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Efficiency and productivity of China's outsourcing industry

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ABSTRACT

Based on a panel data set covering 17 provincial regions of China during the period from 2005 to 2011, this paper investigates the efficiency and productivity of China'soutsourcing industry, using super-DEA and DEA-Malmquist index method. Our results show that the average growth rate of total factor productivity is about 37% annually and the main source of that growth lies in technological progress, while diseconomy of scale impedes the growth rate of productivity of China's outsourcing industry.

Key words: Outsourcing industry; Efficiency and productivity; Super-DEA; DEA-Malmquist index

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INTRODUCTION

During the last two decades, outsourcing industry of China has witnessed such a rapid development that it has become the second biggest offshore outsourcing service provider, with a total contract amount of 23.83 billion US Dollar in 2011, after India. However, some underlying conditions which had been supporting the development of Chinese outsourcing industry began to change. Firstly, the implementation of new labor law from 2008 made labor costs in China increasing gradually, e.g. the average annual pay per capita in China in 2005 was 8.4 thousand US Dollar whereas that number achieved 11.2 thousand US Dollar in 2011, a 33 percent growth in only 6 years. Secondly, the reform of RMB exchange rate since 2005 has increased its value compared to that of US Dollar, growing from 8.19 RMB Yuan equaling to 1 US Dollar in 2005 to 6.45 equivalent to 1 in 2011, an increase of 21.2 percent.

The above mentioned environmental changes are challenging Chinese outsourcing industry's cost leader strategy which has been the engine of its development in last years, namely, in order to keep up with changes in business environment and maintain its competitiveness in the future, there are calls for China's outsourcing industry to compete by efficiency and productivity. Before changing its strategy from cost leader to productivity, it is desirable to have a full understanding of the status quo concerning China's outsourcing industry productivity, e.g. , how about the efficiency and productivity changes during past years, what has been the source of that change, what is/are the most appropriate channel(s) of efficiency gains in the coming years. We intend to answer those questions by means of empirical study using DEA related methodology. To our knowledge, this is the first comprehensive efficiency and productivity study on China's outsourcing industry and we hope our research results could provide policy makers as well as industry leaders with insights into their strategy changes.

The remainder of the paper is organized as follows. Section 2 presents brief discussions on methodology, model specification and data collection. We report and then analyze estimated results of efficiency and productivity in section 3, some concluding remarks and policy implications of this study are made in section 4.

EXPERIMENTAL SECTION

Methodology, model specification and data

2.1 Methodology and model specification

We take 17 provincial regions of China, where 21 model cities for outsourcing industry are located and the outsourcing industry outputs account for about 95% of national total outputs, as decision making units, investigating efficiency, productivity change and its source using a panel data set from 2005 to 2011. We will not provide any detailed explanation on DEA related methodology due to limited space of this paper as well as the existence of that kinds of review papers and books [1].

2.2Data collection

In line with Cobb-Douglas production function model, the choice of inputs to production should mainly focus on labor factor and capital factor. Taking availability and credibility of data collection into consideration, we use labor forces engaging in and capital investments in information processing, computer service and software as labor input and capital input to outsourcing industry, respectively. As to outputs, the study chooses the money value of software service exports as well as revenues from system integration and support service as two outsourcing industry's output indexes.

The definition of outsourcing industry in this study follows that given by Commercial Department of China in its 556th notice, titled *the notice on implementation of model projects in service outsourcing industry*, issued in 2006, data employed is mainly collected from *China statistic yearbook in electronic information industry* and *China yearbook in information industry*, part of data are taken from outsourcing industry leading website *China service outsourcing internet* and academic database providers such as *CEInet Statistics Database* and *DRCNET Statistics Database System*.

Table 1 presents a summary statistics of the variables included in this study. All monetary values are adjusted for inflation by GDP index and measured in year 2005 Chinese RMB and US Dollar.

Table 1 The mean of inputs and outputs variables for 17 DMUs from 2005 to 2011

	Y_1 (Million US Dollar)	Y_2 (Million RMB Yuan)	X_1 (Thousand)	X_2 (Million RMB Yuan)
2005	94.1	110.194	57.24	7015.3
2006	303.2	122.430	61.53	7047.1
2007	358.1	111.323	66.38	6151.8
2008	580.5	142.221	72.04	6470.8
2009	885.4	169.633	77.98	7117.4
2010	1156.9	197.512	85.57	6041.4
2011	1448.7	265.368	98.94	4656.7

Y_1*: software service exports ;* Y_2 *:revenues from system integration and supporting service;*

X_1 *: labor forces engaging in information processing;* X_2 *: capital investments in information processing.*

RESULTS AND ANALYSIS

3.1 Estimates of efficiency and its decomposition

We calculate efficiency scores of every DMU using super-DEA model given that traditional DEA model is incapable of ranking DMU when the numbers of efficient DMU are more than one. For DMU that have efficiency scores below or equal to one, the results from super-DEA model and traditional DEA model are the same, while for DUM that have efficiency scores beyond one, the results from two models are different. Table 2 provides the technical efficiencies and their decomposition of individual DMUs in 2011(other years' results are available on request).

As shown in Table 2, outsourcing industries in Liaoning, Sichuan, Chongqing and Shanghai obtained efficiency scores beyond one, meaning those DMUs produced at the frontier in 2011 and could not produce more effectively under given production technology. Pure technical efficiency stands for the deviation of realized production from production possibility frontier, reflecting the internal management level and resource utility level of DMUs with given production technology, ranging from zero to one, the average value of pure technical efficiency of 17 DMUs in 2011was 0.934, a relatively higher score when compared with that of scale efficiency. While as far as individual DUM is concerned, a slight difference could be found, ranging from 1 for Liaoning and other regions to 0.761 for Zhejiang province, indicating there is a big room for improvements in management level and resource utility level. As indicated by the name, scale efficiency gives hints on whether DMUs have achieved best scale economy, a state

of being equal to one. In contrast to pure technical efficiency, the average score of scale efficiency for DUMs was small and the difference among individual DMUs was quite big, ranging from 0.06 for Anhui and 0.08 for Heilongjiang to 1 for Liaoning and other 3 regions.

Table 2 Efficiency scores and their decomposition for 17 DUMS in 2011

DMU	Ranking	Super-DEA	DEA	Pure technical Efficiency	Scale efficiency	Trends in scale economy
Beijing	8	0.707	0.707	1	0.707	drs
Tianjin	12	0.233	0.233	1	0.233	irs
Shanghai	4	1.184	1	1	1	-
Liaoning	1	3.959	1	1	1	-
Guangdong	6	0.876	0.876	1	0.876	drs
Jiangsu	5	0.946	0.946	0.951	0.995	irs
Shandong	7	0.846	0.846	0.868	0.974	irs
Zhejiang	10	0.536	0.536	0.761	0.704	irs
Fujian	11	0.513	0.513	0.976	0.525	irs
Hubei	14	0.113	0.113	0.85	0.133	irs
Anhui	17	0.057	0.057	0.951	0.06	irs
Heilongjiang	16	0.067	0.067	0.835	0.08	irs
Jiangxi	13	0.121	0.121	1	0.121	irs
Hunan	15	0.103	0.103	0.813	0.126	irs
Sichuan	2	1.651	1	1	1	-
Chongqing	3	1.638	1	1	1	-
Shanxi	9	0.630	0.63	0.869	0.724	irs
Average		**0.803**	**0.573**	**0.934**	**0.603**	

In concluding this subsection, we argue that scale diseconomy due in particular to small scale (as shown in Table 2, most DUMs were a state of increase return to scale) led to low technical efficiency scores in 2011, being 0.573 from traditional DEA model and 0.803 from super-DEA model. As exceptions, outsourcing industries in Beijing and Guangdong were facing decrease return on scale, indicating that both provinces should reduce their scales to a proper level in order for further efficiency gains.

Table 3 Annual productivity changes for 17 DMUs from 2005 to 2011

Period / DMU	05-06	06-07	07-08	08-09	09-10	10-11	Average [a]
Beijing	1.05	0.78	1.11	0.84	1.14	1.56	1.08
Tianjin	0.94	0.61	2.27	1.76	1.42	1.42	1.40
Shanghai	2.27	1.03	1.11	1.15	1.19	1.40	1.36
Liaoning	2.73	1.20	1.43	1.89	1.09	1.60	1.66
Guangdong	2.26	0.65	1.87	1.27	1.05	1.37	1.41
Jiangsu	2.30	1.62	1.37	1.22	1.02	1.02	1.43
Shandong	1.37	1.06	1.19	1.75	1.63	1.19	1.37
Zhejiang	1.33	1.00	1.22	1.12	1.11	1.19	1.16
Fujian	0.78	0.90	1.21	1.33	1.49	0.96	1.11
Anhui	0.57	1.28	0.78	0.79	0.97	0.97	0.89
Hubei	4.97	0.61	1.21	1.44	1.09	0.88	1.70
Heilongjiang	1.07	1.13	0.93	0.99	1.22	0.87	1.04
Jiangxi	1.12	0.83	4.80	0.54	0.48	1.32	1.52
Hunan	1.50	0.96	0.73	0.88	0.90	3.34	1.39
Sichuan	2.52	1.56	0.31	2.14	0.53	1.55	1.44
Chongqing	2.30	1.50	1.10	1.58	1.00	2.13	1.60
Shanxi	1.01	0.73	5.82	1.45	0.42	1.51	1.82
Average[a]	**1.77**	**1.03**	**1.67**	**1.30**	**1.04**	**1.43**	**1.37**

[a] *The results are arithmetic means of individual indexes.*

3.2 Estimates of total factor productivity change

Table 3 presents annual productivity change from 2005 to 2011. As can be seen, the productivity of China's outsourcing industry is in a trend of increase during the sample period, with a growth rate of 37 percent per year on average. In particular, the growth rate from 2005 to 2006 was 77 percent, the biggest one during the sample period. We think of this as the results of announcement by central government in 2005 of supporting outsourcing industry and the relatively low level of starting point in 2005 which means a big room for growth. So far as individual DMU is concerned, results show that Liaoning and Chongqing have experienced rapid development in their outsourcing industries for the sample period whereas Anhui is the only DMU that has suffered from a decrease. As will be discussed afterward, Liaoning has served as the benchmark for nationwide outsourcing industry. As for Chongqing, there are 26 national research universities, engineering centers and state key laboratories, over 800 thousand talents, including 33 academicians from Chinese Academy of Sciences and Chinese Academy of Engineering are working in

those academic institutes, which consequently lay the foundations for the development of outsourcing industry. While on reasons for decrease in Anhui, chen argues that the slow speed at which infrastructure construction and over competition against limited resources needed for outsourcing development eventually impede the growth of outsourcing industry in this province [2].

3.3 Decomposition of productivity change

Pioneered by Farrell (1957)[3], extended mainly by Caves et al. (1982)[4] and Färe et al. (1989, 1994)[5-6], the research on the source of productivity change has witnessed vital progresses during the past years. Following Färe et al. (1994), the productivity (or total productivity factor, hereinafter, TFP) change can be defined by the product of pure efficiency change (PEC), scale efficiency change (SEC) and technological change (TC), which could be seen as the evidence of catching up, scale fitness and innovation. In addition, the product of PEC and SEC is usually referred to as technical efficiency change (TEC).

As can be seen in Table 4, during the period from 2005 to 2011, the geometric means of TPP change in China's outsourcing industry is about 27.2 percent per year on average, which is smaller than arithmetic means. With respect to the source of TFP change, it is apparent that technological change accounts for the most share of TPF change, whereas pure efficiency change, reflecting the distance from realized production point to production possibility frontier and catching-up effects in a given period, shows a minus change of 0.3 percent per year on average.

Table 4 Malmquist index of average productivity changes: 2005 to 2011

Items / DMU	TEC	TC	PEC	SEC	TPC change
Beijing	0.944	1.076	1.000	0.944	1.015
Tianjin	0.991	1.284	1.016	0.975	1.272
Shanghai	1.000	1.296	1.000	1.000	1.296
Liaoning	1.000	1.576	1.000	1.000	1.576
Guangdong	1.126	1.165	1.084	1.039	1.312
Jiangsu	1.157	1.198	1.099	1.052	1.385
Shandong	1.073	1.255	0.980	1.095	1.347
Zhejiang	0.973	1.186	0.941	1.034	1.154
Fujian	1.083	1.021	0.984	1.100	1.106
Hubei	1.067	1.245	0.963	1.108	1.328
Anhui	0.713	1.333	0.757	0.943	0.951
Heilongjiang	0.906	1.124	0.823	1.100	1.019
Jiangxi	1.122	1.115	1.164	0.964	1.251
Hunan	1.127	1.058	0.948	1.189	1.193
Sichuan	1.407	1.180	1.228	1.146	1.659
Chongqing	1.136	1.225	0.963	1.180	1.392
Shanxi	1.368	1.198	1.000	1.368	1.640
Average[a]	**1.058**	**1.202**	**0.997**	**1.062**	**1.272**

[a] *the results are geometric means of individual indexes.*

As the main contributor to TFP change, technological change refers to creation and application of new knowledge to various activities of the production process, resulting in economic benefits. Employees could produce more outputs with given inputs by means of on and/or off the job training, process reenginerring, introduction of new equipments and so on. Further to that, they may creat high value-added products or service at a given time by the help of R&D actitities. Although all of the above mentioned channels could bring about technological change, as far as outsourcing industry is concerned, it is personnel training, process reengineering and the development of high value added products, rather than equipment investmens that play a mojor role in the technological progress.

As mentioned above, the outsourcing industry in Liaoning has been serving as the benchmark for that in the rest of China. By talking with business executives from some outsourcing servive providers, we are informed general developing pathes of technological progress, namely at the outset of the outsourcing industry, training and process reengineering are the main channels,while as the accumaltion of experience, lessons and other resources, a switching from low-end low value added activities to high-end high value added activities become gradually more important in improving the speed of technological change.

CONCLUSION

Based on a panel data set covering 17 provincial regions of China during the period from 2005 to 2011, this paper investigates the efficiency and productivity of China outsourcing industry using super-DEA and DEA-Malmquist index method. Our research shows：(1) with the contribution from technological change, the productivity of China outsourcing industry has experienced a rapid growth during the period from 2005 to 2011; (2) outsourcing industries

in most regions are in a state of below best level scale except Beijing and Guangdong; (3) there is serious inequality in efficiency as well as productivity change among different regions, outsourcing industries in areas such as Liaoning, Sichuan and Chongqing stand for the highest efficiency level and most rapid productivity growth rate when compared with those located in areas such as Anhui, Heilongjiang and other provinces; (4) during the sample period, outsourcing industry in Shanxi is characterized by the rapidest productivity growth rate as well as the biggest fluctuation in 17 provincial regions, on the contrary, Anhui is the sole region with a decreasing trend in productivity change. However between the two extreme points, outsourcing industry of Liaoning shows a rapid and stable increase in its productivity.

Our empirical findings have policy implications on China's outsourcing industry competitive strategy change. Areas like Liaoning have been in a position to shift its outsourcing service from current low-end cost leader activities to relatively high value added activities, which necessitate the industry-university co-operations [7-8], further, taking account of important role played by knowledge-intensive business provider in the knowledge contextualization, de-contextualization and re-contextualization [9] which is necessary for outsourcing service providers in their shift to high end activities, attracting world famous high end outsourcing activities providers such as IBM and Accenture from developed economies is particularly important. While outsourcing industries in regions such as Anhui and Heilongjiang should pay more attention to enlarging their scale by means of exploiting both internal and external markets, China has tremendous financial and manufacturing industry which are the main potential and real outsourcers, in this sense, cost leader strategy is still necessary for firms in those areas. Finally, as the value-up of RMB in international market makes the purchasing of foreign firms cheaper than before, by a variety of equity investment in targeted foreign outsourcing service firms, outsourcing service providers of China could acquire skills and talents needed in high end activities and channels to enter foreign markets from their counterparts in developed economies.

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