



Article Market Efficiency under the Arrangement of Transaction Rules of the RCCL Market from the Supply-Side Perspective

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Abstract: This paper analyzes market efficiency under the formal transaction rules of the rural collective construction land (RCCL) market in Nanhai District. These transaction rules are not perfect, market uncertainty is strong, and transaction costs remain high. Transaction rules are an important means by which the government can intervene in the market, protect farmers' land-use and income rights, and make the market more open, equitable, and just. Using a field survey (260 questionnaires) in Nanhai District, Guangdong Province, China, we estimated the impact of the openness, equity, and justice of transaction rules on the transaction costs of the RCCL market. Tobit models were constructed, and the results showed the following: (1) The overall level of market efficiency of the RCCL in Nanhai District is low. In different regions, the highest market efficiency is in Guicheng Street and the lowest is in Xiqiao Town. However, after excluding the influence of environmental and random factors, the overall level of market efficiency decreased, while the market efficiency of Lishui and Xiqiao Town increased. (2) The influencing factors of RCCL market efficiency under the arrangement of transaction rules are mainly related to the disclosure of information in the openness dimension, income distribution and supervision in the fairness dimension, and land-price formation in the fairness dimension. Therefore, we suggest that the lower the transaction cost of an RCCL market, the more active the market will be. It is very important to improve the transaction rules of the RCCL market, reduce the transaction cost, and improve the market efficiency. The transaction rules of the RCCL market should be further improved in the three dimensions of openness, equity, and justice. Our work provides insight into the improvement of market efficiency, which contributes to the development of the RCCL markets in other areas of China and worldwide.

Keywords: transaction uncertainty; asset specificity; openness, equity and justice; input and output

1. Introduction

Many traditional systems hinder economic and social development, resulting in low market efficiency. Many scholars use qualitative analysis methods to analyze the change in land systems, and conclude that land system reform is important, for example, Palestine's land system is very outdated. The musha in Palestine was an efficient, dynamic economic institution that facilitated investment and promoted local economic development [1]. In addition, some scholars use the method of marginal production function to calculate the economic output value of crops. For example, economic models to determine plans for enhanced farmland reserves to participate in conservation [2]. Comparing the advantages and disadvantages of different systems, most of them learn to use Cobb–Douglas in the physical inputs multiplied by a function of the characteristics. In Israel, cooperative villages operate under an equal land allocation rule. In a study on the production and distribution consequences of

three alternative hypothetical allocation rules, separately assessing the cost and output, it was found that distributing land equally is modestly effective compared to the income inequality generated by the other rules [3–5]. With regard to the choice of system, most public institutions evaluate the cost of policy implementation. In the process of applying economic efficiency in collective public institutional decision-making, policy procedures and adopted systems are judged by transaction cost with regard to whether the main decision-makers bear all the costs of the action and benefit from it [6]. Some scholars analyze the market efficiency, in order to prevent excessive market competition and low efficiency, adopt the analysis method of transaction cost, and think that the government should intervene in the market to improve efficiency [7–10]. In the private market, individual maximization decisions will completely internalize all social costs and benefits, because property rights have been fully defined and enforced at a reasonable cost. Similarly, if there are incentives and constraints, political markets are formulated in the best way. If this is not the case, the externality of decisions will rise, which will lead to the failure of choice [11–13]. Therefore, the influence of social rules on the interests of decision-makers is very important, because the cost expended in the execution of rules affects market efficiency. The implementation of transaction rules in a rural collective construction land market affects the transaction cost of rural shareholding cooperatives.

Urban land commercialization began in late 1980s in China's eastern coastal area [14]. The supply of urban construction land is low and expands to rural areas. The rural collective construction land began to be invisibly transferred in the 1990s, but without the guidance and regulation of the system, the interests of farmers are damaged in the RCCL transfer (the rural collective construction land). In order to protect the rights and interests of the weak farmers, the government promulgated the rules of rural collective construction land transfer, and began to pilot it in different regions of China. For example, in 1999, the Ministry of Land and Resources selected Nanhai District for the pilot of RCCL transfer. After nine years, the central government issued a series regulation on RCCL transactions. In 2008, the policy issued that rural collective construction land is the same as state-owned construction land, which has the same rights and same prices for land in the same location. After seven years, 33 pilot areas were selected nationwide. Now the open, equitable, and just trading rules are emphasized so that the rights and interests of farmers are better protected [15,16].

The transfer of RCCL is hot all over the country, especially in Nanhai District of Guangdong Province. However, looking at the RCCL market, how about its market efficiency? Is it necessary to improve the market trading rules and improve the market operation efficiency? Based on this thinking, this paper analyzes the relationship between input costs and output from the RCCL trading rules (openness, equity, and justice) three attributes. The supply-side is the main research object, representing the interests of farmers. However, the farmers are the weak side of the rural collective construction land transfer, and their interests are easily deprived by the government. Therefore, the transaction rules should fully protect the rights and interests of farmers.

2. Theoretical Framework and Hypotheses

2.1. Theoretical Framework

"Efficiency" refers to whether all the input elements of an individual or a group can achieve optimal allocation in a certain period of time, which fundamentally reflects the realization degree of resources or labor value, that is, the ratio between input and output [17]. Capital, land, and labor are the main input elements of production, and the efficiency of the system is the basis of its existence. Lin Yifu (1989) [18–20] believed that, apart from the role of the state, the institutional arrangement that can provide more services is theoretically more efficient in terms of the given production and transaction costs. If the quantity of services provided by two systems is equal, the institutional arrangement with lower cost is more effective. He emphasized the role of transaction cost in institutional structure for institutional efficiency.

As shown in Figure 1, if y is the total output of the RCCL market, y = f(x) is the output curve of the village collective and x is the input of the RCCL supplier. If the supplier inputs unit AB into the RCCL, they can achieve the output target of unit AE, but because of the cost under the arrangement of transaction rules, only the output target AD can be obtained under the same input level. If we want to achieve the output target of unit AE, we must pay the RCCL input of unit AC [21,22].



Figure 1. Total and net output curves.

The RCCL market in Nanhai District experienced induced institutional change from the bottom up in the development period, and mandatory institutional change led by the government from the top down. The government now formulates the transaction rules and organizes transactions through the trading platform. The government makes the land transaction rules and supervises land organization transactions dominated by the direction and speed of the change of the RCCL market, and the arrangement of rules affects the transaction activities of the land market, which then affects the market operation efficiency of the RCCL. Excessive government intervention in the RCCL transaction market will lead to low efficiency. Therefore, after searching through and summarizing the transaction rules and regulations of the RCCL market, the three dimensions (openness, equity, and justice) of transaction rules were selected for this paper, and the impact of the rules on market efficiency was analyzed according to Williamson's transaction cost theory in the new institutional economics [23–26], so as to improve the transaction rules of the RCCL market, reduce transaction costs, and improve market efficiency (As shown in Figure 2). Under the arrangement of the transaction rules of the RCCL market, the input of the market supplier (rural collective) organizing transaction activities is mainly affected by a series of transaction activities, such as formulating an RCCL transfer scheme, voting by village shareholders, applying for approval, organizing transactions, and signing contracts. The results showed that the level of specialization of transaction personnel, the number of village collective leaders and shareholders, the area of collective construction land transfer, the attributes of the geographic location, and the three attributes of the uncertainty of transaction rules (openness, equity, and justice) all affect the output value of suppliers.



Figure 2. The theoretical framework.

2.2. Hypothesis

Under the arrangement of transaction rules, the output of the supplier is mainly the total money of each parcel of land. The lower the degree of openness, equity, and justice, the higher the costs of the information searching and negotiation. In addition, due to the lack of supervision, the pricing will be unreasonable under uncertain transaction rules, which will lead to a negative impacts on farmers' interests and an unreasonable distribution of farmers' income. Therefore, if the transaction cost of supplier investment is higher, the market efficiency will be lower. On the other hand, if the transaction rules are more open, equitable, and just, the cost of the information searching and negotiation will be lower. With strict supervision, the price of RCCL transfer will be reasonable and the farmers' income will be guaranteed, thus promoting the development of the RCCL market, and leading to higher market efficiency. The lower the degree of openness, equity, and justice, the higher the costs of the information searching and organization negotiation, and so the lower the market efficiency.

Hypothesis 1 (H1). *The stronger the uncertainty of the three attributes of transaction rules (openness, equity, and justice), the higher the transaction costs of the supplier, and the lower the market efficiency.*

The market efficiency of rural collective construction land is affected not only by the degree of perfection of transaction rules, but also by the level of local economic development. The higher the level of economic development, the more developed the technology, and the more open the information,

and the more vigorous the demand for the rural collective construction land market. Therefore, to a certain extent, it makes up for the shortcomings of transaction rules.

Hypothesis 2 (H2). Except trading rules, the external economic environment also has an impact on market efficiency. If the level of local economic development is much higher, it will promote the improvement of market efficiency.

3. Study Area, Data, and Methodology

3.1. Study Area

Nanhai District (22°48′03″–23°18′00″ N, 112°51′55″–113°15′47″ E) is located in Foshan City, Guangdong Province (As shown in Figure 3). Guangdong is adjacent to Hong Kong and Macao. It seized the opportunity of industrial restructuring to enter a period of fast economic development. At present, the comprehensive strength of Guangdong's industrial economy is of the foremost in the country. In 2015, Nanhai District was the only pilot area in Guangdong Province in the reform of the RCCL. The pilot lasted for three years and ended in 2017. The reform promoted the development of a rural collective economy, as well as agricultural modernization and new urbanization. We chose Nanhai District as our study area as it had the first typical market-oriented RCCL transactions.



Figure 3. Location of Nanhai District, Guangdong, China.

3.2. Data Collection

We conducted an empirical study based on data collected from five towns in Nanhai District, Guangdong in 2018. We interviewed most villages in Nanhai District which participated in the rural collective construction land transfer, and conducted in-depth interviews with village cadres and villagers who participated in RCCL transfers. The survey respondents were mainly the shareholders in EC (Economic Cooperative) and EJC (Economic Joint Community), rural collective leaders, and personnel involved in transactions of the RCCL market. We obtained 269 questionnaires, of which 260 were valid. Other socioeconomic data on rural collectives were drawn from the yearbooks.

3.3. Variables

The market operation efficiency index mainly analyzed the input, economic output, and external environmental impact of three attributes of transaction rules (openness, equity, and justice) under the arrangement of RCCL market transaction rules, and was used to construct a system of operational efficiency.

3.3.1. Input-Output Index

According to the characteristics of RCCL market transaction rules, from the three attributes of openness, equity, and fairness, land information disclosure degree, transaction result information disclosure degree, the manner of bidding, income distribution, supervision mode, land pricing, and required service fee were selected as input indicators [27–29]. The total money of each parcel of land was taken as the output index.

From the input index (as shown in Table 1), the disclosure degree of plot information (X_1) reflected the coverage of the transaction rules of the RCCL market in the disclosure of information. The degree of disclosure of transaction results (X_2) reflected the extent to which RCCL market land transaction results are supervised by the masses. The manner of bidding (X_3) reflected the degree of acceptance by the transaction subject, which reasonably reflected the land value. Income distribution (X_4) reflected the degree of equity of the RCCL market. The supervision mode (X_5) reflected the fact that the stricter the supervision and management in the transaction process, the more effective it is at preventing corruption, speculation, and collusion and ensuring equity in the process. The more orderly the market competition, the more reasonable and obvious the land value and the higher the market operation efficiency. Land pricing (X_6) reflected the degree of justice in the RCCL market. The pricing should have a relevant basis. Farmers should have the right to participate in making decisions regarding RCCL pricing. The required service charge (X_7) reflected the justice of market transactions. The lower the service fee, the lower the transaction costs.

3.3.2. External Environment Variables

According to the influence of external environmental variables, such as asset specificity and other uncertainties, combined with the actual situation of the RCCL market, the industrialization level, foreign investment level, transaction cost, number of leaders and shareholders, education level, and geographic location were analyzed. The variables affecting market efficiency were selected.

			Definition	
	Human assets	Education level (Z_1)	Primary school = 1, junior high school = 2, senior high school = 3, university = 4, postgraduate = 5, doctor = 6	
Accel an acificity		Leaders (Z ₂)	Number of collective leaders	
Asset specificity		Shareholders (Z ₃)	Number of villager shareholders	
	Physical assets	Land scale (Z_4) Actual value (m^2)		
	Geographic location	Distance (Z_5)	Distance from land traded to town center (km)	
		Degree of disclosure of information about $plot(X_1)$	Village level = 1, town level = 2, district level = 3, national standard = 4, information platform = 5	
	Openness	Degree of disclosure of information about results (X ₂)	Village level = 1, town level = 2, district level = 3, national standard = 4, information platform = 5	
		Manner of bidding (X_3)	Explicit bidding = 1, implicit bidding = 0	
		Income distribution (X_4)	5:5 = 1; 4:6 = 2; 3:7 = 3; 2:8 = 4; 1:9 = 5	
Transaction uncertainty -	Equity	Supervision mode (X ₅)	No supervision = 1, platform internal supervision = 2, government participation in platform supervision, offline = 3, government and villager participation in platform supervision, online = 5, government, villager, and public participation in platform supervision, online = 5	
	Justice	Manner of determining price (X_6)	Government evaluation = 1, third-party intermediary evaluation = 2, government and third-party intermediary together = 3, third party, village representatives, and government intermediary together = 4, third party, village representatives, and enterprises = 5	
		Service charge (X_7)	$\geq 10,000 = 1;9999-6000 = 2;5999-2000 = 3;$ 1999-101 = 4; $\leq 100 = 5$	
	Influence of external	Industrialization level (E ₁)	Total industrial output	
Other transaction uncertainty	environmental factors	Level of foreign investment (E_2)	Foreign investment funds (RMB 10 ⁸)	
—	Transaction costs	Other transaction costs (E_3)	Other transaction costs (RMB 10 ²)	

 Table 1. Influencing factors of market efficiency.

3.4. Methods

A three-stage data envelopment analysis (DEA) model excludes the impact of capital specificity, external environmental factors, and random errors in the evaluation results, and can obtain a "purer" efficiency value reflecting the operational efficiency of the RCCL market [30–35]. Therefore, the three-stage DEA method was selected for the evaluation.

(1) In the first stage, the DEA model was constructed. The BCC (Abbreviation for banker, Banker, Charnes and Cooper) model was used to evaluate the operation efficiency of RCCL market.

$$\operatorname{Min}\left[\begin{array}{c} \theta - \varepsilon \left(e^{T} s^{-} + e^{T} s^{+} \right) \right] \\ \text{s.t.} \begin{cases} \sum_{i=1}^{n} \lambda_{i} x_{ij} + s^{-} = \theta x_{oj} \\ \sum_{i=1}^{n} \lambda_{i} y_{ir} - s^{+} = y_{or} \\ \sum_{i=1}^{n} \lambda_{i} = 1 \\ \lambda_{i} \geq 0; \ s^{-}, s^{+} \geq 0 \end{cases}$$
(1)

In Formula (1), i = 1, 2, n, j = 1, 2, ..., m, and r = 1, 2, ..., s; x_{ij} represents the *j*th input index of *i*-DMU (Decision making unit); *yir* represents the *r*th output index of the *i*-DMU; and θ is the efficiency value of the DMU. When $\theta = 1$ and $s^- + s^+ = 0$, the DEA is effective. When $\theta = 1$ and $s^- + s^+ > 0$, the weak DEA of the DMU is effective. When $\theta < 1$, the DMU is not effective.

(2) In the second stage, a similar stochastic frontier analysis (SFA) model was constructed. In order to minimize the influence of external environmental factors and random errors, based on the analysis results of the first step, the input redundancy was taken as the dependent variable, and the external environmental factors and random error were used as independent variables for regression analysis to construct the SFA model:

$$s_{ij} = f(z_j; \beta_i) + v_{ij} + u_{ij}$$

$$\tag{2}$$

where z_j is the environmental input factor, β_i is the coefficient of environmental factors, v_{ij} refers to the error caused by uncontrollable factors, and u_{ij} is the error caused by management inefficiency.

(3) The efficiency value of the RCCL market was taken as a dependent variable, and the transaction rules influencing the operational efficiency of the market were taken as independent variables. A tobit regression model was established to analyze the influence of these factors on RCCL market efficiency.

4. Results and Discussion

4.1. Results and Discussion

4.1.1. Analysis of Empirical Results

The results (before adjustment) are shown in Table 2. Before excluding the external environment and random error influence, the efficiency of the RCCL market in Nanhai District was low. The comprehensive technical efficiency was 0.129, pure technical efficiency was 0.415, scale efficiency was 0.310, and the return to scale was in the increasing stage. From different regions, the overall efficiency of the RCCL market was the highest in Guicheng Street at 0.151, with a pure technical efficiency of 0.425 and a scale efficiency of 0.355. Due to its better geographic location, Guicheng Street leads the development of villages in Nanhai District. Its secondary and tertiary industries are more developed, foreign investment is concentrated, the amount of investment is relatively large, and information dissemination is relatively transparent. In addition, the service level of trading platforms is relatively high.

Number	Region	First Stage (before Adjustment)				
Tumber		TE	РТЕ	SE	Scale	
1	Guicheng Street	0.151	0.425	0.355	Inc	
2	Dali Village	0.136	0.410	0.332	Inc	
3	Lishui Village	0.112	0.406	0.276	Inc	
4	Shishan Village	0.141	0.438	0.322	Dec	
5	Xiqiao Village	0.106	0.398	0.266	Inc	
	Total efficiency	0.129	0.415	0.310	Inc	

Table 2. Market efficiency of RCCL in Nanhai District before adjustment. TE: technical efficiency; PTE: pure technical efficiency; SE: scale efficiency; Inc: increasing; Dec: decreasing.

Second, the comprehensive technical efficiency of Shishan Village was 0.141, pure technical efficiency was 0.438, scale efficiency was 0.322, and the returns to scale were decreasing. Shishan is a comprehensive village located in the middle of Nanhai District with the functions of industry, scientific research, and an education base, with high industrial output value and a large amount of foreign investment, industrial upgrading, and effective allocation of RCCL. Therefore, the actual RCCL output in Shishan is higher.

Third, the comprehensive technical efficiency of Dali town was 0.136, pure technical efficiency was 0.410, scale efficiency was 0.332, and the returns to scale of the RCCL market were in the increasing stage. Dali is the hub of Guangfo traffic. There are many overseas investors, and the market is more flexible and mature than that of nearby villages, which makes the market efficiency relatively high. The comprehensive technical efficiency of Lishui town was 0.112, pure technical efficiency was 0.406, and scale efficiency was 0.276. The returns to scale of the RCCL market were in the increasing stage. Compared with other areas, Lishui has no advantage in terms of geographic location, and its economic development level is lower than its industrial development level, so the efficiency of its RCCL market is low. Finally, the comprehensive technical efficiency of Xiqiao town was 0.106, pure technical efficiency was 0.286, and the returns to scale of the RCCL market were in the increasing stage. Xiqiao has no obvious location advantage, its level of economic development is the weakest compared with other regions, and its industry and commerce are far behind other regions. The development of tourist resorts is the main industry with local resource characteristics, and its output value is low, so the efficiency of the RCCL market is low.

4.1.2. Influence of Environmental Factors on Output

According to the measurement results of the first stage, the relaxation of each input variable was obtained as the explained variable, the SFA model of the relaxation amount of input by the environmental variables outside the trading rules was established, and the SFA estimation results of the second stage were obtained. The regression estimation results, generated using FRONTIER 4.1, are shown in Table 3. The value of γ between 0 and 1 tended toward 1, which indicated that management inefficiency exists, passing the LR (Likelihood ratio) test. This shows that other uncertainty, asset specificity, and random factors have an influence on market efficiency. Therefore, it was necessary to eliminate the influence of other environmental factors outside the transaction rules when selecting the three-stage DEA. Compared with the random factors, the environmental factors had a significant impact on market efficiency. Looking at the regression coefficients of the eight explanatory variables, all of them passed the significance test, which shows that the variables outside the trading rules had an impact on the relaxation of input variables. Among these, the levels of local industrialization and foreign investment, land area, and the numbers of leaders and shareholder representatives had the greatest impacts on market efficiency.

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Slack	X1	X2	X ₃	X4	X5	X ₆	X ₇
Industrialization level	-0.892 ***	-0.712 ***	-0.746 ***	-0.678 ***	-0.899 ***	-0.616 ***	0.225 ***
Level of foreign investment	-0.550 ***	-0.422 ***	-0.409 ***	-0.301 ***	-0.488 ***	-0.315 ***	0.105 ***
Plot location	-0.006 ***	-0.011 ***	-0.051 ***	-0.189 ***	-0.526 ***	-0.327 ***	0.169 ***
Area size	-0.267 ***	-0.242 ***	-0.201 ***	-0.299 ***	-0.466 ***	-0.258 ***	0.206 ***
Education level	-0.157 ***	-0.112 ***	-0.101 ***	-0.029	-0.191 ***	-0.118 ***	0.020
Number of collective leaders	-0.396 ***	-0.552 ***	-0.497 ***	-0.368 ***	-0.329 ***	-0.171 *	0.355
Number of village shareholders	-0.772 ***	-0.850 ***	-0.702 ***	-0.609 ***	-0.881 ***	-0.599 ***	0.506
Other transaction costs	0.155 **	0.107 **	0.102 *	0.220	0.091 ***	0.046	0.110
Constant	-0.691 ***	-0.466 ***	-0.253 ***	-0.365 ***	-0.512 ***	-0.389 ***	0.089 ***
γ	0.866 ***	0.759 ***	0.789 ***	0.855 ***	0.912 ***	0.806 ***	0.722 ***
LR	28.92 ***	26.15 ***	19.86 ***	15.08 ***	12.11 ***	9.77 ***	8.63 ***

Table 3. Stochastic frontier analysis (SFA) estimation results in the second stage.

* Significant correlations at the 0.10 level (p < 0.10, both sides); ** significant correlations at the 0.05 level (p < 0.05, both sides); *** significant correlation at the 0.01 level (p < 0.01, both sides). The meaning of symbols is the same below.

The regression coefficients of the local industrialization level for relaxation variables such as the disclosure of transaction information, income distribution, the mode of supervision, and the manner of determining price were negative, which indicates that the higher the industrialization level, the more developed the local economy, and the more convenient it is for villagers in economically developed areas to obtain information, which promotes the disclosure of market information in the RCCL market. In addition, the level of science and technology and management in economically developed areas promotes improvement in the autonomous ability of collective economic organizations. A more developed region will have a higher level of science and technology, a more open market, more flexible modes of transaction, more diversified supervision methods and channels, and more reference basis and rationality of land price formation. However, more service fees will be required, which is not conducive to improving the market efficiency.

This result shows that foreign investment brings about local economic development and promotes openness of the local economy, thus promoting information openness in the RCCL market and making the income distribution between farmers and the government more equitable. In addition, it also increases the supervision degree of market transactions and promotes the improvement of market efficiency. The higher the transaction costs of the RCCL, the higher the input transaction costs, which is not conducive to market efficiency. The regression coefficients of the relaxation variables of geographic location and transaction plot area on the disclosure of information, the mode of supervision, the manner of determining price, and income distribution between rural collectives and the government were negative, while the regression coefficient of the service fee relaxation variable was positive, indicating the effect of geographic location and plot area closer to the town center. The more open the transfer of information, the more regulatory channels and methods there will be. In addition, there will be more supervision of the price formation mode, which promotes the transfer of RCCL and is conducive to the improvement of market efficiency. The higher the transaction costs, the lower the market efficiency.

The influence coefficient of educational level on input redundancy of almost all variables was negative, indicating that when the traders have a higher level of education, more investment costs can be saved and market efficiency can be improved. The input redundancy influence coefficient of the numbers of leaders and shareholder representatives is almost negative, which indicates that the participation of more leaders and representatives in transfers is more conducive to openness and information transparency, and more beneficial to promoting the rationalization of income distribution

and the diversification of supervision methods, and promoting the RCCL market as more open, equitable, and just, which improves market efficiency. The influence of other costs on all slack variables was positive, indicating that with more transaction costs of collective organizations in the process of RCCL transactions, the output and the market efficiency will be reduced.

4.1.3. Analysis of the Results of the Third Stage

According to the coefficient and Equation (2) of SFA regression, the input variable value was adjusted, the new value and the original output value were resubstituted into the DEA–BC² model, and the final efficiency value (after adjustment) was obtained, as shown in Table 4.

Number	Region -	Third Stage (after Adjustment)				
		TE	PTE	SE	Scale	
1	Guicheng Street	0.105	0.382	0.275	Inc	
2	Dali Village	0.099	0.396	0.250	Inc	
3	Lishui Village	0.108	0.430	0.252	Inc	
4	Shishan Village	0.120	0.419	0.286	Inc	
5	Xiqiao Village	0.103	0.415	0.248	Inc	
	Total efficiency	0.107	0.408	0.262	Inc	

Table 4. Market efficiency of RCCL in Nanhai District after adjustment.

Through the calculation and analysis of the third-stage DEA model, the following was found: First, after excluding the environmental variables, asset specificity, and random error influence, the comprehensive technical efficiency of the RCCL market in Nanhai District declined; the adjusted efficiency value was 0.107, the pure technical efficiency value was 0.408, and the scale efficiency value was 0.262. Second, the comprehensive technical efficiency, pure technical efficiency, and scale efficiency of Guicheng Street, Dali, and Shishan decreased, while the pure technical efficiency of Lishui and Xiqiao increased. This showed that environmental factors outside the transaction rules have a great influence on the input-output efficiency of RCCL in Nanhai District. The market efficiency of RCCL in Nanhai District under the arrangement of transaction rules was low, and the returns to scale, which were still in the increasing stage, had not reached the optimal value. Therefore, we should perfect the trading rules and reduce the input costs to improve the market's efficiency. Third, the change range of comprehensive technical efficiency of Xiqiao was very small, the pure technical efficiency increased after adjustment, and that was higher than Guicheng Street and Dali. After adjustment, the pure technical efficiency of Lishui was 0.430, which was higher than other villages. This shows that although Xiqiao and Lishui do not have a superior geographic location or developed industry and commerce, the agricultural industrialization and scale and informatization of the two villages in fact lead to a higher market efficiency and intensive utilization of land resources. Compared with Guicheng and Dali, Xiqiao and Lishui have more open, equitable, and just market trading rules.

4.1.4. Factors Influencing Market Efficiency

Many factors affect the market efficiency of an RCCL. Using Tobit regression analysis based on the efficiency value as the dependent variable, the factors influencing market efficiency were taken as independent variables. Through tobit regression, this paper studied the factors influencing the market efficiency of the RCCL in Nanhai District. First, the multiple collinearity test of regression model was used and the test of variance inflation factor (VIF) was selected. The results showed that the VIF was much lower than 10 (if VIF exceeds 10, there is a serious multicollinearity problem).

In terms of uncertainty, the three dimensions of uncertainty of transaction rules, openness, equity, and justice, affect the market efficiency of RCCL (as shown in Table 5). The more open the transaction information, the lower the costs of information searching, which is conducive to reducing the input and increasing the output of rural collectives and improving the market efficiency. Income distribution

had a positive impact. The more reasonable the income distribution, the more farmers' rights and interests are protected. The more scientific and popular the supervision method, the more equitable the transaction will be. This can prevent not only corruption between the government and collective economic organizations, it can protect the rights and interests of farmers. Land price has a positive impact on market efficiency [36,37]. The RCCL is owned by the farmers. The transaction price needs to be reasonable according to the actual situation in rural areas. Farmers should have the right to vote on decisions related to the RCCL transfers [38,39]. With a higher or lower price, the land value cannot be reasonable, and there are transaction risks for farmers. The higher industrial level, science technology, and management level are more conducive to promoting openness, equity, and justice in the RCCL market.

In terms of asset specificity, education level has a positive impact on market efficiency; the higher the education level of the people participating in the transaction, the lower the costs of searching for transaction information. This is beneficial to the supply-side, leading to savings transaction costs, increased output, and improved market efficiency. The number of leaders has a positive impact on market efficiency. More collective leaders are conducive to promoting the role of supervision and management, which promote openness, equity, and justice in the RCCL market. Transaction area has a positive impact on market efficiency. The larger the transaction areas, the higher the incomes of farmers who will pay more attention to supervising transactions that promote market efficiency.

4.2. Policy Implications

This paper studies the relationship between transaction rules and market efficiency, enriches the literature of RCCL market research, and provides a theoretical system and research methods for scholars, so as to improve the transaction rules of the RCCL market. In addition, the results show that the market efficiency of RCCL is low. The government should pay more attention to the RCCL market, and guide and regulate rural collective construction land transfer. According to Williamson's transaction cost theory, this paper studies the uncertainty of three attributes of transaction rules (openness, equity, and justice), analyzes and compares the transaction costs, selects more open, equitable, and just trading rules, reduces government intervention, and improves market operation efficiency.

The market transaction rules mainly need to be further adjusted and improve the transparency of transaction information, the rationalization of income distribution, and the fairness of land pricing, and strengthen supervision and management in the process of RCCL transactions [40,41], so as to make the whole transaction process open and transparent, fair, and just. We should ensure the security of land property rights in transactions and reasonably protect the interests of farmers. Furthermore, due to the different economic development levels in different regions, the openness, equity, and justice of the transaction rules should be combined with a local background system in order to create perfect RCCL transaction rules.

		Variable	Coef.	Std. Err	t	<i>p</i> > t
Transaction uncertainty		Degree of disclosure of information about plot X_1	0.014 ***	0.012	2.96	0.009
	Openness	Degree of disclosure of information about results X_2	0.217	0.002	1.36	0.103
		Manner of bidding X ₃	0.062	0.011	1.15	0.118
	Equity	Income distribution X ₄ 0.081 ***		0.001	4.50	0.006
		Mode of supervision X ₅	0.395 **	0.004	2.46	0.045
	Justice	Means of determining price X_6	0.026 **	0.026	2.51	0.039
		Service charge X ₇	-0.017	0.023	-1.04	0.162
Other uncertainties	Industrialization level	Total industrial output value E_1	0.006 ***	0.015	5.08	0.005
	Level of foreign investment	Foreign investment E ₂	0.057	0.013	1.17	0.116
	Transaction costs	Other transaction costs E_3	-0.045 *	0.012	-2.29	0.056
Asset specificity	Education level	Education level Z ₁	0.028 *	0.011	2.22	0.069
		Number of collective leaders Z_2 0.04		0.002	2.64	0.029
	Level of sen-organized governance	Number of village shareholders Z_3 0.005		0.001	0.96	0.651
	Area size	Size of trading area Z_4	0.017 **	0.002	2.71	0.022
	Location	Plot location Z ₅	0.012	0.004	0.66	0.803
		Constant	0.106 **	0.046	2.56	0.036
		Log likelihood	309.351			
		Pseudo R ²	-0.118			
		LR chi ²	52.65			
		Prob > chi ²	0.000			

Table 5. Factors influencing the RCCL market.

* Significant correlations at the 0.10 level (p < 0.10, both sides); ** significant correlations at the 0.05 level (p < 0.05, both sides); *** significant correlation at the 0.01 level (p < 0.01, both sides).

5. Conclusions

With the rapid development of urban land marketization, the land, especially urban land, became more and more scarce. In order to regulate the RCCL into the market, the pilot areas have issued market trading rules. Therefore, we choose to study three attributes of transaction rules (openness, equity, and justice). We mainly focus on the transaction cost of the supply side (the rural collective) and the output. Due to the local economic development level having a certain impact on the market efficiency of RCCL, we select the SFA model to exclude the influence of different economic levels of each township and random errors. Under the same level of economic development, how about the real market operation efficiency of Nanhai District? We find that under the arrangement of market trading rules, the market operation efficiency is low. Then, we analyze the reasons for the low market efficiency, and propose to improve the open, equitable, and just trading rules.

The limitations of the study are as follows: Firstly, based on Williamson's transaction cost theory, this paper constructs the theoretical framework of the relationship between the supply-side (rural collective) input costs and the market efficiency of the RCCL market under the arrangement of transaction rules. We estimate the transaction costs of RCCL only from the three attributes of transaction costs are not only affected by the uncertainty (openness, equity, and justice), but also by other uncontrollable factors. In addition, these three attributes of variables may be able to find a better alternative, so as to estimate the transaction cost more accurately. Secondly, excluding the impact of external environmental variables on market efficiency, these external environmental variables may select the substitutes. This can more accurately reflect the market efficiency. Due to the limitations of the selected variables and data, the market efficiency of RCCL needs to be further studied. Finally, we only analyze the relationship between the input and output of the supply side. In the next step, we need to combine the relationship between the input and output of the demand side and the costs of government expenditure to comprehensively analyze the market operation efficiency.

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