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Effects of Transfer of Land Development Rights on Urban–Rural Integration: Theoretical Framework and Evidence from Chongqing, China

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Abstract: The transfer of land development rights (TDR) is a significant policy tool for advancing urban–rural integration. This study establishes an analytical framework to examine the influence mechanism of TDR on urban–rural integration, considering the flow of land, capital, and population factors. Furthermore, an indicator system is developed to evaluate urban–rural integration across economic, social, and population dimensions. Using panel data from Chongqing, China (2013 to 2019), this article adopts the global principal component analysis (GPCA) method and time-varying difference-in-difference (TV-DID) model to analyze the effects of the land quota trading project, known as the '*Dipiao*' policy. The results show that TDR can effectively promote urban–rural integration, though with a four-year time lag. Heterogeneous effects of TDR on urban–rural integration are observed across different districts and counties, with the more pronounced promotion in areas characterized by low agricultural land value or high industrial land value. This study further analyzes the influence mechanism of TDR on urban–rural integration. It concludes with policy implications on improving TDR to promote urban–rural integration.

Keywords: transfer of land development rights; urban–rural integration; global principal component analysis; time-varying difference-in-difference; Chongqing

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1. Introduction

The escalating disparities between urban and rural areas have been witnessed worldwide, and the urban–rural divide has emerged as a preeminent concern in the contemporary context [1–3]. Whereas urban areas occupy a rapidly increasing share of land, rural areas tend to have fewer residents and lower GDP per capita compared to their urban counterparts [4,5]. Given that land constitutes the material foundation and spatial carrier for urban–rural development, the inequitable allocation of land resources between urban and rural areas has become a significant factor of imbalances in urban–rural development [6,7]. The unimpeded and unrestricted flow of land[1], capital, and other essential elements between urban and rural areas is of pivotal importance in facilitating the integration of urban and rural development [8–11]. The facilitation by removing barriers to the flow of land is considered a vital policy tool in advancing urban–rural integration within the context of contemporary urbanization in China [12], and the transfer of land development rights (TDR) has been implemented in pilot cities. Nevertheless, it remains to be examined whether the exploration of TDR genuinely contributes to urban–rural integration given the existing land institutions. Clarifying the mechanism and effect of TDR on urban–rural integration and leveraging the role of TDR in achieving integrated urban–rural development and rural revitalization have become critical scientific and social propositions and imperatives for China.

Article 10 of the Chinese Constitution states the distinction of land ownership between urban and rural land—state-owned land in urban areas and collective-owned land in rural areas. Rural–urban land conversion can be legally achieved only through a state requisition process, while the legal authorization for the private transfer of rural land-use rights for non-rural use has never been promulgated by the Chinese government [13]. Characterized by a strict boundary between urban and rural land, the current dual land management system in China inevitably leads to a considerable urban–rural divide in economic well-being and imposes significant constraints on rural land development rights [14–16][2]. With the rapid and massive urbanization in China, numerous farmers have migrated from rural areas, resulting in a considerable amount of vacant rural construction land and land resources. In an effort to address the issue of urban–rural land division and alleviate the contradiction in urban–rural land supply, the Chinese government has implemented the "Increase-decrease Linkage" policy (Zengjian Guagou). Since 2004, it has allowed local governments to convert certain amounts of agricultural land to urban construction land if they create an equal amount or more agricultural land from rural construction land. Building upon this policy, Chongqing has explored a market trading mechanism, namely, the *Dipiao* policy, to further facilitate the trading of urban and rural land development rights, which has become a prominent approach to promoting urban–rural integration [17].

In the realm of land policy-making, there has been extensive discussion in the existing literature regarding the effect of TDR on equitable development and social justice. Aiming to compensate landowners for losses caused by strictly regulated zoning procedures and other spatial planning regulations, TDR was introduced to counter the unequal allocation of initial development rights across diverse regions [18,19]. Proponents claim that TDR schemes were designed to fulfill the principle of social justice by correcting inequities [20,21]. An empirical evaluation of TDR programs in the United States demonstrated that TDR could be a viable supplementary policy for achieving a balance between growth and preservation [22]. In Turkey, the decent combination of market-led TDR and the command-control function of the traditional land-use plan helps to restore equity, balance, and fairness [23]. Drawing from the experiences in Hong Kong, TDR can be a potential tool to increase equity and mitigate the impact of rigid planning laws or actions on private property [24]. However, some scholars argue that a general application of TDR cannot guarantee the equity and fairness of the planning system. Italian urban planning techniques are evolving into a more open system characterized by the free movement and the marketability of land development rights. This allows certain parcels to be developed at higher densities compared to those in their vicinity, resulting in an unequal distribution and new forms of speculative activity [25].

In the context of the Chinese land system, diverse perspectives exist concerning the positive role of TDR on urban–rural integration. Proponents believe TDR is a potential tool to promote urban–rural integration. They examine how TDR optimizes the allocation of urban and rural land and supports rural revitalization by enabling the possibility of farmers to participate in the appreciation of urban land value [26–35]. Furthermore, urban–rural integration is undeniably a complex geographical process that requires a meticulous examination of potential unintended consequences. Critics argue that farmers are placed in a disadvantaged position in this process, experiencing dispossession and exploitation, which ultimately leads to ineffective protection of their rights and inadequate compensation [36–38]. Also, it is pointed out that the rent-seeking behavior and policy deficiencies resulted in failures to effectively promote coordinated urban–rural development and even exacerbated the urban–rural divide [39–42]. Thus, it is crucial to emphasize the significance of adopting a wise stance to gain a comprehensive understanding of the intricate nature of urban–rural integration [43]. This involves the establishment of collective wisdom through practices such as community building to empower individuals in mitigating adverse effects related to the transformation of urban–rural relationships [44,45]. Additionally, the dependent variables of primary interest in the relevant quantitative research encompass the urban–rural income gap [46,47], the growth of income among urban

and rural residents [48], and the urban–rural industrial structure [49]. Additionally, from the perspective of a spatial scale, existing studies predominantly focus on macro-level units such as provinces and cities as the primary units, while little research has been conducted on the district/county scale [50].

However, despite the wealth of literature on the effects of TDR that has provided useful insights, the effect mechanism of TDR on the flow and interaction of various factors in the process of urban–rural integration remains incomplete. The burgeoning quantitative research rests on a relatively simplistic image of urban–rural integration, mainly focusing on economic performance, which may miss many of its important dimensions. On the whole, further research is necessary to investigate the intricate mechanism underlying the effect of TDR on urban–rural integration, and it is essential to employ quantitative measurement to conduct a comprehensive evaluation of urban–rural integration encompassing diverse dimensions.

This article aims to examine the relationship between TDR and urban–rural development and explore the mechanisms through which TDR affects urban–rural integration to provide a comprehensive framework and a perspective of TDR for the optimal allocation of urban–rural land resources and advancement of urban–rural coordinated development. In the sections that follow, we develop an analytical framework that illustrates how TDR drives urban–rural integration and construct evaluation indicators for urban–rural integration based on three key dimensions. Empirically, we then quantitatively analyze the spatial patterns of urban–rural integration across 37 districts and counties in Chongqing using the global principal component analysis (GPCA) method. Furthermore, the relationship between TDR and urban–rural integration will be examined through the time-varying difference-in-difference (TV-DID) model based on Chongqing's panel data between 2013 and 2019.

2. TDR and Urban–Rural Integration: A Theoretical Framework

2.1. Connotations of TDR and Urban–Rural Integration

2.1.1. TDR and *Dipiao* Policy

TDR is the process of transferring the development rights from one parcel of land to another, which allows more development on the second parcel (land-receiving area), while the originating parcel (land-sending area) experiences a reduction or restriction in development opportunities [51]. This market-based mechanism plays a key role in offsetting the restrictions imposed on development rights caused by regulatory institutions such as land management systems [52,53].

This article explores the transfer of land development rights between urban and rural areas, where cities serve as the land-receiving areas, obtaining more construction land quotas, while rural areas are land-sending areas facing constraints on development [54]. According to the land administration system in China, it is notable that while the Linkage Policy was initiated by the central government, the local governments are the actual land suppliers for urban construction [55]. Consequently, diverse operational approaches have emerged across different regions, with the *Dipiao* policy proposed by the Chongqing government representing one of the most typical programs [56,57]. In 2009, the State Council approved the establishment of the Chongqing Rural Land Exchange (CRLE) to carry out experiments on land quota transactions within the whole city region of Chongqing [38]. The local government introduced a credit system known as *Dipiao*, which could be literally translated as *land ticket* or *land certificate*, enabling the securitization of land development rights [37].

The *Dipiao* policy has been adopted as a means of TDR within the context of the dual land property rights arrangements in China [58]. According to the *Dipiao* Transaction Rules of Chongqing Rural Land Exchange (Revised in 2019), *Dipiao* mainly involves rural homestead land and other rural collective construction lands [59]. Before the land quotas are securitized as *Dipiao*, the rural construction land should be reclaimed back to qualified agricultural land and undergo strict approval by the local bureau of land resources. Once

the high-quality reclaimed land is accepted, *Dipiao* is officially issued. Figure 1 illustrates the *Dipiao* transaction process. Firstly, the construction land quotas would be gathered in CRLE and be traded to developers through auction or tender. Secondly, CRLE will pay a substantial monetary reward as compensation for their land at the prevailing market price, which is much higher than the normal land compensatory fee [60]. A notable aspect is that 85% of the net revenue from the sale of the land quotas is allocated to rural villagers (the relocated peasants who previously lived on the land), with the remaining 15% going to the rural collective.

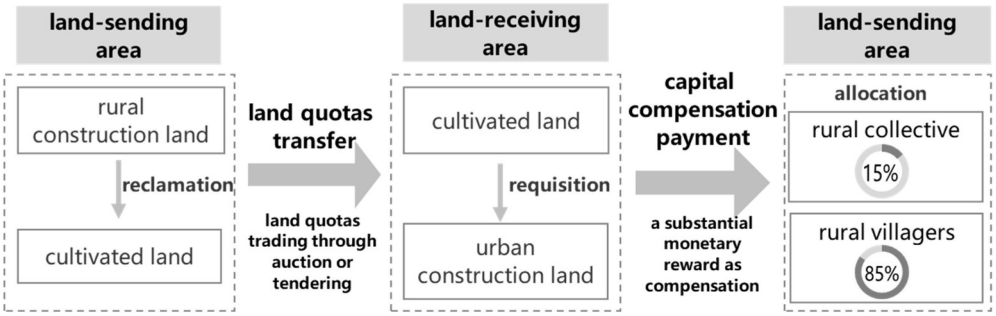

Figure 1. The *Dipiao* transaction process in Chongqing.

2.1.2. Urban–Rural Integration

Urban–rural integration is a comprehensive and multi-dimensional dynamic concept, which entails the establishment of effective links between urban and rural populations, land, and industries through the two-way free flow and equal exchange of resources and factors [61,62]. This concept perceives cities and villages as an organic whole, emphasizing the process of promoting the mobility of production factors and balancing the allocation of public resources. Urban–rural linkages can be promoted through the circulation of commodities, population mobility, infrastructure connectivity, provision of public services, and cooperation in environmental governance. These efforts facilitate economic, social, ecological, and other forms of collaboration between urban and rural areas [63].

The urban–rural integration analyzed in this article primarily focuses on economic integration, social integration, and population integration. In the economic dimension, urban–rural integration is manifested by the gradual narrowing of the urban–rural income and productivity gaps, the transformation of the rural economy toward non-agricultural sectors, and the convergence of urban–rural industrial structure [64]. In terms of population, urban–rural integration is characterized by a high urbanization rate, with the majority of the population concentrated in urban areas [65]. In the social dimension, urban–rural integration entails equitable living conditions, social welfare, and quality of life for both urban and rural residents, which manifests in the development and broader coverage of comprehensive public service facilities, as well as an improvement in the living standards of urban–rural residents.

2.2. Influence Mechanism of TDR on Urban–Rural Integration

From the above connotations, it becomes evident that the flow of land factors between urban and rural areas is an essential requirement and a significant prerequisite for achieving urban–rural integration [63]. The TDR policy, based on the flow of land factors, can exert further influence on urban–rural relations and development by facilitating the flow of population and capital factors. These three primary factors play a crucial role in shaping the dynamics of urban–rural coordinated development. It is expected that the spatial transfer and exchange in the flow of three key factors—land, capital, and population—resulting from the process of TDR will have an impact on the three dimensions of urban–rural integration. The theoretical framework is shown in Figure 2.

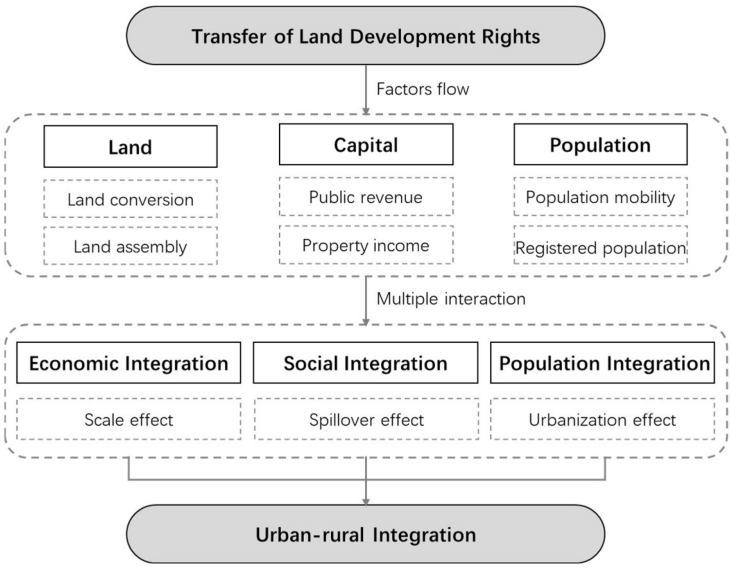

Figure 2. The theoretical framework between TDR and urban–rural integration.

Regarding the land factors, the TDR policy breaks the government's monopoly on rural–urban construction land transfers, enabling rural land resources to have more access to convert to urban uses. In response to the increasing urban population, urban areas face an expanding demand for construction land to support residential and industrial development. Therefore, obtaining more construction land quotas can address land resource constraints and promote urban development [66]. In contrast to this, in rural areas, there are a considerable number of unused houses and extensive undeveloped rural construction land [67]. The TDR policy can contribute to enhancing overall land-use efficiency by reasonably facilitating land-use conversion. Additionally, the practice of TDR in China involves reclaiming rural construction land and converting it into cultivated land, providing an opportunity for concentrated and contiguous rural land assembly, which may change the scale of agricultural land management and impact agricultural production efficiency [68,69]. In general, the TDR policy has the potential to accelerate land transfers from less productive producers to more productive ones or to more profitable uses.

From the perspective of capital factors, the funds obtained from the TDR process should be given back to the farmers and rural collectives, allowing rural land owners to share the benefits generated by urban land development, thus leading to capital flows between urban and rural areas. Land plots located in undeveloped rural areas or away from urban areas are the subjects of the land-sending area in TDR projects, and their rural owners are expected to significantly benefit from the compensation of land transfers. The introduction of tradable land-use rights quotas enables rural households to increase their property income [70]. Furthermore, some farmers who lose their rural homesteads may migrate to cities and engage in non-agricultural employment, thereby earning wage income [35,71]. Additionally, the compensation payment allocated to the rural collectives provides additional funds to support the infrastructure and improve living conditions in rural areas [59].

From a population perspective, the incomes generated from land quota transactions provide the initial financial support for rural laborers and their dependents, who tend to migrate to urban areas [38]. In some cases, the farmers in land-sending areas will be granted the chance to move into a high-rise apartment at a subsidized price, coupled with the provision of urban household registration (hukou) benefits [72,73]. The TDR policy, as well as its supporting policies, such as encouraging farmers' relocation to newly constructed rural communities, offers a more equitable pathway for all farmers to participate in rapid urbanization, accelerating the transition of some farmers into wage workers. Simultaneously, the agglomeration of rural residents significantly reduces the cost of providing public services

and effectively harnesses the positive externality and spillover effects of public services. The liberation of the rural population from the constraints of land ownership promotes urbanization and further facilitates the transition of migrant workers into registered urban residents [74].

On the whole, the TDR policy has strong effects on land use, income and employment structure, and agricultural production in rural areas, ultimately changing the economic, social, and population urban–rural integration through the reallocation of land resources, human resources, and capital factors [75]. It is expected that the TDR policy will promote integrated urban–rural development through the income effect, resource effect, and urbanization effect.

3. Materials and Method

Initially, evaluation indicators for urban–rural integration were constructed based on three key dimensions: economic integration, social integration, and population integration. The global principal component analysis (GPCA) method was employed to assess the urban–rural integration index, followed by the TV-DID model to measure the effect of TDR on urban–rural integration within the context of Chongqing (Figure 3).

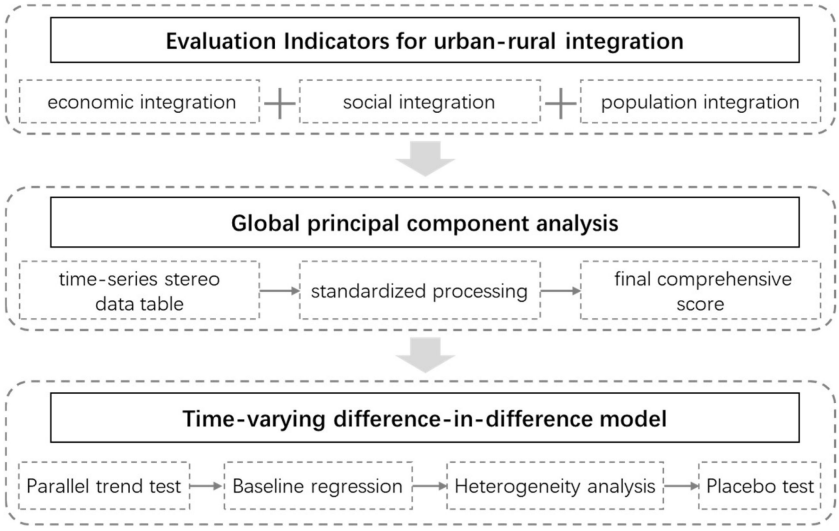

Figure 3. Research methodology diagram.

3.1. Study Area and Data

3.1.1. Study Area

Chongqing is a typical mountainous city located in southwestern inland China (Figure 4). The urban–rural income gap in Chongqing peaked in 2006, making it one of the cities with the largest urban–rural divide in China (Figure 5). The challenges of limited construction land resources and the imbalance between urban and rural development have become pressing issues. In 2007, Chongqing was chosen as a National Pilot Area for Comprehensive Reforms in Coordinating Urban and Rural Development. This initiative aimed to achieve coordinated rural and urban development through comprehensive reforms in all sectors [76]. By 2019, the amount of rural construction land transferred to urban construction land in Chongqing had reached about 24,000 hectares, with a total land value of nearly 50 billion Chinese yuan (CNY). Considering the extensive scale of land development rights trading in Chongqing and the well-established market platform, it is of immense value and significance to conduct an empirical study in Chongqing.

Figure 4. The location and administrative division of the study area.

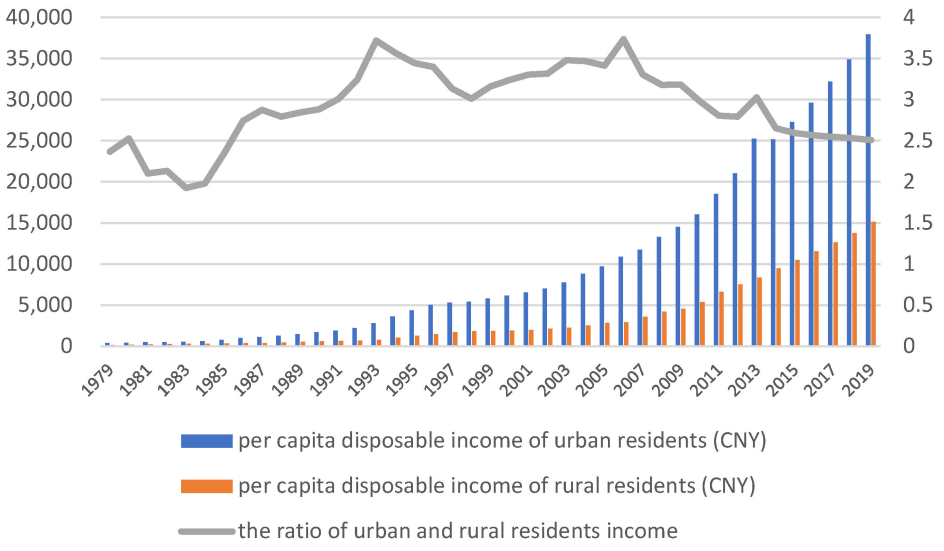

Figure 5. Income gap between urban and rural residents in Chongqing.

3.1.2. Variables and Data Source

(1) Dependent variables

The urban–rural integration index is considered a dependent variable. Based on the connotation of urban–rural integration discussed above and previous studies analyzing the influencing mechanism of urban–rural integration [76–79], an evaluation indicator system has been established following the principles of integrity, scientific nature, and feasibility. Fully considering data availability and validity, three indicators were selected to measure the urban–rural integration level in various counties and regions in Chongqing, namely economic integration, population integration, and social integration.

As shown in Table 1, the economic integration indicator includes six secondary indicators: the ratio of urban–rural residents' per capita disposable income, the ratio of urban–rural residents' per capita wage and salary income, the ratio of urban–rural residents' per capita property income, the ratio of urban–rural residents' per capita consumption expenditure, the ratio of urban–rural Engel coefficient, and proportion of the output value of the secondary and tertiary industries. Next, the population integration indicator includes four secondary indicators: urbanization rate, the proportion of the registered population within the permanent resident population, urban–rural disparity coefficient of employment proportion, and the ratio of urban–rural employed population. Finally, the social integration indicator includes six secondary indicators: population coverage rate of broadcast programs, the number of hospital beds per thousand people in health institutions, the number of medical technical personnel per thousand people in health institutions, the ratio of urban–rural per capita transport and communications expenditure, the ratio of urban–rural per capita education, cultural and recreation expenditure, and the ratio of urban–rural per capita healthcare and medical services expenditure.

Table 1. Urban–rural integration evaluation index system.

Primary Indicators	ID	Secondary Indicators	Calculation Method	Unit	Indicator Type
Economic integration	E1	Ratio of urban–rural residents' per capita disposable income	Per capita disposable income of urban households/per capita disposable income of rural households	%	Negative
	E2	Ratio of urban–rural residents' per capita wage and salary income	Per capita wage and salary income of urban households/per capita wage and salary income of rural households	%	Negative
	E3	Ratio of urban–rural residents' per capita property income	Per capita property income of urban households/per capita property income of rural households	%	Negative
	E4	Ratio of urban–rural residents' per capita consumption expenditure	Per capita consumption expenditure of urban households/per capita consumption expenditure of rural household	%	Negative
	E5	Ratio of urban–rural Engel coefficient	The ratio of food expenditure to total consumption expenditure of urban households/the ratio of food expenditure to total consumption expenditure of rural households	%	Positive
	E6	Proportion of the output value of the secondary and tertiary industry	The logarithm of the proportion of the sum of the output value of the secondary and tertiary sectors to the regional gross domestic product	%	Positive

Table 1. *Cont.*

Primary Indicators	ID	Secondary Indicators	Calculation Method	Unit	Indicator Type
Population integration	P1	Urbanization rate	Urban population/permanent resident population	%	Positive
	P2	Proportion of registered population in the permanent resident population	Registered population/permanent resident population	%	Positive
	P3	Urban–rural disparity coefficient of employment proportion	The proportion of employed persons to resident population of urban households—the proportion of employed persons to resident population of rural households	%	Negative
	P4	Ratio of urban–rural employed population	The number of employed people within urban households/the number of employed people within rural households	%	Negative
Social integration	S1	Population coverage rate of broadcast programs	-	%	Positive
	S2	Number of hospital beds per thousand people in health institutions	The logarithm of the number of hospital beds in health institutions/population at the year-end (1000 persons)	Beds/ 1000 persons	Positive
	S3	Number of medical technical personnel per thousand people in health institutions	The logarithm of the number of medical technical personnel/population at the year-end (1000 persons)	Persons/ 1000 persons	Positive
	S4	Ratio of urban–rural per capita transport and communications expenditure	Per capita transport and communications expenditure of urban households/per capita transport and communications expenditure of rural household	%	Negative
	S5	Ratio of urban–rural per capita education, cultural, and recreation expenditure	Per capita education, cultural and recreation of urban households/per capita education, cultural, and recreation expenditure of rural household	%	Negative
	S6	Ratio of urban–rural per capita healthcare and medical services expenditure	Per capita healthcare and medical services of urban households/per capita healthcare and medical services expenditure of rural household	%	Negative

(2) Independent variable

This article investigates whether TDR policy has played a pivotal role in improving urban–rural integration. Therefore, the presence and timing of *Dipiao* transactions in different regions of Chongqing are represented as dummy variables in this research. In this model, 'du' represents the grouping dummy variable, du = 1 represents the areas where *Dipiao* transactions occurred during the observed period, and du = 0 represents the areas without *Dipiao* transactions occurring during the observed period; 'dt' is the timing dummy variable, dt = 0 represents the years before *Dipiao* transactions occurred, and dt = 1 represents the years after *Dipiao* transactions occurred. The product of these two terms, du × dt, is the independent variable.

(3) Control variables

We seek to capture factors that are typically found to be significant in determining comprehensive urban–rural development. Specifically, we consider the economic development level, financial development level, social investment level, and external trade level. The economic development level is described by per capita GDP (d1) and total retail sales of consumer goods (d2); the financial development level is depicted by government general budgetary revenue, which reflects the government's ability to balance the gap between urban–rural development (d3) and total deposit balance of RMB of financial institutions (d4); social investment level is quantified by analyzing the total investment in fixed assets (d5); the external trade level is characterized by total imports and exports (d6). These indicators have been widely acknowledged in the existing literature and hold relevance for understanding the multifaceted dynamics of urban–rural development.

A series of panel data from 2013 to 2019, covering 37 districts and counties in Chongqing, was selected for the model. The data on *Dipiao* transactions in various areas of Chongqing are collected from the official website of Chongqing Country Land Exchange, specifically from the announcements of *Dipiao* transaction results. The data on dependent variables and control variables are obtained from the Chongqing Statistical Yearbook (2014–2020) and Chongqing Survey Yearbook (2014–2020).

3.2. Method

3.2.1. Global Principal Component Analysis

Given the dynamic and comprehensive nature of the urban–rural relationship, the static principal component analysis (PCA), which is limited to cross-sectional data, is no longer suitable. To conduct an indicator assessment of urban–rural integration, the paper employs the global principal component analysis (GPCA), a dynamic multi-attribute decision-making model that builds upon the classical PCA methodology [80].

First, to analyze the 16 urban–rural integration indicators over a span of seven years, it is essential to establish a time-series stereo data table. Second, it is necessary to perform standardized processing to ensure that the indicators are transformed into a consistent scale. For positive indicators, the transforming equation is as follows:

$$y_{ij} = \frac{x_{ij} - min(x_{ij})}{max(x_{ij}) - min(xi_j)}. \quad (1)$$

The transforming equation for negative indicators is as follows:

$$y_{ij} = \frac{max(x_{ij}) - x_{ij}}{max(x_{ij}) - min(x_{ij})}. \quad (2)$$

where x_{ij} denotes the initial value of the index, $min(x_{ij})$ and $max(x_{ij})$ are the minimum and maximum values of the index among the evaluation objectives, respectively, and y_{ij} is the standardized value.

We used Stata16.0 software to perform the Bartlett test (BT) (Bartlett, 1950) and Kaiser–Meyer–Olkin (KMO) test (Kaiser and Rice, 1974). The approximate chi-square of Bartlett's test is 2743.421, and the significance level is 0.000 (less than 0.01). The result of the KMO test is 0.767 (greater than 0.5), which indicates that there is a strong correlation among test indicators. Therefore, further analysis could be conducted. Next, the eigenvalues and contribution rate of the global principal components are calculated, and principal components are determined according to the criterion that the eigenvalues should be more than 1. Finally, the weight coefficients of the principal component matrix are calculated, and the comprehensive score of urban–rural integration is constructed. The formula for calculating the comprehensive score is as follows:

$$Z = k_1F_1 + k_2F_2 + \cdots + k_nF_n \quad (3)$$

where Z is the comprehensive score; k_1, $k_2 \ldots k_n$ is the contribution rate of each principal component; F_1, $F_2 \cdots F_n$ is the score of each principal component.

3.2.2. Time-Varying Difference-in-Difference Model

In the field of policy effect evaluation, the difference-in-difference (DID) model based on natural experiments is widely regarded as the most commonly used method [81]. In the DID model, samples are divided into treatment and control groups to comprehensively investigate the differences before and after the implementation of a certain policy [82]. We take the districts and counties that witnessed *Dipiao* transactions as the treatment group, while those without *Dipiao* transactions serve as the "control group". Since the origin of *Dipiao* policy implementation varied across different districts or counties within the treatment group, the study employs the time-varying DID method (TV-DID). The model is formulated as follows:

$$Y_{it} = \alpha + \beta du \times dt + \gamma X_{it} + year_t + area_i + \varepsilon_{it} \quad (4)$$

where i represents the area, t represents the year, the dependent variable Y_{it} represents the urban–rural integration index of the area i in the year t; du is a dummy variable that equals 1 for the treatment group and 0 otherwise, dt represents the temporal dummy variable that equals 1 for the time period after policy implementation and 0 otherwise; X_{it} represents the control variable; $year_t$ is the temporal fixed effect, $area_i$ is the individual fixed effect, ε_{it} is the random disturbance term. This study focuses on the positive and negative direction of coefficient β and its significance. If β is significant and greater than 0, it means that the *Dipiao* policy plays a positive effect on the urban–rural integration of the objects.

4. Results

4.1. Measured Results of Urban–Rural Integration

Five principal components were extracted by the GPCA method, and the cumulative variance contribution rate was 74.52%. This can explain most of the information of the original variables. The results of the comprehensive score of the urban–rural integration index for districts and counties in Chongqing are shown in Table 2. From the perspective of the majority of districts and counties, the scores of the urban–rural integration index, which encompass the cumulative scores across all dimensions, have improved with slight fluctuations in overall urban–rural integration. Among the analyzed areas, only Wuxi County experienced a decrease in the urban–rural integration index from 2013 to 2019, yet it should be noted that there was a noticeable improvement in prior years.

Figure 6 further reveals the spatial characteristics of the urban–rural integration index, with the Jenks optimal natural fracture method in ArcGIS 10.4 adopted to divide them into five categories between the years 2013 and 2019. The urban–rural integration index generally exhibits a pattern of gradual decrease with increasing distance from the city center, i.e., from the southwest toward the southeast and northeast of Chongqing. From 2013 to 2019, the districts located in the city center, such as Shapingba District, Dadukou District, and Jiangbei District, emerged as the top-performing areas in terms of urban–rural integration. Nonetheless, when considering the changing trends, a more evident improvement in urban–rural integration is witnessed in economically underdeveloped districts and counties, exemplified by notable cases in Yunyang County, Wushan County, and Youyang County. Over a period of seven years, the urban–rural integration index experienced growth of more than two-fold in these three counties, with Wushan County even experiencing a three-fold increase.

Table 2. Score of urban–rural integration index.

Districts and Counties	2013	2014	2015	2016	2017	2018	2019
Wanzhou District	3.1000	3.1649	3.2138	3.2615	3.3530	3.4117	3.5103
Fuling District	3.2917	3.3033	3.4056	3.4758	3.7325	3.7741	3.8692
Dadukou District	4.7000	4.9387	5.0954	5.6618	5.5795	5.2766	5.4547
Jiangbei District	5.5487	5.7591	5.9214	6.0330	6.4400	6.8212	6.8793
Shapingba District	4.8072	4.8376	5.1192	4.9443	4.9254	5.0369	5.1503
Jiulongpo District	4.7523	4.5779	4.8033	4.7695	4.9069	4.8507	4.8879
Nan'an District	4.0785	3.9607	4.2656	4.4277	4.4807	4.6816	4.7285
Beibei District	4.2639	4.3939	4.5123	4.5408	4.3324	4.7386	4.6020
Qijiang District	3.0824	2.9934	2.8820	3.2261	2.8573	3.6148	3.9047
Dazu District	2.3166	2.5517	3.0072	2.6988	2.4799	2.8631	3.2120
Yubei District	3.1765	3.3029	3.6232	3.8158	3.6702	3.8127	3.8656
Ba'nan District	3.6491	3.7609	4.0098	4.0434	4.2842	4.2620	4.2618
Qianjiang District	2.6048	2.8184	2.8920	2.9202	3.0460	3.2627	3.2079
Changshou District	3.3009	3.2861	3.4347	3.3915	3.5889	3.6437	3.9474
Jiangjin District	2.7794	2.7580	2.9196	3.0289	3.2698	3.3219	3.4866
Hechuan District	2.7072	2.6519	2.8791	3.0162	3.3137	3.4391	3.5416
Yongchuan District	3.2624	3.2661	3.0849	3.2442	3.3361	3.6423	3.7447
Nanchuan District	2.1986	2.3278	2.2127	2.3273	2.9999	3.1142	3.2380
Bishan District	3.0693	2.8705	2.8177	3.4550	3.5787	3.6043	3.6695
Tongliang District	2.4782	2.5881	2.9804	3.1850	3.2607	3.4239	3.5283
Tongnan District	1.5851	2.2999	2.1555	2.3914	2.6715	2.6076	2.7606
Rongchang District	3.0090	2.7095	2.9496	3.0852	3.1240	3.4392	3.6185
Kaizhou District	1.9215	2.1205	2.1324	1.8953	2.0682	2.4838	2.4934
Liangping District	2.1653	2.2326	2.5059	2.4089	2.4846	2.1165	2.2574
Wulong District	1.8093	2.0523	1.9704	2.4277	2.5073	2.6409	2.7843
Chengkou County	1.1125	1.1829	1.0691	1.5800	1.8921	2.1685	2.0698
Fengdu County	1.7450	1.7737	2.0278	2.1091	2.3772	2.7329	2.9756
Dianjiang County	2.2811	1.8850	2.0082	2.2150	2.4029	2.7282	2.8725
Zhongxian County	1.7171	2.0430	2.2527	2.2761	2.4531	2.6990	2.8726
Yunyang County	1.0670	1.1892	1.4023	1.4508	1.6955	2.0366	2.5631
Fengjie County	1.5895	1.5909	1.6618	1.8794	1.8968	2.2794	2.4554
Wushan County	0.7925	0.6811	1.0122	1.2792	1.8049	2.2805	2.5866
Wuxi County	2.0732	2.2191	2.0911	2.8487	2.8625	2.9996	1.7962
Shizhu County	1.6596	1.7953	2.1691	2.3956	2.7810	2.9236	3.0070
Xiushan County	1.5207	1.5896	1.7830	2.0303	2.0528	2.4250	2.5737
Youyang County	0.9648	1.3004	1.9088	1.8202	1.9249	2.0367	2.1829
Pengshui County	1.1090	0.7968	0.7611	1.0085	1.2229	1.5392	1.6758

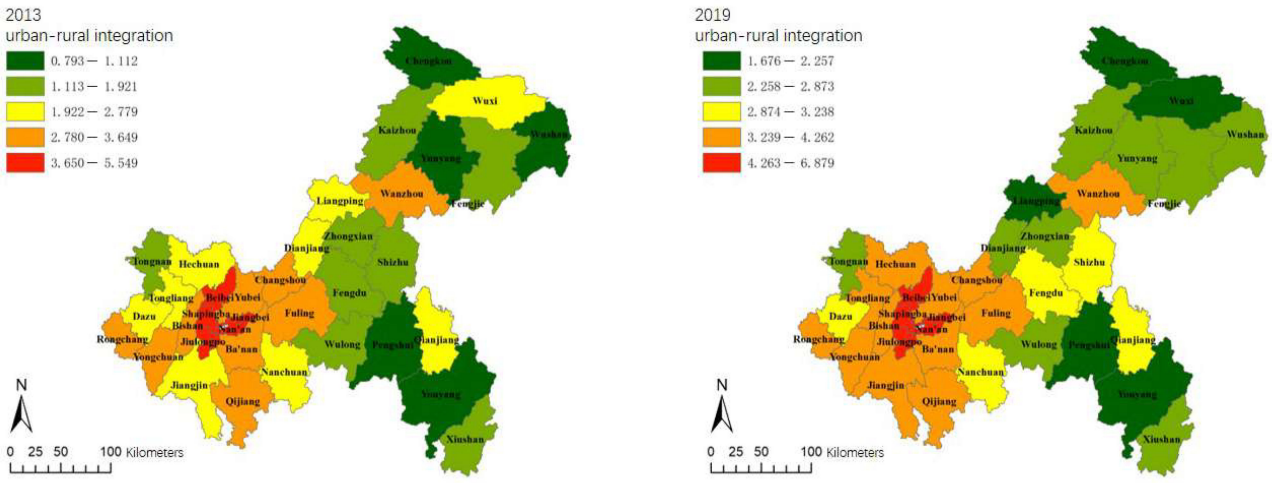

Figure 6. The distribution characteristics of urban–rural integration index in Chongqing (2013–2019).

4.2. Assessment of the TDR Effects on Urban–Rural Integration

4.2.1. Parallel Trend Test

In the context of the TV-DID method, it is crucial for the model to satisfy the 'parallel trend assumption,' which implies that trends in the outcomes between the treatment group and the control group are expected to be the same if the policy implementation does not have an effect on the treatment group. This assumption signifies that, in the pretreatment period without the policy intervention factors, there should be no inherent differences between the treatment group and the control group, and the diverging trends observed between the two groups in the post-treatment period can be attributed to the policy implementation. In order to fulfill this assumption, we introduced modifications to Equation (4) by incorporating insights from the study conducted by Beck et al. (2010) [83]. Since the *Dipiao* policies were implemented progressively across various areas, rather than selecting a specific year, we generated $du \times dt^{-k}$ ($du \times dt^{+k}$), which encompass the counterfactual year dummy variable dt and the treated group dummy variable du. Considering that the *Dipiao* policy was initiated in 2008, and with only a limited number of cities adopting the policy after 2012, dt^{-1} is employed to signify cities prior to the policy implementation. The modified equation is as follows:

$$Y_{it} = \alpha + \beta du \times dt^{k} + \gamma X_{it} + year_{t} + area_{i} + \varepsilon_{it} \quad (5)$$

The parallel trend test results provide evidence that satisfies the parallel trends assumption fundamental to the TV-DID model. Before the implementation of the *Dipiao* policy, the estimated coefficients were statistically insignificant, indicating no appreciable variation in the trend of the promoting effect on urban–rural integration between the treatment group and the control group. However, following the policy's initiation, the promoting effect gradually appeared beginning in the fourth year. This indicates a slight time lag in the policy's effect on promoting urban–rural integration. The primary factor contributing to this phenomenon could be that the time lag typically encountered between the sale of land quotas and the subsequent payment of capital compensation often spanned one or more years.

4.2.2. Baseline Regression Results

According to the two stages of the TDR process in Chongqing, which involve land quota trading and capital compensation payment, there was a time interval of between one and several years between these two stages. Consequently, both stages were considered the independent variables for regression analysis, with 'du·dt_land' representing land quota trading and 'du·dt_capital' representing capital compensation payment. In this section, the effect of TDR was estimated based on Equation (4), in which the du·dt_land and du·dt_capital were used for estimation purposes. The results of the four models are presented in Table 3, where models (1) and (2) illustrate the results with du·dt_land as the independent variable, while models (3) and (4) display the results with du·dt_capital as the independent variable. Moreover, models (1) and (3) are free from the effect of any control variables, while models (2) and (4) include all relevant control variables. All regression analyses were conducted with control for area and year fixed effects and area-level clustering standard errors. As suggested by models (1) and (2), estimated coefficients in β were 0.2915 and 0.2720, respectively, and were both statistically significant, passing the significance level test of 1%. Additionally, the coefficients shown in models (3) and (4) were also both positive, while only the coefficient of Model (3) was statistically significant. On the whole, the positive coefficients indicate that with the implementation of the land quotas transactions, the urban–rural integration in the treatment group witnessed a significant increase. Furthermore, the coefficients in models (1) and (2) were higher than those in models (3) and (4), suggesting that land quota trading seemed to play a more crucial role than capital compensation payments. Subsequently, the following sections will primarily

focus on the implementation of land quota trading, with du·dt_land being utilized as the core independent variable.

Table 3. The effect of TDR on urban–rural integration in Chongqing between 2013 and 2019.

Independent Variable	Dependent Variable: Urban–Rural Integration Index			
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**
du·dt_land	0.2915 ***	0.2720 ***		
	(0.0907)	(0.072)		
du·dt_capital			0.1446 *	0.1007
			(0.0848)	(0.0822)
d1		0.0017 ***		0.0017 ***
		(0.0004)		(0.0004)
d2		0.0032		0.0038
		(0.0047)		(0.0048)
d3		0.0001 *		0.0001 *
		(0.0001)		(0.0001)
d4		0.0000		−0.0001
		(0.0003)		(0.0003)
d5		−0.0004		−0.0004
		(0.0009)		(0.0009)
d6		−0.0003		−0.0003
		(0.0002)		(0.0002)
Constant	−0.3573 ***	−1.3408 ***	−0.2066 **	−1.1430 ***
	(0.0849)	(0.3046)	(0.0806)	(0.3211)
Observations	259	259	259	259
Year FE	Yes	Yes	Yes	Yes
Area FE	Yes	Yes	Yes	Yes
R-square	0.9729	0.9791	0.9725	0.9786

Note: *, **, and *** represent 10%, 5%, and 1% significance levels, respectively. Standard errors are clustered by area in parentheses.

4.2.3. Heterogeneity Analysis

The regression analysis above demonstrates the promotion effect of TDR policy on urban–rural integration. Given the vast territorial area of Chongqing, there are variations in land resources, geographical conditions, and economic development among the districts and counties, which may lead to different effects of TDR policy on urban–rural integration. Therefore, it is necessary to examine the heterogeneity in the study area. Under the government's implementation of a minimum price protection system, the income from *Dipiao* transactions is relatively consistent across different areas, while the land values exhibit regional variations.

We primarily focus on the influence of agricultural output value generated by farmland and industrial output resulting from construction land. (1) Agricultural output value per land unit (CNY/hectare per year). The agricultural output value per unit area of farmland in each district and county was sorted in ascending order. The districts and counties with agricultural land values above the median were considered to have higher agricultural land values, while those below the median were categorized as having lower agricultural land values. It is observed that districts and counties with lower farmland values tend to face challenges such as abandoned farmland and population outflow [84]. Additionally, farmers participating in *Dipiao* transactions are more likely to benefit from TDR policies in such areas. (2) Overall industrial labor productivity (CNY/person per year). The overall industrial labor productivity in each district and county was sorted in ascending order. The districts and counties with higher industrial production above the median were considered to have higher industrial land value, while those below the median were categorized as having lower industrial land value. The districts and counties with higher industrial land value are more likely to attract population from rural areas to urban areas, and TDR

policies seem to have a greater effect on the integration of urban and rural populations in these areas.

Table 4 reports the heterogeneity analysis results, where models (1) to (4) represent the groups divided based on agricultural land value, while models (5) to (8) represent the groups divided according to industrial land value. To be precise, the control variables were absent in models (1), (3), (5), and (7) and were included in models (2), (4), (6), and (8). Comparing the results of the higher agricultural land value group and the lower agricultural land value group in models (1) to (4), the coefficients were negative in models (1) and (2), while they were positive in models (3) and (4), clearly indicating that TDR policy had a positive effect specifically in the districts and counties with lower agricultural land values. In comparing the results of the higher and lower industrial land value groups, it is observed that while each coefficient was positive in models (5) to (8), only models (5) and (6) showed statistical significance, passing the significance level test of 1%. The coefficients in Models (7) and (8) were not statistically significant. The results showed that the TDR policy had a positive effect, specifically in the districts and counties with higher industrial land values.

Table 4. The heterogeneity analysis results.

Independent Variable	Dependent Variable: Urban–Rural Integration Level							
	Higher Agricultural Land Value		Lower Agricultural Land Value		Higher Industrial Land Value		Lower Industrial Land Value	
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
du·dt_land	−2.9020 ***	−2.7216 ***	0.2926 ***	0.3158 ***	0.4398 ***	0.4270 ***	0.0050	0.080009
	(0.0000)	(0.0794)	(0.0961)	(0.0635)	(0.0889)	(0.0683)	(0.0627)	(0.0719)
d1		0.0007		0.0022 ***		0.0009 ***		0.0022 ***
		(0.0005)		(0.0004)		(0.0002)		(0.0004)
d2		0.0038		−0.0033		−0.0026		0.0183 ***
		(0.0063)		(0.0067)		(0.0049)		(0.0060)
d3		0.0001 **		−0.0007		0.0002 ***		−0.0023 ***
		(0.0001)		(0.0008)		0.0000)		(0.0006)
d4		−0.0001		0.0009		0.0001		−0.0003
		(0.0004)		(0.0008)		(0.0003)		(0.0005)
d5		−0.0007		0.0010		−0.0008		0.0030 *
		(0.0009)		(0.0015)		(0.0008)		(0.0014)
d6		−0.0002		−0.0016		−0.0000		−0.0004 **
		(0.0002)		(0.0024)		(0.0000)		(0.0001)
Constant	1.9502 ***	1.4609 ***	−0.4278 ***	−1.4552 **	−0.4330 ***	−0.7506 ***	1.8155 ***	1.0010 ***
	(0.0475)	(0.3039)	(0.0742)	(0.6627)	(0.0769)	(0.2524)	(0.0537)	(0.2929)
Observations	126	126	126	126	126	126	126	126
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-square	0.9753	0.9792	0.9085	0.9421	0.9854	0.9891	0.9600	0.9779

Note: *, **, and *** represent 10%, 5%, and 1% significance levels, respectively. Standard errors are clustered by area in parentheses.

4.2.4. Placebo Test

Having controlled for a series of major observable area characteristics, it was not possible to control the influence of all the characteristics, especially the influence of those that were non-observable. Although dual fixed effects have been employed in the baseline regression analysis, some characteristics may have different influences over time, thus affecting the identification of the hypothesis. To further examine whether the urban–rural integration index was influenced by TDR policies rather than other factors, we adopted the indirect placebo test, which has been widely used in relevant studies. Specifically, we constructed 'pseudo-policy dummy variables' by randomly generating a low-carbon city list (experimental group) as a replacement for the variable du × dt. The process was repeated 500 times and 1000 times, respectively, and the variables were estimated using Model (2). Given that the variables were randomly generated, it was expected that $\beta = 0$. In other words, if β was not equal to 0, it indicated that there were other characteristics affecting the estimation results.

Figure 7 portrays the distribution of the obtained estimates for 500 and 1000 repetitions of the 'pseudo-policy dummy variables', respectively. The results indicate that the mean values of β were nearly zero and were not statistically significant. This indicates that the non-observable variables did not have a significant effect on urban–rural integration, thereby further validating the robustness and replicability of the initial baseline regression results in this article.

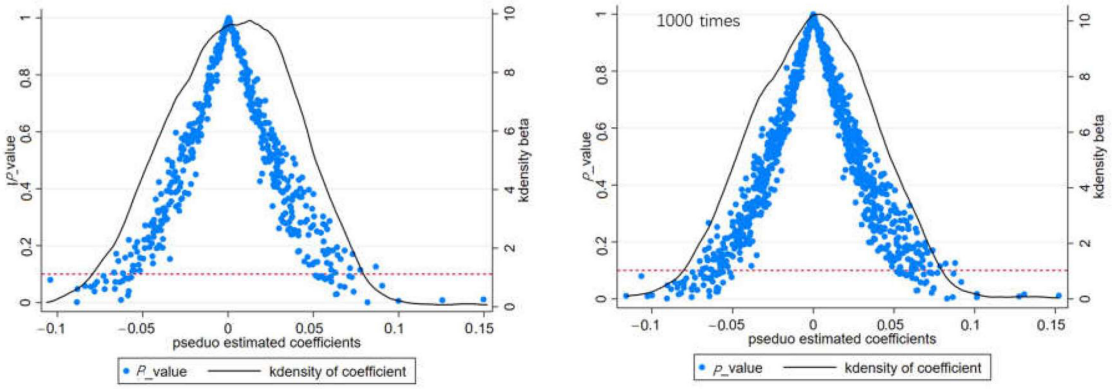

Figure 7. The results of the placebo test.

5. Discussion

5.1. Why Does TDR Improve Urban–Rural Integration?

5.1.1. The Realization of Rural Land Development Rights Value

Given the current land system framework in China, rural land development rights are not considered a separate and distinct form of rights. Only when the transfer of rural land development rights is allowed can they temporarily have an independent form from the broader concept of land property rights. According to the theory of TDR, the value of land assets obtained by farmers in land-sending areas should be equivalent to the value of urban construction land development; however, it still remains much lower. Although the standard of eminent domain in Chongqing has increased in recent years, as indicated in the notice issued by the Chongqing Municipal Government on the compensation and resettlement standards for land acquisition in 2021, the compensation price for acquired rural land is approximately CNY 40,000 to 60,000 per mu. Based on the minimum protection policy established by the Chongqing government, the current transaction price of *Dipiao* in Chongqing is at least CNY 178,000 per mu. Although the *Dipiao* policy still cannot fully reflect the property value of rural land, at least the lowest trading price with *Dipiao* is significantly higher than the government's compensation standards for land acquisition, thereby playing a positive role in narrowing the income gap between urban and rural residents.

5.1.2. Urbanization and Income Structure Transition

The compensation payment received from TDR is a one-off property income for rural landowners in the land-sending area. However, TDR can have an indirect and more profound impact on the income structure of rural residents. As the transfer of construction land quotas from rural areas to urban areas escalates, the rural population increasingly migrates to cities, resulting in a higher urbanization rate. Some researchers also found through interviews that the *Dipiao* policy presents farmers with equal opportunities for being involved in urbanization [38]. The shift in identity from farmer to migrant worker also signifies a transition in income structure, with wage income becoming dominant over operational income. Figure 8 presents the average per capita income statistics of rural residents in various districts and counties of Chongqing from 2013 to 2019, indicating that the wage income of rural residents consistently surpassed the income from operations. Therefore, TDR not only boosts short-term property income but also has the potential to

influence an increase in wage income, ultimately exerting a consistent and enduring impact on rural economic development.

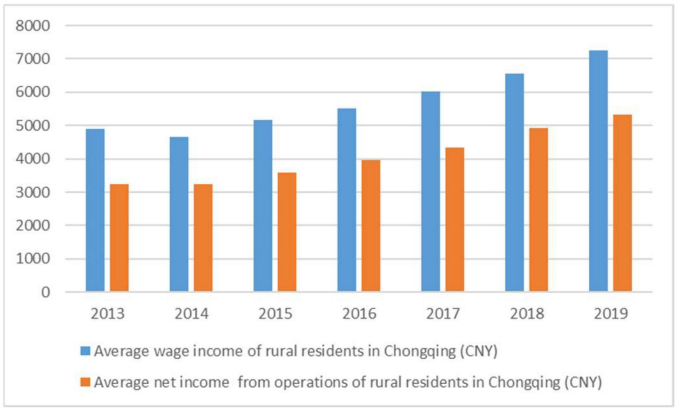

Figure 8. The average income of rural residents in Chongqing (2013–2019).

5.1.3. Government Preferences and Transfer Payment Characteristics

According to the comparison of the spatial patterns of urban–rural integration in Chongqing between 2013 and 2019, it is evident that the overall level of urban–rural integration was increasing. The growth was particularly pronounced in underdeveloped areas and counties located far from the city center. This can be attributed to the government's prioritization of the underdeveloped districts and counties while promoting the *Dipiao* policy, leading to evident characteristics of transfer payments associated with *Dipiao*. By the end of 2022, more than 263,000 acres of land quotas had been traded under the '*Dipiao*' policy in Chongqing, with a total value of over CNY 70 billion. It is noticeable that around three-quarters of these trading projects took place in poverty-stricken districts and counties, involving nearly CNY 52 billion and effectively contributing to poverty alleviation efforts. Additionally, in Chengdu's Dipiao policy practice, poverty alleviation of farmers was often a major consideration for the local governments for approving TDR project proposals from applicants. Part of the revenue generated from land quota transactions was used to finance various rural development and revitalization projects [67]. The farmers who have given up their rural land development rights would receive compensation and resettlement housing in return. According to the interviews with those farmers, the living conditions in rural areas have considerably improved through the TDR projects [40]. However, the effect of TDR was various across different districts and counties is different. The average *Dipiao* transaction prices per acre of construction land had remained consistent regardless of the various districts or counties, consistently approaching the minimum protection price established by the government. As a result, districts and counties with varying levels of economic development might experience different policy effects from a similar amount of property income, with potentially greater impact observed in areas characterized by lower per capita income.

5.2. How to Optimize TDR Policy to Further Improve Urban–Rural Integration?

5.2.1. Enhancing Rural Land Rights and Facilitating Marketization of Land Development Rights

The *Dipiao* policy introduces a new approach for converting rural land into urban construction land within the current land system in China, yet it falls short of fully overcoming the constraints of the urban–rural dual land system. Essentially, rural land development rights still need to be further improved, which constitutes the fundamental prerequisite for promoting rural prosperity and urban–rural equal development. The implementation of TDR policies in China still remains predominantly a government-led process of adjusting and transferring land quotas, making it challenging to achieve true marketization within

the context of a top-down annual land-use plan and predetermined urban construction land quotas.

The planned nature of *Dipiao* is also evident in terms of the transaction quantity and usage. Initially, the central government imposed planned control over the *Dipiao* transactions in Chongqing. In principle, the construction land quotas generated by *Dipiao* should not exceed 10% of the annual planned land-use quota. Although the central government later lifted restrictions on the scale of *Dipiao* transactions, the Chongqing Municipal Government continued to set its own annual planned land-use quota and dynamically adjusted it according to the annual land-use plan. The current construction land quotas formed in *Dipiao* transactions still exhibit high asset specificity, with only two-thirds of the transaction volume truly available for use, primarily acquired by state-owned enterprises [85]. Additionally, the urban–rural system is a complex system composed of various factors, and the transformation of urban–rural relations cannot be achieved in a short period of time. Therefore, even with optimization of the process and rules of the TDR policies, the effectiveness of enhancing urban–rural integration cannot be immediately realized.

5.2.2. Optimizing the TDR Process and Zoning Management

The time lag of the effectiveness of the *Dipiao* policies may result from the lengthy process in the issuance of *Dipiao* and the complexity of the urban–rural factor flow. An important principle of the TDR system is "reclamation before trading". While this approach prevents the loss of cultivated land and ensures the quantity and quality of cultivated land after reclamation, it adversely impacts the interests of farmers. According to the current regulations governing *Dipiao* transactions, the entire process typically takes a minimum of 307 days to complete. In contrast, farmers often receive their monetary compensation one or two years afterward, or even longer, instead of immediately after the *Dipiao* trading.

It was found that the reclamation of cultivated land in areas with high output value has resulted in a widening urban–rural gap. This could be attributed to the fact that farmers in these areas already had high agricultural incomes, and the benefits derived from *Dipiao* transactions did not significantly promote further economic development. On the other hand, the significant promotion of urban–rural integration in areas with low output value can be attributed to the stronger impact of large-scale production resulting from cultivated land reclamation and the improvement of agricultural output value. For regions with lower agricultural income, the same income from *Dipiao* transactions has a greater impact on their production and livelihood. Therefore, the government should adopt a differentiated regional TDR policy that takes into consideration the various agricultural and industrial development characteristics and development needs of each district and county. To conduct zoning management, when approving *Dipiao* applications from land-sending areas, priority can be given to districts and counties with low cultivated land output value as well as those experiencing significant population loss.

6. Conclusions

The urban–rural divide in China has been exacerbated by the significant challenges associated with the dual land institution, which has long constrained the realization of urban–rural integration and rural revitalization. The introduction of TDR in China has partially facilitated rural–urban land transfers. As evidenced by the case of 37 districts and counties in Chongqing, TDR policy plays a positive role in narrowing the gap between rural and urban sectors in China.

The insights obtained from our empirical study and the theoretical framework should have significant implications for understanding the relationship between TDR and urban–rural integration. Nevertheless, there are also some important issues left out of our framework. While our results indicate a positive impact in Chongqing, it is worth noting that the applicability of TDR in promoting urban–rural integration in other regions of China might vary. Future research should expand its scope, drawing evidence from a more diverse array

of cities or regions. It is crucial to acknowledge the limitations associated with the data employed in this study. This requires more systematic and long-term analyses, including data tracking and the incorporation of surveys, to provide more scientifically grounded policy implications for enhancing both urban–rural integration and land allocation efficiency.

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Data Availability Statement: Publicly available sources of the data used in this study are described in the article; for other data used, please contact the corresponding author on reasonable grounds. The data of the *Dipiao* transaction amount can be found on the following websites: http://nyncw.cq.gov.cn/ (accessed on 20 August 2023).

Conflicts of Interest: The authors declare no conflict of interest.

Notes

[1] In this context, 'flow of land' refers to the transfer of development rights.

[2] The concept of 'land development rights' has not been introduced within China's legal framework. However, it is widely accepted that land development rights in China are typically categorized based on the differentiation between urban and rural land ownership.

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