Impact of structure on unified efficiency for Chinese service sector—A two-stage analysis

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HIGHLIGHTS

- Structure has a significant impact on the efficiency of the service sector.
- Finance is the most efficient service subsector.
- Transportation is least efficient service subsector.
- The unified efficiency of the service sector differs across subsectors and regions.

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ABSTRACT

Due to the ongoing structural transformation in China, the service sector now constitutes approximately half of the total Chinese output. At the same time, the internal structure of this sector continues to change rapidly with the level of Chinese development. We analyze the impact of changes in the structure of Chinese service sector on the unified efficiency of Chinese service sector considering the energy consumption and carbon dioxide emissions. The non-radial directional distance function and the global data envelopment analysis method are combined to measure the unified (technical, allocative, operational and environmental) efficiency of Chinese service sector at both regional and sectoral levels. The results indicate that the financial sector and the sector of transportation, storage and post are the industries with the highest and lowest unified efficiency respectively. There exist differences across industries and regions in the unified efficiency of the service sector. As a second stage, a panel Tobit regression is processed to examine the effect of service structure on the unified efficiency of the service sector, in which a significant impact appears to exist. Promoting economic development and enhancing investment in research and development are beneficial to improving the unified efficiency of the service sector.

1. Introduction

Technological progress and efficiency improvement are the vital sources of long-term sustainable economic growth [1]. The technological progress in the service sector, which is assessed by productivity, has been studied for many years. The efficiency of the service sector has not been paid sufficient attention.

Since the 1970s and 1980s, developed countries have experienced economic structural transformation dominated by the service sector. For mature economies, the service sector basically accounts for above 70% of the whole economy. With the adjustment of economic and industrial structures, the development of Chinese service sector
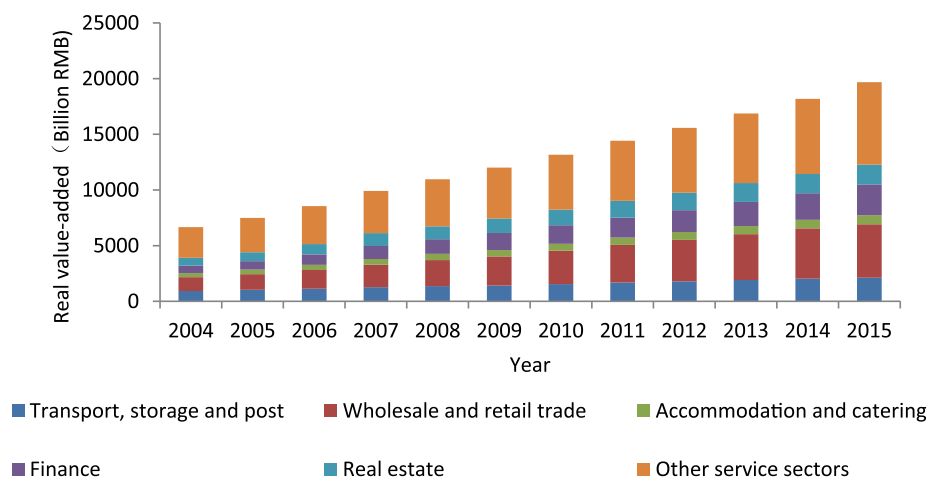

Fig. 1. The real value-added of Chinese service sector by sub-sectors over 2004–2015 (2004 constant price).

(tertiary industry)[1] is accelerating. With a growth rate of 7.8%, the value-added of Chinese service sector accounted for 51.6% of the national economy in 2016. The 13th Five-Year-Plan of China proposes to attach importance to the quality and efficiency of development when speeding up the development of the service sector.

Meanwhile, the internal structure of the service sector and the production and organization styles are constantly changing. Compared with traditional service industries such as accommodation and catering, modern service industries such as the finance industry and the real estate industry grew faster (see Fig. 1). The proportion of labor-intensive traditional services in the service sector is gradually decreasing, while the proportion of emerging human-capital-intensive modern services is increasing. Due to the heterogeneity among the service sub-sectors, the efficiency of the service sector varies with the structural change.

Due to its heterogeneity and miscellaneous categories, the efficiency of the service sector has not attracted much attention. Furthermore, there is little literature on the impact of structure on the efficiency of the service sector. This paper attempts to analyze the impact of changes in the service structure on the efficiency of the service sector in view of the heterogeneity among the service sub-sectors.

The traditional indicator for measuring and evaluating the development of the service sector is labor productivity as the service sector is traditionally labor-intensive. However, with the modernization of the service sector, the development of the service sector relies increasingly

on other production factors such as capital and energy. According to the OECD/IEA, the service sector in mature economies basically accounts for 9% of total final energy consumption and 12% of carbon emissions.[2] The energy consumption of Chinese service sector is larger than the total energy consumption of Japan. The energy consumption in the service sector and the subsequent environmental problems should not be overlooked and needs to be taken into account in the efficiency estimation of the service sector. Under the framework of neoclassical production theory, the total-factor efficiency, taking into account the substitution between various input factors, has been widely developed and applied in productivity or efficiency assessment. In addition to producing the desirable outputs, carbon dioxide and other pollutants are also produced and then discharged into the environment as undesirable outputs. Literature tends to incorporate the energy consumption and environmental emissions into the calculation framework of total-factor efficiency, taking into account the desirable output and undesirable output simultaneously.

In this paper, a two-stage approach is employed. We first calculate the total-factor unified efficiency (TUE) of Chinese service sector at both regional and sectoral levels. In the second stage, we further examine the impact of structure on the TUE for Chinese service sector in consideration of the heterogeneity and the internal structural change in the service sector. The TUE index, which is estimated by the widely used approach of data envelopment analysis (DEA), is a comprehensive evaluation index pertaining to the efficiency of all the input and output variables. It measures the utilization efficiency of individual inputs, the operational efficiency of desirable outputs, and the environmental efficiency of undesirable outputs in a unified treatment [2]. Therefore, the TUE, considering the relations between factors, is suitable for analyzing the inefficient loss of the entire production system caused by irrational and mismanaged resource allocation.

The contributions of this paper are as follows. First, to the best of our knowledge, this study is the first to measure the unified efficiency of the service sector. Considering the heterogeneities among regions and sub-sectors, we estimate the TUE of Chinese service sector at both regional and sectoral levels, which gives a comprehensive efficiency evaluation of the Chinese service sector. Second, although literature stresses the heterogeneity of the service sector and the difficulties it

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[1] The service sector generally refers to a collection of production units and enterprises that produce and sell service products. Since the uniformity of the caliber and scope of the service sector brings difficulties to the statistical work, the National Bureau of Statistics of China revised the latest revision of the "classification rule of three strata industry" in 2013, specifying that the tertiary industry is the service sector. The service sector refers to the industries except for the primary industry and the secondary industry, specifically including wholesale and retail trade, transportation, storage and post, accommodation and catering, information transmission, software and information technology services, finance, real estate, leasing and business services, scientific research and technology services, water conservancy, environment and public facilities management, resident services, repair and other services, education, health and social work, culture, sports and entertainment, public administration, social security and society organizations, international organizations, as well as agriculture, forestry, animal husbandry and fishery services in agriculture, forestry, animal husbandry and fishery, mining auxiliary activities in the mining industry, metal products, machinery and equipment repair in the manufacturing industry.

[2] The data is sourced from the International Energy Agency, Tracking Industrial Energy Efficiency and CO2 Emissions (Paris, France: OECD/IEA, 2008), 94. Note that China and OECD/IEA have different statistic calibers of the service sector.