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Family Net Income, Input Factor Prices and Agriculture Services Selection Behavior of Maize Farmers

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Abstract: Scaling service operations is an effective way to promote modernization among small farmers. Exploring the factors influencing grain farmers' choices in selecting services is essential to promote the strong development of the agricultural production service market and improve the efficiency of agricultural operations in China. Based on the 2019 data on corn farmers in the China Rural Revitalization Survey (CRRS) database, and using the Double-Hurdle Model, the factors influencing the service selection behavior of corn farmers are explored, and the research conclusions are as follows: (1) agricultural service prices have a negative impact on the demand for agricultural services, which varies from service to service; (2) labor prices do not influence the demand for any kind of service; (3) land circulation rents have a negative impact on the demand for agricultural services, which varies from service to service; (4) a high family net income can significantly prompt the adoption of agricultural services, which varies from service to service; (5) small-scale farmers are more sensitive to changes in service prices than large-scale farmers; (6) the four economic factors have no effect on the sowing service market. Based on the above conclusions, this paper puts forward suggestions such as improving the market price mechanism for agricultural production services, and increasing subsidies related to agricultural production services.

Keywords: grain farmers; agricultural production services; behavioral decision making; influencing factors

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1. Introduction

Small-scale farmers are the main agricultural operators in China, and it is of great significance to promote the effective connection between small-scale farmers and the big market to improve the operating efficiency of small-scale farmers. In order to speed up the process of national industrialization and liberate the productive forces, in 1978, China established a rural land management system based on the household responsibility system. The household responsibility system allows land to be provided by the State to a village cooperative of farmers so that each of them receive an equal plot, or they can rent out their use rights to another farmer.

The implementation of the household responsibility system has mobilized enthusiasm for production, provided sufficient material capital for the country's industrialization, and promoted economic growth, but it has also caused China to form and remain in a decentralized and fragmented land management state for a long time. In the long run, it is difficult for agriculture to achieve economies of scale; at the same time, advanced agricultural technology and planting experience cannot be smoothly transmitted to rural areas, the conversion rate of results is low, the efficiency of agricultural output and economic benefits are low, the agricultural production of small scale and of low efficiency is gradually

decoupled from the growing demand for high-quality agricultural products, and China's agricultural competitiveness has lagged behind that of developed countries for a long time, which will not only hinder China's industrialization process, but also pose a threat to China's food security. So, how to achieve efficient agricultural production under the conditions of small-scale decentralized operation?

Achieving large-scale production is an important way to connect smallholder farmers to large markets. There are many ways to achieve large-scale production. Land transfer is considered to be an important method for large-scale agricultural operation. But due to the imperfect land transfer contract, fierce competition among factors, and high agricultural production costs [1,2], there is a large gap between the benefits of land transfer and the expected results [3,4]. Therefore, land transfer alone cannot completely solve the problem of the disadvantaged position of smallholder farmers in the market. In a context of decentralized land management, the purchase of agricultural productive services may also be an effective way to improve efficiency. Since the establishment of the household production contract responsibility system, the agricultural production service industry has grown from a weak link in the rural economy to an engine for the transformation and upgrading of the agricultural and rural economy [5]. The development of agricultural production and service industry is very important for improving China's agricultural production efficiency, optimizing the factor input structure, and promoting the high-quality development of agriculture. Many research results suggest that agricultural productive services can compensate for the disadvantages of fragmented production structures, optimize factor allocation to save costs [6], reduce environmental pollution, and increase agricultural yields [7–9]. Therefore, agricultural production services can help grain farmers to achieve the goal of improving the quality, efficiency and income of agricultural production, so as to ensure China's food security and achieve sustainable development.

Although the role of agricultural productive services in agricultural production is highly recognized, there is still a lot of room for development in the future. In 2020, the number of smallholder farmers served by various service organizations reached 78.047 million, and in 2022, the number of various socialized service organizations nationwide reached 1.041 million, serving only approximately 89 million smallholder farmers (Data Source: *A Report on Chinese Rural Economic Development in 2022*). With nearly 200 million smallholder farmers in China, why has the agricultural production service industry not been fully adopted by smallholder farmers, and what are the factors influencing the choice of agricultural services?

Behind farmers' differentiated service preference is the interaction of social relations, household business characteristics, transaction costs, market environment and other factors.

Economic factors play an important role in farmers' decision to use agricultural services. First, the agricultural machinery service is a common example of an agricultural production service, and there is an obvious substitution relationship between machinery and labor [10]. Second, if the cost of using agricultural technology is too high, such as the high cost of genetically modified corn seeds, then farmers' adoption rates will also be reduced [11]. Third, when making technology adoption decisions, farmers pay more attention to the economic return of the technology than the yield [12], and the probability of adopting agricultural production techniques is also low for low-net-income farmers [11,13]. Finally, sufficient and transparent market information helps farmers better learn about agricultural production services, and increases the likelihood of adoption [14,15].

Price support policies and fertilizer subsidy policies may promote the adoption of agricultural technology services by farmers [16]. Karh et al., (2019) suggest that policies designed to increase the adoption of agricultural production services are more likely to succeed when they provide farmers with inputs that farmers perceive as complementary, including mineral fertilizer [17]. However, due to credit constraints, agricultural support policy may promote the adoption of an agricultural service but inhibit the adoption of complementary services [18].

Social capital has a positive effect on agricultural production service adoption [19,20]. Cameron (1999) used panel data to study the dynamics of seed adoption in high-yielding new varieties, showing that learning from one's own experience plays an important role in adoption decisions [21]. Genius et al., (2014) hold that social learning and technology diffusion were considered to be powerful determinants of technology adoption and diffusion, and they could be mutually reinforcing [22]. Karishman and Patham (2014) believed that social learning has long-term effects on improving the adoption rate of technology services, but technology extension does not have long-term effects [23]. Usman and Ahmad (2018) hold that exploitative and explorative learning act as the parallel mediators between social capital and the adoption of best crop management practices [24]. Shikuku (2019) suggests that social learning can help to address informational constraints to the adoption of agricultural technologies [25].

The adoption of agricultural technology by farmers also depends on land lease models. While cash-renters are less likely than owner-operators to use conservation farming, share-renters are not, mainly because of uncertainty about the timing of benefits from the introduction of agricultural technology services [26]. Group participation is also associated with higher adoption rates of agricultural production services [27–29]. Technical training for women has helped to increase the adoption of agricultural technical services by this group [30]. Soil characteristics, cropping systems, and size of farming operation can also influence farmers' decision [31].

Through the summary of the above literature, we can find that there are three problems which we need to explore more deeply: first, the existing literature rarely explores the influence of service price on the service choice behavior of small farmers; second, it rarely explores the service choice behavior of grain farmers from the perspective of regional heterogeneity and service heterogeneity; and third, regarding the model selection, the Logit and Probit models used in most of the literature cannot overcome the endogenous problems caused by sample self-selection. So this paper uses the Double-Hurdle Model to explore the influencing factors of farmers' service selection behavior, and provides reference opinions and suggestions for subsidy policies related to agricultural production services.

2. Materials and Methods

2.1. The Theoretical Basis and Research Hypothesis

2.1.1. The Impact of Factor Prices on the Demand for Agricultural Production Services

Although agricultural production services are an intangible commodity, their supply and demand are not significantly different from the tangible commodity market. Agricultural production services are a modern production factor, which generally exists in the form of mechanical services in the process of agricultural production to substitute own labor [32]. Since the economic return from non-agricultural employment is higher than that from agricultural production, the opportunity cost for farmers engaged in agricultural production increases, resulting in the psychology of abandoning agriculture, the outflow of rural surplus labor, the structure of agricultural labor gradually tends to be aging and changed, the decrease in the number of agricultural laborers and the scarcity of a high-quality agricultural labor force promote a rise in labor prices, and farmers' demand for agricultural machinery gradually increases, which creates favorable conditions for the development of the agricultural production service market. From this, Hypothesis 1 and Hypothesis 2 are proposed.

Hypothesis 1. *Rising prices for agricultural production services lead to a decrease in the demand for agricultural production services.*

Hypothesis 2. *Higher labor prices promote the adoption of production agricultural services by farmers.*

When the land rent is reduced, the operating conditions of rural households will improve, and the operating costs will be reduced, so rural households may be willing to use agricultural productive services, and increase the purchase of agricultural productive services. In the case of a reduction in land rents, the willingness of farmers to expand their planting will also increase [33], and the increase in planting area may also lead to an increase in the purchase of agricultural productive services. When the land rent rises, the land operator has two choices, one is to reduce the planting area, which itself will lead to a decrease in the demand for socialized services, and the other is that even if the land is still rented, and the planting area is not less, due to the more investment in the early stage, the farmer may consider reducing the demand for socialized services in the future and do it by their own labor as much as possible. Therefore, when the price of land rent rises, the farmer will decrease the usage of outsource services at this time. This leads to Hypothesis 3.

Hypothesis 3. *The increase in land circulation rent has a restraining effect on the demand for production services by rural farmers.*

2.1.2. The Impact of Agricultural Income on the Demand for Agricultural Production Services

Firstly, the low financial returns from agriculture determines that agricultural production requires long-term and large household capital. A sufficient family net income can ease farmers' agricultural investment constraints and improve farmers' expectations of agricultural income, thereby increase their willingness to manage agriculture. So farmers with a high family net income are likely to choose and try new technology or agricultural services.

Hypothesis 4. *An increase in the net income of the family can encourage farmers to purchase production agricultural services.*

2.2. Empirical Data and Model Setting

2.2.1. Data Sources

The research data in this paper are derived from the China Rural Revitalization Survey (CRRS) database. From August to September 2020, the database investigation team conducted a survey of 300 villages in 150 townships in 50 counties in 10 provinces across the country. The sampling method of the survey provinces was as follows: 1/3 of the number of all provinces were randomly selected from the eastern, central, western and northeastern regions, and finally three provinces of Guangdong, Zhejiang and Shandong were selected in the eastern region, two provinces of Anhui and Henan were extracted in the central region, four provinces of Guizhou, Sichuan, Shaanxi and Ningxia were extracted in the western region, and Heilongjiang Province was extracted in the northeast region.

Equidistant sampling was applied to counties and townships according to per-capita GDP, and sample villages were randomly selected from two areas with poor and better local economic development levels with the cooperation of the township government. The survey method adopted for the sample farmers is to first screen out certain farmers in the village according to the roster provided by the village committee, and then through equidistant groups—each group randomly selects 1 household, each village selects 14 farmers, and 2 farmers are used as alternatives.

The survey was divided into three sections: individuals, families and villages. The contents of the individual survey include the basic characteristics, education status and employment status of the respondents; the content of the household survey includes the characteristics of the family population, income and expenditure, planting structure, land circulation, working outside the home, and understanding of the reform of the collective property rights system; the content of the village survey includes the population and organization of the village, land status, rural undertakings, agricultural production and operation, and collective economic development. The data on the reform of the rural collective property rights system include whether the reform has been completed, whether

collective shares have been set up, the attitude of villagers, and their understanding of the reform; the data on the rural collective economy include assets, liabilities, income, and expenditure.

This paper mainly uses questionnaires at the individual and household levels, and after using the linear difference method, forward and backward filling methods to fill in the data gaps and the data cleaning process, this paper selects the three services of cultivating land, harvesting and sowing service as the research objects, with a sample size of 806, 836 and 809 samples, respectively.

2.2.2. Model Setting

This paper selects the Double-Hurdle Model proposed by Cragg (1971) [34]. The rationale for choosing this model is that it can handle sample selection bias that cannot be solved by the Logit and Probit models. The reason for the estimation bias is that the zero value of the observed explanatory variable in the sample may come from two sources: one is that no matter how the external environment changes, the farmer will not choose the service, and the other is that the farmer is limited by the external conditions and so does not choose the service, but once the appropriate external conditions are available, the farmer will produce service demand. That is, the decision to participate in the market and the decision on how much to buy are decoupled. So single-stage regression models such as the Logit and Probit and Tobit models do not distinguish between these two zero values, which may lead to model estimation bias [35]. The estimation process of the two-column model is divided into two stages, the first stage is estimated using the Probit model, and the second stage is estimated using the Tobit model.

The first stage is a binary choice model for whether farmers purchase services, as follows:

$$d_i^* = \gamma + \alpha Z_i' + \varepsilon_i \quad (1)$$

in which d_i^* is the latent variable of whether a farmer buys a service or not, d_i is whether farmers purchase services, if $d_i^* > 0$, then $d_i = 1$, and the farmer will enter the second phase of the regression equation; otherwise, $d_i = 0$, and this sample of farmers will not enter the second stage of the regression equation. Z_i' represents all explanatory variables that affect the latent variable of whether a farmer purchases a service, ε_i is the error term.

The second stage is the decision-making model of the purchase intensity of agricultural production services by farmers, expressed as follows:

$$y_i^* = \delta + \beta X_i' + u_i \quad (2)$$

in which, y_i^* is the latent variables in purchasing intensity of agricultural production services of farmers, y_i is the intensity of purchasing agricultural production services of farmers, if $d_i^* > 0$ and $y_i^* > 0$, and then $y_i = d_i^* \times y_i^*$; otherwise, $y_i = 0$. X_i' represents all explanatory variables that affect the latent variable of the intensity of farm household service purchases, u_i is an error term.

2.3. Variable Selection and Descriptive Statistics

The explanatory variable in this study is the amount of service purchased, and the service area of land cultivation, seeding, harvesting and fertilization is used as the explanatory variable. As can be seen from Table 1, 51% of the farmers in the total sample used sowing services, and the average area using sowing services was 0.307 hectares. Approximately 9% of the farmers use the pest and disease control service, and the average area using the pest and disease control service is 0.18 hectares. Approximately 37% of farmers use fertilization services, and the average area using fertilization services is 0.146 hectares. Approximately 50% of the farmers use the harvesting service, and the average area using the harvesting service is 0.846 hectares. 43% of the farming farmers use tilling services, and the average area using tilling services is 0.43 hectares.

Table 1. Descriptive statistics of variables.

	The Variable Name	Label or Unit	Average Value	Standard Deviation	Minimum	Maximum
Five services Service area	Tilling	hectares	0.43	1.32	0.000	16.08
	Sowing	hectares	0.307	1.17	0.000	16.08
	Harvesting	hectares	0.846	2.65	0.000	33.5
Whether to adopt the service	Sowing	1 = Yes; 0 = No	0.51	0.50	0.000	1.000
	Harvesting	1 = Yes; 0 = No	0.50	0.50	0.000	1.000
	Tilling	1 = Yes; 0 = No	0.43	0.49	0.000	1.000
Service price	Harvesting	Thousand Yuan/hectare	1.437	742.8	375	2964.285
	Sowing	Yuan/hectare	536.1	300.45	12.165	3750
	Tilling	Thousand Yuan/hectare	1.035	813.9	136.335	3000
Labor prices	Prices for hired workers during busy agricultural periods	Yuan/Day	130.01	51.99	0.000	300.000
Land circulation rent	Land circulation rent	Thousand Yuan/hectare	8604.6	6543.45	0.000	45,000
Household income variable	Net income of the family	Thousand Yuan	71,170.97	14,293.66	-3.93×10^4	8.40×10^5
The extent of the development of the market for agricultural production services in villages	Tilling services	hectares/person	0.57	1.85	0.000	19.52
	Seeding services	hectares/person	0.31	0.60	0.000	5.17
	Fertilization services	hectares/person	0.19	0.485	0.000	4.06
	Pest and disease services	hectares/person	0.18	0.61	0.000	5.2
	Harvesting services	hectares/person	0.85	1.69	0.000	10.58
Village topography	Whether located on a plain or not	1 = Yes; 0 = No	0.47	0.50	0.000	1.000
Part-time employment of the head of household	Whether or not working part-time	1 = farming; 2 = part-time	1.46	0.50	1.000	2.000
The degree of land fragmentation	Average area of a piece of tilling	hectare/block	0.32	11.99	0.001	157.000
The level of education of the head of the household		Primary school education or less	0.37	0.48	0.000	1.000
		Junior high school, high school, or junior college degree	0.49	0.50	0.000	1.000
		Bachelor's degree or above	0.14	0.34	0.000	1.000
Age of the head of household		Less than or equal to 30 years old	0.02	0.13	0.000	1.000
		Greater than 30 years old and less than or equal to 55 years old	0.57	0.50	0.000	1.000
		Older than 55 years old	0.41	0.49	0.000	1.000
Zone dummy variables	Northeast	1 = Yes; 0 = No	0.13	0.34	0.000	1.000
	Eastern	1 = Yes; 0 = No	0.16	0.37	0.000	1.000
	Central	1 = Yes; 0 = No	0.25	0.43	0.000	1.000
	West (control group)		0.46	0.50	0.000	1.000

The core explanatory variables include eight variables: service price of tilling, sowing seed, harvesting and fertilization, labor price, land rent, net income from corn planting in 2019 and planting subsidy in 2019. The average service price for tilling service is 1035 yuan/hectare, the average service price for the sowing service is 536.1 yuan/hectare, the average service price for the fertilization service is 658.95 yuan/hectare, the average service price of the harvesting service is 1437.75 yuan/hectare, and the average service price of the pest and control service is 378.45 yuan/hectare. The average labor price is 130.01 yuan/day. The average land rent is 8604.6 yuan/hectare. In 2019, the average net income of farmers from corn planting was 4865.45 yuan, and the average income from national planting subsidies received by farmers in 2019 was 2145.43 yuan.

The control variables include three types of variables: family business characteristics variables, village-level characteristics variables and regional dummy variables. The characteristics variables of the household operation mainly include four variables: the age of the head of the household, the level of education, whether he or she is engaged in a business outside farming and the degree of fragmentation of the cultivated land. Village-level characteristics variables include village topography and the degree of market development of agricultural production services in the village. In this paper, the western region was used as the control group in the regional dummy variables, and the descriptive statistical results of the variables are shown in Table 1. The proportion of household heads aged 30 years old or younger is approximately 2%, the proportion of groups with a head older than 30 years up to 55 years old is approximately 57%, and the proportion with a head of household over 55 years old is approximately 41%. Approximately 37% of the heads of farmers have an education level of primary school or less, approximately 49% have a junior secondary, high school or junior college degree, and approximately 14% of have a bachelor's degree or above. From the perspective of the degree of part-time work of household heads, the proportion of household heads working as full-time farmers is approximately 46%, and the proportion of heads of farmers engaged in part-time farming is approximately 54%. The average value of the fine-fragmentation degree of cultivated land was 0.32 hectare/block. The mean topographical relief of the villages is 0.47, indicating that approximately 47% of the villages are located in plains areas. In this paper, the per-capita service area of each village is used to indicate the degree of development of the agricultural production service market, and the higher the value, the more complete the development of the agricultural production service market and the stronger the supply capacity of agricultural production service organizations.

3. Results

3.1. Regression Results of the Overall Samples

This paper will focus on the influence of economic factors on the choice behavior of agricultural productive services of maize growers. Table 2 shows how economic factors influence farmers' area uptake of agricultural services. Here, we mainly based our analysis on the results of the second-stage regression of the Double-Hurdle Model, with the other results shown in Table A1. As can be seen from Table 2, column 2, the prices of tillage services negatively influence the area uptake of tillage services, confirming Hypothesis 1, and the labor prices during agricultural busy period have no effect on the area uptake of tillage services, not confirming Hypothesis 2. We can also see that the land circulation rents have no effect on the area uptake of tillage services, not confirming Hypothesis 3, and the family net income can positively influence the area uptake of tillage services, confirming Hypothesis 4. According to the results in column 3, the area uptake of sowing services is not influenced by any economic factor. According to the results in column 4, the area uptake of harvesting services is only positively influenced by the net income of the family.

Table 2. Overall sample estimates of the three kinds of agricultural services.

	Tillage Services	Sowing Services	Harvesting Services
The prices of agricultural services	−0.000 ***	0.003	−0.000
	(−2.770)	(0.088)	(−1.360)
The labor prices	−0.001	−0.009	−0.001
	(−0.689)	(−0.499)	(−0.745)
The land circulation rent	0.000	−0.002	−0.000
	(0.615)	(−0.607)	(−0.579)
The family net income	0.000 *	0.000	0.000 ***
	(1.820)	(0.210)	(3.275)

Note: In the second column, the estimated coefficient for the price of services was −0.00037; the estimated coefficient for the net income of households was 0.00000287; and the estimated coefficient for the net income of households was 0.00001 in the fourth column. The very small estimates are due to the large differences in the magnitude of the independent and dependent variables. **** indicates significant at the 1% and 10% statistical levels, respectively.

3.2. Analysis of Regression Results of Small-Scale Farmers Samples

Table 3 shows how economic factors influence small-scale farmers' area uptake of agricultural services. In terms of the prices of services, we can see that the prices of tillage services have a negative effect on the area uptake of the tillage services, and the price of harvesting services have a negative effect on the area uptake of harvesting services. We can also see that the prices of labor price during agricultural busy period have no effect on the area uptake of any kinds of services. In terms of land renting price, it can be seen that the area uptake of tillage services can be negatively influenced by the land renting prices, and the area uptake of harvesting services can also be negatively influenced by the land renting prices. In the case of the net income of the family, we can see that the area uptake of any kind of agricultural service cannot be influenced by the net income of the family.

Table 3. Sample estimation results of small-scale farmers.

	Tillage Services	Sowing Services	Harvesting Services
The prices of agricultural services	−0.000 ***	0.000	−0.000 ***
	(−5.399)	(0.756)	(−2.772)
The labor prices	0.000	−0.000	0.000
	(0.649)	(−1.283)	(0.203)
The land circulation rent	−0.000 **	−0.000	−0.000 *
	(−2.317)	(−0.756)	(−1.801)
The family net income	0.000	0.000	0.000
	(0.653)	(0.284)	(1.402)
R-squared	0.2732	0.2460	0.3754

Note: In the second column, the estimated coefficient for the price of services was −0.000113; the estimated coefficient for the land circulation rent was 0.000001. In the fourth column, the estimated coefficient for the price of services was −0.00005; the estimated coefficient for the land circulation rent was 0.000001. The very small estimates are due to the large differences in the magnitude of the independent and dependent variables. ****** indicates significant at the 1%, 5% and 10% statistical levels, respectively.

3.3. Analysis of Regression Results of Large-Scale Farmers

Table 4 shows how economic factors influence large-scale farmers' area uptake of agricultural services. In terms of the prices of services, we can see that only the prices of tillage services have a negative effect on the area uptake of the tillage services. We can also

see that the prices of labor price during agricultural busy period have no effect on the area uptake of any kinds of services. In terms of land renting price, it can be seen that only the area uptake of tillage services can be negatively influenced by the land renting prices. In the case of the net income of the family, we can see that only harvesting services can be positively influenced by the net income of the family, and the other two kinds of services are not be influenced by the net income of the family.

Table 4. Regression results of large-scale farmers samples.

	Tillage Services	Sowing Services	Harvesting Services
The prices of agricultural services	−0.000 *	−0.000	−0.000
	(−1.766)	(−0.498)	(−1.473)
The labor prices	0.001	0.000	−0.002
	(0.494)	(0.011)	(−0.789)
The land circulation rent	−0.000 *	0.000	0.000
	(−1.810)	(0.115)	(0.105)
The family net income	0.000	0.000	0.000 ***
	(1.305)	(1.152)	(2.887)
R-squared	0.1567	0.2973	0.4595

Note: In the second column, the estimated coefficient for the price of services was −0.00013; the estimated coefficient for the land circulation rent was 0.00002. In the fourth column, the estimated coefficient for the family net income was 0.00001. The very small estimates are due to the large differences in the magnitude of the independent and dependent variables. **** indicates significant at the 1% and 10% statistical levels, respectively.

3.4. Calculation of Elasticity

In order to better present the above sample estimation results, we calculate the factor price elasticity and income elasticity of farmers' demand for services. The formula for calculating the price elasticity and income elasticity of services is as follows:

$$e_{sevp} = \frac{\partial y_k}{\partial p_k} \cdot \frac{E(p_k)}{E(y_k)} = \beta_{p_k} \cdot \frac{E(p_k)}{E(y_k)} \tag{3}$$

$$e_{sevinc} = \frac{\partial y_k}{\partial income} \cdot \frac{E(income)}{E(y_k)} = \beta_{income} \cdot \frac{E(income)}{E(y_k)} \tag{4}$$

y_k is the area of service, p_k is the factor price, $\beta_{(pK)}$ is the marginal effect of factor price on the area of service, and β_{income} is the marginal effect of pure income or crop-related subsidies on the area of service. $E_{(\beta k)}$ represents the average price and $E_{(yk)}$ represents the average service area.

Tables 5–7 show the price elasticity of demand and income elasticity of services for all farmers, large-scale households and non-large-scale households.

Table 5. Calculation of elasticity of Tillage service demand.

	Service Price	Labor Prices	Cultivated Land Circulation Rent	Family Net Income
Small-scale farmers	−1.67	0	−0.45	0
Large-scale farmers	−0.12	0	−0.17	0
Total sample	−2.22	0	0	0.45

Table 6. Calculation of elasticity of demand for seeding services.

	Service Price	Labor Prices	Cultivated Land Circulation Rent	Family Net Income
Small-scale farmers	0	0	0	0
Large-scale farmers	0	0	0	0
Total sample	0	0	0	0

Table 7. Calculation of elasticity of harvesting service demand.

	Service Price	Labor Prices	Cultivated Land Circulation Rent	Family Net Income
Small-scale farmers	−1.0	0	−0.164	0
Large-scale farmers	0	0	0	0.34
Total sample	0	0	0	0.70

4. Discussion

For Hypothesis 1: The prices of agricultural services have a negative effect on the area uptake of the service. According to the estimating results in Table 2, we can see that the prices of tillage services are more likely to influence the area uptake of tillage services compared with the other two kinds of services. That suggests the role of the prices of services in the tillage service market are more efficient than the other two markets. The reason may be that the tillage services are in great demand, which prompts the development of the tillage service market, and improve the efficiency of the prices of tillage services. The prices of harvesting services can only affect the demand for small-scale farmers, with no effect on large-scale farmers. And according to the results in Table 5, the price elasticity of tillage services of small-scale farmers is higher than that of large-scale farmers; otherwise, the demand for harvesting service of small-scale farmers is much more influenced by the price of harvesting services than that of large-scale farmers. The reason may be that for small-scale farmers, an obvious and stable increase in agricultural profit is difficult to achieve, so they pay more attention to the cost of maize planting, as long as the service prices rise, their demand will drop significantly, but for large-scale farmers, they have enough capital to buy agricultural services, although there is an increase on service price. In a word, the Hypothesis 1 is confirmed.

For Hypothesis 2: Higher labor prices prompt the adoption of production agricultural services by farmers. But our estimating results shows that the area uptake of any kind of service is not influenced by the labor prices. The reason may be that the supplement of the family own labor and the other reason is that higher labor prices increase the cost of maize planting, so the farmers are willing to be engaged in non-agricultural job. Above all, the Hypothesis 2 is not confirmed.

For Hypothesis 3: The increase in land circulation rent has a restraining effect on the demand for production services by rural farmers. This hypothesis can be confirmed according to the estimating results above. On the one hand, the increase in land circulation rent leads to an increase in the cost of maize planting, which will restrain farmers' adoption of the agricultural services. On the other hand, the increase in land circulation rent may make farmers decrease the area of maize planting, which will contribute to the less area uptake of the agricultural service. Of course, this effect varies from farmers from farmers. Large-scale farmers may be less influenced by land circulation rent than small-scale farmers due to their higher possibility of more profit.

For Hypothesis 4: An increase in the net income of the family can encourage farmers to purchase production agricultural services. This hypothesis can be confirmed according to according to the estimating results above. Besides, we can see that the family net income has no effect on the area uptake of the small-scale farmers, the reason may be that small-scale

farmers are intended to buy other goods than agricultural productive inputs when they have an increase on the family net income due to the low rate of return.

5. Conclusions

Based on the corn farmers data in the 2019 China Rural Revitalization Survey (CRRS) database, and using the Double-Hurdle Model, we explored how economic factors influence the area uptake of the agricultural services, and the research conclusions are as follows: First, agricultural service prices have a negative impact on the demand for agricultural services, which varies from service to service. Second, labor prices do not influence the demand for any kind of service. Third, land circulation rents have a negative impact on the demand for agricultural services, which varies from service to service. Fourth, a high family net income can significantly prompt the adoption of agricultural services, which varies from service to service. Fifth, small-scale farmers are more sensitive to changes in service prices than large-scale farmers. Sixth, the four economic factors have no effect on the sowing service market.

(1) A healthy agricultural service market needs an efficient service price. So it is necessary to continue to improve the price mechanism of the agricultural production service market, and improve the service quality of all services of the service market, and stimulate the effective demand for farmers.
(2) We have the price elasticity of the tillage service market and the harvesting service market, so we can subsidize the service providers of these two service markets and promote the development of the two markets, indirectly reduce the operating costs of corn farmers, so that farmers can benefit.
(3) This study also finds that an increase in household net income can prompt the adoption of agricultural production services by farmers, so the willingness of farmers to adopt agricultural production services can be increased by giving subsidies to farmers who plant maize.

Inadequacies:

(1) This paper is based on the fact that all the farm households receive the same services of farming, sowing and harvesting, but, in fact, there are differences in the quality of service provision between different regions, this paper does not accurately identify the differences among the same kinds of services.
(2) This paper is a data analysis based on cross-sectional data, so the price elasticity is not changed with time. With panel data, the results of the estimates will be more reliable.

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Appendix A

Table A1. Supplement to regression results of Table 2.

	Tillage Services		Sowing Services		Harvesting Services	
	The Decision Equation	**The Quantity Equation**	**The Decision Equation**	**The Quantity Equation**	**The Decision Equation**	**The Quantity Equation**
The prices of agricultural services	0.000		0.007		0.019	
	(0.042)		(0.947)		(0.989)	
The labor prices	−0.005 **		−0.000		−0.005	
	(−2.133)		(−0.032)		(−0.868)	
The land circulation rent	0.000		0.001 **		0.001	
	(1.195)		(2.487)		(1.000)	
The family net income	0.000		−0.000 ***		0.000 *	
	(0.191)		(−4.418)		(1.949)	
The development of the agricultural services	0.003	0.099 ***	0.012	1.269 ***	0.017	0.395 ***
	(1.025)	(3.415)	(1.227)	(10.308)	(1.209)	(5.796)
landsplit	−0.051 ***	3.804 ***	−0.082 ***	0.483 *	−0.061 ***	2.847 ***
	(−5.338)	(14.437)	(−4.329)	(1.774)	(−3.371)	(14.536)
plant	0.249	−0.483	1.662 ***	14.034 ***	−4.974	1.984
	(0.922)	(−0.226)	(4.737)	(4.497)	(−0.061)	(0.584)
edu1	−0.007	2.071	−1.150 ***	1.562	−0.529	1.805
	(−0.025)	(1.079)	(−3.132)	(0.687)	(−0.647)	(0.650)
edu2	−0.092	1.274	−0.688	0.308	−1.256	4.696
	(−0.223)	(0.454)	(−1.321)	(0.111)	(−1.384)	(1.236)
age1	0.736	8.826	−6.380	−6.420	−2.741	−4.136
	(1.190)	(1.050)	(−0.037)	(−1.005)	(−0.001)	(−0.372)
age2	0.838	9.495	−5.988	−6.685	−2.633	−0.092
	(1.261)	(1.134)	(−0.035)	(−1.042)	(−0.001)	(−0.008)
var1_12	−0.347	6.141 ***	−0.020	−0.800	−0.103	1.731
	(−1.491)	(2.999)	(−0.070)	(−0.404)	(−0.197)	(0.654)
northeast	0.000	13.171 ***	0.007	2.745	0.019	11.737 **
	(0.042)	(3.608)	(0.947)	(0.765)	(0.989)	(2.081)
east	−0.005 **	−1.480	−0.000	9.417 ***	−0.005	10.644 ***
	(−2.133)	(−0.576)	(−0.032)	(3.529)	(−0.868)	(2.737)
central	0.000	−5.203 **	0.001 **	6.748 ***	0.001	5.586
	(1.195)	(−2.138)	(2.487)	(2.709)	(1.000)	(1.463)
_mill		−45.680 ***		27.323 ***		−31.759 ***
		(−5.400)		(3.507)		(−4.563)
_cons	1.300	−15.638	7.144	−21.756 ***	8.593	−15.770
	(1.404)	(−1.623)	(0.042)	(−2.862)	(0.002)	(−1.145)

Note: ****** indicates significant at the 1%, 5% and 10% statistical levels, respectively.

Table A2. Supplementary to regression results of Tables 3 and 4.

	Tillage Services		Sowing Services		Harvesting Services	
	Small	**Large**	**Small**	**Large**	**Small**	**Large**
mean_gdsev	0.002 *	0.012 ***	0.008 **	0.074 ***	0.011 ***	0.062 ***
	(1.730)	(3.005)	(2.276)	(3.579)	(2.763)	(4.803)
landsplit	0.056 **	0.008	0.043 ***	0.005	0.053 ***	0.054 ***
	(2.476)	(0.505)	(2.775)	(0.823)	(2.985)	(2.890)
plant	0.017	0.360 *	0.082 ***	−0.058	0.076 ***	−0.154
	(0.583)	(1.750)	(3.027)	(−0.363)	(3.026)	(−0.435)
edu1	0.034	0.018	0.012	−0.071	0.005	0.084
	(1.475)	(0.091)	(0.724)	(−0.407)	(0.344)	(0.290)

Table A2. *Cont.*

	Tillage Services		Sowing Services		Harvesting Services	
	Small	**Large**	**Small**	**Large**	**Small**	**Large**
edu2	0.024	−0.314	−0.021	−0.017	0.012	0.655
	(1.080)	(−1.481)	(−0.984)	(−0.086)	(0.467)	(1.518)
age1	−0.045	0.300	0.046	−0.036	−0.034	−0.585 *
	(−0.988)	(0.607)	(1.184)	(−0.149)	(−1.449)	(−1.890)
age2	−0.023	0.474	0.032	0.006	−0.020	−0.558
	(−0.485)	(0.896)	(0.794)	(0.026)	(−0.749)	(−1.416)
var1_12	0.026	−0.123	0.007	0.046	0.008	−0.557 *
	(1.228)	(−0.562)	(0.353)	(0.313)	(0.534)	(−1.717)
northeast		0.770 **		−0.052		−0.007
		(2.267)		(−0.351)		(−0.015)
east	−0.134 ***	−0.074	0.034	0.149	−0.033	0.331
	(−3.698)	(−0.455)	(1.187)	(0.743)	(−0.852)	(1.302)
central	−0.152 ***	−0.036	0.009	0.163	−0.066 *	0.119
	(−4.374)	(−0.205)	(0.356)	(0.777)	(−1.736)	(0.333)
_cons	0.236 ***	−0.016	−0.072	−0.149	0.090 *	1.006
	(2.872)	(−0.025)	(−1.419)	(−0.423)	(1.796)	(1.415)

Note: ****** indicates significant at the 1%, 5% and 10% statistical levels, respectively.

References

1. Zhu, W.; Paudel, K.P.; Inoue, S.; Luo, B. Farmland lease, high-rent threat and contract instability: Evidence from China. *China Agric. Econ. Rev.* **2021**, *13*, 799–831. [CrossRef]
2. Che, Y. Mismatch: Land reallocations, recovery land rental and land rental market development in rural China. *China Agric. Econ. Rev.* **2014**, *6*, 229–247. [CrossRef]
3. Qiu, T.; He, Q.; Choy, S.T.B.; Li, Y.; Luo, B. The impact of land renting-in on farm productivity: Evidence from maize production in China. *China Agric. Econ. Rev.* **2020**, *13*, 78–95. [CrossRef]
4. Liu, Y.; Wang, C.; Tang, Z.; Nan, Z. Will farmland transfer reduce grain acreage? Evidence from Gansu province, China. *China Agric. Econ. Rev.* **2018**, *10*, 277–292. [CrossRef]
5. Jiang, L. The development course and experience enlightenment of agricultural productive service industry in China. *J. Nanjing Agric. Univ. Soc. Sci. Ed.* **2016**, *16*, 104–115+157.
6. Tang, L.; Liu, Q.; Yang, W.; Wang, J. Do agricultural services contribute to cost saving? Evidence from Chinese rice farmers. *China Agric. Econ. Rev.* **2018**, *10*, 323–337. [CrossRef]
7. Chen, S.; Zhong, Z.; Lu, H. Impact of agricultural production outsourcing service and land fragmentation on agricultural non-point source pollution in China: Evidence from Jiangxi Province. *Front. Environ. Sci.* **2023**, *10*, 1079709. [CrossRef]
8. Chen, X.; Liu, T. Can Agricultural Socialized Services Promote the Reduction in Chemical Fertilizer? Analysis Based on the Moderating Effect of Farm Size. *Int. J. Environ. Res. Public Health* **2023**, *20*, 2323. [CrossRef]
9. Zhu, Y.; Deng, J.; Wang, M.; Tan, Y.; Yao, W.; Zhang, Y. Can Agricultural Productive Services Promote Agricultural Environmental Efficiency in China? *Int. J. Environ. Res. Public Health* **2022**, *19*, 9339. [CrossRef]
10. Liu, Y.; Hu, W.; Jetté-Nantel, S.; Tian, Z. The Influence of Labor Price Change on Agricultural Machinery Usage in Chinese Agriculture. *Can. J. Agric. Econ. Can. Agroecon.* **2014**, *62*, 219–243. [CrossRef]
11. Xu, R.; Wu, Y.; Luan, J. Analysis of farmers' willingness to adopt genetically modified insect-resistant rice in China. *China Agric. Econ. Rev.* **2016**, *8*, 368–382. [CrossRef]
12. Michler, J.D.; Tjernström, E.; Verkaart, S.; Mausch, K. Money Matters: The Role of Yields and Profits in Agricultural Technology Adoption. *Am. J. Agric. Econ.* **2019**, *101*, 710–731. [CrossRef]
13. Suri, T. Selection and Comparative Advantage in Technology Adoption. *Econometrica* **2011**, *79*, 159–209. [CrossRef]
14. Hiebert, L.D. Risk, Learning, and the Adoption of Fertilizer Responsive Seed Varieties. *Am. J. Agric. Econ.* **1974**, *56*, 764–768. [CrossRef]
15. Atanu, S.; Love, H.A.; Schwart, R. Adoption of Emerging Technologies Under Output Uncertainty. *Am. J. Agric. Econ.* **1994**, *76*, 836–846. [CrossRef]
16. Miller, T.; Tolley, G. Technology Adoption and Agricultural Price Policy. *Am. J. Agric. Econ.* **1989**, *71*, 847–857. [CrossRef]

17. Krah, K.; Michelson, H.; Perge, E.; Jindal, R. Constraints to adopting soil fertility management practices in Malawi: A choice experiment approach. *World Dev.* **2019**, *124*, 104651. [CrossRef]
18. Feder, G. Adoption of Interrelated Agricultural Innovations: Complementarity and the Impacts of Risk, Scale, and Credit. *Am. J. Agric. Econ.* **1982**, *64*, 94–101. [CrossRef]
19. Geleta, S.; Natcher, D.; Henry, C.J. The effect of information networks on the scaling out of new agricultural technologies: The case of pulse variety adoption in Southern Ethiopia. *J. Rural. Stud.* **2023**, *99*, 153–166. [CrossRef]
20. Kos, D.; Lensink, R.; Meuwissen, M. The role of social capital in adoption of risky versus less risky subsidized input supplies: An empirical study of cocoa farmers in Ghana. *J. Rural Stud.* **2023**, *97*, 140–152. [CrossRef]
21. Cameron, L.A. The Importance of Learning in the Adoption of High-Yielding Variety Seeds. *Am. J. Agric. Econ.* **1999**, *81*, 83–94. [CrossRef]
22. Genius, M.; Koundouri, P.; Nauges, C.; Tzouvelekas, V. Information Transmission in Irrigation Technology Adoption and Diffusion: Social Learning, Extension Services, and Spatial Effects. *Am. J. Agric. Econ.* **2014**, *96*, 328–344. [CrossRef]
23. Krishnan, P.; Patnam, M. Neighbors and Extension Agents in Ethiopia: Who Matters More for Technology Adoption? *Am. J. Agric. Econ.* **2014**, *96*, 308–327. [CrossRef]
24. Usman, M.; Ahmad, M.I. Parallel mediation model of social capital, learning and the adoption of best crop management practices: Evidence from Pakistani small farmers. *China Agric. Econ. Rev.* **2018**, *10*, 589–607. [CrossRef]
25. Shikuku, K.M. Information exchange links, knowledge exposure, and adoption of agricultural technologies in northern Uganda. *World Dev.* **2019**, *115*, 94–106. [CrossRef]
26. Soule, M.J.; Tegene, A.; Wiebe, K.D. Land Tenure and the Adoption of Conservation Practices. *Am. J. Agric. Econ.* **2000**, *82*, 993–1005. [CrossRef]
27. Fischer, E.; Qaim, M. Linking Smallholders to Markets: Determinants and Impacts of Farmer Collective Action in Kenya. *World Dev.* **2012**, *40*, 1255–1268. [CrossRef]
28. Zhang, Y.; Lu, Q.; Yang, C.; Grant, M.K. Cooperative membership, service provision, and the adoption of green control techniques: Evidence from China. *J. Clean. Prod.* **2023**, *384*, 135462. [CrossRef]
29. Ma, W.; Abdulai, A. IPM adoption, cooperative membership and farm economic performance: Insight from apple farmers in China. *China Agric. Econ. Rev.* **2018**, *11*, 218–236. [CrossRef]
30. Kondylis, F.; Mueller, V.; Sheriff, G.; Zhu, S. Do Female Instructors Reduce Gender Bias in Diffusion of Sustainable Land Management Techniques? Experimental Evidence From Mozambique. *World Dev.* **2016**, *78*, 436–449. [CrossRef]
31. Rahm, M.R.; Huffman, W.E. The Adoption of Reduced Tillage: The Role of Human Capital and Other Variables. *Am. J. Agric. Econ.* **1984**, *66*, 405–413. [CrossRef]
32. Hayami, Y. *Agricultural Development: An International Perspective*; Johns Hopkins Press: Baltimore, MD, USA, 1971; ISBN 978-0-8018-1259-0.
33. Liu, Y.; Zhou, Y.H. The impact of the change of land rent on the adjustment of grain-growing behavior. *J. South China Agric. Univ.* **2021**, *20*, 85–96.
34. Cragg, J.G. Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. *Econometrica* **1971**, *39*, 829. [CrossRef]
35. García, B. Implementation of a Double-Hurdle Model. *Stata J.* **2013**, *13*, 776–794. [CrossRef]