asian economies over the past several decades. In trying to understand this divergence in estimates, we first review different methodologies that were adopted by these studies in measuring the total factor productivity.

Most approaches measuring TFP assume a neoclassical production function for each of the aggregate economy:

$$Y = AF(K, L). \tag{1}$$

Taking logs and differentiating both sides with respect to time, we obtain:

$$\frac{\Delta Y}{Y} = \varepsilon_K \frac{\Delta K}{K} + \varepsilon_L \frac{\Delta L}{L} + \frac{\Delta A}{A}, \tag{2}$$

where $\Delta Y/Y$, $\Delta K/K$, $\Delta L/L$, and $\Delta A/A$ are growths in output, capital, labor, and technical progress (i.e. TFP), respectively. The parameters ε_K and ε_L are output elasticities with respect to capital and labor, respectively. Given this specification, two main approaches are available to measure TFP: growth accounting and the regression-based approach.

The growth accounting approach simply uses available data on output, capital, labor, and output elasticities to calculate and separate out the contribution of TFP on growth. Among the many issues with this calculation, one critical problem is that the output elasticities are not observed. This problem is commonly addressed by imposing assumptions of competitive labor markets and constant returns to scale. These assumptions imply that the output elasticities are equal to the shares of each input. For calculation, this model only requires labor shares, which are obtained from the national accounts data of each country. However, labor share data rely on

compensation data for employees, which suffer from various mismeasurement errors and are unavailable for most of the non-OECD economies.[1] To employ the growth accounting approach when labor share data are lacking, most studies assume a constant labor share, usually between 0.55 and 0.70, based on the relatively stable labor shares of OECD economies. However, a constant labor share or constant elasticities assumption taken in this approach is actually imposing a constant elasticity of substitution form on the production function. Therefore, the calculation under this approach adds an additional assumption on the production function. Furthermore, this assumption has important influence in the measurement of the TFP in terms of size and trend. Still, due to the lack of data availability and due to its attractiveness in simplicity of calculation, the latter approach has been a dominant method in calculating TFP when dealing with comprehensive set of country data.

The regression-based approach assumes a specific form of production and estimates the parameters of production function using the input and output data. This approach does not impose a competitive market assumption in principle and, therefore, does not utilize labor share data in the estimation.[2] Various functional forms are assumed in the estimation for the productions, such as Cobb–Douglas, constant elasticity of substitution, or a transcendental logarithmic form, depending on the nature of technology assumed and the restrictions on the output elasticities. Output elasticities are calculated from the estimated coefficients, and, in turn, TFP is derived. Although this method avoids the mismeasurement problems related to labor shares and the assumptions regarding labor markets associated with the growth accounting approach, it has several econometric and data problems of its own. Specifically, the input and output variables usually exhibit nonstationarity, which makes obtaining meaningful results difficult. Furthermore, when capacity utilization is not incorporated into the capital stock data, variations in outputs are not well captured by variations in capital stocks due to the smoothness in the changes of capital stocks. However, capacity utilization data are very difficult to obtain since they are unavailable for most countries.

2.2. Controversies regarding TFP measurements for Asian economies

In the late 1990s, due to the re-emergence of interests in sustained growth and the surprisingly rapid and sustained growth over three decades of four newly industrialized East Asian economies (NIEs; Hong Kong, Korea, Singapore, Taiwan), many studies analyzed the growth of these economies. However, the studies suggested two widely different views regarding the nature of growth in these 4 NIEs and also in the ASEAN economies for the more recent period.[3] Some studies support an assimilationist view, which claims that high rate of technological change – a result of an infusion of high technology from more advanced economies – is the main driver of growth in the Asian economies (e.g. Easterly and Levine, 2001; Iwata et al., 2002; Klenow and Rodriguez-Clare, 1997; Pack, 1993; Pack and Page, 1994; Sarel, 1997; World Bank, 1993; Young, 1992). Due to globalization, these economies were able to absorb and master foreign technologies at a low cost. Furthermore, they developed new skills based on the absorbed technologies. This attributes the success of the Asian economies to government interventions that facilitate assimilation and to

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[1] One well-known mismeasurement issue is the exclusion of self-employment compensation, which may be substantial for the developing economies in particular.

[2] Rather, the competitive labor market assumption can be tested in the regression as in Kim and Lau (1994, 1995).

[3] This discussion partly relies on Felipe (1997) who provides a comprehensive summary of the TFP controversies surrounding the East Asian economic growth.