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China's total factor productivity estimates by region, investment sources and ownership

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ABSTRACT

This paper constructs China national and provincial physical capital and human capital for the period 1984–2006. The estimation of physical capital is extended to the use of sources of fund and ownership of fund. The growth accounting framework is used to calculate the output, input and total factor productivity growth rates. The relative variance method is used to compare the relative importance to output growth by input growth and productivity growth. The empirical findings show that although output growth in post-reform China has been contributed much by growth in total factor productivity, output volatility has relied more on input growth, and TFP growth has not been supported by complementary changes. There are regional differences when looking at the performance of individual growth rates.

1. Introduction

Empirical studies on the economic growth and total factor productivity (TFP) in the Asian economies by Young (1989, 1993, 1995), Krugman (1994) and Kim and Lau (1994) have argued that economic growth has been contributed more by growth in capital inputs than growth in TFP. Since China's economic reform in 1978, China has experienced a two-digit economic growth rate in most years. Studies by Borensztein and Ostry (1996), Chow and Li (2002) and Bosworth and Collins (2008) have shown that China has achieved an average annual TFP growth rate of about 3%. However, both Demurger (2001) and Young's (2000) "Stories" on China's post-reform economic growth has pointed to the lack of system change that includes, for example, distortion in relative prices and central control

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that have led to economic rents maintained by favored regions. Other studies have compared China's economic growth and TFP growth performance with other Asian economies (Wu, 2000, 2004).

This paper revisits the growth accounting approach in Baier, Dwyer and Tamura (2006) to examine China's post-reform economic growth for the period 1984–2006, and calculates the relative variances that compare the importance of input growth and TFP growth to economic growth. Both national and provincial data are used to estimate the physical capital and human capital stocks. In addition, the construction of the national and provincial capital stock in Chow and Li (2002), Li (2003) and Liu and Li (2006) is extended to include data on total investment in fixed assets classified under sources of fund and ownership of fund. The construction of the human capital is based on an inventory approach in Li et al. (2009). A summary of the data is shown in Appendix A.

The 30 provinces in China are grouped in four geographical regions. The Eastern region consists of the ten coastal provinces of Beijing, Tianjin, Hebei, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong and Hainan. The Western region includes the eleven interior provinces of Inner Mongolia, Xinjiang, Tibet, Qinghai, Gansu, Ningxia, Sichuan (including Chongqing), Guizhou, Yunnan, Guangxi and Shaanxi. The Northeastern region consists of the three provinces of Heilongjiang, Jilin and Liaoning. The Central region composes of the remaining six non-coastal provinces of Shanxi, Henan, Hubei, Hunan, Anhui and Jiangxi.

Section 2 discusses the growth accounting framework and constructs the national and regional physical capital per worker, as well as to construct physical capital based on sources of fund and ownership of fund. In addition, this section shows the level of human capital at national and regional levels. Section 3 calculates the output, input and TFP growth rates for the sample period 1984–2006, and the discussion is extended to the use of sources of fund and ownership of fund in Section 4. Before concluding, Section 5 examines the relative contribution to output growth between aggregate input and TFP.

2. Growth accounting

The estimation of TFP using growth accounting has been considered by Baier et al. (2006) as the more appropriate method than regression analysis because the error term is likely to correlate with the inputs in a causal manner. In the Cobb–Douglas production function, for example, the difference between the log output and the weighted average log inputs is log TFP, but the log output variable is obviously correlated with both the level of inputs and the growth rates of inputs. This is because productive firms will attract both physical capital and human capital, and similarly, fast growing technologies will attract high rates of physical and human capital investments. Hence, the accumulation of factors induces TFP growth rates, while the exogenous accumulation of technology induces factor accumulation (Solow, 1956, 1957; Lucas, 1988; Romer, 1990; Tamura, 2002, 2006). In short, errors are impossible to disentangle in a regression format.

The relationship between output and inputs of physical capital stock and human capital stock in the Cobb–Douglas production function can be considered as follows:

$$Y(t) = A(t)F(K(t), H(t)), \tag{1}$$

where $Y(t)$, $K(t)$, $H(t)$ and $A(t)$ indicate, respectively, output, physical capital, human capital and TFP at time t. Using lower case letters to denote the growth rate of the variables per worker, Eq. (1) becomes (Baier et al., 2006):

$$a = y - \alpha k - (1 - \alpha)h, \tag{2}$$

where α represents capital's share of income. The TFP growth rate in Eq. (2), a, represents the "catch all" term that includes anything not counted by physical capital and human capital, such as technical progress, failure of the assumption of constant return to scale, changes in efficiency, data error and so on.

The shares of human capital $(1 - \alpha)$ in Eq. (2), can be estimated by the share of total income received by the number of employed persons over a period of time. This is calculated as the ratio of the compensation of employees to the Gross Domestic Product (GDP) for each province in the sample