Study on Performance of Development of Sports Industry in China – Based on DEA Nonlinear Estimation

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Abstract　Assessment of performance of China's sports industry is not only favorable for grasping development level of sports industry，but also able to，from micro perspective，find out factors influencing development of sports industry and their contribution to development of sports industry．Through selecting quantitative indicators for development of sports industry，the authors analyzed performance of development of sports industry in China and analyzed regional difference of sports industry by the data envelopment analysis（DEA）method．The study indicated that （ⅰ）performance of sports industry in recent years takes on growth trend，which may give the credit to scientific and technological progress；（ⅱ）the development of sports industry in China has distinct spatial difference，best in eastern regions，better in middle regions，and poor in western regions．

Key words　Sports industry，Performance，DEA，Spatial difference

1　Background and related literature

With rapid economic development，sports industry，situated in core position of China's soft power，is receiving wider and wider attention．In March 2010，the State Council issued *Guiding Opinions on Accelerating Development of Sports Industry*，reflecting huge potential of sports industry，as a new industry．Assessing performance of development of sports industry is not only favorable for grasping development level of sports industry at macro level，but also favorable for finding out factors influencing development of sports industry and their contribution to development of sports industry at micro level，so as to come up with feasible policies and promote development of China's sports industry．

At present，domestic scholars mainly take qualitative analysis of development of sports industry．Typical cases are as follows．Wang Ping[1] analyzed internal and external factors influencing development of sports industry．In his opinion，external factors mainly include lack of countermeasures and relevant support policies in external competitive environment，leading to weak foundation for development of the sports industry，as a new industry；internal factors mainly include overall level and individual structure of development of sports industry（the overall level means the sports industry lacks effective distinct sector，and industrial structure remains imbalanced state；individual level means individual sector should keep coordinated with overall development trend of sports industry and deepen the development of specific sector）．Yang Shengli[2] analyzed the influence of growth and market development of competitive sports industry from the perspective of market development，and analyzed existing problems and put forward recommendations for proper development of sports industry with Table Tennis Super League as an example．Xing Xiaomei and Zhou Mingfang[3] discussed cycle problem of development of sports

industry from the perspective of industrial cycle，and divided life cycle of sports industry development into three stages：initial stage （sports industry sprouts），development stage（facilities of sports industry remain excellent operation state），and mature stage（all factors of sports industry development reach the highest level of contribution，and environment required for sports industry development is in the best condition）．

As to quantitative analysis of sports industry development，domestic scholars mainly study influence of external factors．In general，these can be divided into three types．The first type mainly analyzes influence of economic development on sports industry．For example，Chen Junqin[4] stated that economic development restricts sports industry development，overall development level of sports industry and specific industrial structure also influence economic development，thus economic development is the foundation of sports industry development．The second type mainly discusses non-economic factors of social development．Typical scholars of this type include Lu Yuanzhen and Wang Jinqiu．Lu Yuanzhen[5] analyzed development prospect of sports industry from the perspective of population aging and put forward amusement，recreation and body fitting functions of sports industry．Wang Jinqiu made quantitative analysis of influence of social system and technological progress on sports industry development．The third type mainly focuses on importance of talents to sports industry development．Typical scholars of this type include Ge Bing，Tang Yue，and Wang Jing．Ge Bing[7] analyzed influence of talents on sports industry，studied sports industry development on the basis of such indicators as sportsmen and scientific and technological talents，and reached the conclusion that sports industry development not only needs professional sportsmen as foundation，but also needs technology as support．Tang Yue[8] analyzed factors influencing sports industry development from perspective of supply and demand，and reached the conclusion that human resource is an essential factor influencing demand of sports industry．Wang Jing[9]

also found that human capital factor is an essential factor influencing sports industry development.

Previous researches show that domestic researches about sports industry development have laid preliminary foundation, but it is required to enhance researches in system and depth. At present, there is neither scholar assessing the efficiency of sports industry development, nor scholar comparing regional difference of sports industry development. In this situation, based on previous researches and from perspective of input and output, we made tentative assessment of performance of China's sports industry development. In order to grasp spatial distribution of China's sports industry, we made comparison of regional difference in sports industry development, in the hope of finding decisive factors and coming up with countermeasures and recommendations for coordinated development of China's sports industry.

2   Assessment of current development situations of China's sports industry

In recent years, especially after 2008 Beijing Olympic Games, sports industry, as a new industry, received a good development with support of related policies. However, due to imperfect development system of sports industry, in the process of development, many problems are exposed, which can be analyzed from following four levels.

2.1   Sports industry and its structural development level
2.1.1   Overall development level of sports industry. In recent years, China's sports industry has made significant achievements with promotion of related policies. The added value of China's sports industry increased to 246.2 billion yuan in 2011 from 98.3 billion yuan in 2006, with annual average growth rate up to 16.53%, far higher than the overall development level of the whole country. From Fig. 1, it can be seen that the added value of China's sports industry takes on "leap – frog" growth status, and the growth rate is characterized by frequent fluctuation. In 2006 – 2007, the growth rate of sports industry was higher. However, due to impact of financial crisis, the output value of sports industry increased from 2007, but the growth rate drops sharply. In 2008, the growth rate dropped to 16.05%, and became the lowest point in the "Eleventh Five-Year Plan" period. Later, with issue of market rescuing policies and success in holding Beijing Olympic Games, the output value of sports industry returned to the rapid development track. In 2009, the growth rate of the added value of sports industry reached 19.26%. Then it became stable and the average growth rate still exceeded the growth rate of GDP, indicating China's sports industry has a broad development prospect.

2.1.2   Structural development of sports industry. From Fig. 2, major parts of existing sports industry are production of sports goods, clothes, shoes and hats, accounting for 70.98% of total added value, indicating that the production sector of sports goods has the largest contribution to sports industry development, the next is sales of sports goods, clothes, shoes and hats. These two sectors account for 80% of the total output value of sports indus-
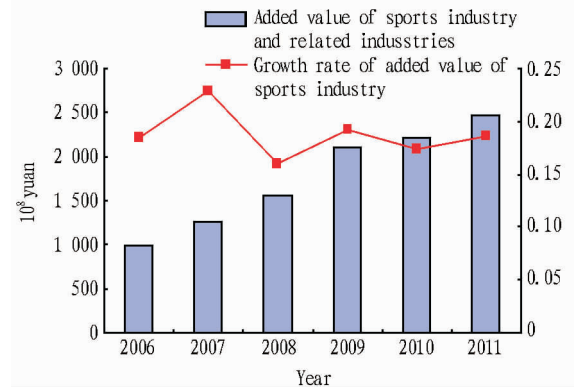

Fig. 1   Development trend of China's sports industry in 2006 – 2011

try. Therefore, the pillar of sports industry is production and sales sectors of sports goods. Sports training accounts for 0.63% of the total added value, indicating China inputs little in soft power of sports industry, which is not favorable for long – term development of sports industry.
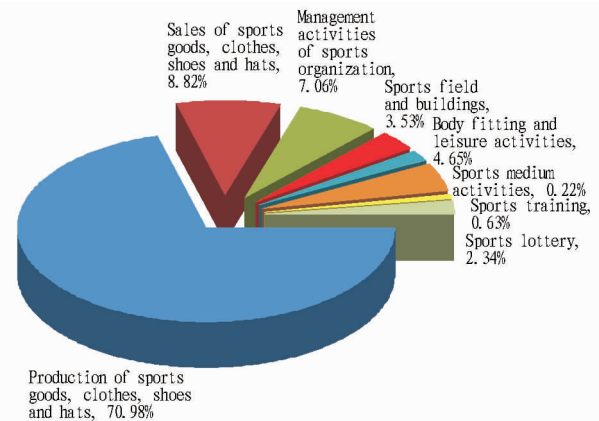

Fig. 2   Distribution chart for structure of China's sports industry in 2011

2.2   Employees of sports industry   Cultivation of sports talents in China is mainly pertinent cultivation. It firstly divides talents according to competition, coach, education, science and technology, and referee. However, it lacks comprehensive cultivation of talent marketing, financial accounting and planning, resulting in lack of talents in sports operation and management. Besides, there are few high-skill and high-level professional sports personnel, failing to satisfy demand of sports industry development. This is an essential factor influencing sports industry development and lacks of competition at international market.

2.3   Input of sports industry   With constant improvement of market economic system and development of market economy, the support of government for sports industry has significant improvement, but the fiscal expenditure on sports industry is far lower than other industries. In addition, the input of sports industry is limited to funds and lacks related policies guiding development of sports industry, leading to current sports industry putting consumption and sales of sports industry first and blindly guiding con-

sumption and production. In training and education of sports industry, it is also relatively weak.

2.4 Sports science and technology   Sports science and technology mainly involve broadcasting technology, broadcasting machines, and design technologies of multi-functional sports fields. Besides, functional development and network information technologies oriented towards sports and body fitting devices are also incorporated in sports science and technology. At present, relevant authorities provide massive support in sports science and technology. With promotion of scientific and technological progress, China's sports industry has received considerable development. Nevertheless, there are still many prominent problems. Firstly, research achievements and application of technologies for sports industry have a long interval period, leading to research and development failing to keep step with practice. Secondly, scientific and technological input is mainly concentrated on high end products. In other words, scientific and technological research and development are mainly carried out to satisfy demands of high end consumers, rather than benefit the masses. Finally, restrictive bottleneck for scientific and technological development of sports industry lies in adjustment and intervention of government. Relevant authorities neglect the relationship between supply and demand. Consequently, there are problems of efficiency reduction and waste of resources.

3 Estimation of development performance of China's sports industry

3.1 Study methods   Data Envelopment Analysis (DEA) is a nonparametric method in operations research and economics for the estimation of production frontier. For a given production set, it is able to find out the smallest concave cone of all production points through linear programming. Then, it can infer the optimal production point, which is in general the set of bending line. The essence of DEA is to determine relatively effective production frontiers through statistical data, and study technological progress of departments and enterprises with theory and approach of production frontiers. DEA – Malmquist index is used to calculate total factor productivity index with the aid of distance function on the basis of panel data. Malmquist is widely applied in analysis of input and output, and it can be divided into efficiency index and technological progress index. In this study, we used Malmquist index to evaluate dynamic changes in efficiency of China's sports industry, in order to obtain practical application effect. In DEA theory, technological growth index = pure technological growth index × increasing returns to scale = efficiency improvement index × technological progress index, while the efficiency improvement index × technological progress index is the composite index in DEA approach.

3.2 Selection of data and indicators   Based on availability, science and comprehensiveness of data, we selected added value of sports industry as output indicator; input indicator includes labor, capital and technology of sports industry (labor is expressed in employees of sports industry, capital is expressed in budget value of sports industry in current year, and technology is measured by number of China's patents in sports industry). To eliminate influence of external factors such as price change, values were converted to price of the year 2000. All data were selected from *China Statistical Yearbook*, statistical yearbooks of each province, and website of General Administration of Sport of China. And 2006 – 2011 time series were adopted.

3.3 Empirical results and analyses   According to principle of DEA, we took employees, budge value, and number of patents of sports industry in the current year as input indicators, and used added value of sports industry as output indicator of sports industry. Through substituting DEAP2.1 software, we obtained following results.

Table 1   Performance of China's sports industry development in 2006 – 2011

Time	EC	TC	M
2006	0.952	1.031	0.982
2007	0.956	1.034	0.989
2008	0.958	1.039	0.995
2009	0.962	1.103	1.061
2010	0.967	1.107	1.070
2011	0.966	1.115	1.077

Note: EC signifies coefficient for technological efficiency of sports industry, TC refers to coefficient for technological progress of sports industry, and M stands for composite index of performance of sports industry development.

From Table 1, we can see that both technological efficiency and technological progress of sports industry take on increasing growth trend, indicating that increase in technological progress of sports industry leads to increase in efficiency of development of sports industry, and composite index of performance of sports industry development also takes on gradual increasing trend. In addition, with constant improvement in performance of sports industry, the growth rate of technological progress is higher than that of technological efficiency, indicating that technological progress plays a decisive role in improving performance of sports industry. Therefore, technology is one of the most essential factors influencing performance of China's sports industry development.

4 Comparison of difference of sports industry in provinces

In order to analyze spatial distribution of development of China's sports industry, it is quite necessary to compare development performance of sports industry in provinces. In this study, we separately selected typical cities in eastern, middle and western regions. For eastern regions, we selected Beijing, Shanghai, and Tianjin municipalities; for middle regions, we selected Jilin, Hubei and Henan provinces; for western regions, we selected Xinjiang Uygur Autonomous Region, Shaanxi and Sichuan provinces. Similarly, we also took employees, budget value and number of patents in sports industry in the current year as input indicators, and took added value of sports industry as output indicator.

Through DEA principle, we obtained following calculation results (listed in Table 2).

Table 3　Development performance of sports industry in typical cities of China（average level in 2006 － 2011）

Regions	Typical cities	EC	TC	M	Rank
Eastern	Beijing	1.056	0.971	1.026	1
	Shanghai	1.021	0.970	1.023	2
	Tianjin	0.990	1.007	0.989	4
Middle	Jilin	1.000	0.974	0.976	5
	Hubei	0.993	1.031	0.966	7
	Hunan	1.007	0.960	0.997	3
Western	Shaanxi	1.004	0.843	0.974	6
	Xinjiang	1.011	0.965	0.933	8
	Sichuan	0.922	0.825	0.923	9

Note：EC signifies coefficient for technological efficiency of sports industry, TC refers to coefficient for technological progress of sports industry, and M stands for composite index of performance of sports industry development.

From Table 2, we can find the significant spatial difference in development performance of sports industry in provinces. Specifically, Beijing takes lead in development of sports industry, the next is Shanghai. This indicates that Beijing and Shanghai have made considerable progress in comprehensive development of sports industry. In middle regions, Hunan Province focuses on development of sports technology and accordingly leaps to the third place among cities we selected. On the whole, development of sports industry takes on distinctive gradient characteristic, better in eastern regions, average in middle regions, and poor in western regions. Therefore, the key to overall development of China's sports industry lies in coordinated development of all regions.

5　Conclusions and policy recommendations

5.1　Conclusions　Through selecting corresponding input and output indicators, and estimating development performance of China's sports industry by DEA approach, we arrived at following conclusions. (1) Overall performance of China's sports industry is significantly increasing in recent years, which should give the credit to increase in technological progress. However, since the growth rate of technological progress is low, the scientific and technological level of sports industry has space of improvement. (2) The development of China's sports industry has distinct characteristic of spatial difference. In general, eastern regions are better, middle regions are average, and western regions are poor in performance of sports industry development. In central cities of each study region, it is characterized by economic growth promotes development of sports industry, and Beijing and Shanghai take lead in development of sports industry.

5.2　Policy recommendations　(1) It is recommended to enrich sports development and take the road of multi-functional development. Setting up a completely categorized and functioned sports industry system is the necessity for optimizing structure of sports industry. Currently, it should firstly speed up expansion of body fitting and recreation sectors, advocate scientific and healthy body fitting ideas and guide adjustment of consumption structure with body fitting and competition performance as leading sectors. Appropriate consumption structure will promote reasonable flow of production factors, and accordingly form proper structure of sports industry. Secondly, it should accelerate developing backward sectors related to sports industry, and improve quality of related sectors. Intermediate sector and consulting sector are connecting points of China's sports industry and play important role in promoting development of competitive sports industry and common people's sports industry. (2) It is proposed to attach importance to sports science and technology, and coordinate development of regional sports industry. Strategy for distribution of sports industry should be formulated at both national level and regional level, and development of sports industry should be coordinated from different viewpoints. The state should make clear overall distribution of sports industry, and all regions should comply with the overall distribution strategy. In addition, all regions should have regional awareness in distribution of sports industry development, and deepen cooperation with government and departments. Leaders responsible for development of sports industry should have regular meetings to discuss related problems, and should deepen cooperation with enterprises in actively holding exhibition of sports goods, to make the exhibition become a platform for supply and demand enterprises of sports goods. (3) It is recommended to cultivate sports personnel, and give prominence to status of personnel resource in sports industry. Firstly, it should select a batch of high quality personnel who are willing to engage in sports industry, to cultivate them to become core force of sports industry. Secondly, it should take practical measures, break the regional barrier, and attract excellent operators of other sectors to develop sports industry mutually, and to form the pattern of accommodating all related sectors. Thirdly, it is better to create free, fair and unconstrained social environment for personnel growth and development, encourage bold innovation and exploration, and praise those personnel who make outstanding contribution, so as to further stimulate their enthusiasm, pioneering and creativity in development of sports industry. In addition, it is feasible to cultivate inter-disciplinary talents through job-specific training, off-the-job training, exchange and introduction of long-distance education, and transform talent structure of sports industry through exchange of backbones of enterprises. Finally, through combining professional step of high level sports events, it is expected to set up compensated transfer and free flow mechanism of sports personnel, encourage high colleges and universities to open sports operation and management courses or disciplines, and establish national level bases for cultivating sports operation and management personnel.

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to the fact that human capital accumulation is insufficient to offset depreciation, which will lead to a decline in rural income. In the reality, the considerable outflow of rural young labor leads to the outflow of rural human capital, and based on the model's equilibrium conditions of this section, we get the theoretical point of view of vicious cycle of increasingly solidified urban-rural dual economic structure. (ⅳ) From the set of four differential equations of balanced necessary conditions of various sectors, we can find that there is interaction among physical capital, human capital, technological progress, labor number and other factors, and the impact of these factors on income will be passed to other factors through the accumulation of final gains, thus affecting the final income.

Especially in light of R&D model hypothesis, technological advances are from the accumulation of human capital, strengthening the role of human capital factor in the income of sectors. Thus, to narrow the economic gap between urban and rural areas, it is necessary to change the urban bias fiscal and financial systems, greatly enhance the physical capital and human capital input in rural areas to prevent the rural human capital from excessively flowing into urban sector, and strengthen the intensity of industry nurturing agriculture.

4 Conclusions

This article builds a dynamic endogenous urban-rural dual economic model closely linked to China's reality, and carries out mathematical economics analysis of optimized conditions for urban and rural sectors. The results show that the labor growth rate of urban-rural sectors must be greater than the time discount rate, or else there would be a vicious cycle of diminishing returns in the sectors; the accumulation rate of physical capital and human capital of urban-rural sectors, and the rate of technological progress, need to be greater than the corresponding depreciation rate plus the time discount rate, otherwise there would be a vicious cycle of diminishing returns in the sectors; the low accumulation rate in the rural sector, and the occurrence of labor outflow, human capital loss and lack of investment, will expand income gap between urban and rural areas, which is a reason for solidification of urban-rural dual economic structure.

Therefore, to avoid the widening income gap between urban and rural areas, it is necessary to strengthen the degree of industry nurturing agriculture, and increase rural factor inputs to form a virtuous cycle of urban-rural input and output, ultimately achieving the goal of reducing the income gap between urban and rural areas and weakening the urban-rural dual economic structure.

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