Household Labour Migration and Farmers' Access to Productive Agricultural Services: A Case Study from Chinese Provinces

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Abstract: Household labour migration experiences may have a staggering impact within developing countries, especially in dynamic societies like China, where labour migration is obvious. The present study's objective is to investigate whether household labour migration contributes to the probability of farmers' access to productive agricultural services. The study's empirical setup is comprised of household survey data of 541 farmers in Shaanxi, Henan, and Sichuan provinces. The study proposes a counterfactual model to evaluate the average processing effect of an urban migrant with the help of the endogenous transformation of the Probit model. The results show that labour migration for work directly affects farmers' access to productive agricultural services and indirectly affects farmers' access to productive agricultural services through three channels: labour input, land transfers, and planting structure adjustments. The study further confirms that labour migration for work has a significant heterogeneity in the probability of obtaining productive agricultural services for farmers with or without non-agricultural income. Simultaneously, the labour migration area for work has significant heterogeneity in the probability of farmer households' access to productive agricultural services. The government should extend support towards productive agriculture services. Agricultural demonstration services and on-hand training of migrant labour should be highlighted.

Keywords: migrant workers; productive services; endogenous transformation; Probit model; treatment effect

1. Introduction

Agricultural mechanization services, as a modern element, have developed rapidly in rural China. The number of service providers for agricultural machinery operations increased from 165,600 in 2008 to 187,300 in 2016. The number of individuals in the labor force engaged in agricultural mechanization services soared almost threefold, from 0.73 million to 2.08 million [1]. The introduction of modern production factors into agriculture is an essential requirement for the construction of modern agriculture. Productive agricultural services are a variety of trusteeship or outsourcing services provided by service providers mainly around agricultural production links, including agricultural machinery, technology, labor services, etc., which serve agricultural production as a new production factor [2–4]. As a modern agricultural production mode, productive agricultural services can realize the agricultural industry chain's proliferation and significantly reduce the agricultural materialized cost and production operation cost with its efficient service mode and professional service processes. It could greatly promote agricultural efficiency and increase farmers' income [5,6]. In recent years, the government has gradually introduced a series of policy measures to support the development of effective agricultural services, which has affirmed the critical role of effective agricultural services in the development of modern

agriculture [7,8], further improved and enriched the connotation of productive agricultural services [9,10], and provided necessary policy support and the basis for the development of effective agricultural services [11,12].

In this context, academic circles have conducted extensive discussions on effective agricultural service research [13,14]. In a study of agricultural services of Northern Ghana, Anang and Asante [15] examined the impact of farmers' family operation characteristics on access to productive agricultural services from the perspective of farmers' microbehaviour decisions. Existing research found that the main factors affecting farmers' access to productive agricultural services include family planting area, planting years and their proportion of non-agricultural income [16,17], as well as resource endowment, the career differentiation of farmers [15], and the agricultural production scale [18,19]. Other scholars have conducted in-depth analyses of productive agricultural services [20,21]. In a study of Zambia, Sebatta et al. [20] identified the importance of productive agricultural services in terms of easy access to agricultural finances after evaluating a study of Chinese rice farmers by Tang et al. [21]. Some scholars (such as Deng et al. [22] in eastern, central, and western China, Gao et al. [23] in 28 provinces in China's mainland, and Choithani et al. [24] in India's rural–urban transition zone) have found that the outflow of a large number of the young rural labour force has led to the dilemma of an insufficient quantity and unbalanced structure of agricultural labour force production. Agricultural production services can effectively be replaced by the input of a family agricultural production labour force, thus promoting agricultural scale operations [25,26], improving farmers' income [27,28], and increasing agricultural production efficiency [29,30].

Since the economic reform, China has been witnessing a continuous transfer of many rural labourers to urban non-agricultural industries to provide population dividends for economic growth [31]; the effective distribution of labour enforcement in urban and rural areas has been realized [32]. Problems such as the "contradiction between people and land" in rural areas have been alleviated to a certain extent and have led to a shortage of agricultural production labour [33], extensive production, and arable land abandonment in some regions [34]. Given the imbalance between rural households' production and operation and the labour input structure, their ability to steadily ensure food supply security while increasing family income has become a significant problem. In the past few years, productive agricultural services have developed rapidly in China, effectively reducing the impact of rural labour on agricultural production, easing agricultural production's involution, and promoting farmers' modern production factors [35,36]. In a comparison analysis between the Netherlands and Japan, Igata et al. [37] found that productive agricultural services can effectively save agricultural production management and control costs and effectively improve farmers' current management level. By purchasing productive agricultural services, farmers strip out a specific production link and exclusively engage in certain production links, improving agricultural production efficiency [38]. Under the background of the continuous promotion of migrant workers in rural areas, some farmers gradually withdraw from agricultural production links to create a fair market scale for agricultural production services [39–41]. The existing literature provided a research gap and raised the following questions: (i) Does household labour migration experience promote farmers' access to productive agricultural services? (ii) Will farmers break through the agricultural production constraints caused by the lack of labour and technical elements by obtaining productive agricultural services? (iii) Will productive agricultural services improve the level of specialization and socialization of agricultural production? The present research attempts to answer the above research questions by the following assessment. First, the current study uses econometric models to analyze how labor migration affects farmers' adoption of productive agricultural services. Second, we explore whether there is heterogeneity in the effect of labor migration on farmers' adoption of productive agricultural services. The answers to the above questions can have significant practical and academic value. In the context of the continuous expansion of non-agricultural employment in

developing countries, some rural households can use the above results to decide whether to adopt productive agricultural services and increase their actual benefits.

2. Background Analysis and Hypothesis Development

The population migration model of Harris–Todaro [42] points out that the wage gap between urban and rural areas is the fundamental incentive for the continuous transfer of the urban and rural labour force. A large number of individuals participating in the labour force are transferred from rural areas to urban non-agricultural sectors [43,44], which inevitably triggers the re-allocation of family labour resources between non-agricultural and agricultural production by farmers [45,46]. This, in turn, prompts farmers to redistribute the amount of family labour and divide family labour time, thus affecting the input structure of the agricultural means of production of farmers and changing the original agricultural production mode [47,48]. The urban migration of the labour force will inevitably intensify the rigid labour constraints of agricultural production, but at the same time, higher wages and income broaden the income boundary of rural households [49,50]. The income of migrant workers returning to household agricultural production can effectively ease the financial constraints of agricultural production reinvestment [51–53]. By purchasing productive agricultural services to replace labour inputs in agricultural production, farmers can reduce the physical requirements of labour, ease the pressure of time allocation between agricultural and non-agricultural production, and effectively promote the obtainment of comparative income. The migrant labour force mainly affects farmers' access to productive agricultural services through three aspects, which are described below.

On the one hand, rational small-scale farmers allocate their family's flexible management structure to a limited labour force to maximize benefits. Most of the family labour force tends to increase family income by comparing non-agricultural employment activities, such as migrant workers, with higher income, which reduces the input of the agricultural production labour force and facilitates family income due to the rigid allocation of the labour force [54]. Savary et al. [55] evaluated the central Asian regions and found that farmers increase the input of alternative elements to cope with insufficient labour resources in agricultural production. Some farmers will take productive agricultural services with high work efficiency and less labour time to make up for the negative impact caused by the shortage of labour force. These tactics can not only obtain higher wages but also accurately grasp the time pattern of crop planting, alleviate the problem of structural shortage of the labour force in the busy season, achieve the simultaneous growth of wages and operating income, and ensure an increase in production and income of farmers' families [52]. On the other hand, many migrant workers significantly reduce their familiarity with family agriculture, and most migrant workers are of lower age, have higher technical qualities, and are participants in a more vigorous physical labour force [56]. The old, disabled women and children who are left behind decrease family agricultural production capacity and intensity [57]. To alleviate the hard work involved in agricultural production, farmers will increase the demand for productive agricultural services, use modern production factors to replace heavy manual work, ensure the stability of the input of agricultural production factors, and improve agricultural production efficiency. McCullough [58] evaluated the Sub-Saharan African agricultural sector and found labor productivity significantly depends on how productive services attract skilled labour. In a study of the rice farmers of Zhejiang and Jiangsu provinces in China, Li and Li [59] found agribusiness mostly tends to receive support from productive service providers to facilitate low operating costs and promote low input production.

Hypothesis 1 (H1). *Labor force migration reduces the agricultural production labor force input, encouraging farmers to obtain productive agricultural services.*

The increase in the number of migrant workers will cause the diversification of the source of rural households' livelihoods and theoretically reduce the dependence of rural households on the original land [60], resulting in a decline in the effect of agricultural

production on increasing farmers' income. At this time, farmers will realize the continuous blocks and pieces of operation employing land transfer or replacement. Due to the reduction of absolute scale and the expansion of relative scale, some farmers will gradually withdraw from the production process of some agricultural links and gradually turn from agricultural production completed by a single household to large-scale production of contiguous areas [61]. This provides a feasible space for farmers to obtain productive agricultural services. By acquiring specialized productive agricultural services, farmers can reduce the risk of production reduction caused by insufficient agricultural production factors and ultimately increase their income.

Conversely, as far as reality is concerned, there exists uncertainty regarding non-agricultural employment activities, such as migrant workers, changes in the workplace and changes in the nature of work [62], and the induction of traditional rural cultural ideas such as "fallen leaves return to roots". The phenomenon of some farmers "leaving their hometown" but not "leaving agriculture" or "entering the city" but not "abandoning the land" is widespread, and they may therefore reclaim the cultivated land when they go out to work or their income changes [63,64]. Under the condition that the division of labour between agriculture and non-agricultural specialization is not mature, the farmers' access to productive agricultural services will not change the land contract right and management right, but will also take into account the material production and social security functions of land [65] to maximize the benefits of families.

Hypothesis 2 (H2). *Labor force migration promotes agricultural land transfer and influences farmers to obtain productive agricultural services.*

In general, farmers growing a single variety are able to improve the probability of obtaining productive agricultural services [66]. On the one hand, the development of the rural credit market is relatively backward, and the internal industrial structure of agriculture is unreasonable, which means that the allocation of farmers' credit funds is unbalanced and the use efficiency is low [67]. Labour migration is a meaningful way to ease the constraints of family capital liquidity. Due to the alternation of labour shortages and peak season in non-agricultural sectors, some farmers use their spare time to produce agricultural products [68]. At this time, farmers can obtain agricultural production services through planting structure adjustments (planting crop varieties with low labour intensity, short daily management and protection time, and capable of being planted as a single variety) to alleviate the difficulty of labour quality supervision and high transaction costs in the process of crop production [69].

On the other hand, migrant workers are more likely to choose less labour-intensive crops for agricultural production [70], which is limited by the regional planting structure of crops and imitation among farmers, resulting in crop varieties' convergence. Such a situation increases the supply capacity of productive agricultural services [71] and promotes farmers' probability of obtaining productive agricultural services [72]. According to the above analysis, this paper puts forward Hypotheses 3 and 4. Figure 1 represents the graphical illustration of the study.
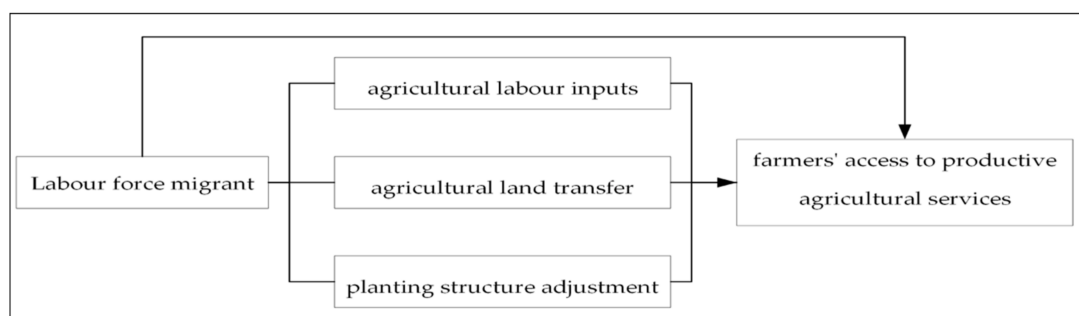

Figure 1. Analysis of the framework.

Hypothesis 3 (H3). *Labor force migration promotes planting structure adjustments, thereby promoting farmers' access to agricultural production services.*

Hypothesis 4 (H4). *Labor force migration reduces agricultural production labor force input, thereby influencing farmers to obtain productive agricultural services.*

3. Materials and Methods

3.1. The Setting of the Measurement Model

This study uses the endogenous switching Probit model to analyze the impact of migrant workers on farmers' access to production services, as suggested by similar studies [73–75]. On this basis, the "counterfactual" framework is constructed to analyze the average processing effect of migrant workers on the probability of farmers obtaining productive services. This method can not only deal with the problem of selection bias caused by unobservable factors and observable factors, but can also use the maximum likelihood estimation to estimate the impact [76] of external migrant farmers and non-external migrant farmers on the probability of selecting productive agricultural services, which can effectively deal with the problem of information leakage. The study uses STATA V16.0 software to craft the findings. All associated variables and their definition has been stated in Table A1 (please check Appendix A). The decision of migrant workers is treated as a variable (T_i), such that if the labour force is migrant, $T_i = 1$, otherwise 0. Whether rural households are migrant workers can be expressed as:

$$T_i = \begin{cases} 1, \gamma Z_i + \mu_i > 0 \\ 0, \gamma Z_i + \mu_i \leq 0 \end{cases} \quad (1)$$

In Formula (1), Z_i represents the relevant variable that affects whether the labour force goes out to work; γ is the coefficient to be estimated, and, μ_i is the random disturbance term. T_i represents the observed decision result of whether the labour force goes out to work: $T_i = 1$ indicates that the labour force goes out to work, and $T_i = 0$ indicates that the labour force does not go out to work.

The resulting equation for the probability of farmers obtaining productive agricultural services in the two states of the decision-making of labour migration is:

$$y_{1i}^* = \beta_1 X_{1i} + \varepsilon_{1i} \ y_{1i} = I(y_{1i}^* > 0)$$
$$y_{0i}^* = \beta_0 X_{0i} + \varepsilon_{0i} \ y_{1i} = I(y_{0i}^* > 0)$$
$$y_i = \begin{cases} y_{1i} & , \ T_i = 1 \\ y_{0i} & , \ T_i = 0 \end{cases} \quad (2)$$

In Formula (2), y_{1i}^* and y_{0i}^*, respectively, represent the latent variables of the probability that farmers obtain productive agricultural services when the labour is out of work and when the labour is not out of work, which determines the observed binary productive agricultural service acquisition state variables y_{1i} and y_{0i}. X_{1i} and X_{0i} represent the covariates that affect the probability of farmers acquiring productive agricultural services; β_1 and β_0 represent the coefficients to be estimated, respectively. ε_{1i} and ε_{0i} represent random error terms, which follow a normal distribution with zero means. ρ_0 and ρ_1 represent the correlation coefficient of (ε_0, μ) and (ε_1, μ), respectively, and ρ_{10} represents the correlation coefficient of (ε_0, ε_1).

3.2. Dependent Variable

3.2.1. Access to Productive Agricultural Services

In order to define productive agricultural services, the research refers to the Guidance of the Ministry of Agriculture, the National Development and Reform Commission and the Ministry of Finance on Accelerating the Development of Productive Agricultural Services, the Notice of the General Office of the Ministry of Agriculture and Rural Areas on Carrying

out Special Statistics of Productive Agricultural Services and the research of relevant scholars [77–79]. In general, productive agricultural services refer to the social services that run through the chain of agricultural production and operation and directly complete or assist in completing agricultural pre-production, production, and post-production operations. It mainly includes planting production services, agricultural machinery renting, agricultural product marketing services, and other types of services [80,81]. However, by combing sample areas and relevant scholars' research compared with the pre-production and post-production services of productive agricultural services, the production services play a more critical role in farmers' production and operational decision-making [82,83]. Therefore, this paper's inspection of productive agricultural services mainly focuses on two types: agricultural machinery use services (farming, planting, and harvesting) and field management services (medication, irrigation, weeding, and pest control) in the agricultural production process. If the farmer does not obtain any of the productive agricultural services, the value is 0. On the contrary, if the farmer obtains one or a combination of them, it is considered that the farmer obtains productive agricultural services and therefore, the value is 1. According to the sample areas' survey results, 43.44% of the sample farmers obtained agricultural machinery usage services, and 44.55% of the sample farmers used field management services.

3.2.2. Processing Variable

Migrant labour refers to the rural household labour force's employment behaviour, specifically regarding whether an individual chooses to leave the domicile to obtain wage income [84]. At present, there are generally two definitions of migrant workers in the academic community. One reflects the situation of migrant workers according to the head of household or the production and operational decision-maker. The second relies on the status of migrant workers or the income status of family migrant workers for all family members of the rural household [85,86]. The present article selects the first method, which uses whether the household head went out to work in 2018 to measure labour status out of work. The main reason for this choice is because the head of the household plays a decisive role in allocating family resources and leads the decision-making of family production and operations. Among the sample farmers, 72% are migrant workers, indicating that migrant work has gradually become the main channel for farmers to obtain income.

3.2.3. Control Variables

Referring to the research of relevant scholars [87–90] combined with the actual situation in rural China, this paper selects 14 variables within 4 categories as the control variables of the equation, including the characteristics of the head of household, family characteristics, family social network and characteristics of villages. The household characteristics consist of three variables: the head of household, education status, and health status. The family's characteristics include seven variables: the operating area, the degree of arable land fragmentation, the quality of arable land, credit constraints, family income, family size, and the proportion of the elderly in the family. The family social network includes two variables: the number of visiting relatives and communication interaction frequency. The village characteristics include two variables: the village's economic level and the village's traffic condition.

3.2.4. Identification Variable

The identification variables must be added to the selection equation when the Probit model is used for estimation [91]. This study utilized the number of migrant workers in the village as the identification variable. The reason for selecting this identification variable is that, in the relevant literature on the impact of migrant workers, most studies take village-level data and migration social networks as the tool variable [92,93]. Farmers usually obtain migration information and resources through a local network of families,

relatives, and communities in the outflow area. This provides social support for migrant farmers, reduces the search cost of seeking jobs and improves migrant workers' success.

3.3. Data Sources

Data have been collected according to a questionnaire survey conducted from August to October 2019. The selection of the survey area mainly considered two factors. First, the surveyed provinces are an important food production province in the central and western regions of China, and the development of effective agricultural services is representative of the country. Second, the surveyed provinces are the main outflow provinces in the central and western regions of China, and the labour outflow phenomenon is evident. The survey was conducted in 12 cities (counties) in 3 provinces of Shaanxi, Sichuan, and Henan. The survey mainly adopted a combination of stratified sampling and random sampling [94,95]. The specific sampling procedure is as follows: in each province, 3–4 cities (counties) were selected according to agricultural production and economic development, then 2–3 townships were randomly selected from each city (county). Subsequently, 2 villages were randomly selected from each township, and 10–15 households were randomly selected from each village. In the survey, 600 questionnaires were finally distributed. Excluding missing samples and farmers who did not meet the conditions, the number of valid questionnaires was 541, with an effective rate of 90.1%. The questionnaire mainly adopted "one-to-one" interviews to investigate the decision-makers, heads of households, or family members who know about agricultural production. The questionnaire mainly included necessary information regarding family members, agricultural production and management information, rural governance participation, access to productive agricultural services, social capital, and psychological perception. Moreover, the questionnaire also included the village's economic development status, agricultural production status, and social development status. Shaanxi, Henan, and Sichuan are essential food production regions in China. According to China Statistical Yearbook data, the total power of agricultural machinery in these three provinces increased from 182.61 million kilowatts to 195,447,700 kilowatts from 2011 to 2019. The province's total grain output rose from 101.9 million tons to 114.24 million tons. The total power of agricultural machinery and grain production has continued to grow simultaneously, which further supports a dramatic boost in agricultural mechanization and productive services in agriculture.

3.4. Descriptive Statistics

Looking at the essential characteristics of the sampled households (see Table A2), the heads of households are mainly older males, among which household heads aged between 40 and 59 accounts for 65.06% of the sample, and those with a high school or technical secondary education or above account for only 27.54% of the sample. From the perspective of farmers' household operation status in the survey sample area, the area of arable land operated by interviewed households is mainly 3 to 5 mu, accounting for 56.38% of the sample. The area of operation of interviewed farmers is at a moderate level. The family size of sample farmers is mainly 3~5 people, accounting for 66.91% of the sample. Most of them live together with three generations of grandparents. They need to maintain their children's education burden and need to bear part of the pension pressure. Additionally, in 2018, 59.15% of the sample households' annual income was more than sixty thousand yuan. In general, the sample farmers' essential characteristics are consistent with the regional situation, indicating that the sample selection is representative to a certain extent.

4. Results

4.1. Analysis of the Estimation Results of the Migrant Model

The estimation results of Table 1 show that among the head of household's characteristics, the head of household's age harms the migrant workers at a significant level of 5%, which is consistent with the research conclusions of Xu et al. [96]. It is more likely that as the age of the head of household continues to increase, their physical strength and

labour skills begin to decline. It is therefore easier to stay in the rural areas to undertake the responsibility of agricultural production, the family pension and child care; the possibility of engaging in migrant work therefore continues to decline. The education status of household heads positively impacts the labour force tools for going out, but the impact is not significant. Among family characteristics, credit constraints positively impact the probability of migrant workers at a significant level of 1%. Farmers with higher credit constraints lack livelihood and production funds [97]. However, the lack of property and collateral and financial institutions to avoid risks increases the threshold of credit loans to farmers, and the financial status of farmers' families therefore further tightens. The results also show that the family size impacts the migrant workers at a significant level of 5%, and the family size significantly reduces the probability of migrant workers. It is more likely that China's family structure has changed such that the proportion of children has decreased, while the elderly proportion has increased. The high cost and high demand of social and moral pressure and the strong sense of responsibility generated by the feedback cultivation of farmers have prompted more family members to choose to stay in rural areas to take care of the elderly groups, thus reducing the possibility of migrant workers [98]. There was no significant impact seen with relation to the operating area, the degree of arable land fragmentation, the quality of arable land, the family income, and the elderly's proportion to the migrant workers. In the family social network, the frequency of interaction affects the prevalence of migrant workers at a significant level of 5%, and the higher the frequency of interaction between farmers and villagers, the lower the possibility of migrant workers. In general, farmers produce value in the village acquaintance society [99]. We found that the higher the frequency of communication between farmers and village residents, the stronger the convergence of their lifestyle, the stronger the village identity and the sense of belonging. Furthermore, we found that the higher the village's dependence, the lower the possibility of migrant workers. The number of visiting relatives positively impacted the migrant workers' tools but did not pass the study's significance test. In villages' characteristics, the variables of villages' economic level and traffic conditions have no significant impact on migrant workers.

4.2. The Estimation Results of the Model of Farmers' Access to Production Services

Among the head of household's characteristics, we have identified that age, education status, and health status have no significant impact on the access to productive agricultural services of migrant and non-migrant farmers. Among the family characteristics, the degree of arable land fineness negatively impacts the external migrant farmers' access to productive agricultural services. The impact on the non-external migrant farmers' access to productive agricultural services does not pass the significance test. Compared with non-external migrant farmers, the degree of arable land fineness of the external migrant farmers has a more significant impact on their access to productive agricultural services. Seemingly, credit constraints and family size significantly positively impact the ability of farmers who do not migrate for work to obtain productive agricultural services. The impact on external migrant farmers on obtaining productive agricultural services has not passed the significance test. It is more likely that the larger the non-migrant farmers' family size, the more pressure they face on their families' livelihood and raising their children to care for the elderly. Usually, most rural farmers tend to shorten their working time by obtaining productive agricultural services, saving supervision costs, easing the family pension's pressure, and ensuring their internal stability [100]. In the family social network, the number of visiting relatives only positively impacts the productive agricultural services of migrant farmers at a significant level of 1%. However, the frequency of communication interaction only has a positively impact compared with non-migrant farmers. The frequency of communication and interaction between migrant farmers and rural residents is not high, and the impact of the village social network on their agricultural production decisions is further weakened. Among the village characteristics, the variables of the economic level and the traffic condition of the village only have a significant impact on the rural migrant

workers' access to productive agricultural services, and the impact on the rural migrant workers' access to productive agricultural services has not passed the significance test. The following Table 1 reports the error correlation coefficient of the joint estimation of the model of the labour force migrants' and farmers' access to productive agricultural services (ρ_1 and ρ_0). The table also the Wald test value of the independence test of the equation. The estimation results show that the correlation coefficients of error terms are significantly negative at the significance level of 1%, indicating a sample selection error in the model of agricultural producer services acquisition, consistent with the research estimation results. Among them, the equation's independence test value was 15.44, which rejected the original assumption that the selection equation and the result equation were independent of each other at the 1% significance level. Therefore, it is appropriate to adopt the ESP model.

Table 1. Regression results of the impact of migrant workers on farmers' access to productive agricultural services.

Variable Name	Selection Equation (Migrant or Not)		Outcome Equation (Whether to Obtain Productive Agricultural Services)			
			Migrant Workers		Non-Migrant Workers	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Age of head of household	−0.015 **	0.007	0.004	0.008	0.001	0.012
Education status of householders	0.012	0.066	−0.046	0.069	−0.026	0.103
Health status of the head of household	0.128	0.112	−0.029	0.121	−0.020	0.182
Operating area	−0.023	0.020	0.044	0.027	0.020	0.031
Fineness of cultivated land	0.073	0.064	−0.18 **	0.084	−0.236	0.148
Quality of cultivated land	−0.021	0.105	0.065	0.106	0.011	0.188
Credit constraints	0.533 ***	0.148	−0.050	0.173	0.514 **	0.254
Family income	0.0672	0.095	−0.056	0.096	0.115	0.159
Family size	−0.115 **	0.047	0.030	0.053	0.140 *	0.075
Proportion of elderly in the family	−0.004	0.003	0.003	0.003	0.007	0.005
Number of relatives visited	0.015	0.012	0.047 ***	0.017	−0.034	0.028
Frequency of communication and interaction	−0.260 ***	0.087	0.105	0.092	0.345 **	0.147
Economic level of villages	−0.170	0.112	0.200 **	0.100	0.210	0.176
Traffic conditions in villages	0.164	0.124	0.271 *	0.145	0.051	0.224
Migrant workers in villages	0.677 ***	0.092	-	-	-	-
Constant term	−2.438 *	1.326	−1.572	1.295	−5.678 ***	2.116
Area dummy variable	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Residual correlation coefficient	$\rho_1 = -0.819$ *** $\rho_0 = -0.710$ ***					
Model fitting test	117.02 ***					
Log pseudo-likelihood	−524.272					
Independence test of the equation	15.44 ***					
Number of observations	541					

Note: ***, ** and * represent significant statistical levels of 1%, 5% and 10%, respectively. The control variable is consistent with the control variable in Table 1, and the estimation result is omitted.

4.3. Estimation of Treatment Effect

After estimating the selection equation and the result equation, the corresponding group's individual treatment effect (TT, TU, and TE) was calculated. The average treatment effect (ATT) of the treatment group, the average treatment effect (ATU) of the control group, and the average treatment effect (ATE) of all samples were calculated by averaging the individual treatment effect. As demonstrated in Table 2, the average treatment effect (ATT) of the treatment group (T = 1) is 0.623 for the probability of farmers obtaining productive agricultural services, which indicates that the probability of farmers from the labour force who do not include migration significantly reduces by 62.3%. The control group's average

treatment effect (ATU) (T = 0) was 0.573, i.e., the probability of the farmers who did not work out of the country would significantly increase by 57.3% if they worked out of the country. If all sample farmers are migrant workers, all samples' average processing effect (ATE) is 0.609.

Table 2. Processing effect of migrant workers on the probability of farmers obtaining productive agricultural services.

	Endogenous Transformation Probit Model		
	ATT	ATU	ATE
Probability of obtaining productive agricultural services	0.623 *** (0.176)	0.573 * (0.204)	0.609 *** (0.143)

Note: coefficient standard error is shown in the brackets; ***, ** and * represent the significant statistical levels of 1%, 5%, and 10%, respectively.

4.4. Transmission Mechanism Test

In this part, the paper further analyzes the transmission mechanism of the impact of migrant workers on farmers' access to productive agricultural services. According to the previous theoretical analysis, this paper selects labour input, land transfer, and planting structure adjustment as the three channels that affect farmers' access to production services. First, the transmission mechanism channel is used to return migrant workers to test whether migrant workers directly affect labour input, land transfer, and planting structure adjustment. Second, the channel's transmission mechanism and whether farmers obtain productive services will be a regression to test the impact of labour input, land transfer, and planting structure adjustment on farmers' access to production services.

Among them, work indicates whether the labour force is migrant workers, and service indicates whether the farmers obtain productive agricultural services. Channel represents the three variables of the transmission mechanism, as is described in the following. In this paper, the farmers' "working hours per mu of labour input for farming" is used to measure labour inputs, "whether there is land transfer in your home in 2018" is used to describe land transfer, and "whether there is a planting structure adjustment in your home in 2018" is used to measure planting structure adjustments. The Iv-Probit and Iv-Regress regression results in Table 3 show that migrant workers significantly reduce labour inputs and improve the probability that farmers will engage in land transfers and planting structure adjustments. At the same time, farmers' agricultural production labour input has a significant negative impact on farmers' access to agricultural production services. Land transfers and planting structure adjustments significantly impact farmers' access to agricultural production services. Hypotheses 1, 2, and 3 are verified. This shows that migrant workers directly impact farmers' access to productive agricultural services and indirectly affect farmers' access to productive agricultural services through three channels: labour inputs, land transfers, and planting structure adjustments. By considering the above viewpoint, the study concludes the final results as:

Hypothesis 1 (H1). *Labor force migration reduces the agricultural production labor force input, encouraging farmers to obtain productive agricultural services (accepted).*

Hypothesis 2 (H2). *Labor force migration promotes agricultural land transfer and influences farmers to obtain productive agricultural services (accepted).*

Hypothesis 3 (H3). *Labor force migration promotes planting structure adjustments, thereby promoting farmers' access to agricultural production services (accepted).*

Hypothesis 4 (H4). *Labor force migration reduces agricultural production labor force inputs, thereby influencing farmers to obtain productive agricultural services (accepted).*

Table 3. Estimation results of the conduction mechanism test.

	Iv-Regress		Iv-Probit		Iv-Probit	
	Migrant Workers or Not	**Labour Input**	**Migrant Workers or Not**	**Land Transfer**	**Migrant Workers or Not**	**Adjustment of Planting Structure**
Migrant workers in villages	0.167 *** (0.021)	-	0.170 *** (0.023)	-	0.170 *** (0.023)	-
Migrant workers or not	-	−5.587 *** (0.893)	-	1.290 *** (0.455)	-	1.212 *** (0.469)
Constant term	−0.093 (0.326)	9.933 *** (2.423)	−0.093 (0.339)	−3.045 *** (1.169)	−0.093 (0.339)	−0.824 (1.155)
F value	15.92	-	-	-	11.34	-
	Probit		Probit		Probit	
	Whether to obtain productive agricultural services		Whether to obtain productive agricultural services		Whether to obtain productive agricultural services	
Labour input	−0.762 ** (0.311)		-		-	
Land transfer	-		0.597 *** (0.158)		-	
Adjustment of planting structure	-		-		0.302 ** (0.147)	
Constant term	−3.842 *** (1.324)		−4.374 *** (1.304)		−4.674 *** (1.314)	
Pseudo R^2	0.428		0.440		0.426	
sample size	541		541		541	

Note: robust standard error is shown in brackets; ***, ** and * are significant at the statistical level of 1%, 5%, and 10%, respectively; control variables are consistent with the control variables in Table 1, and the estimated results are omitted.

Concurrent operations of farmers result from reasonable allocations of the family labour force between agriculture and non-agricultural production by farmers according to family resource endowments [30], which means that different agricultural production entities at the current stage have different resource endowments. This leads to differences in their willingness, motivation, and behaviour in agricultural and non-agricultural production. Farmers' income can be divided into agricultural income as the main source and non-agricultural income as the primary source. For the farmers whose income is mainly from agriculture, migrant workers mainly rely on the transfer of surplus or seasonal labour to obtain non-agricultural income to enrich the family income. For the farmers with non-agricultural income as their primary income source, migrant labour has become their main income source and led to structural and seasonal labour force shortages in agricultural production. At this time, farmers gradually reduce the proportion of household agricultural production, and productive agricultural services can effectively make up for the shortage of agricultural labour force, which has become an important choice for migrant farmers. Regarding the relevant scholars' research, this paper uses whether the household income is mainly based on agricultural income to measure the degree of part-time employment of farmers and incorporates multiplying the income from agriculture and the labour force migrant into the benchmark model. Probit is used to analyze the impact of migrant workers on whether the farmers who mainly earn income from agriculture obtain productive agricultural services [8], and the LPM model is used to test the soundness.

Table 4 estimates the results, which show that whether farmers mainly rely on income from agriculture has a significant negative impact on their access to productive agricultural services. This indicates that farmers' degree of concurrent employment affects their access to productive agricultural services. However, for farmers whose income is mainly non-agricultural, the probability of obtaining productive agricultural services is significantly increased by the labour union, with an increase of 0.220. However, for farmers whose income is mainly from agriculture, the probability of obtaining productive agricultural services is also significantly increased by the labour union, with an increase of 0.574. This can be calculated based on the regression results, wherein 0.220 + (0.354) = 0.574. This

shows that migrant workers positively affect access to productive agricultural services for these two types of farmers, and the level of improvement is more evident for farmers whose income is mainly from agriculture.

Table 4. Analysis of the impact of migrant workers on farmers' access to productive agricultural services.

	(1) Probit	(2) Probit	(3) LPM	(4) LPM
Migrant workers	0.220 *** (0.043)	0.243 *** (0.041)	0.248 *** (0.049)	0.273 *** (0.048)
Whether the main income is from farming	−0.179 ** (0.091)	−0.202 ** (0.091)	−0.157 * (0.090)	−0.184 ** (0.089)
Whether migrant workers are mainly engaged in agriculture	0.354 *** (0.128)	0.376 *** (0.128)	0.310 ** (0.121)	0.339 *** (0.121)
Control variable	Controlled	Controlled	Controlled	Controlled
Regional virtual variable	Controlled	Uncontrolled	Controlled	Uncontrolled
Sample size	541	541	541	541

Note: ***, ** and * are significant at the statistical level of 1%, 5%, and 10%, respectively; the estimated result in the Probit model is the marginal effect; the robust standard error is shown in brackets; the control variable is consistent with the control variable in Table 1, and the estimated result is omitted.

The differentiated location selection of migrant workers has an essential impact on farmers' economic activities, production, and life. When the working distance of rural households gradually extends from the county to the province and other provinces, the commuting cost and time between the worksite and the hometown gradually increases, resulting in a high labour cost of agricultural production in the family. Compared with the rural migrant workers in the county, the rural migrant workers across the county pay less attention to agricultural production; their focus of work deviates from agriculture, and they are more inclined to obtain non-agricultural income through migrant workers [32]. Simultaneously, for the farmers who work across the county at long distances, the farmers' uncertainty and their families' agricultural production increases, and the ability to avoid the risk of agricultural losses is weakened. Compared with the county household workers and farmers, agricultural production investment is reduced due to the inability to work concurrently.

On the contrary, agricultural production and planting are seriously decreased due to the lack of labour force and the upsurge of migrant income [101]. The maximum boundary of agricultural production and planting may be within the county. Once the distance of migrant workers is beyond the county, the ability of farmers to obtain productive agricultural services is significantly reduced. Concerning the research of relevant scholars, this paper uses pure farming, county domestic workers, and county foreign workers to measure the distance of migrant workers. Meanwhile, the square of the distance of migrant workers is included in the benchmark model. Probit is used to analyze the impact of the distance of migrant workers on farmers' access to productive agricultural services, and the LPM model is used for the robustness test.

The estimated results of regression (1) in Table 5 show that the estimated value of the coefficient of the primary term of the distance of migrant workers is positive and significant at the significance level of 1%. In comparison, the estimated value of the square term's coefficient of the distance of migrant workers is negative and significant at the significance level of 1%. According to the calculation, the value of the turning point of the distance of migrant workers is 1.883, which is between the pure farming and the county internal affairs workers. The above results show that the impact of distance between migrant workers and farmers' access to productive agricultural services presents an inverted "U" shape and is reversed in the County Office of internal affairs. If other conditions remain unchanged, an increase in working distance increases farmers' likelihood of obtaining productive agricultural services when the working distance is limited within the county. In contrast, increasing working distance reduces the likelihood of farmers obtaining productive agricultural services when the working distance exceeds the county.

Table 5. Analysis of the impact of labour distance on farmers' access to productive agricultural services.

	(1) Probit	**(2) Probit**	**(3) LPM**	**(4) LPM**
Working distance	0.339 *** (0.059)	0.782 *** (0.148)	0.841 *** (0.161)	0.916 *** (0.159)
Migrant distance square	−0.090 *** (0.020)	−0.167 *** (0.038)	−0.178 *** (0.040)	−0.192 *** (0.040)
Control variable	Controlled	Controlled	Controlled	Controlled
Regional virtual variable	Controlled	Uncontrolled	Controlled	Uncontrolled
Sample size	541	541	541	541

Note: ***, ** and * are significant at the statistical level of 1%, 5%, and 10%, respectively; the estimated result in the Probit model is the marginal effect; the robust standard error is shown in brackets; the control variable is consistent with the control variable in Table 1, and the estimated result is omitted.

4.5. Robustness Test: Change of Estimation Method

The ERM model was used to test the selection equation's robustness, as well as the result equation to verify the above results' robustness further. The traditional methods to solve the estimation errors caused by "self-selection" mainly include the tool variable, matching, etc. These methods are only applicable to a problem where the endogenous variable is continuous, and the endogenous variable of this study is a class variable. Therefore, the ERM Model (extended regression model) is used for estimation. Whether the endogenous variables are continuous, two-value variables, or ordered variables, the model can be regression-based by using tool variables through sub-modules [102]. Table 6 shows that the estimated results of the number of migrant workers and the labour force migrant workers in villages are consistent with previous results, which further proves the robustness of the previous estimates, i.e., the migrant labour force can effectively improve the probability of farmers obtaining productive agricultural services. Hypothesis 4 is again confirmed to be correct.

Table 6. Robustness test on the impact of migrant workers on farmers' access to productive agricultural services.

	(1)	**(2)**	**(3)**	**(4)**
	Migrant Workers or Not	**Whether to Obtain Social Services**	**Migrant Workers or Not**	**Whether to Obtain Social Services**
Number of migrant workers in villages	0.180 *** (0.020)	-	0.190 *** (0.020)	-
Migrant workers	-	2.119 *** (0.207)	-	2.080 *** (0.193)
Control variable	Controlled	Controlled	Controlled	Controlled
Regional virtual variable	Controlled	Controlled	Uncontrolled	Uncontrolled
Wald test	285.51		258.77	
Log pseudo likelihood	−545.53		−578.61	
Sample size	541		541	

Note: robust standard error is shown in brackets; ***, ** and * are significant at the statistical levels of 1%, 5%, and 10%, respectively; control variables are consistent with the control variables in Table 1, and the estimated results are omitted.

5. Discussion

This paper provides a comprehensive empirical analysis which examines the impact of labor migration on farmers' access to productive agricultural services and its impact pathways. Our study finds that the presence of labor migration in farmers' households significantly promotes their households' access to productive agricultural services. These results broaden the previous studies of many scholars, which have shown that household labor migration positively affects farm production decisions and household decisions of farm households under a variety of circumstances [103–105]. In fact, labor migration is a strategic behavior for families to respond to shocks and risks to maximize returns [106]. Many labor force migrations can obtain higher returns from the industrial sector and make up for the decline in agricultural productivity due to agricultural labor shortages [23]. In addition, the benefits obtained from labor migration are transmitted through capital, which can provide a financial supply for agricultural production and reduce the risk of not purchasing investments in agricultural production due to a shortage of wealth [107]. The

findings of this paper are mainly consistent with the research of Caulfield et al. [108], who noted that labor migration not only changes the social relations of these households, but that migrant remittances have an impact on promoting the active adoption of extensive farm machinery farming services by farming households.

In addition, we found that the effect of labor migration distance on farmers' access to productive agricultural services is not linear, but shows an inverted "U" shape, which indicates that the effect of labor migration distance on farmers' access to productive agricultural services increases first and then decreases. The above findings are not consistent with the study of Fan et al. [109]. In practice, when household labor migration leads to a decrease in the number of agricultural laborers, some households purchase productive agricultural services to make up for the shortage of household agricultural labor [110]. However, when the distance of household labor migration is larger, some households choose to withdraw from agricultural production, because their income source mainly relies on non-farm income [96], which leads to a lower impact effect.

Of course, there are still some limitations of this paper that we need to study in the future. First, the scope of our chosen study is only the sample survey data of three central grain-producing provinces in China, and the results of the study may be difficult to be generalized to more agricultural production regions and areas. Therefore, in the future, we hope to continue to apply more advanced survey techniques to expand the number of respondents. Second, when we considered the services of the productive agricultural link, we only considered the services of the production link. In the future, we should expand to more services of the sales and distribution links. Third, the research design used in this study utilizes cross-sectional data, which measures farmers' perceptions at only one point in time. Farmers' production decision behavior changes over time as they gain practical experience. Therefore, we need access to panel data to assess the validity of the results of this study.

6. Conclusions

Based on the theoretical model of the impact of migrant worker's experience on farmers' access to productive agricultural services, this paper uses the survey data of 541 farmers in Shaanxi, Sichuan, and Henan provinces. We adopt the endogenous transformation Probit model (ESP) to construct the "counterfactual" analysis framework to estimate the impact of migrant workers' experience on farmers' access to productive agricultural services. The results show that: (1) labor force migration can significantly enhance farmers' access to productive agricultural services; (2) labor force migration affects farmers' access to productive agricultural services, mainly through three paths. These are reducing agricultural labor inputs, promoting land transfers and increasing planting structure adjustments; (3) the effect of labor force migration on farmers' access to productive agricultural services is significantly different between non-farm income-oriented and farm income-oriented households with predominantly non-farm income; (4) the effect of the distance of labor force migration on farmers' access to productive agricultural services shows an inverted "U" shape.

Based on the above research conclusions, the following policy implications have been suggested: policymakers should expand the function and coverage of productive agricultural services, ensure the actual needs of migrant workers and farmers for agricultural production are being met, and effectively increase income and increase production by obtaining productive agricultural services. On the other hand, for farmers whose income is mainly from agriculture, authorities should actively encourage them to use productive agricultural services to expand their planting area and eventually reduce agricultural production costs through service scale and land scale operations, eventually improving their agricultural income. The private-public partnership should be encouraged to flourish in order to smooth the transition of productive agricultural services. The productive agricultural service provider should extend their promotional and marketing programs and provide full support to small rural farmers.

Institutional Review Board Statement: As the study does not involve any personal data and the respondent was well aware that they can opt-out anytime during the data collection phase, any written institutional review board statement is not required.

Informed Consent Statement: As the study does not involve any personal data and the respondent was well aware that they can opt-out anytime during the data collection phase, any written institutional review board statement is not required.

Data Availability Statement: The associated dataset of the study is available upon request to the corresponding author.

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

Appendix A. Information of Variables

Table A1. Variable name and definition.

Variable Name	Variable Definition	Mean	Std.
Dependent variable			
Access to productive services	Whether farmers obtain productive agricultural services: Yes = 1, no = 0	0.62	0.49
Processing variable			
Migrant workers	Whether the labour force is migrant: Yes = 1, no = 0	0.72	0.45
Control variable			
Characteristics of the head of household			
Age of head of household	The actual age of the head of household; unit: age	51.49	11.02
Education status of householders	Actual education status of the householder: illiquid = 1, primary school = 2, junior high school = 3, senior high school (technical secondary school) = 4, junior college = 5, undergraduate and above = 6	3.14	1.10
Health status of the head of household	The actual physical condition of the householder: no labour capacity = 1, relatively unhealthy = 2, general = 3, relatively healthy = 4, very healthy = 5	3.22	0.694
Family characteristics			
Operating area	The actual operating area of the family; unit: Mu	4.98	3.08
The fineness of cultivated land	The proportion of land parcels in actual household operation; unit:%	0.87	1.02
Quality of cultivated land	Cultivated land quality level: very poor = 1, relatively poor = 2, general = 3, relatively good = 4, very good = 5	3.36	0.66
Credit constraints	Whether the family has borrowings: Yes = 1, no = 1	0.77	0.42
Family income	The logarithm of family income last year	11.06	0.72
Family size	The actual number of family members; unit: the person	4.68	1.40
The proportion of elderly in the family	The proportion of the elderly in the total household population; unit: %	17.96	20.66
Family social network			
Number of relatives visited	Number of visiting relatives on New Year's Day; unit: the person	8.06	5.31
Frequency of communication and interaction	Frequency of communication with villagers: very few = 1, relatively few = 2, general = 3, relatively many = 4, very many = 5	3.80	0.81
Characteristics of villages			
Economic level of villages	Economic development of villages: very backward = 1, relatively backward = 2, general = 3, relatively rich = 4, very rich = 5	3.82	0.69

Table A1. *Cont.*

Variable Name	Variable Definition	Mean	Std.
Traffic conditions in villages	Convenient transportation in Villages: very not convenient = 1, relatively not convenient = 2, general = 3, relatively convenient = 4, very convenient = 5	4.26	0.58
Identifying variable Migrant workers in villages	Number of migrant workers in villages last year	6.29	0.78

Appendix B. Demographic Data

Table A2. Household information of sample farmers in the survey area.

Variable	Category	Number	Ratio (%)	Variable	Category	Number	Ratio (%)
Gender of the head of household	Male	500	92.42%	Household arable land (mu)	<3	87	16.08%
	Female	41	7.58%		(3–6)	305	56.38%
Age of head of the household (years)	<40	61	11.28%		(6–9)	94	17.38%
	(40–49)	195	36.04%		>9	55	10.17%
	(50–59)	157	29.02%	Household size (pers) [1]	<3	26	4.81%
	(60–69)	92	17.01%		(3–5)	362	66.91%
	>70	36	6.65%		>6	153	28.28%
Education level of head of the household	Primary school and below	126	23.29%	Annual household income (thousand yuan)	<30	72	13.31%
	Junior high school	266	49.17%		(30–60)	149	27.54%
	High school/technical school	126	23.29%		(60–90)	133	24.58%
	College degree and above	23	4.25%		>90	187	34.57%

Note: The variables in the table reflect the basic situation of rural households in 2018; affected by the rounding algorithm, the sum of the proportions of rural households in different categories under each variable may not necessarily be 100%. [1] Conversion of international area unit: 1 mu = 0.067 ha.

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