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Mismatch in Urban Construction Land Use and Economic Growth: Empirical Evidence from China

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Abstract: Seeking land use development strategies is an effective policy tool to support economic development, especially in developing countries. Previous studies evidence the indispensable role of urban construction land use (UCLU) in regional economic development. However, neglecting the two-stage characteristic and mismatch of UCLU could misinterpret the strategy. This study, considering a two-stage characteristic, aims to explore how land use development strategy affects economic development. First, we create a measure for UCLU mismatch. Second, using both linear and nonlinear models, we explore the possible relationship between the land use strategy and economic development. Subsequently, robustness and the potential path-dependent reinforcement loop (PDRL) are discussed further. Finally, the fundamental channels are investigated in the mechanism analysis section. The results confirm that temporary positive effects stimulate economic development, whereas permanent potential negative effects undermine robust economic development. In addition, the PDRL shows that irrational adoption of the strategy would mean succumbing to low- and medium-industries. We also find that land and capital demonstrate exogenous properties that function as visible hands, with economic regulation exploring UCLU mismatches and misallocation of resources. However, the overuse of these two policies could lead to an unhealthy cycle of mutually reinforcing adverse effects. Based on these findings, we propose policy recommendations to support the rational use of this strategy.

Keywords: land-use development; urban land development mismatch; resource misallocation; economic development; urban construction land use

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1. Introduction

A scarce resource, land is essential to facilitate sustainable urban development. Urban areas host more than half the total world population and are centers of economic activities [1]. The top ten cities in the United States (US) account for nearly 20% of the total population but more than 30% of total GDP [2]. Presently, urban areas are witnessing continual and rapid expansion worldwide. Research data suggest that by 2100, the total urban area will increase to 1.8–5.9 times its 2000 size [3]. The strategy of pursuing development through efficient land use for constructing buildings and infrastructure and attracting investment to stimulate economic development is widely used as a powerful policy tool in several countries [4]. Theoretical and empirical studies have focused on addressing how this strategy affects economic development. Initial studies and economists, represented by William Petty (1623–1687) and David Ricardo (1772–1823), discussed optimal allocation of land as a scarce resource [5]. Subsequent studies considered land as a capital investment [6] and introduced it into the economic system [7–15] to further explore economic problems. To summarize, land rent theory and production theory explain the relationship between land use and economic development. Land rent theory demonstrates the dynamic mechanism of intensive land use to pursue greater benefits through fewer land inputs, specifically in the context of land as a scarce natural resource [16]. Production theory focuses on the equilibrium mechanism of land use as a fixed production factor or carrier to pursue greater benefits by adjusting the allocation of other variable factors of production [17].

The above studies provided a strong foundation for research on urban construction land use (UCLU). Recent studies examining UCLU from various perspectives [18–20] and across different regions and countries [21,22] focused on the efficiency [23] or allocation [24,25]/ misallocation [26] of UCLU to improve economic indicators. Although the existing literature has explored the relationship between UCLU and economic development further, focusing on land rent theory or production theory, there are gaps between the reality of UCLU and discussions based on these two theories. Here, the attributable reason is that prior studies ignored the critical characteristic of UCLU, which we call a two-stage dimension.

The process of UCLU is significantly different from agricultural land or other production resources, which are directly used in production. In fact, UCLU cannot be put to practical use directly because preliminary construction based on the user's purpose is indispensable. That is, the two-stage characteristic of UCLU includes the preliminary construction stage (i.e., construction stage) and the practical use stage (i.e., production stage). However, previous theories and studies either focused on the intensive use of UCLU by compacting construction during the construction stage or the economic benefits created in the production stage, ignoring the comprehensive two-stage characteristic of UCLU. Therefore, we explore the impact of UCLU on economic development, specifically considering the two-stage characteristic for providing a more comprehensive outlook.

Our analysis considers the exogeneous aspect of UCLU on economic development, which is usually used as an effective policy strategy for seeking development through land use to stimulate economic growth in China. Due to the criteria of state-ownership, we propose the strategy of seeking development through land use to reflect the local government's strategy of stimulating economic development by transferring industrial land at low prices to attract investment and selling commercial and residential land at high prices to supplement fiscal revenue to improve people's livelihoods. Although some studies discussed the topic by investigating land transfer, income [27,28], and investment in fixed assets [29,30], they ignored the potential negative effect of the strategy over a long period, as it could result in the mismatch of UCLU. Thus, the strategy of seeking development through land use focuses on economic gains that are realized within a short period, resulting from income transfer and construction activities. However, this approach is considered irrational for economic development in the long term due to unclear planning for the urban built-up area, which is reflected by the concept of mismatch of UCLU.

At present, only a few studies have investigated the impact of the strategy of seeking development through land use, considering the two-stage characteristic of UCLU. We focus on the mismatch of UCLU as a measure of the strategy of seeking development through land use and explore the impact of this strategy on economic development. These approaches connect our empirical framework to studies that focus on the two-stage characteristic and mismatch of UCLU. However, there are only a few studies addressing these issues. In addition, our analysis is also connected to studies on the relationship between UCLU and economic development. Some scholars argued that construction and land development contribute significantly to economic development [31], indicating that rapid urbanization has resulted from the dependence on income generated from land transfer, which accounts for 70% of the total fiscal revenue [32]. Due to the dual incentives of fiscal decentralization and economic growth, seeking development through land use is more likely to be adopted to achieve rapid benefits [33]. Some studies reported that land expansion and land fiscal values vary across different regions in China [34] and suggested that the linkage between land finance and urban land scale growth should be managed based on the region more conducive to robust economic growth [35]. However, in recent years, the relationship between land fiscal revenue and economic development has been examined and comprehensive studies focusing on the topic are neither satisfactory nor systematic.

In recent years, path-dependence for regional economies and urban systems has been discussed in detail, which provides a reference for developing a potential path-dependent reinforcement loop (PDRL) in this paper. Path dependence is an important concept to understand in the evolution of economic and social systems, and it also has obvious geographical implications. The diversification of regional economic growth rates is large due to path dependence: a region's economy depends on an earlier established industrial structure [36]. Some scholars have produced a detailed exploration of how to analyze the mechanisms of regional economic evolution with the path dependence theory [37]. There are also studies on whether path dependence exists a priori and how to measure path dependence on a regional scale [38]. With further research on the relationship between path dependence and regional economic development, some studies have carried out critical reflection and discussion on the classical model of regional path dependence [39,40]. Relevant research is gradually improving.

In summary, a substantial amount of literature shows that as the fundamental factor of production, UCLU has played an indispensable role in regional economic development. The direct benefits of UCLU, generated mainly from the land fiscal revenue and investments made in fixed assets, such as real estate and infrastructure development, are supporting many regions in achieving accelerated economic growth, which is termed as seeking development through land use. However, neglecting the mismatch in UCLU could lead to misinterpretation of the strategy. This study examines the strategy of seeking development based on how land use affects economic development. It is motivated by the observation that the process by which UCLU transforms new and superior inputs into improved or new products is a series of processes of first construction and then production changes. However, few studies have noticed the two-stage characteristic of UCLU and focused on the impact of seeking development through land use on economic development considering the two-stage characteristic. Here, data envelopment analysis (DEA) is beneficial as it creates a proxy indicator of the mismatch of UCLU (MI) to thoroughly and comprehensively reveal the influence of seeking development through land use on economic development. Using the linear model (ordinary least squares) and nonlinear model (threshold regression model), we explore the possible relations between MI and economic development. Subsequently, the robustness and potential path-dependent reinforcement loop of MI on economic development are further discussed. Finally, the fundamental channels have been investigated in the mechanism section.

This study measures the mismatch of UCLU and reveals its double-faced effect on economic development indicators, which confirms the temporary positive effect of stimulating economic development as well as the permanent potential negative effect of undermining healthy economic development. Based on the study results and discussion, we propose the path-dependent reinforcement loop (PDRL) of UCLU mismatch and consumer industries to reflect the aftermath of the unreasonable adoption of the strategy for seeking development. With that, we further explore the mechanism of PDRL from the perspective of the mismatch of UCLU and misallocation of capital and labor resources. We find that land and capital have shown an exogeneous attribute acting as the visible hand with economic regulation, while labor resource allocation has more endogenous characteristics, which are affected by the allocation of capital and land. Moreover, unhealthy loop strengthening and adverse effects of each other have been proposed to reveal the interactive effect of the mismatch of UCLU and labor and capital.

The rest of the paper is organized as follows. Section 2 provides the theoretical analysis. Section 3 presents the methodology and data description, and Section 4 summarizes the main results and discussion. Section 5 presents the mechanism analysis. Finally, Section 6 concludes and recommends the study implications.

2. Theoretical Analysis

2.1. Mismatch of UCLU

The mismatch of UCLU is determined by the land use process, which is a two-stage phase. The land use process consists of a construction phase and a production phase. The transformation of resources is carried out in the construction phase, followed by production in the production phase, which creates economic and social benefits. Because of this, mismatches in UCLU commonly arise between the two phases. However, very few studies have explored this issue. Figure 1 illustrates the two-stage characteristics and the mismatch of UCLU.

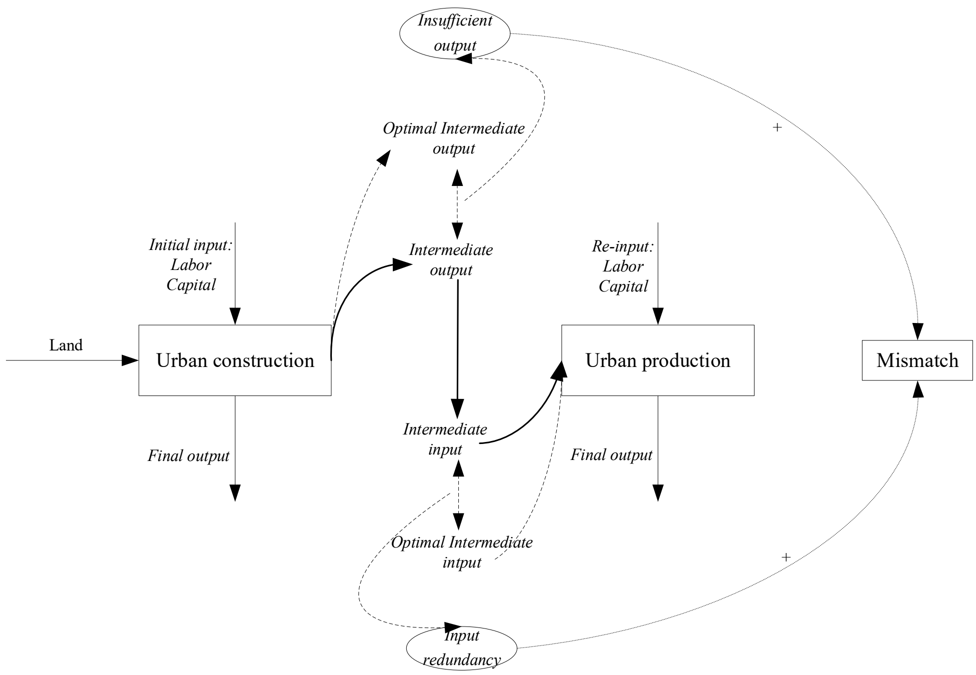

Figure 1. Framework of mismatch between urban construction and urban production.

Figure 1 shows that during urban construction, land, capital, and labor resources are used for undertaking construction activities. During the urban construction stage, output is categorized into final and intermediate output. As residential buildings cannot be classified into the urban production stage, we regard it as the final output in the urban construction stage. Intermediate outputs are mainly used to provide infrastructure and spaces to support production activities in the urban production stage, such as industrial plants and commercial buildings. However, during the urban construction stage, intermediate outputs (AIO) are usually insufficient due to ineffective processes, such as technical factors. There is potential to improve AIO with the limited land available and other inputs called optimal intermediate outputs (OIO). In other words, OIO are the maximum intermediate outputs of UCLU during the urban construction stage. The gap between OIO and AIO denotes insufficient outputs (IO). After urban construction inputs are transformed, AIO will be included in the urban production stage as intermediate inputs (AII) accompanying re-inputs, including labor and capital to implement production activities such as secondary and tertiary industries. Similarly, the gap between AII and optimal intermediate inputs (OII) for the urban production stage are redundant inputs (RI). These inputs form the final output at the urban production stage. The two-stage UCLU process is completed, as shown in Figure 1. We can see that the mismatch between urban construction and urban production is made up of IO and RI. According to actual conditions, the following set of constraints are obtained:

$$\begin{cases} AIO \leq OIO \\ AIO = AII \\ AII \geq OII \end{cases} \tag{1}$$

We propose below two scenarios covering all possible situations.

(1) $OIO = OII$. In this situation, there is no mismatch between the two stages—effective urban construction stage and effective urban production stage. Theoretically, the mismatch is 0 on the condition that the urban construction stage and urban production stage are effective ($OII = AIO = OIO$). However, practically, we can observe that AIO is usually less than OIO and more than OII because both urban construction and urban production stages are commonly ineffective. In the scenarios of $OII < AIO < OIO$, $OII = AIO < OIO$ or $OII < AIO = OIO$, although the mismatch is not 0, we can take measures to improve efficiencies in urban construction and urban production stages to achieve perfect mismatch. Therefore, we measure the mismatch of UCLU efficiency theoretically between these two stages by considering only OIO and OII.

(2) $OIO > OII$. In this situation, there is a mismatch between urban construction and urban production stages. Given the two-stage series UCLU model, in the scenarios of $OII < AIO < OIO$, both these stages are ineffective, and the mismatch is highly significant. When $OII = AIO < OIO$ or $OII < AIO = OIO$, the mismatch is alleviated. However, AIO are usually less than OIO during the urban production stage and AII are usually redundant for OII during the urban production stage. In other words, AIO are usually insufficient due to ineffective processes in the urban construction stage, and for the actual requirements of the urban production stage, AII directly from AIO are usually wasteful. Therefore, the sum of IO in the urban construction stage and RI in the urban production stage reflect the mismatch of UCLU between both these stages.

2.2. Mismatch of UCLU and Economic Development

From the analysis presented in Section 2.1, seeking development through the two-stage series, characteristic of UCLU, is an important strategy for local governments to facilitate economic development in the short term [41]. To outline the theoretical relationship between the mismatch of UCLU and economic development, we construct a simple two-sector dynamic unbalanced growth model into which land is introduced as the key production factor [42].

To simplify the analysis framework, we assume that there are two sectors in the economic system: productive industries and consumer industries. Y_{1t} and Y_{2t} represent the output of productive industries and consumer industries, respectively. The input production factors of productive industries are capital (K), labor (L), and land (E); the input production factors of consumer industries are labor, manufacturing, and finished products. The production function and growth rates of input factors in these two sectors are as follows:

$$\begin{cases} Y_{1t} = A_t^{\kappa}(\omega K_t)^{\alpha}(\sigma L_t)^{\beta}E_t^{\lambda} \\ Y_{2t} = [(1-\omega)K_t]^{\gamma}[(1-\sigma)L_t]^{\upsilon}Y_{1t}^{\theta} \\ \Delta K = sY_1, \Delta A = hA, \Delta L = mL, \Delta E = nE \end{cases} \tag{2}$$

where α, β, γ, λ, υ, κ, and θ are the output elasticity of K, L, E, A, and the manufacture of finished products. ω is the proportion of capital that is input into productive industries to total capital input. σ is the proportion of labor that forms the input for productive industries to total labor input. s is the saving rate. h, m and n represent the growth rates of technology, labor, and land. The increase in capital (ΔK) comes from the savings value of the output in the production phase, which is s multiplied by Y_1. The growth rate of capital (g) is given as

$$g = \frac{\Delta K}{K} = \frac{sY_1}{K} = s\omega^{\alpha}A_t^{\kappa}(K_t)^{\alpha-1}(\sigma L_t)^{\beta}E_t^{\lambda} \tag{3}$$

Here, we take the derivative of g over time t to obtain the change in the rate of capital growth rate $\hat{g}$:

$$\hat{g} = \frac{\Delta g}{g} = (\alpha - 1)g + \kappa h + \beta m + \lambda n \tag{4}$$

Thus, when $\hat{g}$ is 0, we can obtain g in a stable state:

$$g = \frac{\kappa h + \beta m + \lambda n}{1 - \alpha} \tag{5}$$

Therefore, the growth rates of productive industries is:

$$g_{Y_1} = \alpha g + \kappa h + \beta m + \lambda n = \frac{\kappa h + \beta m + \lambda n}{1 - \alpha} \tag{6}$$

Similarly, the growth rates of consumer industries is:

$$g_{Y_2} = \upsilon m + (\gamma + \theta)\frac{\kappa h + \beta m + \lambda n}{1 - \alpha} \tag{7}$$

To further discuss the impact of seeking development by land on the industrial structure optimization, we explored the ration of g_{Y_2} to g_{Y_1} so as to reflect the level of the real economy [43].

$$Q = \frac{g_{Y_2}}{g_{Y_1}} = \gamma + \theta + \upsilon m \frac{1 - \alpha}{\kappa h + \beta m + \lambda n} \tag{8}$$

Generally, the local government has a strong desire to make investments and pursue development through land use due to political promotion incentives and financial pressure (Li and Wang, 2015). In this case, the contribution of land to the local economy and land output elasticity are increasing. Therefore, land output elasticity can be regarded as the increasing function of transfer of land income r [44]. That is, $\lambda = f(r)$ and $f(r)' \geq 0$. Given Equation (8),

$$Q = \frac{g_{Y_2}}{g_{Y_1}} = \gamma + \theta + \upsilon m \frac{1 - \alpha}{\kappa h + \beta m + (f(r))n} \tag{9}$$

From Equation (9), we can observe that the derivative of Q to r is less than 0 ($\frac{\partial Q}{\partial r} < 0$), which shows that increase in land transfer income would reduce Q. In other words, the strategy of pursuing development through land use has a negative impact on productive industries and a positive effect on consumer industries. The local government's dependence on land finance and pursuance of economic growth would increase the economic virtualization risk. On the one hand, by transferring industrial land at low prices, the local industrial structure, dominated by medium- and low-end manufacturers and the construction industry, has been strengthened further, which restrains industrial upgrading. On the other hand, local governments sell commercial and residential land at high prices, resulting in the advanced development of consumer industries, far ahead of productive industries. Therefore, we propose our hypotheses.

Hypothesis 1. *The strategy of seeking development through land use is short-term and effective at stimulating local economic development.*

Income generated from a land transfer is mainly used for constructing infrastructure to attract investments, thus strengthening local economic growth. However, seeking development through land use would lead to an inequitable industrial structure that undermines improvement of the local economy over the long term.

Hypothesis 2. *Seeking development through land use would lead to a decline in the path of dependence on medium- and low-end industries in the long term, which eventually results in the stagnation or even decline of local economic growth.*

From the above theoretical analysis, the inverted-U shape between the mismatch of UCLU and the economy has been assumed. We explore our hypothesis empirically in the following sections.

3. Methodology and Data

3.1. Mismatch Measurement

Based on the analysis in Section 2.1, the two-stage process of UCLU includes the urban construction stage and the urban production stage. To measure the mismatch of UCLU, we explored the two-stage DEA serial model as follows [45–47].

$$E_k = \max \frac{\sum_{a=1}^{b} \eta_a T_{ak} + \sum_{p=1}^{q} w_p^1 Z_{pk} + \sum_{r=1}^{s} u_r Y_{rk}}{\sum_{i=1}^{m} v_i X_{ik} + \sum_{p=1}^{q} w_p^2 Z_{pk} + \sum_{h=1}^{g} f_h H_{hk}}$$
$$s.t. \begin{cases} \dfrac{\sum_{a=1}^{b} \eta_a T_{aj} + \sum_{p=1}^{q} w_p^1 Z_{pj} + \sum_{r=1}^{s} u_r Y_{rj}}{\sum_{i=1}^{m} v_i X_{ij} + \sum_{p=1}^{q} w_p^2 Z_{pj} + \sum_{h=1}^{g} f_h H_{hj}} \leq 1 \\ \dfrac{\sum_{a=1}^{b} \eta_a T_{aj} + \sum_{p=1}^{q} w_p^1 Z_{pj}}{\sum_{i=1}^{m} v_i X_{ij}} \leq 1 \\ \dfrac{\sum_{r=1}^{s} u_r Y_{rj}}{\sum_{p=1}^{q} w_p^2 Z_{pj} + \sum_{h=1}^{g} f_h H_{hj}} \leq 1 \\ v_i, \eta_a, w_p^1, w_p^2, f_h, u_r \geq 0, j = 1, 2, \ldots, n \end{cases} \tag{10}$$

where E_k is the overall efficiency (OE) of UCLU. For DMU_j $(j = 1, 2, \cdots, n)$, in the urban construction stage, X_{ij} $(i = 1, 2, \cdots, m)$ is the input; T_{aj} $(a = 1, 2, \cdots, b)$ is the final output without participating in the activities of the urban production stage; Z_{pj} $(a = 1, 2, \cdots, q)$ is the intermediate output of the urban construction stage and the intermediate input of the urban production stage. In addition, in the urban production stage, H_{ij} $(i = 1, 2, \cdots, g)$ is the re-input, and Y_{rj} $(r = 1, 2, \cdots, s)$ is the final output. v_i and η_a are the input weight and final output weight of the urban construction stage, respectively. w_p^1 and w_p^2 are the intermediate output weight in the urban construction stage and the intermediate input weight in the urban production stage. f_h is the weight of re-input and u_r is the weight of final output in the urban production stage, respectively. Overall efficiency (OE) denoted as E_k, efficiency of the urban construction stage is represented by E_k^1, and efficiency of the urban production stage is represented by E_k^2. Therefore, E_k, E_k^1, and E_k^2 are as follows [48]:

$$E_k^1 = \frac{\sum_{a=1}^{b} \eta_a T_{aj} + \sum_{p=1}^{q} w_p^1 Z_{pj}}{\sum_{i=1}^{m} v_i X_{ij}} \tag{11}$$

$$E_k^2 = \frac{\sum_{r=1}^{s} u_r Y_{rj}}{\sum_{p=1}^{q} w_p^2 Z_{pj} + \sum_{h=1}^{g} f_h H_{hj}} \tag{12}$$

$$E_k = \frac{\sum_{a=1}^{b} \eta_a T_{aj} + \sum_{p=1}^{q} w_p^1 Z_{pj} + \sum_{r=1}^{s} u_r Y_{rj}}{\sum_{i=1}^{m} v_i X_{ij} + \sum_{p=1}^{q} w_p^2 Z_{pj} + \sum_{h=1}^{g} f_h H_{hj}} \tag{13}$$

According to Equations (1) to (4), we can obtain the E_k, E_k^1, E_k^2, OIO, IO, and RI. Here, the mismatch (MIM) and mismatch ratio (MI) are defined as follows:

$$MIM = IO + RI \tag{14}$$

$$MI = 1 - \frac{(Z_{pj} - RI)}{(Z_{pj} + IO)} \tag{15}$$

3.2. Empirical Model

Initially, we use linear models to explore the double-faced effect of seeking development through land use that allows for both the positive and negative effects on economic development as in Hypothesis 1, which is captured by the quadratic term of the strategy's proxy (MI) of seeking development through land use. We estimated all the models with time and provincial regional fixed effects, further lagging the key independent variable (MI), to explore the delayed effects on economic indicators (GDP per capita, $PGDP$) to reduce simultaneity bias.

Regional-level time-varying controls include regional size (i.e., total number of employees, $Toem$), innovation ability (i.e., ratio of patent authorization to patent application, $Patq$), industrial structure (i.e., the ratio of consumer industries to productive industries, $Indus$), and total factor productivity (Tfp). The impact of regional size ($Toem$) influences performance and other regional-level characteristics significantly [49]. Controlling for regional size is essential to estimate our models at the regional level, and larger regions (i.e., more number of employees) are more capable of undertaking the extra expenditure associated with offering more products and forming larger consumer markets [50–52]. Innovation ability ($Patq$) controls knowledge intensity and contrasts the overall differences associated with industrial quality to industrial quantity at the regional level, reflecting the high-end and high-value industrial scale associated with the increase in firm size and scope and capital skill and intensity [53]. Wages usually capture the impact of human capital [54,55], years of schooling [56–58], and educational level [59–61], and depending on the quality of the labor force, they are frequently studied together as they affect local economic performance [62–64].

The inclusion of total factor productivity (Tfp) as a control is significant as it has a determining influence on the local firm's performance in production efficiency, as confirmed by previous studies from both a theoretical and empirical perspective [65–67]. Regions that are more productive usually perform better than other regions in economic output and obtain more revenue at a lower cost, even after controlling regional size [68]. Moreover, due to certain unavoidable reasons, potential related factors cannot be introduced in our models, and we find a strong and valid instrument for MI that allows us to fully control the endogeneity in our models, thus Tfp provides an effective control variable as the proxy of other potentially omitted variables that cannot be included in our control set. The estimation model takes the following form:

$$\begin{aligned} \log(PGDP_{it}) = \beta_0 + \beta_1 MI_{it} + \beta_2 \log {MI_{it}}^2 + \sum_{j=1}^{k} \lambda_j MI_{it-j} \\ + \sum_{m=3}^{6} \beta_m X_{it} + \alpha_i + \nu_t + \mu_{it} \end{aligned} \tag{16}$$

where β_0 is the constant; β_1 and β_2 are the coefficients to be estimated of MI_{it} and ${MI_{it}}^2$, respectively; β_m $(m = 3, 4, 5, 6)$ are the coefficients of the control variables (X_{it}); λ_j is the coefficient of lagging MI_{it}. α_i and ν_t are the region- and time-specific fixed effects, respectively. μ_{it} is the error term.

As shown above, MI may exert both positive and negative effects on economic indicators. To capture the turning points of MI, we adopt the threshold regression model proposed by Hansen [69] to reexamine the potential double effect. The thresholds obtained from data that do not depend on specific hypotheses and function forms is the advantage over other nonlinear models. We explored the nonlinear casual effect initially using a single threshold model:

$$\log(PGDP_{it}) = \alpha_0 + \alpha_1 MI_{it} \cdot I(MI_{it} \leq \eta) + \alpha_2 MI_{it} \cdot I(MI_{it} \geq \eta) + \sum_{j=1}^{k} \lambda_j MI_{it-j} + \sum_{m=3}^{6} \alpha_m X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (17)$$

where α_0 is the constant; α_1 and α_2 are the coefficients of the $\log(PGDP_{it})$ in low and high regimes, defined according to the cutoff (η) of MI_{it}; $I(\cdot)$ is the indicator function, which equals 1 when the parenthetical condition is satisfied and equals 0 when it is not. α_m $(m = 3, 4, 5, 6)$ are the coefficients of the control variables (X_{it}); λ_j is the coefficient of lagging MI_{it}. γ_i and δ_t are the region- and time-specific fixed effects, respectively.

Finally, we observed that industrial structure ($Indus$) is significant as a control because its direct effect on the economic indicator and indirect effect depend on the presence of complementarities of MI as proposed in Hypothesis 2. The immediate strategy of seeking development through land use motivates local governments to take measures to strengthen the impact of policymaking that facilitates defining the path dependence of medium- and low-end industries. Instead, a different industrial structure would significantly affect the performance of the strategy that seeks development through land use. To capture the presence of complementarities between MI and $Indus$, we estimate the results using the following form:

$$\log(PGDP_{it}) = \beta_0 + \beta_1 \log MI_{it} + \beta_2{}' \log MI_{it} * Indus + \sum_{j=1}^{k} \lambda_j \log MI_{it-j} + \sum_{m=3}^{6} \beta_m X_{it} + \alpha_i + \nu_t + \mu_{it} \quad (18)$$

where $\beta_2{}'$ is the coefficient of the interaction of $\log MI_{it}$ and $Indus$; μ_{it} is the error term.

3.3. Robustness Test

Although several control variables have been introduced into our Equations (7)–(9), we must further address the potential endogeneity caused by some unavoidable reasons such as omitted variables, and simultaneity bias, among others. To handle the endogeneity problem, we adopt an instrumental variable strategy based on Equation (8). Here, land transfer income ($Ltri$) reflects the local government's preference to adopt the strategy of seeking development through land use, and is not considered in the GDP [70]. Moreover, it is not strongly correlated with other controls in our models. Therefore, we explore $Ltri$ as the instrumental variable of $\log MI_{it}$ in Equation (8). Below [71,72], we consider the two-step estimation method to conduct the instrumental variable strategy using the panel threshold regression model.

$$\hat{MI}_{it} = \lambda_0 + \lambda_1 Ltri + \sum_{m=2}^{k} \lambda_m X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (19)$$

$$\log(PGDP_{it}) = \alpha_0 + \alpha_1 \hat{MI}_{it} \cdot I(\hat{MI}_{it} \leq \eta) + \alpha_2 \hat{MI}_{it} \cdot I(\hat{MI}_{it} \geq \eta) + \sum_{j=1}^{k} \lambda_j \hat{MI}_{it-j} + \sum_{m=3}^{6} \alpha_m X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (20)$$

We know that climate characteristics such as weather, temperature, and humidity are widely used as effective instrumental variables [73]. Therefore, exogenous variables such as the Heating Degree Day (HDD) and Conditioning Degree Day (CDD) are introduced as the instrumental variables of MI to further enhance the robustness of the results. Both HDD and CDD are used to support building heating or cooling to fully utilize and adapt to China's different climatic characteristics. The duration of high and low temperatures has a significant impact on construction activities. Therefore, it is reasonable to assume that HDD and CDD strongly correlate with UCLU but are not related to GDP. In addition, HDD and CDD are exogenous to other control variables. Hence, we take HDD and CDD as the instrumental variables to investigate the effect of MI on GDP.

$$\hat{MI}_{it} = \lambda_0 + \lambda_1 HDD_i + \lambda_2 CDD_i + \sum_{m=3}^{k} \lambda_m X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (21)$$

$$\log(PGDP_{it}) = \alpha_0 + \alpha_1 \hat{MI}_{it} + \sum_{m=2}^{5} \alpha_m X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (22)$$

3.4. Data Sources

Restricted by data availability, panel data from 30 provincial regions (Tibet, Hongkong, Macau, and Taiwan are excluded due to missing data) in China from 2004 to 2019 are used for the purpose of our analysis. Data related to GDP per capita are from China National Statistical Yearbooks. Data about employees have been sourced from the China National Statistical Yearbooks and the China Human Resources and Social Security Yearbooks. The ratio of patent authorization to patent application is from the China Science and Technology Statistical Yearbooks. Raw data required for calculating the total factor productivity and the mismatch of UCLU across 30 provincial regions are obtained from the China National Statistical Yearbooks and the Provincial Statistical Yearbooks. Table 1 reports the descriptions of the statistical summaries for all the variables.

Table 1. Description of statistical summaries.

Variable	Obs	Mean	Std. Dev.	Min	Max
Mi	480	0.499	0.247	0	0.9
GDP	480	0.449	0.03	0.363	0.522
Cdd	480	0.167	0.09	0	0.353
Mmk	480	0.234	0.177	0.001	1.471
Mml	480	0.431	0.44	0.001	3.424
Indus	480	1.164	0.637	0.527	5.234
Patq	480	0.606	1.407	0.082	31.215
Tfp	480	1.592	0.748	0.07	2.98
Toem	480	0.295	0.037	0.197	0.385
Hdd	480	0.325	0.037	0.169	0.374

4. Results and Discussion

4.1. Mismatch of UCLU

The mismatch of UCLU across 30 provincial regions was measured from Equations (1) to (6). Figure 2 shows the results and changing trends of the mismatch ratio. Heterogeneity exists in the changing trends of the mismatch ratio across different regions. There are about nine types of provincial regions according to the changing trends by K-means clustering. However, based on the analysis, we can classify them into the following five categories.

Figure 2a shows the changing trend of MI in Beijing and the watershed in 2013. Before 2013, the mismatch ratio was above 0.4 and decreasing at a low speed. However, after 2013, the mismatch ratio decreased to 0 and remained in optimal status thereafter, which reflects that the strategy of seeking development through land use was adjusted after 2013 and achieved a favorable effect. Similarly, the changing trends of MI in Chongqing, Shannxi, and Qinghai were reduced during the study period and finally remain around 0.3 after 2016, as shown in Figure 2c. In addition, the MI of Fujian, Hainan, and Ningxia (Figure 2h) declined with drastic fluctuations. Although MIs in the above regions declined to a different extent and fluctuated due to various changes, it is reasonable to classify them into the first category as land mismatch was alleviated during the period.

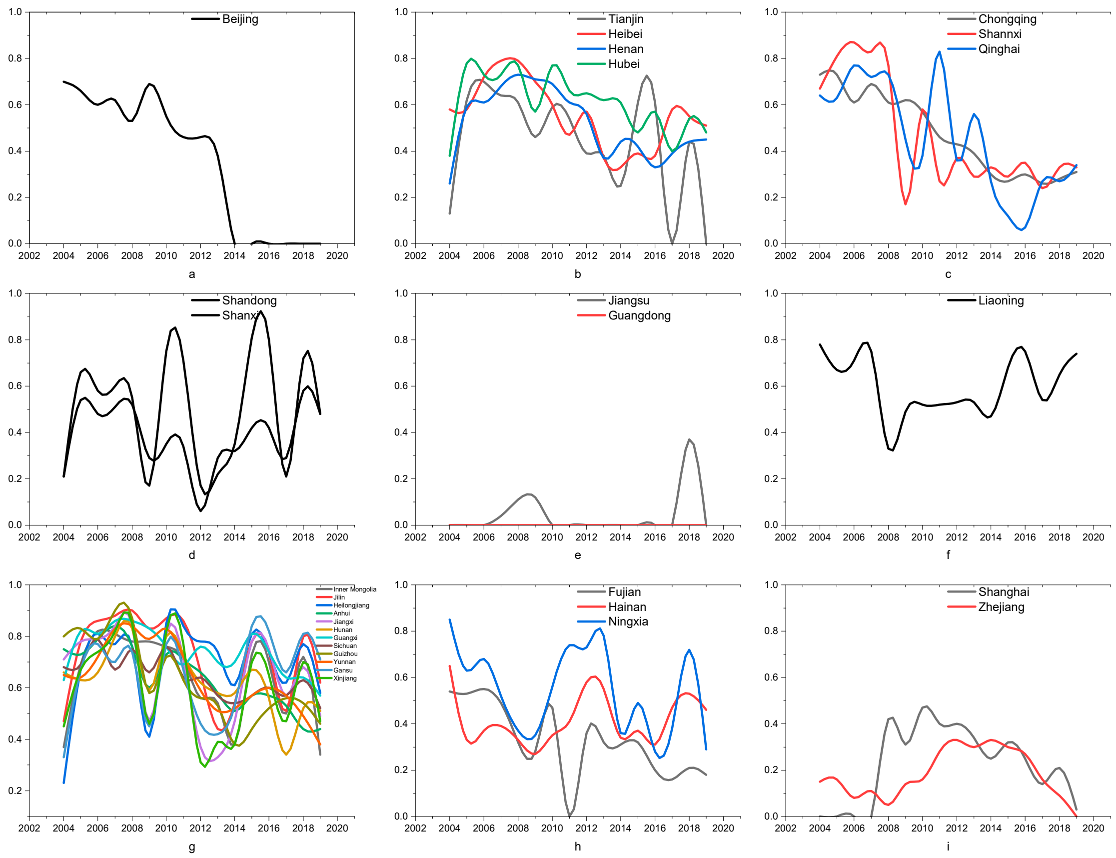

Figure 2. Mismatch ratio (Mi) of 30 provincial regions. (**a**) is the Mi of Beijing. (**b**) is the Mi of Tianjin, Hebei, Henan and Hubei. (**c**) is the Mi of Chongqing, Shaanxi, Qinghai. (**d**) is the Mi of Shandong and Shanxi. (**e**) is the Mi of Jiangsu and Guangdong. (**f**) is the Mi of Liaoning. (**g**) is the Mi of Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Hunan, Guangxi, Sichuan, Guizhou, Yunnan, Gansu, Xinjiang. (**h**) is the Mi of Fujian, Hainan, Ningxia. (**i**) is the Mi of Shanghai and Zhejiang.

From Figure 2b,i, the inverted-U shape category can be obtained according to the changing trend of the MI. Tianjin, Hebei, Henan, and Hubei showed an upward trend before 2006, a downward trend after 2013, and remained volatile between 2007 and 2012, which can be called the inverted-U shape changing trend. The maximum MI in these regions was 0.8 and occurred around 2006, and the minimum occurred after 2014. Although land mismatch has declined, it is necessary to take effective measures to improve it further. Approximately, Figure 2i showed a clear inverted-U shaped trend change in the MI in Shanghai and Zhejiang. However, most MIs were below 0.5 and close to 0 in 2019, far less than that shown in Figure 2b. Shanghai and Zhejiang have an extensive manufacturing industry base that has been upgraded continuously, far ahead of other regions, and this facilitates UCLU efficiency during the production stage. Although we classify the regions in Figure 2b,i into the inverted-U shape category, it is essential to adopt different strategies to mitigate land mismatch. Instead, the MI in Liaoning presents a U-shaped changing trend that first decreases and later increases, with a minimum value above 0.4 in 2008. Although heavy industries have been developed, with the rise of high-tech industries represented by electronic information, Liaoning is facing an adverse situation of industrial recession and population outflow. Seeking development through land use can alleviate the financial pressure within a short time, but deepening the reform strategy is an immediate concern for achieving sustainable, high-quality development.

Compared to Shanghai and Zhejiang, Jiangsu and Guangdong have the same type of developed industries and flexible management. However, MI in Jiangsu and Guangdong was less than 0.4 during the study period, which is much lower compared to other regions in China, including Shanghai and Zhejiang. In 2008 and 2018, the MI in Jiangsu appeared only as brief spikes. Therefore, we classify them into a robust category that shows an optimal UCLU status. In contrast, the MI in Shandong and Shannxi changed from 0.1 to 0.9 and fluctuated drastically during the study period. It is, therefore, reasonable to conduct a sequence of planned development between construction and production. In this study, we classify them into a volatile category.

Finally, the last category includes Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Hunan, Guangxi, Sichuan, Guizhou, Yunnan, Gansu, and Xinjiang, with irregular and volatile MI and without clear changing trends. However, only the MI in Inner Mongolia and Yunnan tend to show a downward trend and is less than 0.4 after 2014. Inner Mongolia is a vast territory, accounting for 12.3% of China's total area, but the population is only about 20 million and flows out constantly with a growth rate of −0.27% [74–76]. Yunnan is a famous tourist destination with abundant natural resources and a predominant deep cultural heritage protected by the government. The economic output of the two regions is dominated by primary and secondary industries, which may be the reason for the low land mismatch ratio. Other provincial regions, including Jilin, Heilongjiang, Anhui, Jiangxi, Hunan, Guangxi, Sichuan, Guizhou, Gansu, and Xinjiang, have an adverse situation, characterized by highly volatile and irregular land mismatch. It is indispensable, therefore, to formulate clear future development plans and industrial strategies for high-quality, sustainable development.

4.2. Double-Faced Effect and Robustness

Before conducting a threshold regression model, the number of thresholds must be tested through the F statistic. Table 1 shows the test results of the model specifications. In Table 2, model (1) depicts the test results of Equation (8), and model (2) depicts that of Equation (10). As observed, when setting a single threshold, the F-statistic estimators of model (1) and model (2) are 18.03 and 42.97, respectively, significant at the 5% level. While setting double thresholds, the F-statistic estimators of model (1) and model (2) are not significant. Therefore, the hypothesis of a single threshold cannot be rejected and that of double thresholds is not applicable for model (1) and model (2) at the 5% confidence level. Hence, we adopt the single threshold regression model to explore the nonlinear relationship between $\log MI_{it}$ and $\log(PGDP_{it})$. Table 3 shows the regression results.

Table 2. Threshold model specification test results.

	Threshold Type	Model (1)	Model (2)
Estimator of threshold (η)	Single threshold	0.6200	0.5539
	Double threshold	0.2600	0.5260
F test of threshold	Single threshold	18.03 *	42.97 **
	Double threshold	10.70	12.45

* $p < 0.1$, ** $p < 0.05$.

In Table 3, column (1) shows the results from a linear model without a quadratic term and thresholds for comparison. Column (2) depicts the result of the linear model with the quadratic term of the strategy's proxy (MI), and column (3) depicts the results for the threshold cases of Equation (8). The results in column (2) show that the coefficients of MI and its quadratic term (Mi2) are 0.0337 and −0.0488, all significant at the 5% confidence level, which confirms the inverted-U shape relationship between MI and GDP. Moreover, the results in column (3) from the threshold regression model prove the statistically significant positive effect before the threshold and negative effect after the threshold of MI on GDP, further strengthening the evidence of double-faced effects proposed in Section 2.2. We notice that in column (1), the effect of MI on GDP is significantly negative at the 1% confidence level, reflecting that the progress of seeking development by land has pushed the MI beyond the turning point in Equation (7) and the threshold value in Equation (8) in most regions. Therefore, the strategy of seeking development through land use is no longer a suitable option for local economic development, and continuing to implement the strategy would undermine sustainable development in the future.

Table 3. Double-faced effect results.

	(1)	(2)	(3)
MI	−0.0407 *** (−5.01)	0.0337 *** (2.89)	
Mi2		−0.0488 *** (−4.03)	
$Mi \leq \eta$			0.00258 * (1.89)
$Mi > \eta$			−0.00714 ** (−2.05)
Patq	0.000118 (0.93)	0.0000450 (0.39)	0.000306 (0.91)
Indus	−0.0383 (−1.26)	−0.00664 * (−1.68)	−0.00263 * (−1.82)
Tfp	0.00127 * (1.89)	0.00169 *** (4.46)	0.00159 ** (2.55)
Toem	1.588 *** (3.52)	1.171 *** (2.76)	1.546 *** (2.81)
L.Mi	−0.0156 * (−1.86)	−0.00747 ** (−2.29)	
_cons	0.438 *** (47.00)	0.104 *** (4.82)	0.0781 *** (5.06)
N R^2	450 0.470	420 0.856	480 0.831

t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

From the estimated results of other controls in Table 3, there is no significant difference between the four panel models, indicating the robustness of the study results. The coefficients of innovation ability (*Patq*) are positive in the four panel models, but they are not statistically significant. This indicates that it is difficult to confirm that high-tech industries have played a major role in economic development. The coefficients of industrial structure (i.e., the ratio of consumer industries to productive industries, *Indus*) are significantly negative in panel models (2), (3), and (4), which is consistent with our hypothesis proposed in Section 2.2. Combining the coefficients of industrial structure with that of MI, we have a strong reason to state that the strategy has failed to improve economic growth as earlier. In addition, the coefficients of *Toem* and Tfp are significantly positive in all the four panel models, indicating that the input of labor and productivity have a positive impact on economic development. Significantly, the coefficients of the one-period lagging term of MI in models (1) and (2) are significantly negative while the coefficients of the two-period lagging term are no longer significant, implying a lag effect of MI on GDP, but no cumulative effects of multiperiod lag terms.

To enhance the robustness of our results, we further conduct the estimations based on Equations (11) and (13), applying the two-stage least squares (2SLS) method. The estimator of the under-identification test, Anderson canon. corr. LM statistic, is 10.496 and the P value is 0.0053, indicating that the excluded instruments are relevant to MI. Further, the Cragg –Donald Wald F statistic is 8.75, which is above the 25% maximal IV size. Table 4 shows the results. Column (1) shows that MI has a significant influence on GDP, while column (2) proves the inverted-U shape relationship between MI and GDP. The results confirm the robustness of our findings.

Table 4. Results of robustness test.

	(1)	(2)
MI	−0.0328 * (−1.73)	
$\hat{M}i \leq \eta$		0.278 *** (2.90)
$\hat{M}i > \eta$		−0.288 *** (−3.71)
Patq	0.000525 (0.04)	0.00143 (0.02)
Indus	−0.00448 * (−1.89)	−0.00950 *** (−4.65)
Tfp	0.00135 * (1.93)	0.00134 *** (3.60)
Toem	1.498 *** (3.15)	0.390 *** (3.85)
_cons		0.482 *** (33.81)
N	480	480
R^2	0.804	0.965

t statistics in parentheses. * $p < 0.1$, *** $p < 0.01$.

4.3. Path-Dependent Reinforcement Loop

To further investigate the reinforcement loop effects of MI and industries, we estimate the results based on Equation (7), as shown in Table 5. From column (1), the coefficients of MI, $Indus$, and their interaction term ($MiIndu$) are −0.0753, 0.0357, and 0.0291, respectively, significant at the 1% confidence level. The results further strengthen the conclusion that the pursuit of development through land use has pushed MI beyond the threshold value in most regions. Nevertheless, we find that $Indus$ could moderate the negative effect of MI on economic development because of the positive coefficient of $MiIndu$. Meanwhile, MI could enhance the impact of $Indus$ on GDP. The above results confirm that although MI passed the threshold value and failed to stimulate economic development, it can heighten GDP by reinforcing the positive effect of $Indus$. In addition, $Indus$ mitigates the negative effect of MI on GDP. Therefore, the reinforcement loop of UCLU mismatch and consumer industries is generated and continuously strengthened.

As can be observed, an inverted-U relationship is obtained between MI and GDP in Section 4.2. Although the path-dependent reinforcement loop (PDRL) is confirmed, it is unclear how $Indus$ affects the nonlinear relationship between MI and GDP. Therefore, we further examine the outcome of the inverted-U relationship between MI and GDP when PDRL works. Table 5 shows the results in columns (2), (3), and (4).

In column (2), we introduce the quadratic term (Mi2) into Equation (9) and find that although the interaction term $MiIndu$ has a significant effect on GDP, the impact of MI on GDP is insignificant. We do not have sufficient evidence to prove the interaction effect between MI and $Indus$ after introducing the quadratic term. Subsequently, we replace $MiIndu$ by $MiIndu2$, which is the interaction term of the quadratic term (Mi2) and $Indus$. However, the effect of $MiIndu2$ has not passed the significance test, as shown in column (3). Finally, given the results in column (2) and column (3), we delete MI and keep MI and $MiIndu2$. As shown in column (4), the coefficient of Mi2 is −0.0812 and significant at 1% confidence level, reflecting that the relationship between MI and GDP is a parabola that opens downward. The coefficient of $MiIndu2$ is 0.0325, significant at the 5% confidence level, but is contrary to the coefficient of Mi2. The result shows that an increase in the coefficient of $Indus$ could decrease the absolute value of the coefficient of Mi2. Furthermore, any decrease in the absolute value of the negative coefficient of Mi2 will widen the parabola opening further, as shown in Figure 3.

Table 5. Path-dependent reinforcement effect results.

	(1)	(2)	(3)	(4)
Mi	−0.0753 *** (−3.78)	0.0197 (0.60)	0.0462 * (1.82)	
Mi2		−0.0836 *** (−4.32)	−0.115 *** (−3.95)	−0.0812 *** (−4.20)
Indus	0.0357 *** (3.48)	0.0389 *** (2.70)	0.0399 *** (3.49)	0.0380 *** (3.20)
MiIndu	0.0291 *** (3.08)	0.0182 ** (2.36)		
MiIndus2			0.0244 (0.08)	0.0325 ** (2.05)
Patq	0.000308 *** (3.28)	0.000134 (0.01)	0.000113 (0.04)	0.000215 ** (2.08)
Tfp	0.00137 ** (2.45)	0.00104 * (1.79)	0.00107 * (1.72)	0.00127 ** (2.33)
Toem	1.554 *** (3.43)	1.539 *** (4.21)	1.542 *** (5.45)	1.545 *** (4.67)
_cons	0.427 *** (8.11)	0.408 *** (6.94)	0.406 *** (3.70)	0.417 *** (5.88)
N	480	480	480	480
R^2	0.411	0.435	0.433	0.425

t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

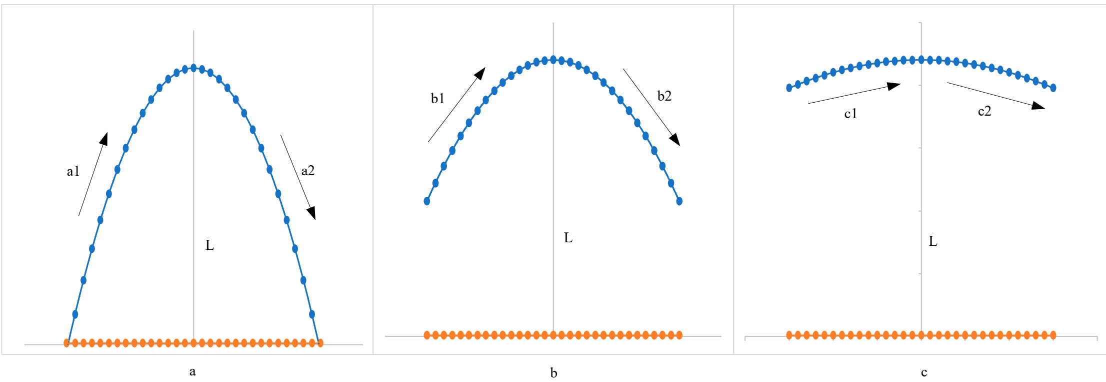

Figure 3. Increase in the coefficient of *Indus* could open the parabola wider. Figure 3, a1, b1, and c1 indicate the direction vector of the positive effect of Mi2 on GDP before the axis of symmetry (L). Figures a2, b2, and c2 are the direction vector of Mi2 on GDP after L.

From Figure 3a,b and finally to Figure 3c, the increase in *Indus* decreases the effect of Mi2 on GDP continuously; consequently, the opening of the parabola becomes bigger and wider. In other words, the angle between the direction vector and the horizontal axis become narrow, indicating continuous weakening of both the positive and negative effects of *MI* on GDP. Importantly, a higher proportion of consumer industries could dilute the impact of the strategy of seeking development through land use.

5. Mechanism Analysis

5.1. Mismatch and Misallocation

It is common knowledge that land, labor, and capital are the fundamental resources of an economic system. As described in Hypothesis 1, the mismatch of UCLU could stimulate economic development through large-scale construction activities, which can attract temporary labor and capital resources. Moreover, consumer industries complementing the mismatch of UCLU further strengthen the PDRL. Notwithstanding these achievements, the critical fact that marketization of the local production factor market is severely insufficient [77] cannot be overlooked. Therefore, we have good reasons to assume that the mismatch of UCLU facilitates the misallocation of labor and capital. Indeed, this mismatch of UCLU and misallocation of resources could improve GDP growth briefly, but it could also undermine the economic system chronically. To further explore if the possible channels of mismatch of UCLU and misallocation of labor and capital affect economic indicators, we first introduce the misallocation of both labor (*Mml*) and capital (*Mmk*) in Equation (14).

$$\log(PGDP_{it}) = \alpha_0 + \alpha_1 MI_{it} + \alpha_2 Mml_{it} + \alpha_3 Mmk_{it} + \sum_{m=4}^{6} \alpha_m X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (23)$$

Subsequently, the interaction terms of *MI* and *Mmk* (*MiMk*) and the interaction terms of *MI* and *Mml* (*MiMl*) are introduced into Equation (14). Finally, *MiMk* and *MiMl* are introduced into Equation (14), and Table 6 shows the results.

Table 6. Mismatch of UCLU and misallocation of labor and capital.

	(1)	(2)	(3)	(4)
Mi	−0.0522 *** (−3.63)	−0.0824 *** (−4.97)	−0.0466 *** (−5.31)	−0.0775 *** (−3.44)
Mmk	0.0406 *** (4.67)	−0.00426 (−0.05)	0.0416 *** (4.74)	−0.00322 (−0.06)
Mml	−0.0298 *** (−4.16)	−0.0416 *** (−4.68)	−0.0281 *** (−3.79)	−0.0401 *** (−3.29)
MiMk		0.142 *** (4.19)		0.141 *** (3.17)
MiMl			−0.00974 * (−1.87)	−0.00835 * (−1.77)
Patq	0.000297 (0.04)	0.000293 (0.03)	0.000288 (0.01)	0.000285 (0.02)
Tfp	0.00178 (0.09)	0.00194 (0.05)	0.00173 (0.03)	0.00189 (0.01)
_cons	0.476 *** (3.31)	0.490 *** (2.85)	0.474 *** (4.18)	0.489 *** (3.06)
N	480	480	480	480
R^2	0.271	0.312	0.272	0.313

t statistics in parentheses. * $p < 0.1$, *** $p < 0.01$.

In Table 6, column (1) shows the coefficients of *Mmk* and *Mml* as 0.0406 and −0.0298 at a 1% confidence level. Notably, misallocation of capital has a positive effect on GDP, while misallocation of labor has a negative effect. Although an accordant theory that influences misallocation of resources on economic development has not been founded [78,79], effective resource allocation is reasonable for economic development [80]. Capital allocation has obvious exogenous characteristics in China and acts as a visible hand that regulates the economy. It is determined by policy decision-making and strategic planning at the national level, which could quickly form production capacity and implement economic production in the country's developing regions. However, allocation of labor resources has endogenous characteristics that are directly affected by capital and land allocation. Misallocation of labor presents an ineffective configuration of labor resources. Therefore, we believe that the above may be a possible rational reason for the positive effect of *Mmk* and negative effect of *Mml*.

In addition, the results in column (2) and column (4) show that the coefficient of *MiMk* is 0.14, significant at the 1% confidence level, while the longer effect of *Mmk* on GDP is significant. Thus, it is not possible to conclude the interactive effects of *MI* and *Mmk*. Column (3) and column (4) depict the results of the interactive effect of *MI* and *Mml*. The coefficients of *MI*, *Mml*, and *MiMl* are all significantly negative, which shows that the mismatch of UCLU could worse the adverse effects of misallocation of labor on economic development. Conversely, labor misallocation strengthens the negative effect of the mismatch of UCLU on GDP. These results confirm our assumption for explaining the possible rational reason for the positive effect of *Mmk* and the negative effect of *Mml* to a certain extent.

5.2. Land and Capital: Heterogeneity Effect

From the results in Table 6, we find that both land and capital have attributes of exogeneous policy tools, which can be used to plan economic development at China's national and regional levels. Here, we further explore the heterogeneity effects of *MI*, *Mmk*, and *MiMk* on economic indicators in different groups, as sorted by GDP per capita. Table 7 shows the results.

Table 7. Heterogeneity effects.

	(1)	(2)	(3)	(4)
Mi	0.0289 (0.04)	0.0309 (0.07)	−0.0913 ** (−1.97)	−0.0184 * (−1.80)
Mmk	0.199 * (1.85)	0.217 ** (2.39)	−0.0289 * (−1.69)	−0.0458 * (−1.73)
MiMk	−0.0658 (−0.01)	−0.0000614 (−0.03)	−0.0778 * (−1.72)	−0.0872 * (−1.74)
Patq	−0.0139 * (−1.84)	0.00147 (0.02)	0.000282 *** (3.65)	0.0357 * (1.67)
Tfp	−0.000687 (−0.05)	0.00331 * (1.87)	0.00298 ** (2.36)	−0.000186 (−0.03)
_cons	0.422 *** (4.15)	0.394 *** (5.62)	0.491 *** (3.38)	0.455 *** (4.53)
N	112	112	144	112
R^2	0.394	0.479	0.268	0.261

t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7 shows that the coefficients of *MI* are positive in columns (1) and (2), while negative in columns (3) and (4), which supports the conclusion of inverted-U shape relations. However, we noticed that the effect of *MI* on GDP is not significant in groups with low GDP per capita, as shown in columns (1) and (2). In regions with low GDP per capita, the strategy of seeking development through land use failed to stimulate GDP growth in China, which may then be used to explain the results. Similarly, the effect of *Mmk* on GDP is positive in groups (1) and (2) and negative in groups (3) and (4). It shows that in regions with low GDP per capita, misallocation of capital could promote GDP growth and the opposite in regions with high GDP per capita. As the theory of allocative efficiency of resources shows, it is accepted that in a perfectly competitive market environment, production resources could flow to more efficient regions or enterprises [81]. However, there are other important factors affecting resource allocation in an incomplete market environment that hinders the free flow of resources. Therefore, the possible reason may be that misallocation of capital facilitates capital inflows to developing regions or enterprises and outflow from developed regions or enterprises by planning and regulation at the national or regional level, which confirms the attributes of exogeneous policy tools.

5.3. Land and Capital: Strengthen or Weaken Each Other

Table 7 shows that the coefficients of $MiMk$ on GDP in columns (1) to (4) are all negative but the coefficients in columns (1) and (2) are insignificant. Therefore, the hypothesis that there is no interactive effect of MI and Mmk cannot be rejected. In columns (3) and (4), the coefficients of $MiMk$ are significantly negative, indicating the existence of an interactive effect between MI and Mmk. As the coefficients of MI and Mmk on GDP are negative, it can be concluded that MI could strengthen the negative effect of Mmk on GDP and vice versa in groups with high GDP per capita. The results show that the mismatch of UCLU and misallocation of capital in the developed regions will not only undermine economic development but also form an unhealthy loop strengthening the adverse effects of each other on regional economic development. Therefore, in developed regions, improved marketization in production resource markets is vital to achieving high-quality sustainable growth and development in the economic system.

6. Conclusions and Policy Implications

With panel data comprising 30 provincial regions in China, we measured the mismatch of urban construction land use (UCLU) and explored the relationship between UCLU and economic development. Both linear and nonlinear models were built to investigate the "double-faced effect" of UCLU (MI) on GDP by executing robustness checks on the findings. In Section 5 (Mechanism analysis), the channels of MI affecting economic development have been analyzed. The study conclusions are as follows:

(1) We find that the two-faced effect of MI on GDP is positive in developing regions and negative in developed regions, that is, the inverted-U shape relationship between MI and GDP. The results of threshold regression have a positive threshold for making progress in seeking development through land use, beyond which the impact of MI on GDP is negative, and below which the impact is positive.

(2) The present data show that MI passed the threshold value but failed to stimulate economic development; however, it can improve GDP by reinforcing the positive effect of industrial structure ($Indus$). In addition, $Indus$ could mitigate the negative effect of MI on GDP. Based on this, we propose the reinforcement loop of UCLU mismatch and consumer industries to explain the mechanism.

(3) In developing regions, the strategy of seeking development through land use usually fails to stimulate GDP growth. In developed regions, the mismatch of UCLU and misallocation of capital not only undermine economic development but also form an unhealthy loop strengthening the adverse effects of each other on regional economic development. Similarly, the mismatch of UCLU could worsen the adverse effects of labor misallocation on economic development. Conversely, labor misallocation strengthens the negative effect of the mismatch of UCLU on GDP growth. Therefore, improvement in the marketization of the production resources market is vital to achieving high-quality sustainable development in the economic system of developed regions in China.

Based on these, the following policy recommendations are suggested. First, as China's economy has shifted from high-speed growth to high-quality development, the strategy of seeking development must be implemented cautiously. The study findings confirm the inverted-U shape relationship between MI and GDP and the threshold value. This implies that in some developed regions, the strategy may have a negative impact on economic development. Even in developing regions where MI has not passed the threshold value, it is conducive to focus on the aftermath to avoid falling into the PDRL. Second, clear, long-term planning and rational policies supporting industrial development must be strengthened to avoid industrial virtualization. The study results show that the negative effects of the strategy on economic development are largely due to the mismatch of UCLU, indicating excessive urban land expansion without timely and sufficient development of manufacturing industries. Third, land and capital can be used to stimulate economic development in developing regions. Our findings show that land and capital have more attributes of exogeneous policy tools in China, and they can accelerate the flow of production resources to support developing regions. However, the application of the strategy must vary by region. Meanwhile, development and technological industrial upgrading is indispensable to achieving sustainable development.

This study has attempted to examine the impact of the strategy seeking development through land use and provides supporting recommendations to achieve sustainable development. However, some aspects must be reconsidered in the future. The study's empirical analysis is based on provincial data. The estimates would be more precise if data could be obtained at the city or even individual level. In addition, with more data available, intermediary mechanisms can be tested in future works. However, it should be noted that all policy choices are shaped by values. Therefore, in addition to empirical evidence, personal and group interests will also influence policy choices. Therefore, the research results of this paper cannot completely determine which policies should be selected but should also consider the influence of values and interests in reality.

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