Singapore's Manufacturing Sector's TFP Growth: A Decomposition Analysis[1]

Renuka Mahadevan

The University of Queensland

and

Kali Kalirajan

Research School of Pacific and Asian Studies, The Australian National University

E-mail: Kali.Kalirajan@anu.edu.au

Mahadevan, Renuka, and Kalirajan, Kali—Singapore's Manufacturing Sector's TFP Growth: A Decomposition Analysis

Singapore has been criticized recently for experiencing insignificant total factor productivity (TFP) growth. This paper examines whether this criticism is valid in the context of the manufacturing sector of Singapore. Using new data and the stochastic production frontier approach, TFP growth is decomposed into technological progress and changes in technical efficiency. While the results could not reject the hypothesis that Singapore's output growth is mostly input-driven, they show that, despite technological progress, technical inefficiency is the cause for the low and declining TFP growth in the manufacturing sector. *J. Comp. Econ.,* December 2000, **28**(4), pp. 828–839. The University of Queensland; Research School of Pacific and Asian Studies, The Australian National University. © 2000 Academic Press

Key Words: total factor productivity; technological progress; technical efficiency; stochastic production frontier.

Journal of Economic Literature Classification Numbers: D24, L60, 033.

1. INTRODUCTION

Although many total factor productivity (TFP) studies have been undertaken recently on the manufacturing sector in Singapore, their conclusions differ. For example, Tsao (1985) showed an insignificant 0.08% TFP growth for the man-

---

[1] Comments and suggestions by anonymous referees of this journal, Hélène Bonin, and John Bonin are gratefully acknowledged.

828

ufacturing sector for 1970 to 1979, while Young (1995) estimated an average annual TFP growth of −1% for 1970 to 1990. On the other hand, Wong and Gan (1994) provide evidence of an improvement of annual TFP growth of 4.81% from 1981–1985 to 1986–1990 and Rao and Lee (1995) show improvements of TFP growth from 1976–1984 to 1987–1994. However, Leung (1997) is unable to reach a conclusion on TFP growth improvements for the early 1990's. These mixed results not only warrant further investigation but also raise some important methodological questions.

First, most of these studies used aggregate-level data and ignored industry-specific characteristics that are important from the productivity point of view. Second, except for Wong and Tok (1994) and Cao (1995), these studies adopted the conventional growth accounting approach and estimated TFP growth without distinguishing between the two components of TFP growth. TFP growth stems from a combination of technical progress and improvements in technical efficiency.[2] Technical progress (TP) comes from innovation and the diffusion of new technology. The extent of technical progress is measured by how much the firm's potential frontier shifts from one period to another. A change in technical efficiency, on the other hand, shows the movement of the firm's actual output to its maximum possible output or frontier output, given the technology. However, conventional growth accounting procedures do not distinguish between these two components of TFP growth; rather TFP growth is often used synonymously with technological progress. Failure to take account of changes in technical efficiency in measuring TFP growth produces biased TFP estimates that would indicate that all firms are operating with full technical efficiency. On the one hand, high rates of technological progress can coexist with deteriorating technical efficiency. On the other hand, relatively low rates of technological progress can also coexist with improving technical efficiency. Different policy implications result from different sources of variation in TFP. The stochastic frontier production function approach, which is followed in this paper, allows us to separate out the two components.

The objective of this paper is to decompose the TFP growth in Singapore's manufacturing sector using the stochastic frontier approach and a new panel data set. This data set has 10 more additional years of observations than the previous studies that used the stochastic frontier approach, which include Wong and Tok (1994) and Cao (1995). However, the stochastic frontier model used in this paper is a major improvement over the studies of these authors. The restrictive assumptions of their models that the variation of industry effects, which is measured by TE, is monotone throughout time and that one rate of change applies to all industries are relaxed. Furthermore, Wong and Tok's use of a time trend is a rigid proxy as it does not allow for interindustry differences within the sector and, thereby, leads to biased estimates. In this exercise, time dummies have been used to allow the TP of industries to vary across time. Also, through the use of

---

[2] This point was first discussed in Nishimizu and Page (1982).