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How Much Farmland Are Farmers Willing to Lease? The Construction and Evaluation of a Farmland Transfer Supply Function with Application to a Case Study in China

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Abstract: China is going to vigorously develop a new type of agricultural business that is characterized by large-scale planting, and its farmland transfer market is expected to shift from a "buyer's market" to a "seller's market". In the literature, the optimal scale of farmland management is mainly discussed from the perspective of farmland lessees. The development of a healthy farmland transfer market should also consider the needs of farmland lessors. In this paper, we construct a farmland transfer supply function from the perspective of farmers, based on the theory of land market pricing, and apply it to assess the price–volume relationship using surveyed farmland transfer data on wheat farmers in Henan Province, China. The major findings of the present study are as follows: (i) farmers can optimize the allocation of production factors through the farmland transfer market to maximize their profits, and (ii) the quantity of farmland transferred to the market is significantly positively correlated with the price of farmland transferred, demonstrating a power function relation. Currently, the average price of farmland transferred in China's main grain-producing areas exceeds CNY 800 per *mu*. There is a difference between the actual quantity of farmland transferred and the supply function estimated in this paper, indicating that the market is currently in a crucial period of vigorously promoting farmland transfer. We suggest that government departments follow the laws of farmland transfer, refer to the farmland transfer supply function, and implement policies that support and benefit grain production to provide rapid and consistent guidance to the farmland transfer market.

Keywords: farmland transfer; farmland supply function; perspective of farmland provider; China

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1. Introduction

China's agricultural system has been very dynamic since the end of the 1970s. The household responsibility system was crucial for the early development of agricultural production in China [1,2] and small-scale family management advanced during a certain period [3]. However, this system gradually declined due to the drawbacks of small-scale agricultural production, such as low land production efficiency, poor comparative efficiency of industries, large input of agricultural chemicals [4], and weak international competitiveness of agricultural products [5,6]. Alleviating the tension between population growth and farmland, increasing farmers' income, and stabilizing agricultural production have once again become major issues that must be urgently addressed in China. A moderate-scale agricultural operation mode, with the advantages of family operation and economies of scale, has attracted much attention from researchers and policy-makers; it has become key to developing modern agriculture, rural areas, and farmers in China [7]. In 1987, the Chinese government first explicitly proposed exploring the development mode of moderate-scale farmland management. By 2016, the government officially implemented the "three-rights division" of rural farmland property rights: land ownership, contracting rights and management rights. This "three-rights division" was intended to clarify the relationship between farmland property rights, revitalize the rural land market, promote

moderate-scale agricultural operations, and accelerate the process of agricultural modernization [8,9]. Undoubtedly, the prerequisite for achieving these strategic goals is building an efficient farmland transfer market. It should be noted that the farmland transfer referred to in this paper only means that the management right of rural household contracted farmland is rented out to someone else or in from someone else.

However, China's farmland transfer market is not very efficient or promising. Since China started the pilot reform of rural land ownership confirmation in 2008, the transfer of rural land has accelerated. As a result, the proportion of household contracted farmland transferred reached its peak in 2017 (Figure 1). However, since then, this proportion has continuously declined. Therefore, China's farmland transfer market has entered an unfortunate situation in which rent is high and the transfer rate is low, indicating that the transfer of farmland is valuable but not marketable [10,11]. The key to solving this problem lies in clarifying the price–volume relationship of farmland management rights transfer and determining the supply function of farmland transfer [12]. However, farmland management rights transfer and its influencing factors are complex and diverse, and the goals of farmland supply and demand are inconsistent [13]. To a large extent, the different target demands of lessors and lessees make it difficult for both sides to reach an agreement on the price of farmland transfer. The goal of lessees is often singular: to maximize their profits. On the other hand, the objectives of lessors are often diverse and related to the economic, social, and identity value of farmland to farmers [10]. Thus, it is important to consider the price–volume relationship of farmland supply from the perspective of farmland lessors.

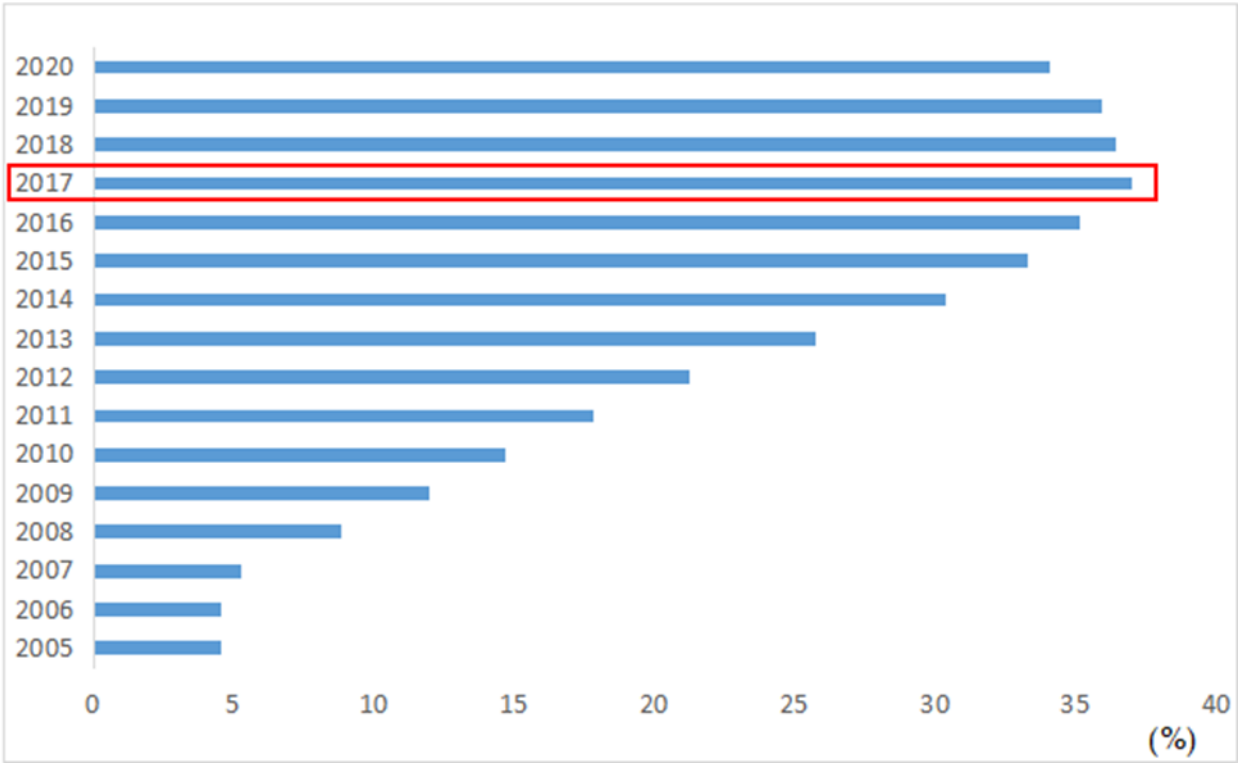

Figure 1. Proportion of household contracted farmland transferred in China's total arable land.

The paper contributes to the literature in three ways. First, a new research perspective is proposed. We argue that a healthy farmland transfer market should balance the interests of farmland contractors and operators. Discussing the optimal demand scale of farmland only from the perspective of the lessee may makes it difficult to protect the interests of both lessees and lessors during farmland transfer.

Second, a new pricing approach for farmland transfer is explored. At present, it is rare to use quantitative analysis tools to accurately measure the supply function of farmland in rural China. Based on farmland market pricing theory and local equilibrium theory, in this paper, we construct, derive, measure, and evaluate the farmland transfer supply function.

Third, this study shows that the relationship between the supply and price of farmland transfer is better represented by a power function, rather than a simple linear model. In other words, as the farmland transfer price increases, from the supply side, the rate of farmland transfer accelerates. This indicates that China is currently in a critical period in terms of farmland transfer and it is necessary to pay special attention to and actively guide the supply side of farmland transfer.

Therefore, this paper is going to construct a general model of the price–volume relationship of farmland transfer based on the theories of farmland market pricing and partial equilibrium from the perspective of the farmland lessors. In detail, this paper will deduce, calculate, and evaluate the farmland transfer supply function. The result will provide a new perspective for perfecting pricing theory of farmland transfer and explore the practice of establishing an efficient farmland transfer market in China.

2. Literature Review

Previous academic studies focused on the following three endeavors: comparing the pricing theories of farmland transfer, analyzing the formation mechanism of farmland transfer prices, and determining the factors that influence farmland transfer.

The first academic focus is comparing the pricing theories of farmland transfer. There are two main theories of farmland pricing: "farmland rent price theory" based on British classical economics and Marx's political economy, and "market price theory" assessing the opportunity cost-benefit from the transfer of farmland management rights. The first theory regards farmland as a special commodity with unique characteristics such as limited property rights, fixed location, heterogeneity of quality, and duality of functions [14]. This theory promotes the transfer of farmland to a certain extent. However, it still has some defects, such as complex operation and insufficiently objective estimation of relevant parameters [15]. The second theory views farmland transfer pricing as an opportunity cost–benefit assessment from the perspective of the temporary transfer of farmland management rights [15]. The market transaction behavior of farmland management rights is embedded in the general price–volume theory of commodity economics, which simplifies the pricing procedure and reduces the subjectivity of the pricing process [16]. In fact, the behavioral decision of farmers choosing not to sell their farmland in the farmland transfer market is essentially the induced demand for farmland. The motivation of farmers to transfer farmland is not unlike the production decision of producers, whose goal is to maximize their profits [17].

The second research focus is analyzing the formation mechanism of farmland transfer prices. Previous studies mainly discussed the formation mechanism of farmland transfer prices from the three perspectives: economic profit, transaction cost, and social ethics [18]. From the first perspective, farmland is regarded as an ordinary, homogeneous production factor and the analysis paradigm of farmland excess profit is adopted to study the formation mechanism of the farmland transfer equilibrium price. From the second perspective, the process of farmland transfer is regarded as a property rights auction, focusing on the impact of transaction costs. From the third perspective, the perspective of behavior, the impact of human and social factors, such as local ethical norms, on the process of farmland transfer is considered [19].

The third research focus is identifying the influencing factors of farmland transfer. Most studies have explored farmland transfer behavior from the perspective of maximizing income [20,21]. Even though the pursuits of farmers have diversified over time and in response to changes in the external environment [22], the most important driver of the farmland transfer decisions of farmers is still how to maximize their profits and household utility [23]. Considering this, many studies focused on the impact of nonfarm employ-

ment [24], agricultural technology and economic conditions [25], policy support [26], land endowment [27], agricultural prices [28,29], characteristics of farmers [30], and local customs [31] on the farmland transfer market.

In summary, by exploring various theories, analyzing the formation mechanism of farmland transfer prices, and studying the influencing factors of farmland transfer, researchers have obtained important results. However, further research is required in at least two areas.

First, the literature often discusses the optimal scale of farmland management from the perspective of farmland contractors. However, a healthy farmland transfer market should consider the interests of farmland contractors and operators [32]. At present, China is vigorously promoting large-scale farmland operations [33]. In the future, China's farmland transfer market is expected to shift from a "buyer's market" to a "seller's market" [34]. Therefore, exploring the relationship between the volume and price of farmland transfer from the perspective of farmland lessors is imperative. Second, previous studies have provided either a general discussion of the influencing factors of farmland supply or a qualitative assessment of the volume–price relationship of farmland transfer. Few studies have accurately estimated the supply function of farmland transfer using quantitative analysis tools.

3. Theoretical Hypotheses and Supply Function

3.1. Necessary and Reasonable Assumptions

The pursuit of maximizing returns is the ultimate determinant of whether and how much farmland a farmer leases. According to this, the supply function of the farmland transfer market is constructed, and it is necessary to make the following reasonable assumptions about the farmland transfer market and the planting decisions of participants.

Hypothesis I: The farmland transfer market is transparent and smooth. This assumption mainly emphasizes the completeness and symmetry of the information on farmland transfer and the smoothness of transactions. In practice, due to the dissemination of information on farmland transfer through various platforms, the establishment and improvement of intermediary agencies, and strong promotion by the government, this assumption seems to hold in real transactions [35,36].

Hypothesis II: The use and planting structure of farmland is the same before and after farmland transfer. This assumption may not always hold in reality. However, according to the field survey conducted in this study and the data available from farmland transfer platforms, more than 70% of farmland is still used for grain crop production after farmland transfer [37]. Moreover, according to the strategic requirements of national food security, which has strong "policy rigidity", the use of grain farmland cannot undergo major changes [37].

Hypothesis III: Nationwide, there is a large number of part-time farmers who can supply farmland, a large number of professional households can absorb farmland, and their preferences are additive. This assumption ensures free competition in the farmland transfer market and excludes a monopoly by the lessees or lessors. In fact, creating a free market environment for the transfer of farmland management rights is an important goal of farmland reform in China.

Hypothesis IV: Farmland management rights [38] and working hours are the two most important tradable resources that farmers can freely dispose of, and the total amount of these resources is constant. The economic dependence of farmer households on farmland is mainly manifested as income dependence and labor employment dependence [10]. The possession and control of farmland contracting rights and their own working time are currently the largest and most valuable resources that Chinese farmers have. From

this perspective, it is logical to regard crop yield as a function of labor and planted area. The input of productive capital also plays a role in improving the efficiency of labor and farmland production. Agricultural capital input is essentially regarded as labor and farmland inputs.

3.2. Construction of Farmland Transfer Supply Function

The scarce resources that farmers (lessors) possess mainly include labor time and cultivated farmland area; therefore, farmers' final decisions will depend upon these two factors, with the goal of maximizing their profits (Table 1). Assuming that the total revenue of a farmer is *TR*, the term should include income from agricultural production (*IAP*), wage income from nonagricultural activities (*WIN*), income from farmland renting (*IFR*), and subsidies for growing grain (*SGG*). The costs for grain farmers mainly include agricultural productive investment (*API*).

Table 1. The core variables affecting farmers' decisions regarding land supply.

Cost Variations	Revenue Variations
Agricultural productive investment (*API*)	Income from agricultural production (*IAP*) Income from nonagricultural activities (*WIN*) Income from farmland renting (*IFR*) Subsidies for growing grain (*SGG*)
Other variables	

To clarify the decision-making variables influencing farmland lessors, the net profit function of farmers is constructed by referring to the relevant literature [39]. First, the Cobb-Douglas (C-D) function of the extended variable is selected to characterize the yield of grain crops. That is, grain production Q is a function of labor (L), capital (K) and land (S).

$$\begin{aligned} Q = Af(L,K,S) = A * L^a * K^b * S^c = A * [l(S_0 - S_G)]^{\mathrm{a}} * [k(S_0 - S_G)]^b * (S_0 - S_G)^c \\ = A * l^a * k^b * (S_0 - S_G)^{a+b+c} \end{aligned} \quad (1)$$

Second, a cost-benefit function for part-time farmers is constructed.

$$\begin{aligned} TR = IAP + WIN + IFR + SGG = P_{YM} * Q + W_{WIN} * [T - l(S_0 - S_G)] + P_F * S_G + SGG * S_0 \\ = P_{YM} * \ A * l^a * k^b * (S_0 - S_G)^{a+b+c} + W_{WIN} * [T - l(S_0 - S_G)] + P_F * S_G + AGF * S_0 \end{aligned} \quad (2)$$

$$AI = k * (S_0 - S_G) \quad (3)$$

where S_0 and S_G represent the total area of the farmer's contracted farmland and the farmland supplied to the transfer market, respectively; *SGG* is the amount of grain growing subsidy per unit area of farmers (In China, subsidies for growing grain are often distributed directly to farmland contractors. Even if the farmland management right is transferred, the grain subsidy is still paid to the original farmland contrac-tors. Therefore, whether the farmland is transferred or not does not affect the receipt of grain subsidies by farmland contractors.); T represents the annual working hours of the farmers; W_{WIN} is the nonfarm payroll wage level; P_{YM} and P_{FT} represent grain prices and farmland transferred prices per unit, respectively; and l and k are the working hours and capital input of farmers per unit of farmland, respectively.

Finally, the net profit function of grain growing for part-time farmers is as follows:

$$\begin{aligned} R = TR - API = \Big\{ P_{YM} * A * l^a * k^b * (S_0 - S_G)^{a+b+c} + W_{WIN} * [T - l(S_0 - S_G)] + P_{FT} * S_G \\ + SGG * \ S_0 \Big\} - k * (S_0 - S_G) \end{aligned} \quad (4)$$

Using the Lagrange extreme value theorem, the following can be obtained:

$$\frac{\partial R}{\partial S_G} = (P_{FT} + k + l * W_{WIN}) - (a + b + c) * P_{YM} * A * l^a * k^b * (S_0 - S_G)^{a+b+c-1} \quad (5)$$

Equation (5) is equal to zero, maximizing the income of farmers and yielding the supply function of China's farmland transfer market:

$$S_0 - S_G = \left[\frac{P_{FT} + k + l * W_{WIN}}{(a+b+c) * P_{YM} * A * l^a * k^b} \right]^{\frac{1}{a+b+c-1}} \quad (6)$$

Based on Equation (6), we introduce the following hypothesis: when other conditions are unchanged, the supply of farmland in China is positively correlated with the price of transferred farmland, and the relationship is manifested as a power function. Meanwhile, the supply of farmland is also negatively correlated with the income of agricultural products (*IAP*) and positively correlated with agricultural productive investment (*API*), agricultural labor time (*l*), subsidies for growing grain (*SGG*), and the employment wage rate of nonfarm sectors.

Next, we estimate the relevant parameters in Equation (6) by using the survey data of farmland transfer in major grain-producing areas. The supply function of farmland transfer is determined, and the transferred farmland quantity measured by Equation (6) is compared with the actual transferred quantity to evaluate the reliability of the supply function of farmland transfer.

4. Estimation and Evaluation of Farmland Supply Function

We estimated the supply function of farmland transfer based on survey data of farmers' farmland transfer in the major wheat-producing areas of Henan Province in 2014. Then, we empirically evaluated the estimated supply function of farmland transfer based on survey data of wheat farmers' farmland transfer in southwest Henan Province in 2019.

The farmland transfer of wheat farmers in Henan Province surveyed in 2014 is presented as a convincing case study. First, Henan is a traditional grain-producing area and the largest wheat-producing province in China. Its wheat output accounts for more than a quarter of the country's total output. Therefore, it is highly relevant to a discussion of the supply function of farmland transfer for wheat farmers in China. Second, the data are from a key period in farmland transfer in China. It was in 2014 that the Chinese government issued the "Opinions on Guiding the orderly Circulation of Rural Farmland Management Right and Developing Moderate-scale Agricultural Operations", indicating that the transfer of farmland management rights in China had entered a new stage of standardized and large-scale development. From 2010 to 2014, China's staple grain prices were in an upward cycle and the grain planting farmland transfer market was hot. In 2014, approximately two-thirds of the farmland used to grow grain on China's representative large family farms came from the transfer market [40]. After 2014, the state gradually abolished the temporary procurement and storage policy of some staple grains, resulting in a drop in grain prices of more than 30%; this diverted farmers away from grain production and hindered the development of the farmland transfer market [41].

4.1. Variable Descriptions and Data Sources

According to Equation (6), the variables involved in the empirical evaluation mainly include the area of contracted farmland of wheat farmers in Henan Province (S_0), the area of contracted farmland supplied to the transfer market (S_G), the wheat growing subsidy (*SGG*), the annual labor input time of wheat growers (*T*), the wage level of nonagricultural employment (W_{WIN}), the price of wheat (P_{YM}), the price of farmland transferred (P_{FT}), and the labor (*l*) and capital (*k*) inputs of grain farmers. Table 2 presents the basic statistical characteristics of the variables.

Table 2. Variable definition and descriptive statistics.

Variables	Definition	Mean	Std.	Min.	Max.	Obs.
$\ln(l)$	Labor input (day/*mu*)	1.962	0.473	0.871	3.082	435
$\ln(k)$	Capital investment (CNY/*mu*)	5.497	0.407	4.616	6.080	435
S_0	Total contracted farmland (*mu*/hh)	6.628	5.231	0.4	45	435
S_G	Net outflow of farmland (*mu*/hh)	4.921	4.275	0.25	45	435
$\ln(P_{FT})$	Farmland rental price (CNY/*mu*)	6.521	0.631	3.789	7.037	435
$\ln(W_{WIN})$	Nonfarm wage (CNY/day)	4.639	0.426	3.774	5.361	435
$\ln(P_{YM})$	Wheat price (CNY/50 kg)	4.816	0.198	4.771	4.890	435
SGG	Subsidy for wheat farmers (CNY/*mu*)	104.888	20.765	0	200	435

Note: hh indicates rural household.

The original data came from two sources. One data source was the authors' field survey on the farmland transfer and production behavior of farmers in the wheat crop production areas of Henan Province, China. Based on the principle of stratified random sampling, the research team selected 2760 farmers in 324 villages in 12 grain-producing prefecture-level cities in the province to conduct a comprehensive study of their unique characteristics, land circulation, and production behavior. A preliminary analysis of the survey data revealed that a total of 1009 farmers participated in land circulation, accounting for approximately 36.6% of all surveyed farmers, which was greater than the national average (approximately 30%) in the same period. Among them, 435 households achieved a net outflow of farmland and planted wheat before and after farmland transfer, accounting for 43.1% of all farmers participating in the transfer of farmland. This indicated that the farmland transfer market was active and in a stage of rapid development in the major grain-producing area of Henan Province during this period.

The second data source was a collation of several publicly available statistical datasets, including the Food and Agricultural Organization of the United Nations Database (FAO), the National Rural Economic Situation Statistical Data (NRSS), the China Rural Operation and Management Statistical Annual Report (CROM), the National Agricultural Product Cost and Benefit Data Compilation (NAPC), the China Statistical Yearbook (CSY), the China Rural Statistical Yearbook (CRSY), the China Labor Statistics Yearbook (CLSY), and Tu liu wang: http://www.tuliu.com (accessed on 28 November 2022).

4.2. Farmland Transfer Supply Function Estimation

First, take the natural logarithm of both sides of Equation (6):

$$\begin{aligned} \ln(S_0 - S_G) &= C + \frac{\ln(P_{FT}+k+l*W_{WIN})}{a+b+c-1} - \frac{\ln(P_{YM})}{a+b+c-1} - \frac{a\ln l}{a+b+c-1} - \frac{b\ln k}{a+b+c-1} \\ &= C + \frac{\ln(X_{P_F})}{a+b+c-1} - \frac{\ln(P_{YM})}{a+b+c-1} - \frac{a\ln l}{a+b+c-1} - \frac{b\ln k}{a+b+c-1} \end{aligned} \quad (7)$$

For ease of expression, let

$$C = -\frac{\ln[A*(a+b+c)]}{a+b+c-1};\ X_{P_F} = P_{FT} + k + l*W_{WIN}$$

Second, conduct regression analysis of Equation (7) to obtain the estimated values of relevant parameters (Table 3).

Table 3. Estimation of the farmland transfer supply function of wheat farmers in Henan Province.

Variables	Coefficients	Standard Error	t Values
$\ln(X_{P_F})$	−5.882 ***	0.285	−20.639
$\ln(P_{YM})$	5.882 ***	0.316	18.614
$\ln(l)$	0.506	0.325	1.556
$\ln(k)$	0.676 *	0.301	2.246
cons	8.621 ***	0.385	22.392
R^2	0.137	-	-
Obs.	435	-	-

Note: *, *** indicates significant at the level of 10% and 1%, respectively.

Finally, by substituting regression coefficients (Table 2) into Equation (6), Equation (8) can be expressed as follows:

$$\ln(S_0 - S_G) = 8.621 - 5.882\ln\left(X_{P_F}\right) + 5.882\ln(P_{YM}) + 0.506\ln(l) + 0.676\ln(k) \quad (8)$$

By sorting out Equation (8), the supply function of the farmland transfer market in the main wheat-producing areas of Henan Province, Equation (9) can be written as follows:

$$S_G = S_0 - \mathrm{e}^{8.621 - 5.882\ln\left(X_{P_F}\right) + 5.882\ln(P_{YM}) + 0.506\ln(l) + 0.676\ln(k)} \quad (9)$$

Equation (8) clearly demonstrates that the quantity S_G of transferred farmland provided by grain farmers into the farmland transfer market is significantly positively correlated with the price (P_{FT}) of farmland transferred. It is significantly negatively correlated with the wheat price (P_{YM}) in the current year, negatively correlated with (but not significantly related to) the average working time (l) of wheat production, and significantly negatively correlated with the average capital input (k) of wheat production.

To better understand the correlation between the quantity of farmland transferred and the influencing factors, the following points should be considered:

First, the higher the price of the transferred farmland is, the more income grain farmers can obtain by increasing the supply of farmland. In other words, this result will motivate grain farmers to transfer more farmland.

Second, the higher the wheat price is, the more income grain farmers can obtain from growing grain on their own farmland. In other words, this result will discourage grain farmers from transferring more farmland.

Third, the amount of labor dedicated to growing wheat does not have a significant impact on farmers' decisions to transfer their contracted farmland. This is possibly because grain farmers have more leisure time. In other words, grain farmers are not sensitive to the labor time cost.

Fourth, the larger the average capital input of wheat production is, the less willing grain farmers will be to transfer their farmland. This result implies that if grain farmers have invested a lot of capital (mostly agricultural mechanization), for example, more than average, it will be very difficult for them to rent out their farmland. This may be particularly true for large-scale grain farmers. On the other hand, they may be more likely to rent in more farmland.

4.3. Reliability of Farmland Transfer Supply Function

To verify the reliability of the estimated supply function of farmland transfer, we conducted an empirical reliability assessment using a dataset from 562 wheat farmers in 11 counties (or cities) in southwestern Henan Province in 2019. Among the 562 grain farmers surveyed, 339 transferred their farmland, accounting for approximately 60% of all the surveyed grain farmers. Ninety-three households showed a net outflow of their contracted farmland, accounting for 27.4% of the total households that transferred their farmland (339).

By inputting relevant data into Equation (9), we estimated that the average transferred farmland of 93 wheat farmers in southwest Henan would be 6.460 *mu* in 2019. This estimate was close to the value obtained in the survey that found that the average scale of farmland transferred was 5.943 *mu* in 2019 (Table 4). This result demonstrated that the formula may be used to predict future values of the farmland transfer market in Henan Province based on the supply function developed in this paper. On the other hand, the difference between the estimated value and the observed result from the survey data indicates that there are some obstacles in the current farmland transfer market in Henan that are not conducive to farmland transfer transactions.

Table 4. Statistics of wheat farmers' farmland transfer in southwest Henan Province in 2019.

Variables	Variable Definitions	Mean	Std.	Min.	Max.	Obs
$\ln(l)$	Labor input (day/*mu*)	2.103	0.510	0.774	3.763	93
$\ln(k)$	Capital investment (CNY/*mu*)	5.548	0.481	4.302	6.598	93
S_0	Total contracted farmland (*mu*/hh)	6.935	5.013	0.610	48.50	93
S_G	Net outflow of farmland (*mu*/hh)	5.943	4.609	0.010	48.50	93
$\ln(P_{FT})$	Farmland rental price (CNY/*mu*)	6.711	0.576	3.146	7.313	93
$\ln(W_{WIN})$	Nonfarm wage (CNY/day)	4.728	0.443	3.912	5.940	93
$\ln(P_{YM})$	Wheat price (CNY/50 kg)	4.771	0.192	4.771	4.828	93
SGG	Subsidy for wheat cultivation (CNY/*mu*)	126	17.256	0	150	93

Note: hh indicates rural household.

In conclusion, considering the perspective of farmland supply farmers, we regard labor and self-owned farmland as the core production factors and construct the farmland transfer supply function based on the land market pricing mechanism and the theory of partial equilibrium. The farmland transfer supply function is estimated by using the survey data from 435 households in Henan, which is mainly a wheat producing area: $S_G = S_0 - e^{8.621-5.882\ln(X_{P_F})+5.882\ln(P_{YM})+0.506\ln(l)+0.676\ln(k)}$. This function accurately reflects the actual situation of farmland transfer in Henan Province and provides a new framework for guiding pricing of rural farmland management rights.

5. Policy Implications and Research Prospects

5.1. Policy Implications

Using our novel farmland transfer supply function, it is straightforward to calculate the farmland transfer area based on the farmland transfer price. The function can provide a reference for the robust and rapid development of the farmland transfer market and help inform macro decision making by government management agencies.

As an example, in 2019, the average price of farmland transfer in China's main grain-producing areas exceeded 800 CNY/*mu*. If the transaction costs are not considered, based on Equation (9), the percentage of farmland supply that is transferred should exceed 60%. There are issues in China's agricultural production process such as excessive labor input and insufficient capital input. Among estimates obtained from the farmland transfer supply function, the labor input ($\ln l$) coefficient was not significant, and the capital input ($\ln k$) coefficient was significant and positive. This indicates that it is time to accelerate the transfer of China's farmland and actively promote moderate-scale agriculture. In view of this, government departments should refer to the farmland transfer supply function to implement policies that support agriculture and benefit farmers, standardize and promote the orderly transfer of farmland, and improve China's agricultural production efficiency.

5.2. Research Expectations

Future research should focus on the following four aspects:

First, we highlighted the impact of regional differences on the farmland transfer supply function. The differences in the natural conditions of farmland, regional level of economic development, and cultural customs in different regions affect the volume–price relationship

of farmland transfer [42]. Therefore, in future studies, it is necessary to consider the influence of regional differences and apply the farmland transfer supply function separately by region to yield more accurate results and draw more robust conclusions.

Second, we emphasized the volume–price relationship when the use of farmland differs before and after farmland transfer (e.g., the planting structure changes). Our method is based on a key assumption that the use of farmland is the same before and after transfer. However, in practice, the land use of some transferred farmland may change and this may lead to disagreements regarding the farmland transfer price and scale between the two sides [31,43].

Third, it is necessary to consider the influence of rural culture, such as rural human relations, on the volume price of farmland transfer. Due to incomplete urbanization and the prominent fragmentation of land in China, there are still many properties that are "leased for the purpose of maintaining interpersonal relations" [44]. That is, migrant workers lease their own agricultural land to their relatives and friends at zero cost. Ignoring this may lead to underestimating the actual price of farmland transfer.

Fourth, future quantitative research on the demand function for the farmland transfer market should be carried to obtain data regarding the demand of operators. Based on two-sided market theory [45,46], the optimal scale and price of farmland transfer in China can be determined, which is important information for China's farmland transfer market.

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