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Analyzing China's productivity growth: Evidence from manufacturing industries

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ABSTRACT

This article examines the growth attributes of manufacturing industries in China for the sample period of 1999–2007. The output growth of manufacturing industries classified under four groups and four regions is decomposed into four components of input growth, scale effect, technical progress, and technical efficiency change. A stochastic frontier model is applied to the translog production function to estimate technical efficiency. Despite the conventional argument that input growth and technical progress are important factors to output growth, the empirical findings show a significant scale effect but a weak technical efficiency change. The contribution to growth from labor has been replaced by human and physical capitals. Structural transformation in the industrial sector is evident, so as regional imbalances.

1. Introduction

China's pursuit of socialist collectivization, focusing mainly on heavy industries since the early 1950s, had given way to economic reform in 1978. The late Deng Xiao-ping's motto that "it does not matter whether it is a black or white cat, so long as it catches mice" indicated a change of ideology. The excess supply in heavy industrial goods coexisted with excess demand in consumer goods at the time of economic reform (Perkins, 1988, 1994; Wu, 2005). The low cost production of light manufacturing

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industries along the coastal provinces attracted foreign investment. Although reform in the manufacturing industries began in the mid-1980s in the southern provinces, Shanghai was designated for development in high-technology industries in the mid-1990s (Wu, 2005). Since the 30 percent devaluation of the Renminbi in January 1994, China's manufactured exports have expanded continuously, resulting in a growing trade surplus. China's National Bureau of Statistics showed in 2008 that the manufacturing, services and primary sectors accounted for 47.4 percent, 41.8 percent and 10.7 percent of GDP, respectively.

Studies on China's manufacturing sector have concentrated on a number of issues. One issue relates to the transformation of state-owned to non-state-owned enterprises in the 1997 strategy of "grasping the large, releasing the small" that increased non-state-owned enterprises (Perkins, 1988; Wu, 2005). In dealing with the data problem, the industrial output data have been adjusted by using benchmark years and industries in Ren and Zheng (2006), Wu (2002) and Maddison and Wu (2008). Szirmai et al. (2005) point out that an adjustment in China's industrial data is more necessary at the early stage of the reform era, where data are missing, but that data reliability has increased in recent years. Another issue relates to the productivity and efficiency performance of such individual industries as iron and steel, oil and aerospace, telecommunication and insurance (Jefferson, 1990; Movshuk, 2004; Ma et al., 2002; Mu and Lee, 2005; Yao et al., 2007).

This paper focuses on the decomposition of the output growth for the manufacturing industries in China. The Solow (1957) classical growth theory that divided output growth into input growth and technical progress assumed constant return to scale and technical efficiency. The translog production function and stochastic frontier model are used to relax Solow's assumptions (Liu and Li, 2008; Li and Liu, 2011). China's high growth in manufacturing output may suggest increasing return to scale. The translog production function relaxes the assumption of constant return to scale with a flexible nonlinear functional form.

Technical inefficiency occurs when the actual output level is less than the maximum possible output with given inputs. The three ways to generate the measure of technical inefficiency are the Malmquist index, data envelopment analysis, and the stochastic frontier model. Ma et al. (2002) and Movshuk (2004) applied the Malmquist index that decomposed productivity into efficiency and technological change to study China's industrial productivity. Sun et al. (1999) and Yao et al. (2007) argued that stochastic frontier and data envelopment analyses are more effective in measuring technical efficiency in China's industries. The stochastic frontier method is preferred because the production function for the analysis of growth attributes can be estimated. The stochastic frontier model can recognize the possibility of technical inefficiency and its contribution to output growth (Aigner et al., 1977; Kumbhakar and Lovell, 2000).

The stochastic frontier model with the translog production function allows us to decompose output growth into four components: input growth, scale effect, technical progress, and technical efficiency change. The contribution of input growth comes from the growth of inputs such as labor and capitals. In addition to the physical capital, we include a human capital proxy represented by the real wages and operation expenses in each industry. The growth of input can reinforce output growth if the production function exhibits increasing return to scale. Note that the scale effect is absent in the traditional Solow's growth decomposition approach. The application of the standard stochastic frontier model with the cross-section data can give a measure of technical inefficiency. Thus, the use of the stochastic frontier model with time-varying technical efficiency and panel data from China allows us to determine if technical inefficiency exists and improves or deteriorates in China.

This article studies the growth attributes of inputs and total factor productivity (TFP), which are in turn composed of the scale effect, technical progress, and technical efficiency change. Based on a total of 29,812 data values from 161 three-digit manufacturing industries in 31 provinces for the sample period 1999–2007, the paper derives the four components in the growth decomposition and compares the importance of input growth with the importance of productivity change and its three components. In addition to the estimation using the aggregate data, we consider the estimations of sub-industrial groups and regions. The manufacturing industries are classified into four major industrial groups: processing, light manufacturing, metal and machinery, and high-technology industries, according to the Industrial Classification and Codes for National Economic Activities (GB/T-2002). The country is divided into four regions: eastern, central, western, and northeastern regions. The eastern, central and