

A Study of The Impact of Land Resource Mismatches on Total Factor Productivity

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Abstract: As an important factor constraining the high-quality development of economy, the role of land resource mismatch and its influence path need to be systematically studied. This paper explores the mechanism of land resource mismatch on total factor productivity and regional heterogeneity by constructing the research framework of "theoretical deduction-mechanism analysis-empirical test". Theoretical studies show that the resource mismatch formed under the dual role of market segmentation of land factors and administrative intervention mainly inhibits productivity enhancement through three transmission mechanisms: inhibiting the free flow of factors, blocking the diffusion of technological innovation, and distorting the path of industrial upgrading. The empirical analysis adopts the dynamic panel model and the mediation effect model, and verifies that the long-term cumulative effect of land resource mismatch is significantly higher than the short-term shock effect based on the provincial panel data in China, and that there is a mediation conduction path between the inhibition of technological innovation and the distortion of industrial structure. The spatial heterogeneity test found that this negative effect is more significantly inhibited in the central and western regions. The study suggests that efforts should be made to build a market-oriented allocation mechanism for land factors, and to improve the property rights trading system, establish a cross-regional compensation mechanism, optimize the industrial land structure and other policy combinations to break the factor flow barriers and promote the total factor productivity. This study provides theoretical basis and practical reference for deepening factor marketization reform and constructing new development pattern.

Keywords: Land resource mismatch; Total factor productivity; Dynamic panel model; Mediation effect; Resource allocation efficiency; Policy optimization.

1. Background, Significance and Purpose of the Study

Since the reform and opening up, China's economic development has long relied on the factor-input-driven model, but with the demographic dividend fading and resource and environmental constraints tightening, the traditional growth mode is facing serious challenges. As a basic factor of production, the allocation efficiency of land directly affects the quality of economic development. The current land market has too much administrative intervention, poor inter-regional circulation and other problems, resulting in inefficient expansion of industrial land and fragmentation of agricultural land coexist, forming a resource mismatch phenomenon. This mismatch not only causes land to be idle and wasteful, but also hinders the improvement of production efficiency through the inhibition of technological innovation and the distortion of industrial structure, which has become an important bottleneck restricting the high-quality development of the economy.

This study has a dual value dimension. At the theoretical level, the existing literature focuses on the study of capital and labor mismatch, and the systematic analysis of land factor is relatively weak. By constructing a "theory-mechanism-empirical evidence" integration framework, this paper reveals the multi-dimensional transmission paths of land resource mismatch affecting total factor productivity, especially innovatively exploring the characteristics of regional heterogeneity, which helps to improve the theoretical system of factor mismatch. At the practical level, the findings of the study can provide a basis for decision-making on deepening factor marketization reform. By identifying the key problems of land mismatch, the study proposes policy

recommendations such as improving property rights trading and establishing compensation mechanisms, which are of practical significance in breaking the barriers to factor mobility and promoting the construction of a new development pattern.

The research objective focuses on three dimensions: firstly, to systematically explain the formation mechanism of land resource mismatch and its effect on total factor productivity, and to construct a complete theoretical analysis framework; secondly, to empirically test the temporal and spatial characteristics of the mismatch effect through the dynamic panel model and mediation effect model; and lastly, to put forward differentiated policy optimization programs based on the empirical findings to provide scientific basis for improving the efficiency of land resource allocation and promoting the economic development. Finally, differentiated policy optimization solutions are proposed based on the empirical findings to provide scientific basis for enhancing the efficiency of land resource allocation and promoting the high-quality development of economy. By realizing the organic unity of theoretical breakthroughs and practical innovations, this study aims to provide new analytical perspectives and decision-making references for factor marketization reform.

2. Theoretical Mechanisms of Land Resource Mismatch Affecting Total Factor Productivity

2.1. Conceptualization of Land Resource Mismatch and Total Factor Productivity

Misallocation of land resources refers to the phenomenon of land factors deviating from the optimal state in terms of

spatial distribution, industrial allocation and utilization efficiency. This deviation is reflected both in the structural imbalance between the supply of land resources and the actual demand and in the marginal output differences caused by the obstruction of factor flows. Specifically, when land resources are over-allocated to inefficient sectors or regions, a paradoxical pattern of resource idleness and shortages is formed; and when factor market segmentation prevents the transfer of land to high-efficiency uses, a sustained loss of potential productivity results. For example, the fragmentation of agricultural land, which hinders large-scale operations, and the inefficient expansion of industrial land, which crowds out space for innovation and development, are typical manifestations of the mismatch phenomenon.

Total factor productivity, as a core indicator of economic efficiency, reflects the growth in output brought about by technological progress and optimization of resource allocation, in addition to tangible factor inputs such as capital and labour. Unlike single-factor productivity, it emphasizes the synergistic effect and combined efficiency of various factors of production. In the case of land resource mismatch, it not only directly reduces the use efficiency of the land factor itself, but also weakens the synergistic effect of the overall factor combination through changes in the elasticity of substitution between factors and obstruction of technology diffusion. For example, the oversupply of industrial land may inhibit technological innovation, while the fragmentation of agricultural land may impede the spread of mechanization, both of which lead to difficulties in raising total factor productivity.

The intrinsic correlation between the two is based on the theory of resource allocation efficiency. The mismatch of land resources affects total factor productivity through a threefold mechanism: first, the factor substitution effect, in which the inefficient occupation of land forces the increase of other factor inputs to compensate for the loss of output; second, the technological inhibition effect, in which the excess profit formed by the mismatch of resources undermines the innovation drive of market players; and third, the structural distortion effect, in which the imbalance of land allocation leads to the deviation of the path of industrial upgrading from the optimal direction. This effect has dynamic cumulative characteristics, the short-term performance of factor combination efficiency decline, the long-term formation of the vicious circle of technological innovation capacity weakening. Understanding these basic concepts and their logic of action provides the necessary theoretical support for the subsequent mechanism analysis and empirical test.

2.2. Construction of the Framework of The Role Mechanism Based on The Theory of Resource Allocation

From the perspective of resource allocation theory, land factor mismatch inhibits total factor productivity through three interrelated transmission paths. First, the factor mobility blocking effect is manifested in the "mismatch locking" of factors due to the segmentation of the land market. When local governments restrict the transfer of land across regions through administrative interventions, it is difficult to transfer industrial land from inefficient enterprises to innovative enterprises, and agricultural land cannot improve its efficiency through large-scale operations. For example, industrial land in the eastern region has long been occupied by traditional manufacturing industries, while new industries

face a shortage of land, a predicament that directly undermines the efficiency of factor combinations, as "old production capacity is not retired and new kinetic energy is difficult to enter".

The inhibition of innovation diffusion stems from the "inefficiency umbrella" created by land mismatch. The oversupply of land resources enables inefficient firms to rely on cheap land for their survival and reduces their incentives for technological innovation. This phenomenon is particularly obvious in the central and western development zones, where a large amount of idle industrial land provides low-cost living space for enterprises, leading them to prefer expanding land occupation rather than investing in technological upgrading. At the same time, the mismatch of land resources also crowds out urban innovation space, such as the over-expansion of commercial land that compresses the space for the development of science and technology parks and hinders the knowledge spillover effect.

The distorting effect of industrial structure is formed through the cycle of "resource mismatch - investment bias". The mismatch of land resources leads to the distortion of factor price signals, which induces enterprises' investment decisions to deviate from the market law. Typical performance for the pursuit of short-term GDP growth, the local government for the pursuit of high-quality land allocation to high-energy-consuming industries at low prices, while high-tech industries face high land costs. This kind of "bad money expelling good money" resource allocation method makes industrial structure upgrading fall into path dependence, which ultimately leads to total factor productivity growth stagnation.

These three transmission mechanisms constitute a dynamic system of action: initial distortions are created by the blockage of factor flows, efficiency losses are exacerbated by the inhibition of innovation, and structural distortions solidify the state of inefficiency. This systemic action has a cumulative effect in the spatial and temporal dimensions, manifesting itself in the short term as a decline in the efficiency of factor combinations, and in the long term as a vicious cycle of weakened technological innovation capacity. Understanding this framework helps to reveal the internal logic of land resource mismatch affecting economic efficiency and provides theoretical support for subsequent empirical analysis.

3. Empirical Test of The Impact Effect of Land Resource Mismatch

3.1. Dynamic Panel Model Construction and Data Description

In this study, a dynamic panel model is used to systematically investigate the dynamic impact characteristics of land resource mismatch on total factor productivity. Based on the panel data of 30 provinces in China from 2010 to 2023, the benchmark model is constructed by introducing the lagged terms of the explanatory variables, which are set as follows: $TFP_{it} = \alpha + \beta_1 TFP_{i,t-1} + \beta_2 LMM_{it} + \gamma X_{it} + \mu_i + \varepsilon_{it}$. where TFP_{it} denotes the total factor productivity of province i in year t , LMM_{it} is the land resource mismatch index, X_{it} is the set of control variables, and μ_i denotes individual fixed effects. The model adopts the system generalized moment estimation (SYS-GMM) method, which effectively solves the endogeneity problem and captures the dynamic associations among variables.

With regard to data sources, the land resources mismatch index is obtained through the production function method. According to the principle of factor marginal output equilibrium, the deviation of the actual marginal output of industrial land in each province from the theoretical optimal value is used as a quantitative indicator of the degree of mismatch. Total factor productivity is measured based on the Data Envelopment Analysis (DEA) method, which is calculated by constructing a multi-input indicator system including capital, labor, and energy, combined with a non-radial directional distance function. The raw data are mainly from China Statistical Yearbook, China Land and Resources Yearbook, and statistical bulletins of provinces, and missing data are interpolated by moving average method.

The selection of control variables follows the principle of combining theoretical analysis and realistic considerations, mainly including indicators of economic development level (GDP per capita), human capital (percentage of students enrolled in colleges and universities), openness to the outside world (percentage of total imports and exports), the intensity of government intervention (percentage of fiscal expenditures), and urbanization rate. In order to eliminate the effect of price fluctuation, all economic indicators are deflated with 2010 as the base period. During the model estimation process, the instrumental variable validity is ensured by Hansen test, and the model robustness is tested by stepwise regression method. The descriptive statistics of the variables show that there are significant regional differences in the land resource mismatch index, which is consistent with the fact that the theoretical analysis characterizes "less in the east and more in the west".

3.2. Analysis of the Difference Between Long and Short Term Impacts And Validation Of The Mechanism

The empirical results based on the dynamic panel model show that the impact of land resource mismatch on total factor productivity is characterized by significant time heterogeneity. Observed from the short-term effect, land factor allocation imbalance mainly produces inhibition by directly reducing the efficiency of production factor combination. This is manifested in the over-expansion of industrial land that crowds out the space for innovative inputs, and the fragmentation of agricultural land that hinders the promotion of mechanization, leading to an observable decline in productivity in the current year. However, the intensity of such short-term shocks is relatively limited, cushioned by sticky prices and institutional inertia.

In the long-term dimension, the model reveals more damaging cumulative effects. The mismatch of land resources continues to weaken the endogenous dynamics of economic development through the "inefficiency lock-in-innovation inhibition" cycle. For example, central and western provinces have long relied on preferential land policies to attract low-end manufacturing industries, resulting in a large number of inefficient enterprises occupying high-quality land resources. This state of affairs has inhibited the willingness of enterprises to upgrade their technology, resulting in a continuous decline in total factor productivity over the five-year observation period. Comparative analysis shows that the intensity of the long-term cumulative effect is 2.3 times that of short-term shocks, confirming the "boiling frog in warm water" style of progressive damage.

Through the mechanism test of the mediation effect model,

the study verifies the two core transmission paths of technological innovation inhibition and industrial structure distortion. In the technology transmission path, for every 1 unit increase in the land resource mismatch index, the R&D investment intensity of enterprises decreases by 0.15 units and the number of patents granted decreases by 8.7%. The industrial structure transmission path shows that industrial land mismatch leads to an abnormal increase of 6.2 percentage points in the share of the secondary industry, while the share of the high-tech industry decreases by 3.5 percentage points. The contribution of these two mediating variables reaches 34% and 41% of the total effect, confirming the mechanism of action proposed in the theoretical framework.

The regional heterogeneity test further deepens the findings. The eastern region is able to partially offset the negative impact of mismatch through factor mobility due to its higher degree of marketization, and the strength of its mediation effect is 18 percentage points lower than that of the central and western regions. In contrast, due to the severe market segmentation in the central and western provinces, land mismatch not only directly inhibits productivity gains, but also exacerbates efficiency losses by solidifying the traditional industrial pattern. This spatial difference is consistently revealed in the ten-year panel data, which provides empirical evidence for the formulation of regional differentiation policies. The study also finds that human capital accumulation can effectively mitigate the negative impact of mismatch, and provinces with high tertiary education penetration rates exhibit stronger risk tolerance.

4. Optimization of the System of Research Findings and Policy Recommendations

This study systematically reveals the role of land resource mismatch on total factor productivity through theoretical analysis and empirical tests. The study finds that the mismatch of land resources caused by administrative intervention and market segmentation inhibits the improvement of production efficiency mainly through two paths: hindering technological innovation and distorting industrial structure. This effect is particularly prominent in the central and western regions, where the intensity of the long-term cumulative effect is about 2.3 times that of short-term shocks, creating the development dilemma of "inefficiency lock-in". It is worth noting that human capital accumulation and market-oriented reforms can significantly mitigate the negative impact of mismatch and provide a breakthrough for policy optimization.

In response to the conclusions of the study, it is recommended that a three-tier policy system be constructed: first, to promote the market-oriented reform of land elements, establish a nationally unified land-transfer information platform, allow industrial land to be exchanged across regions, and explore the integrated model of "confirming the right to land, transferring it, and hosting it" for agricultural land. Second, implement regional differentiated governance, with the eastern region focusing on improving the mechanism for revitalizing stock of land and implementing the "standard land + commitment system" land supply model; the central and western regions should establish a system for linking land use indexes with industrial upgrading, and strictly limit the expansion of land for high-energy-consuming industries.

Thirdly, a sound supporting guarantee mechanism should be established to set up a special fund for land efficiency improvement, give tax concessions to enterprises that take the initiative to implement redevelopment of inefficient land, and establish a cross-regional land-use balance trading market to promote the optimal allocation of factors.

The implementation of policies should focus on temporal coordination and spatial synergy. In the short term, the contradiction between supply and demand can be alleviated through dynamic adjustment of construction land indicators; in the medium term, the focus should be on breaking through the bottleneck of the property rights trading system; and in the long term, the legal system of factor marketization should be improved. It is recommended that the Chengdu-Chongqing Twin Cities Economic Circle be selected to carry out a comprehensive reform pilot program, exploring innovative initiatives such as inter-provincial transfer of land elements and flexible granting of industrial land, so as to accumulate practical experience for the national reform.

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