

## Research on Efficiency Measurement of Urban Land-Use in China

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### Abstract

Whether to consider undesirable outputs factors in the calculation of urban land has an influence on the evaluation of China's urbanization process and land-use efficiency. BC<sup>2</sup>-DEA model and Malmquist index were applied to measure China's land-use efficiency from 2003 to 2010, from both static and dynamic perspectives. It is showed that static efficiency (CE) approached to the frontier owing to pure technical efficiency, while dynamic efficiency (MLP) reduced 9.36% with an average reduction of 1.4%, which was mainly driven by technical degeneration. There are significant differences in land-use efficiency among China's four regions. The East region enjoyed the highest value both on CE and MLP, while the Northeast China showed a downward trend on CE and its value of MLP ranked bottom across the country.

**Keywords:** land-use efficiency; undesirable output; BC<sup>2</sup>-DEA model; Malmquist index

### 1. Introduction

Since the reform and opening up 30 years ago, China has stepped into the rapid growth stage of urbanization with the urbanization rate rising from 17.92% in 1978 to 51.27% in 2011. However, the total economic growth, which was due to the rapid expansion of the scale of urban space (Liu, Zhang, & Chen, 2008), is always at the expense of higher cost and lower efficiency of land-use. As an urban resource, land is the spatial carrier of urban economy, society and environment, and the urban socio-economic development and habitat environment would be directly influenced by its land-use efficiency. Under the background of urbanization in China, it's pivotal to seek highly effective land-use mode, so as to frugally exploit land resources, guarantee the sustainable development of economic, coordinate regional balanced development and protect environmental resources.

International theoretical research on urban land-use efficiency started in the Ecological School which had been popular since 1920s; the descriptive methods were adopted to intuitively identify the spatial distribution and evolution of urban land-use types, and general patterns, such as concentric zone model, sector model and multi-center model (Xu, Zhou, & Ning, 1997) were summarized. In recent years, models like CA, ROC (Geoghegan, 2002), CLUE, IMAGO (Gil & Kiran, 2003), IMPEL (Burrough, 1986) etc. have been applied to quantitative researches on urban land-use changes. In China, Fang Xianzhi (2004) analyzed the features of various kinds of land-use patterns and established efficiency indexes according to different evaluation requirements, who was the first scholars doing researches on urban land-use efficiency. Wang Qunfang and Li Zhibin (2005) evaluated the efficiency of land-use from microscopic point. Some scholars established effective evaluation systems of urban land-use according to the principle of multi-index evaluation. For example, Ye Minting, Wang Yanglin, Peng Jian and Wu Jiansheng (2008) built an evaluation system to assess land-use efficiency in Shenzhen, from four aspects of social, economic, ecological and environmental benefits. However, those evaluation systems determining the weighing values of assessment indexes were often with certain subjectivity and affected the objectivity of evaluation results. Owing to the superiority of endogenously determining the weight of each factor inputs, Data Envelopment Analysis began to be used in the evaluation of the land-use efficiency so as to avoid the subjectivity brought by specific expression of input-output and per index weight. Adopting DEA model and Malmquist index, Guo Tengyun Xu Yong and Wang Zhiqiang (2009) investigated the factors resources efficiencies of metropolises in China and their changing trends during the period 1990-2006. Based on data envelopment analysis, Wu Dewen, Mao

Hanying, Zhang Xiaolei and Huang Jinchuan (2011) analyzed the input-output and scalable efficiency of land-use in 655 cities across China.

The above researched were good references for further study of urban land-use efficiency and introduction of relevant land-use planning policies. However, few of them took undesirable output factors into consideration, which lead to the idealistic conclusions. Therefore, we will introduce the concept of undesirable output into the scope of research on urban land-use efficiency for the first time, and deal with it using linear data transformation function, then build static efficiency model and dynamic efficiency index to calculate the efficiency of urban land-use, so as to provide some references and suggestions for the economical and intensive utilization of land in the progress of urbanization in China.

## 2. Research Methods

Under the hypothesis of using traditional DEA model from the output perspective, both desirable and undesirable outputs were treated as desirable output, in fact, undesirable output growth is not what we expect. So we have to make appropriate treatment of undesirable outputs when dealing with the economic activity containing both desired and undesirable outputs. Using linear data transfer function proposed by Seiford and Zhu (2002), we transformed undesirable output into desirable output, then we can use traditional DEA model directly. When  $y_{ij}^b$  represents undesirable output brought by province  $j$  at time  $i$ ,  $\xi = \max(y_i^b) + 1$ , and  $\max(y_i^b)$  represents the largest undesired output value at time  $i$ , so we will get the converted desired output  $y_{ij}^{b*} = \xi - y_{ij}^b$ .

### 2.1 BC<sup>2</sup>-DEA Model

C<sup>2</sup>R was first put forward by Charnes, Cooper and Rhodes (1978), and it assumes that decision-making unit (DMU) enjoys constant returns to scale (CRS), that is every DMU locating in the best production scale and avoiding the effects of not reaching the optimal size caused by imperfect competition, government regulation or financial constraints etc. In view of this, Banker, Charnes and Cooper (1984) proposed BC<sup>2</sup> model on the basis of the hypothesis that DMU enjoys variable returns to scale (VRS).

$DMU_j$  ( $j = 1, 2, \dots, n$ ) represents the same type of decision-making unit as many as  $n$ , everyone enjoys  $m$  kinds of inputs and  $s$  kinds of outputs, then BC<sup>2</sup>-DEA model based on output-oriented can be expresses as

$$\begin{aligned} & \text{Min } \omega \\ \text{s.t. } & \sum_{j=1}^n \lambda_j x_{ij} \leq x_{i0}, \quad i = 1, 2, \dots, m \\ & \sum_{j=1}^n \lambda_j y_{kj} \geq \frac{1}{\omega} y_{k0}, \quad k = 1, 2, \dots, s \\ & \sum_{j=1}^n \lambda_j = 1, \quad \omega > 0, \quad j = 1, 2, \dots, n \end{aligned} \quad (1)$$

In equation (1),  $\omega$  indicates the efficiency value and  $0 < \omega \leq 1$ , a DMU is DEA efficient when  $\omega^* = 1$ .

With BC<sup>2</sup>-DEA model, we use land-use input-output cross-sectional data of every province at the given year, so we obtain the static efficiency of urban land-use, which measures the relative relationship between a DMU and the best production frontier. The above-mentioned static efficiency is defined as CE, and it can divide into pure technical efficiency (PE) and scale efficiency (SE), moreover  $CE = PE \times SE$ .

### 2.2 Malmquist Index

Malmquist productivity index was initially defined by Caves, Christensen and Diewert (1982) and then improved by Fare, Grosskopf and Norris (1994), it is a non-parametric method using distance function to describe economic activity. Given  $T(t)$  as reference (technology at time  $t$ ), Malmquist index based on output-oriented can be expressed as

$$M_0^t = D_0^t(x^{t+1}, y^{t+1}) / D_0^t(x^t, y^t) \quad (2)$$

Similarly, given  $T(t+1)$  as reference, Malmquist index based on output-oriented can be expressed as

$$M_0^{t+1} = D_0^{t+1}(x^{t+1}, y^{t+1}) / D_0^{t+1}(x^t, y^t) \quad (3)$$

In order to avoid any discrepancy caused by selecting the frame of reference arbitrarily, we access the geometric mean of the above Malmquist values, and it measures the productivity changes from period  $t$  to period  $(t+1)$ , which can be presented as follows

$$M_0(x^t, y^t, x^{t+1}, y^{t+1}) = \left[ \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)} \times \frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^t, y^t)} \right]^{\frac{1}{2}} \quad (4)$$

In equation (4),  $(x^t, y^t)$  and  $(x^{t+1}, y^{t+1})$  indicate input-output vectors in period  $t$  and period  $(t+1)$  respectively, while  $D_0^t$  and  $D_0^{t+1}$  represent distance function with reference to  $T(t)$  and  $T(t+1)$ .

Malmquist index is calculated based on panel data and measures the dynamic efficiency of urban land-use. We can divide it into technical efficiency index (ECH) and technological progress index (TCH), which are expressed as

$$ECH(t, t+1) = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)} \quad (5)$$

$$TCH(t, t+1) = \left[ \frac{D_0^t(x^t, y^t)}{D_0^{t+1}(x^t, y^t)} \times \frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})} \right]^{\frac{1}{2}} \quad (6)$$

ECH measures the degree of catch-up to the production possibility frontier of each DMU from period  $t$  to period  $(t+1)$ , and TCH shows changes of optimal production boundary. Under the assumption of VRS, ECH can be divided into pure technical efficiency index (PECH) and scale efficiency index (SECH). We define the above-mentioned dynamic efficiency as MLP, and then we will work out that  $MLP = ECH \times TCH$  □  $ECH = PECH \times SECH$ .

### 2.3 Variable selection and Data issues

Based on the availability of data and empirical research needs, we collect the input-output data of 30 Chinese provinces during the period 2003-2010 (Data for Tibet are incomplete in the original source). According to the characteristics of production activities of urban land-use, three input factors such as capital stock, labor and land are required, desirable and undesirable output factors will be produced.

Based on the capital stock's accounting method proposed by Zhang Jun, Wu Guiying and Zhang Jipeng (2004) and perpetual inventory method, the value of capital stock is estimated from annual incremental capital stock and all variables are expressed in constant prices in 2002. Labor statistics are represented by the total numbers of employees in the secondary and tertiary industry at the end of each year. Land data comes from urban construction land area which is different from Wang Xiaoming and Yan Hongwen's research using built-up area, as the actual built-up area will be less than the urban construction land area. Desirable output data are measured by the added value of the secondary and tertiary industry, with all variables expressing in constant prices in 2002. While undesired output including industrial wastewater, emissions, sulfur dioxide, smoke, dust and solid waste, we build a comprehensive environmental pollution index by the use of expert scoring method.

## 3. Estimation results and interpretation

### 3.1 Static efficiency of urban land-use

According to equation (1), static efficiency of urban land-use (CE) and its decomposition items PE and SE are presented in Table 1 (In view of the limited space, only list the results of 4 years).

In general, urban land-use efficiency in China presents considerable features as follows: (1) The average overall efficiency is at a high level in China during the period 2003-2010. While value of efficiency is less than 0.9 in 2006 alone, it reaches the highest value of 0.932 in 2010. Across 30 regions, urban land-use efficiency is always at a relatively

optimal frontier in Beijing, Tianjin, Shanghai, Fujian, Hainan and Qinghai, while at a relatively backward level in Yunnan, Jilin, Guangxi, Guizhou, Chongqing and Hubei. (2) SE is the major factor that restricts the value of CE. It is clear in Table 1 that regions with CE approaching 1.0 have reached optimal status in PE, while SE has not achieved the best, such as Guangdong and Zhejiang. Thus, the development and utilization of land in most areas in China have not reached a certain scale, and making it difficult to exert the scale effects.

**Table 1.** Estimated values of CE, PE and SE in China, selected periods during 2003-2010

Region	2004			2006			2008			2010		
	CE	PE	SE	CE	PE	SE	CE	PE	SE	CE	PE	SE
Beijing	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Tianjin	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Hebei	0.977	0.981	0.996	0.939	0.945	0.994	0.992	1.000	0.992	0.961	0.988	0.973
Shanxi	0.907	0.938	0.967	0.957	0.984	0.973	1.000	1.000	1.000	1.000	1.000	1.000
Inner Mongolia	0.907	0.921	0.985	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Liaoning	1.000	1.000	1.000	0.902	0.920	0.980	0.894	0.997	0.897	0.924	1.000	0.924
Jilin	0.832	0.926	0.898	0.844	0.926	0.911	0.755	0.919	0.822	0.748	0.940	0.796
Heilongjiang	1.000	1.000	1.000	1.000	1.000	1.000	0.960	0.964	0.996	0.936	0.949	0.986
Shanghai	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Jiangsu	1.000	1.000	1.000	0.999	1.000	0.999	0.987	1.000	0.987	1.000	1.000	1.000
Zhejiang	0.929	1.000	0.929	0.950	0.988	0.962	0.962	1.000	0.962	0.965	0.974	0.991
Anhui	0.937	0.942	0.995	0.780	0.885	0.881	0.784	0.843	0.930	0.925	0.929	0.996
Fujian	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Jiangxi	0.807	0.880	0.917	0.802	0.878	0.914	0.833	0.886	0.940	0.989	0.992	0.997
Shandong	0.963	0.996	0.967	0.937	0.982	0.954	0.980	1.000	0.980	0.962	1.000	0.962
Henan	0.990	0.996	0.994	0.955	0.963	0.992	1.000	1.000	1.000	0.995	1.000	0.995
Hubei	0.870	0.888	0.980	0.686	0.900	0.762	0.736	0.893	0.824	0.821	0.923	0.889
Hunan	0.998	1.000	0.998	0.808	0.841	0.961	0.841	0.841	1.000	0.918	0.920	0.998
Guangdong	0.996	1.000	0.996	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Guangxi	0.891	0.895	0.996	0.802	0.806	0.995	0.752	0.771	0.975	0.764	0.791	0.966
Hainan	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Chongqing	0.738	0.927	0.796	0.677	0.861	0.786	0.704	0.916	0.769	0.887	0.909	0.976
Sichuan	0.838	0.860	0.974	0.715	0.797	0.897	0.791	0.870	0.909	0.929	0.930	0.999
Guizhou	0.636	0.905	0.703	0.683	0.849	0.804	0.745	0.907	0.821	0.802	0.851	0.943
Yunnan	0.902	0.933	0.967	0.802	0.922	0.870	0.767	0.917	0.836	0.706	0.867	0.814
Shaanxi	0.699	0.874	0.800	0.818	0.884	0.925	0.866	0.892	0.971	1.000	1.000	1.000
Gansu	0.847	0.909	0.932	0.897	0.905	0.991	0.851	0.907	0.938	0.876	0.915	0.957
Qinghai	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Ningxia	0.989	1.000	0.989	1.000	1.000	1.000	1.000	1.000	1.000	0.968	1.000	0.968
Xinjiang	1.000	1.000	1.000	1.000	1.000	1.000	0.959	0.987	0.972	0.876	0.925	0.947
Mean	0.922	0.959	0.959	0.898	0.941	0.952	0.905	0.950	0.951	0.932	0.960	0.969

Affected by factors such as the level of economic development, resource endowments and local policies, China's urban land-use efficiency shows a certain degree of regional characteristics. The nation is divided into four regions known as East, Northeast, Middle and West of China, according to their spatial features. Nationwide and four regions' mean value of CE, PE and SE are presented in Table 2.

According to Table 2, we can conclude that: (1) CE, PE and SE in East region are all in the relatively optimal frontier, and their values are absolutely higher than those in Northeast, Middle and West regions, appearing the same traits with the economic structure of China's four regions. (2) Northeast's CE is higher than Middle and West before 2008, but it has fallen significantly since 2008 while Middle and West have enhanced the growth of CE and catch up gradually. (3) The value of CE in Middle is higher than in West except in 2006 and 2007. (4) Compared to China's average value, CE in Middle and West tends to increase year by year, and CE in Northeast shows a trend like "U"-shape, in addition, it reached the bottom value in 2009.

**Table 2.** China and four regions' mean value of CE, PE and SE, 2003-2010

Region	East			Northeast			Middle			West			Nationwide		
	CE	PE	SE	CE	PE	SE	CE	PE	SE	CE	PE	SE	CE	PE	SE
2003	0.98	0.99	0.99	0.95	0.98	0.97	0.89	0.92	0.96	0.84	0.91	0.92	0.91	0.95	0.95
2004	0.99	1.00	0.99	0.94	0.98	0.97	0.92	0.94	0.98	0.86	0.93	0.92	0.92	0.96	0.96
2005	0.98	0.99	0.99	0.91	0.93	0.97	0.85	0.90	0.94	0.85	0.91	0.93	0.89	0.94	0.95
2006	0.98	0.99	0.99	0.92	0.95	0.96	0.83	0.91	0.91	0.85	0.91	0.93	0.89	0.94	0.95
2007	0.99	1.00	0.99	0.90	0.95	0.95	0.85	0.91	0.93	0.86	0.91	0.94	0.90	0.94	0.95
2008	0.99	1.00	0.99	0.87	0.96	0.91	0.87	0.91	0.95	0.86	0.92	0.93	0.90	0.95	0.95
2009	0.99	0.99	0.99	0.82	0.91	0.91	0.90	0.91	0.98	0.88	0.92	0.95	0.90	0.94	0.96
2010	0.99	1.00	0.99	0.87	0.96	0.90	0.94	0.96	0.98	0.89	0.93	0.96	0.93	0.96	0.97

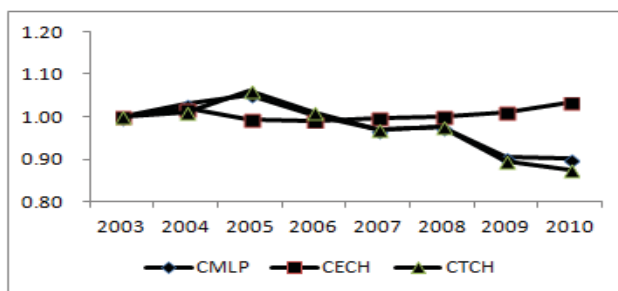
3.2 Dynamic efficiency of urban land-use

Using equation (4) to (6), we figure out the MLP value of dynamic efficiency of urban land-use. Table 3 lists the mean value of MLP and its decomposition items, while Figure 1 depicts the changes of cumulative MLP, ECH and TECH (Cumulative MLP, ECH and TECH marked as CMLP, CECH and CTCH respectively).

**Table 3.** Mean value of MLP, ECH and TCH of 30 Chinese provinces, 2003-2010

Region	MLP	ECH	TCH	Region	MLP	ECH	TCH
Beijing	1.078	1.002	1.075	Hubei	0.970	0.993	0.977
Tianjin	1.010	1.000	1.010	Hunan	0.978	0.991	0.987
Hebei	0.976	1.005	0.971	Guangdong	0.980	1.000	0.980
Shanxi	0.985	1.023	0.963	Guangxi	0.963	0.980	0.982
Inner Mongolia	1.049	1.028	1.020	Hainan	0.960	1.000	0.960
Liaoning	0.963	0.989	0.974	Chongqing	0.988	1.028	0.961
Jilin	0.951	0.982	0.968	Sichuan	1.001	1.026	0.976
Heilongjiang	0.938	0.991	0.947	Guizhou	1.012	1.039	0.975
Shanghai	1.048	1.000	1.048	Yunnan	0.945	0.968	0.976
Jiangsu	0.978	1.000	0.978	Shaanxi	1.034	1.056	0.979
Zhejiang	0.984	1.006	0.978	Gansu	0.969	1.007	0.962
Anhui	0.972	1.004	0.968	Qinghai	0.972	1.000	0.972
Fujian	0.960	1.000	0.960	Ningxia	0.966	0.995	0.970
Jiangxi	0.990	1.032	0.960	Xinjiang	1.006	0.982	1.024
Shandong	0.973	1.004	0.969				
Henan	0.980	1.008	0.972	Mean	0.986	1.005	0.981

It is obvious in Table 3 that MLP of Beijing ranks the first while MLP of Inner Mongolia, Shanghai and Shaanxi are also relatively high, but the ratio of areas where MLP below the national average level reaches 63.33%, and Heilongjiang ranks the last with the lowest value of TCH.



**Figure 1.** CMLP, CECH and CTCH 2003-2010

Combining with Figure 1, it presents that the average growth rate of China's ECH is 0.5% while the cumulative growth rate reaches 3.14% during the sample period, showing a slow trends to increase. And the average reduction rate of China's TCH is 0.5% while the cumulative reduction rate reaches 12.26%, appearing a rapid and sustained decline trend since 2005. As the reduction rate of TCH is larger than the growth rate of ECH, it creates an average reduction rate of MLP reaching 1.4% and cumulative reduction rate reaching 9.36%. It is clear in Figure 1 that the curve of CMLP and CTCH are fundamentally the same on the whole and keep a consistent changing trend. Thus, we could conclude that MLP is mainly determined by TCH, which is consistent with Guo Tengyun's conclusion.

The same as static efficiency of urban land-use, the regional disparities also exist on dynamic efficiency. Nationwide and four regions' average and cumulative values of MLP, ECH and TCH are listed in Table 4, the findings show that: (1) Dynamic efficiency of urban land-use in the four regions is not improved during the sample period. (2) The value of MLP in East is the highest with a cumulative reduction rate of 1.31%; in general, dynamic efficiency in the West surpasses that in the Northeast and Middle, not only does West enjoy a higher mean value of MLP, its cumulative reduction rate of MLP reaches 5.24%, which is far more less than Northeast's 29.36% and Middle's 8.07%; Northeast experiences a serious degradation in MLP, both of its mean and cumulative value rank the bottom across China, which is in line with the changing trends of static efficiency in the Northeast.

**Table 4.** China and four regions' average and cumulative values of MLP, ECH and TCH, 2003-2010

	Mean Value			Cumulative Value		
	ECH	TCH	MLP	CECH	CTCH	CMLP
East	1.0018	0.9975	0.9993	1.0124	0.9745	0.9869
Northeast	0.9884	0.9648	0.9530	0.9185	0.7716	0.7064
Middle	1.0267	0.9634	0.9890	1.2008	0.7653	0.9193
West	1.0113	0.9831	0.9927	1.0811	0.8841	0.9476
Nationwide	1.0047	0.9817	0.9860	1.0327	0.8737	0.9019

It is obvious in Table 4 that ECH and TCH presents disparities in different regions. The Northeast suffers the most significant downturn in MLP, which is mainly derived from the degradation in both ECH and TCH. However, degradation in TCH is the mainly factor that reduces the value of MLP, as its cumulative reduction rate in this region reached 22.84%. ECH of other regions is improved, while degradation intensity of TCH is greater than its improvement. Consequently, the mutually exclusive effect between ECH and TCH didn't cause improvement in MLP in these regions at all.

#### 4. Summary Remarks

In this paper, six major industrial pollutants are defined as "undesirable outputs" generated in the process of urban land-use, and linear data transformation function is used to transfer "undesirable outputs" into "desirable outputs", then BC<sup>2</sup>-DEA model and Malmquist index are applied to measure China's land-use efficiency and regional disparities during period 2003-2010, from both static and dynamic perspectives. It is found that: (1) The level of static land-use efficiency (CE) during the period 2003-2010 is high in China presenting an "U"-shaped trend from downturn to ascension, and scale efficiency (SE) is the major factor that restricts the value of CE; dynamic efficiency of urban land-use (MLP) reduced 9.36% with the average reduction of 1.4%, which was mainly driven by technical (TCH) degeneration reaching an average reduction of 1.9% and cumulative reduction of 12.26%. (2) From regional perspective, it is concluded that both of CE and MLP have significant regional disparities. The value of CE and MLP in the East is the highest, while CE in Northeast experiences a downward trend and its MLP ranks bottom across China; what's more, the effects of TCH and ECH to land-use efficiency vary from different regions at different times.

The conclusion would be a reference in the respect of China's promotion of urbanization construction and improvement of land-use level. (1) We could find that dynamic efficiency of urban land-use experienced degeneration while CE and MLP in the East were both higher than other regions, which indicating the imbalance between regional economic developments. Considering that Eastern regions have suffered severe scarcity of construction land and sharply rise in the cost of land, while the Middle and West reserve a lot of undeveloped arable land resources, thus we should give full play to the dual advantage of high efficiency level in East and arable land suitable for the scale of operation in the Middle, break the denial of the requisition-compensation balance, establish an indicator trading center and optimize the allocation of land resources among different regions. In this way, we could promote the level of land-use efficiency across the country and share the land differential benefits of East to other regions, and ultimately achieve a win-win goal of

improving land-use efficiency and inter-regional coordinated development. (2) Land urbanization transition is one of the cores to promote a better quality of urbanization, and the improvement of land-use efficiency is the mainly access to land urbanization transition, which is close related to land transfer mode. In accordance with the overall goal of China's urbanization and economic restructuring, we must make greater efforts on reform and innovation, promote the transformation of economic development mode by the change of land-use pattern, and fundamentally ease the contradictions between supply and demand of land resources in the next stage. Not only should we ensure the demand of land for urbanization, but also avoid urban overspreading and expanding disorderly. In addition, we have to focus on optimizing space layout and strengthen land-use co-ordination, and gradually build a spatial pattern of development and utilization which consorts construction, agriculture and ecology together harmoniously.

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