land

MDPI

Article

The Second-Round Effects of the Agriculture Value Chain on Farmers' Land Transfer-In: Evidence from the 2019 Land Economy Survey Data of Eleven Provinces in China

Qiang Jin [1], Yanjing Guo [2], Hui Dang [1,3], Junfeng Zhu [1] and Kahaer Abula [4,*]

[1] College of Economics and Management, China Agricultural University, No. 17 Tsinghua East Road, Haidian District, Beijing 100083, China; qiang200102@163.com (Q.J.); danghui@sxufe.edu.cn (H.D.); zhujunf501@sina.com (J.Z.)
[2] Shandong Academy of Social Sciences, No. 56 Shungeng Road, Shizhong District, Jinan 250002, China; sdskyguoyj@shandong.cn
[3] Faculty of Business Foreign Language, Shanxi University of Finance and Economics, No. 140 Wucheng Road, Taiyuan 030006, China
[4] Business School, Xinjiang Normal University, No. 100, Guanjing Road, Shuimogou District, Urumqi 830017, China
* Correspondence: 320180064@xjau.edu.cn

Abstract: In the context of the separation of three rights of land and agricultural modernization, this paper is based on the land economic survey data from eleven provinces in China in 2019, covering the eastern, middle, and western regions of China. Based on the value chain theory and its "second-round effect", which pertains to the multi-round effects of value chain distribution theory, various research methods such as Probit, Tobit, the two-part model, SFA, PSM, and the intermediary effect model are employed to analyze the direct impact of the agriculture value chain (AVC) on farmers' land factor inputs and the income effects caused by them, which are the "second-round effect" of the AVC on land factor inputs. The research results show the following: Firstly, the AVC has a significant positive impact on the behavior and area of farmers' land transferring-in, which helps guide farmers towards large-scale land operation. Secondly, the AVC significantly improves farmers' production efficiency and promotes land transfer through differences in production efficiency, representing the "second-round effect" mechanism of the AVC on land factor inputs. Moreover, the AVC will increase farmers' net land production income by 48.74%, which is the "second-round effect" of the AVC on farmers' agricultural income and also the motivation for farmers' land factor inputs. Finally, the expansion of land area and the improvement of production efficiency jointly increase farmers' agricultural income, among which production efficiency plays a partial intermediary effect in increasing agricultural income if farmers join the AVC. This paper believes that we should further promote the market-oriented reform of land factors, support the innovation of the benefit linkage mechanism of the AVC, and promote appropriate areas of land operation by farmers, thereby achieving common prosperity and promoting agricultural modernization in China.

Keywords: agriculture value chain; land transfer-in; production efficiency; agricultural income; second-round effect; intermediary effect

Citation: Jin, Q.; Guo, Y.; Dang, H.; Zhu, J.; Abula, K. The Second-Round Effects of the Agriculture Value Chain on Farmers' Land Transfer-In: Evidence from the 2019 Land Economy Survey Data of Eleven Provinces in China. *Land* **2024**, *13*, 490. https://doi.org/10.3390/land13040490

Academic Editor: Libang Ma

Received: 17 February 2024
Revised: 31 March 2024
Accepted: 6 April 2024
Published: 9 April 2024

1. Introduction

1.1. Research Background

China is characterized by its vast territory and numerous small-scale farmers, which constitute the basic national conditions. The Household Contract Responsibility System of the 1980s in China, with its system feature of average land distribution based on members of family, resulted in a pattern of dispersed and small-scale land holdings [1], leading to distorted land allocations and an efficiency loss [2]. In comparison with developed countries, China still has a large gap in agricultural large-scale land management [3]. Limited by

the constraints of the national conditions of more people and less land, the fragmentation and dispersion of agricultural land have not seen significant improvement [4]. However, small-scale land operation not only hinders the application of modern technology, thus reducing production efficiency [5] and resulting in high production costs, but also leads to excessive use of pesticides and fertilizers, which can damage the ecological environment [6] and ultimately lead to low land output efficiency.

In order to transform the scale of production and operation of land held by traditional small farmers, the Chinese government has facilitated the establishment of a land transfer market, encouraged new management entities to collaborate with and assist farmers, and fostered the expansion and modernization of regional agricultural production [7]. The prerequisite for land scaling is land transfer, yet the fundamental motivation for land transfer lies in maximizing the value of the land or the household income of farmers [8,9]. The Chinese government has proposed the following: "Promote the construction of the agriculture value chain (AVC), establish multiple forms of value-sharing mechanisms, ... broaden farmers' income-earning channels and enable them to share more value-added benefits of the chain"[1]. They also suggest achieving "an organic link between small farmers and modern agriculture"[2]. The key for farmers to link with modern agriculture is to join the AVC. Leading enterprises and other modern agricultural organizations serve as the backbone of agricultural modernization, and they form a chain structure with farmers, which is the AVC[3]. According to the value chain theory about the existence of "multiple rounds of effects" in the distribution of value [10], the "second-round of effects" in the AVC mainly results in attracting surrounding farmers to join the AVC, thereby increasing factor inputs and boosting farm incomes [11]. Farmers mainly rely on various service organizations with integrating functions to achieve organizational paths of organization [12] and achieve an organic link with the AVC. The AVC has become an important "engine" and the best path for increasing farmers' income [13], thus encouraging farmers to transfer land and develop on a large land scale. A value chain refers to a series of different but interrelated economic activities aimed at maximizing value creation, also known as value-added activities. Their sum constitutes the "value chain"[4] [14,15]. Other scholars have extended and expanded the concept of the value chain [16], which has been widely used in the agricultural field, gradually forming the concept of the AVC. The AVC mainly links with farmers through production factors[5], optimizes the allocation of production factors and improves production efficiency [9,17], facilitates farmers' access to transfer in land, and thus achieves large-scale land operation and increases farmers' income.

1.2. Research Issues

As the main actors of the AVC, can leading enterprises or others by employing modern agricultural production methods influence the development of the participation of farmers in land transfer-in towards large-scale land operation? Can the AVC help improve the production efficiency of farmers joining the AVC and thus increase their income? Answers to these questions will help clarify the mechanisms of how new agricultural business entities promote land transfer, exploit favorable conditions to enhance the efficiency of land transfer, facilitate large-scale land operations, achieve income increases for farmers, and promote sustainable agricultural development.

1.3. Research Gap

Existing research on the impact of the AVC on farmers' transferring of land towards large-scale land development, thus increasing farmers' income, has not yet reached a consensus. There are mainly two different perspectives.

One perspective maintains that leading enterprises or other actors in the AVC can, by employing modern agricultural production methods, influence farming households to take part in land transfer towards large-scale land production development [18]. This can facilitate land operation at an appropriate scale [17,19] and exhibit a significant positive correlation with land productivity [20]. Numerous studies have shown that land operation

at an appropriate scale serves as the foundation of modern agricultural development [21]. The agricultural-scale land operation led by leading enterprises and other actors of the AVC has become an important support and backup for promoting agricultural development and increasing farmers' income [22]. Additionally, the vertical integration AVC model has a greater role in promoting land transferring behavior by farmers [23]. On one hand, farmers with a preference for non-agricultural work tend to transfer out their land, which not only brings them land rent but also allows them to increase their total income through non-agricultural employment [24,25]. On the other hand, farmers who are more experienced in farming operations, in order to exploit the land-scale effects of agricultural production, prefer to join into vertical cooperation with the new management entities of the AVC, thereby preferring to transfer in land [26].

However, some research views disagree with this. Some believe that, due to farmers' pursuit of the "informal security" function of land, this pursuit leads to lower land transfer efficiency [27], and it is difficult for new management entities, such as cooperatives, to have a significant impact on improving farmers' land transfer efficiency [28]. Others believe that small farmers do not have various management costs, mainly rely on family labor, and have higher production efficiency, and their rate of return is not low. The scale of farmers and agricultural efficiency have a negative relationship [17,29], and farmers are not very active in joining agricultural organizations. There are also views that the high efficiency of agricultural industrialization may not bring higher benefits to farmers. Some cooperation models for agricultural organization have a "crowding out" effect on small farmers [30–32], which essentially does not enhance farmers' income [33] and is potentially harmful to the interests of small farmers, particularly through land transfer on a large scale [34]. In addition, some agricultural organizations also have problems, including elite capture and contradicting interests of farmers in relation to organizations like leading enterprises in agricultural industrialization. It is difficult to safeguard the interests of small farmers [35], which is also a reason for their low enthusiasm to link with agricultural industrial organizations.

The inconsistency in research conclusions is mainly due to the heterogeneity of sample farmers, regional economic and social differences, and varying sample survey periods, all of which contribute to a lack of consensus regarding the relationship between large-scale land operation and production efficiency [2]. Thus, it leads to controversy over the view that agricultural organizations promote farmers' efficiency and an increase in income. From the perspective of agriculture development, the research focus of agricultural organizations in terms of linking and promoting farmers should shift its focus from organizational management models to governance of the AVC [10].

The research regarding the AVC's promotion of farmers' development of land-scale operations and increase in income carries significant theoretical and policy implications. While existing studies have conducted extensive discussions, there are still some shortcomings. On one hand, the theoretical analysis conducted in these studies primarily applies to industrial organization theory instead of value chain theory. The focus of traditional agricultural organizations is more on organizational management than on the value relationship among subjects, which makes it difficult to fully explain farmers' production behaviors and motivations [10]. The core of value chain theory lies in value creation and distribution [14], which can better explain the decision-making behavior of the actors at an essential level. On the other hand, the data samples of existing studies are mostly local and sometimes fragmented. Due to the significant time gaps in the survey periods of these samples, the limitations of sample distribution can lead to substantial variations, making it difficult to draw convincing conclusions. Furthermore, while there are numerous case studies and mechanism analyses in the current literature on agricultural organizations, land transfer, and large-scale land operation, empirical research in these areas remains sparse.

1.4. Research Contribution

Given this, this paper aims to provide an empirical examination of the mechanism through which the AVC promotes the transition to large-scale land development through farmers' land transfer, thereby ultimately enhancing farmers' income. And this study is based on the AVC theory and the perspective of the "second-round effect" of value chains [10].

Compared with existing research, the marginal contribution of this paper lies in the following: First, it contains innovations in theoretical application. This study applies the perspective of the "second-round effect" of the AVC [11,36] to analyze farmers' land transfer decisions, ultimately improving the marginal effect of farmers' income [10]. This theory provides a deeper explanation of the viewpoint that rational economic actors are primarily motivated by economic factors. And this theory not only better explains the land input behavior of farmers but also expands the theoretical framework of the "second-round effect" of the AVC, thereby advancing the frontier of empirical research on the AVC. Second, the sample data are more representative. The micro-research data in this paper have two unique advantages: One is that they are time-sensitive, and the other is their wide coverage. These data not only cover China's eastern, middle, and western regions but also reflect the economic characteristics of the AVC and China's land in recent years. In short, the research in this paper not only deepens the understanding of the "second-round effect" of the AVC, but also provides a theoretical basis for formulating policies to promote the appropriate scale of land operation among farmers, which is of positive significance for common prosperity and agricultural modernization in China.

2. Theoretical Analysis

2.1. The Core of the Theory: Multi-Round Effects of the Agricultural Value Chain and the Chain Model of Linking Farmers

According to the value distribution of the value chain theory, the agricultural value chain exerts a "multi-round effect" [10]. The distribution of benefits or measurement of status among the participants in the AVC is the "first round effect", which has been the primary approach in prior research on value chains. The exploration and analysis of the economic effects of the agricultural value chain on different subject factors or product inputs constitute the "second round effect" [11,36], aiming to promote farmers' factor inputs and increase farmers' income [10], thus attracting more farmers to join the AVC. The analysis of the income redistribution or consumption impacts of subjects of the agricultural value chain represents the "third or fourth round effect" of the AVC, aiming to promote fair distribution [37].

This paper focuses on analyzing the "second-round effects" of the AVC, exploring the mechanisms and economic effects of the AVC in linking farmers in the upstream agricultural production stage and facilitating their land factor inputs.

According to classical economic theory, the organization of the AVC mainly links with relevant actors (e.g., farmers) through vertical integration to improve the coordination level of all aspects, such as "production, supply, and marketing". Its core is to promote the development of agriculture towards high-level, industrialized, and large-scale production [38]. The AVC emphasizes the complementary advantages of farmers and leading enterprises, and both parties should leverage their efficiency and resource advantages to improve economic efficiency through strengthening their organization. The farmers, as the essential production and operation units at the upstream segment of the AVC, forge a value-sharing mechanism with other organizational entities (e.g., leading enterprises) [39]. This mechanism greatly avoids value conflicts, prompts farmers to operate in a standardized manner, and jointly enhances the benefits of all actors and the entire chain. According to the cost–benefit theory, the AVC enhances the degree of organization of farmers through increasing expected returns and intermediary organizations such as cooperatives [23].

The various actors in the AVC are deeply linked in terms of value, utilizing high technology to change traditional agricultural production methods through organizational

means. Leading enterprises realize product value through market competitive advantages and brand influence, which, to a large extent, resolves the contradiction between small farmers' "small production and large market" [40]. This forms the AVC development model, which is characterized by "leading enterprises + technology + cooperatives + farmers + value-sharing" [41], ensuring that farmers increase their production and income, thereby promoting the high-level development of the agricultural industry.

Unlike traditional and experiential agriculture, modern agriculture has the characteristics of factor agglomeration and industrialization [42], naturally requiring large-scale land. The AVC promotes the application of advanced technologies and the standardization of farmers' operations, thereby increasing unit output, reducing unit costs, and realizing economies of scale, all through improving the optimal allocation of production factors and the level of organization.

2.2. Theoretical Development: Second-Round Effects of the AVC on the Impact of Land Transfer

According to the viewpoint of "multi-round effects" in the distribution of value along the value chain, the "second-round effects" of the AVC on land elements are mainly manifested in the promotion of land transfers by improving the productivity of farmers. The AVC is not only reflected in the expansion of factor scales [42] but also in the application of high technology and the transformation of production methods. The specific manifestation is the improvement of production efficiency, which is significantly higher than that of traditional smallholder farmers. Based on the perspective that land should be transferred from low-efficiency actors to high-efficiency actors [2], the high efficiency of the AVC attracts land to flow towards leading enterprises or cooperatives, which are the main actors of the AVC. This promotes agricultural industrialization and large-scale development, which are also prerequisites for the application of high technology. Furthermore, compared to individual farmers, actors within the AVC exhibit a strong specialization in the division of labor. High efficiency of agricultural organization is smoothly transmitted to farmers joining the AVC. Farmers who join the AVC have an efficiency advantage and are motivated to transfer in land to expand their land area. Farmers who produce in a decentralized manner exhibit economic characteristics of poor risk resistance and low production efficiency, and there is no positive motivation for them to expand their land area under individual operation.

In China, the AVC utilizes production efficiency differences to promote land transfer along two paths: On one hand, leading enterprises and other actors of the AVC expand their scale of land by organizing farmers' land through a two-stage transfer process involving village collectives. Initially, land transfers into the village collectives and subsequently flows to cooperatives or enterprises [1]. However, this approach may introduce a certain degree of efficiency distortion. On the other hand, the AVC also influences the development of off-farm employment opportunities for labor and the differentiation of farm households. This leads to direct land transfers between farm households based on heterogeneity formation. Farmers who are not good at farming will transfer their land out and develop in non-agricultural fields, while farmers who are good at agricultural operation tend to transfer in land and develop in large-scale land under the influence of the technology spillover effect of the AVC [43]. There are various forms of land transfer [44], and transferring land to enterprises and combining with cooperatives may be the optimal form in the long run [2].

In the context of the continuous development of the rural land transfer market, land resource allocation will be more efficient. The AVC promotes land transfer through various methods, such as unified land transfer and free transfer among farmers, and is conducive to achieving Pareto improvement in land allocation [45], producing a "leveling effect" with labor [46] and realizing economies of scale.

In summary, the AVC facilitates land transfer through differences in production efficiency, thus realizing the large-scale development of agriculture as a prerequisite and foundation for optimizing the allocation of other production factors. This is the "second-round effect" of the AVC in promoting farmers' land factor input [10], which is the impact of the AVC on the production factor inputs of joining farmers. The aim of "second-round

effect" of the AVC is to attract more farmers to join the AVC and to further promote factor inputs from farmers.

2.3. Research Application: The AVC and Agricultural Income of Farmers

The high-efficiency, land-scale, and value-sharing mechanism of the AVC promotes farmers to increase their efficiency and income. This economic benefit, stemming from the AVC's impact on land factor input, precisely constitutes the "second-round effect" of the AVC in boosting farmers' income. According to the theory of expected returns, the AVC's agricultural income-boosting effect encourages farmers to further expand their land area, realize economies of scale, facilitate a circular development model, and further promote land transfer. The AVC promotes the transfer of land from farmers to large-scale developments by increasing their returns from agricultural production.

Further announcements indicate that the AVC promotes the improvement of farmers' production efficiency by increasing the degree of farmers' organization and promoting farmers to expand the area of their land [22,47]. Among them, organization plays an indirect role in land transfer through improving farmers' production efficiency. It should be noted that the high production efficiency obtained by farmers joining the AVC promotes their transfer-in of land to expand the scale of operation. The development of appropriate-scale land operation is conducive to improving production efficiency and becomes a reverse driver to promote the improvement of production efficiency.

In short, the AVC works together to increase farm household organization through return expectations and intermediary organizations such as cooperatives [23]. And the high efficiency is transmitted to the joining farmers through organized efforts. It promotes farmers' production growth by means of land-scale development and enhances production efficiency [47,48]. The AVC's potential for "low unit cost and high production efficiency" serves as the source of increased production income for farmers. This is further enhanced by a value-sharing mechanism that boosts farmers' land production income. In combination with the logic of land transfer caused by the efficiency differences mentioned earlier, the expansion of land area promotes agricultural income growth, which in turn drives farmers to expand their land area. Land expansion also contributes to further improvements in production efficiency[6]. The production efficiency, land area, and agricultural production income jointly form the "second-round effect" of the AVC on farmers' land transfer (see Figure 1).

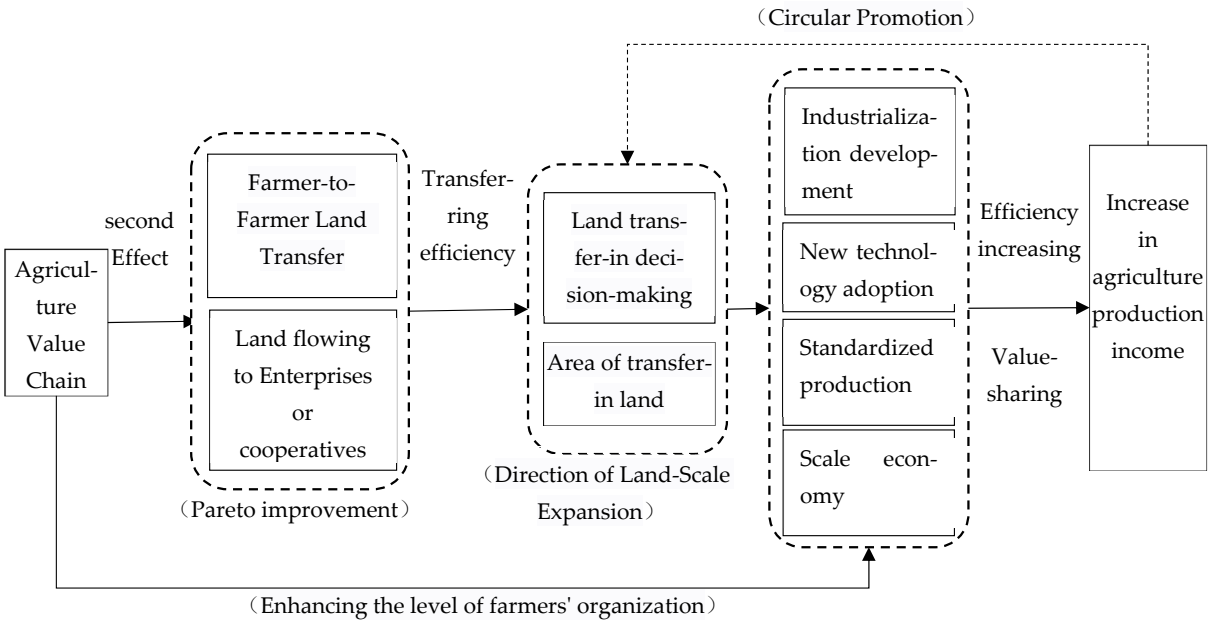

Figure 1. Theoretical analysis framework.

3. Data, Model, and Key Variable

3.1. Data Sources

The data in this paper come from a joint land economic survey conducted by the National Natural Science Foundation of China and the Asian Development Bank (ADB) Inclusive Agricultural Value Chain Development Project. The survey employed a stratified random sampling method and conducted household surveys in 2020, targeting growers in 11 provinces across the eastern, middle, and western regions of China. The data statistics were available until 2019. The eastern region includes five provinces: Heilongjiang, Jilin, Shandong, Zhejiang, and Guangdong. The middle region includes four provinces: Anhui, Shanxi, Henan, and Hunan. The western region includes two provinces: Guizhou and Shaanxi. The specific approach was to randomly select 2 prefecture-level cities in each province and select 1 sample test county (with leading enterprises) and 1 random control county in each prefecture-level city. Each county randomly selected 2 towns, and each town randomly selected 2 villages. Each village randomly selected about 20 planting households for research. A total of 1446 questionnaires were returned, and after deleting abnormal values and samples with severely missing values, 1193 valid samples were finally obtained. Sample effectiveness rate was 82.50%.

3.2. Model Selection

The behavior of farmers in transferring land and managing their land holdings exhibits consistent behavioral patterns, indicating a strong behavioral component [2,18,49]. Taking planting as an example, this paper connects the AVC with farmers' land transfer decisions and transfer areas, examines the impact of the AVC on farmers' land transfer decisions and land areas, and examines the impact of the AVC on joining farmers' land transfer decisions and transfer-in land areas. Therefore, a land transfer model was selected which included two sub-models: a land transfer behavior model and a land transfer area model [2].

1. Land transfer behavior model. Farmer's land transfer decisions are a typical binary variable. Selecting the Probit model as the empirical model, the impact of the AVC on farmers' land transfer behavior was analyzed. The model was established as follows:

$$Pr(Y_i = 1) = Pr(\alpha + \beta X_i + \eta C_i + \varepsilon_i) \quad (1)$$

In the above formula, Y_i represents the land transfer behavior of the i-th farmer; X_i indicates whether the i-th farmer is participating in the AVC; C_i includes the control variables, such as the i-th farmer's household characteristics, village characteristics, etc.; and ε_i represents the residuals.

According to value chain theory's perspective on value chain governance, there are approximately six main modes of the AVC models from an extension perspective: farmers producing for self-consumption, farmers selling their produce directly, farmers selling through trading markets (online or offline), farmers partnering with (internal) companies, farmers collaborating with cooperatives, and contract farming [50]. From farmers' perspectives, the AVC often refers, in a narrow sense, to the linkage of interests between farmers and other entities, forming a chain-like structure. Additionally, farmers, as decision-making units in production and operation, mainly participate in the upstream production process of the AVC.

In practice in China, other combinations or emerging models have also arisen, forming numerous new chain-like models involving farmers and different entities. These include "market (e-commerce) + farmers" [40,51], "agricultural socialized service organizations + farmers" [52], and "family farms, experts, large-scale farmers + small-scale farmers" [53], as well as "new farmers + small-scale farmers" and the "Science and Technology Backyard" [40]. These models essentially represent value chain development based on interest linkage. However, according to academic understandings of value chains and their evolving trends [54], modern agricultural value chains are often conceived as encom-

passing production, processing, transportation, sales, and other related activities. This type of comprehensive AVC is often led by enterprise-dominated agricultural value chains.

Therefore, this study chooses to investigate the AVC led by leading agricultural enterprises (excluding the global value chain) and selects one of the AVC models that is most widely practiced, effective in terms of scale, and positive for farmers' livelihoods (such as the model of leading enterprises + cooperatives + farmers) as a typical representative for quantitative analysis.

As shown in Table 1, a total of 428 households participated in land transfer, accounting for 35.88% of the total sample of farmers. Among them, 108 households transferred out their land, accounting for 9.5%; 320 households acquired land through transferring from other farmers, accounting for 26.82%; and 5 households both transferred in and transferred out land in 2019, accounting for 0.42%. Overall, more than one-third of farmers entered the land transfer market in 2019.

Table 1. Frequency distribution of farmers participating in land transfer among survey samples.

Transfer-Out Land / Transfer-In Land	Transfer-Out Land in 2019	No Transfer-Out Land in 2019	Total
Transfer-in land in 2019	5 (0.42%)	315 (26.40%)	320 (26.82%)
No transfer-in land in 2019	103 (8.63%)	770 (64.55%)	873 (73.18%)
Total	108 (9.5%)	1085 (90.95%)	1193 (100%)

Data source: The authors compiled the data based on the land economic survey.

2. Land transfer area model. Selecting Tobit model as the empirical model, we analyzed the impact of AVC on farmers' land transfer areas. The model was established as follows:

$$Tobit(T_i) = \varphi + \delta X_i + \theta C_i + \omega_i \quad (2)$$

In the above formula, T_i represents the area of land transferred by the i-th farmer; X_i indicates whether the i-th farmer had joined the AVC; C_i stands for control variables such as the i-th farmer's household characteristics and village-level characteristics, and ω_i represents the residuals.

According to Table 2, the number of newly added land transfers for sample farmers in 2019 reached 11,047.18 Mu[7], accounting for 51.14% of the total cultivated land area of the farmers (11,047.18/21,603.12), with more than half of the land entering the transfer market. Among them, 10,224.01 Mu of land was newly transferred in, and 823.17 Mu of land was newly transferred out.

Table 2. The newly leased farmland area of farmers among survey samples in 2019.

Items	Mean	Standard	Min	Max
Area of newly increased land transfer-in (Mu)	11,047.18 [a]	—	—	—
1. Transfer-in land:				
Area of newly added transferred-in land (Mu)	10,224.01 [a]	—	—	—
Area of land transferred in per household (Mu/household)	8.57	123.31	0	4000
2. Transfer-out land:				
Area of newly added transferred-out land (Mu)	823.17 [a]	—	—	—
Area of land transferred out per household (Mu/household)	0.23	1.93	0	50

Data source: The authors compiled the data based on the survey. Note: [a] refers to the total area of arable land newly transferred by participating farmers in the transfer year.

In AVC theory, the "second-round effect" of the AVC on the land transfer of farmers is the impact of leading enterprises and other value chain actors on the land transfer of surrounding farmers, including both farmers who join the AVC and those who do not. In empirical research, the impact of the AVC on the land factor inputs of joining farmers

is tested, and the estimated coefficients and significance are the effects relative to non-joining farmers. Furthermore, the marginal land production benefits generated from this are estimated [10]. This empirical method is in line with the research paradigm of value chains. In addition, considering the potential endogenous and self-selection problems of farmers joining the AVC, this paper employs PSM and two-part models for further estimation, aiming to avoid a possible bias in the results that may reduce the credibility of the conclusions.

3.3. Key Variables

1. Dependent variable. This paper uses "Whether to transfer land" and "Area of transferred land" as dependent variables[8]. They are represented by Y_i and T_i, respectively. If the area of land transferred by farmers in 2019 was greater than 0 (i.e., $T_i > 0$), then $Y_i = 1$; otherwise, $Y_i = 0$. T_i is the area of land actually transferred by farmers in 2019. Based on the theoretical analysis above, this article focuses on land transfer-in rather than land transfer-out. However, as a control, we still conducted an empirical test on land transfer-out.

2. Core explanatory variable: farmers joining the AVC.

The key to integrating farmers with modern agriculture lies in linking with the AVC. The path of farmers joining the AVC deserves careful consideration. In practice, farmers' link with the AVC mainly depends on the establishment of a linking value mechanism through agricultural organization vehicles [39]. According to representative industrial practices in China, three main models dominate the pathways linking farmers in the AVC: cooperative-led, enterprise-led, and agricultural service organization-led [55]. Among them, the vertical integration model of "production, supply, and marketing" represented by leading enterprises [16] is closer to the high end of the value chain [10]. It has a relatively large impact on farmers [38] and has become the dominant mode of agricultural industrialization [56]. It is also the focus of AVC analysis. Furthermore, the involvement of cooperatives[9] helps to enhance the bargaining power of farmers, facilitating their participation in better value-sharing mechanisms [38,41]; that is, farmers can engage in various forms of "secondary distribution"[10] to obtain value-added chain income. This has become a characteristic that clearly distinguishes the AVC from the characteristics of traditional agricultural organization models and other industrial chains [10,41,57]. The intermediary role of cooperatives and the value-sharing mechanism of the AVC help to strengthen the resilience and stability of the AVC [38]. The "leading enterprise + cooperative + farmer" model has become a typical representative of AVCs [58]. Leading enterprises are mainly responsible for establishing an integrated industrial platform encompassing production, supply and marketing, seed selection, technology research and development, and marketing efforts; cooperatives, on the other hand, focus on technical implementation, organizational production, and process guidance. Farmers, meanwhile, allocate their production factors for optimal use and engage in the planting process under the guidance of leading enterprises and cooperatives. The three major actors jointly engage in agricultural production; leading enterprises purchase and process agricultural products in a unified manner and ultimately satisfy the needs of end consumers through marketing channels for value realization. This paper takes the vertical linkage AVC model as the subject of research[11], drawing on the common practices of the existing literature [22,56]. The "leading enterprise + cooperative + farmer" model is used as a proxy variable representing the AVC[12] in the econometric model to empirically test land factor input behavior and its economic effects on farmers participating in this model.

The *i*-th farmer linking with the AVC was identified through a questionnaire survey on whether they had joined a cooperative and operated together with leading enterprises in agricultural upstream production. This paper focuses on the upstream planting segment of the AVC. If the farmer had joined a cooperative and engaged in agricultural production under the guidance of leading enterprises or cooperatives, ultimately with leading enterprises purchasing and selling agricultural products in a unified way[13], then the farmer was

considered to have joined the AVC, and this variable was assigned a value of 1; Otherwise it was assigned a value of 0.

As shown in Table 3, in 2019, 222 farmers joined the AVC, accounting for 18.61%. A total of 121 farmers only transferred their land to enterprises or cooperatives, accounting for 10.14%.

Table 3. The situation of farmers connecting with agriculture value chain.

Variables	No.	Percentage	Mean	Str
Whether to join AVC (Yes = 1, No = 0)	222	18.61%	0.19	0.40
Whether to transfer the land to the enterprises (Yes = 1, No = 0)	109	9.14%	0.09	0.29
Area of land transferred to enterprises (Mu)	6597.29	43.41%	5.53	37.83
Whether to transfer the land to the cooperatives (Yes = 1, No = 0)	54	4.53%	0.05	0.21
Area of land transferred to cooperatives (Mu)	3614.79	23.78%	3.03	32.68

Data source: The authors compiled the data based on the survey. The proportion of land transfer area refers to the proportion of the transfer area of different farmers in the total transfer area.

3. Control variables. Drawing on relevant research [23,38], the influences of characteristics of the household head, family characteristics, and village-level characteristics were controlled. Specific indicator measurements and descriptive statistics are shown in Table 4.

Table 4. Variable selection and descriptive statistics.

Items	Variable Name	Definition or Measurement	Mean	Standard
Dependent variable	Whether to transfer land	Yes = 1, No = 0	0.27	0.44
	Area of transferred land	Area of transferred land in 2019 (Mu)	1.35	9.50
Core explanatory variable	Join the AVC	Whether to join a cooperative and engage in agricultural production with leading enterprises: Yes = 1, No = 0	0.19	0.39
Characteristic variables of household head	Gender	Male = 1, Female = 0	0.88	0.33
	Age [a]	Age of the household head	54.68	10.95
	Education level	Years of schooling of the head of household (years)	7.78	3.22
Family characteristic variables	Whether the household is a party member and cadre household	Yes = 1, No = 0	0.20	0.40
	Number of people engaged in agriculture	Number of people engaged in agriculture in the family (persons)	1.57	6.76
	Family investment in agricultural time	The total time of family members invested in agriculture (months)	6.76	8.08
	Whether to divide the family	Not divided = 1, Divided = 0	0.53	0.50
	Family agricultural income (original value)	Income from family planting industry (CNY)	48,068.87	449,607.90
	Household income level [b]	1 = [0,3), 2 = [3,5), 3 = [5,8), 4 = [8,11), 5 = [11,14), 6 = [14,17), 7 = [17,20), 8 = [20,23), 9 = [23,+∞)	3.18	2.30
Village-level characteristic variables	Whether the land in the village has confirmed land ownership or not	Yes = 1, No = 0	0.95	0.21
	Whether the village has adjusted the land	Yes = 1, No = 0	0.05	0.22
	Proportion of farmers with land transfer in the village	The proportion of farmers with land transfer in the village among the sample farmers at the village level (%)	35.42%	31.11
	Whether land transfer requires collective approval from the village	Yes = 1, No = 2, Unknown = 3	1.68	0.61
	Whether there is a land transfer market in the village	Yes = 1, No = 0	0.11	0.31
Instrumental variable	Rate of farmers who joined AVC in the village [c]	The proportion of farmers who joined in the village-level sample	0.19	0.16

Note: Data from the research group's survey. [a]: the age cutoff is the end of 2019 and the respondents' ages are in years. [b]: the units within the interval are CNY 10,000; [c]: the joining rate is calculated as the average of the answers to this question given by all surveyed households in the village excluding the household in question.

4. Instrumental variable. This paper draws on similar treatment methods to those found in existing research [59] and adopts the "rate of joining the AVC farmers in the village"

as an instrumental variable (IV) for the land transfer model. According to social network theory, the adoption of this variable is mainly due to two reasons: On the one hand, the AVC has a strong driving effect on farmers, showing regional and group characteristics [34], and many farmers joining the AVC are introduced by acquaintances in the village, which has a typical effect of improving farmers' social capital [60]. Individual joining behavior is related to the overall joining rate of the village to some extent. On the other hand, the participation rate of farmers in the village is related to factors such as the village's resource endowment, economic development level, and whether there are capable people in the village. However, these factors do not easily influence individual farmers to join the AVC. This instrumental variable can meet the requirements of relevance and exogeneity.

4. Analysis of Results

4.1. Estimation Results

This paper uses Stata15SE software for regression analysis. The estimated results are presented in Table 5. The estimated coefficients in the table cannot be directly viewed as representing the exact magnitude of their impact on farmers' land transfer behavior or area, but the significance and direction of the coefficients remain meaningful. A significantly positive coefficient suggests that the variable significantly enhanced farmers' willingness to transfer land and increased the likelihood of a large land transfer area.

Table 5. Baseline regression results.

	Land Transfer Decision Model		**Land Transfer Area Model**	
Explained variable	Whether to transfer in land (Model 1)	Whether to transfer out land (Model 2)	Area of transfer-in land (Model 3)	Area of transfer-out land (Model 4)
Core explanatory variable: Whether to join AVC (Join = 1)	0.276 ** (0.132)	0.119 (0.133)	2.200 *** (0.711)	−0.703 (1.122)
Control variables				
Gender of household head (male = 1)	−0.113 (0.154)	0.087 (0.167)	0.432 (0.844)	0.374 (1.331)
Age of household head (logarithm)	−0.152 (0.281)	0.025 (0.265)	−3.222 ** (1.418)	1.303 (2.237)
Education level of the head of household	−0.005 (0.019)	0.000 (0.018)	−0.066 (0.094)	0.004 (0.149)
Party member and cadre household	−0.094 (0.159)	0.060 (0.137)	0.192 (0.725)	−0.975 (1.144)
Number of people engaged in agriculture in the family	0.029 (0.072)	−0.097 (0.082)	−0.268 (0.382)	−1.105 * (0.603)
Time spent on agriculture by the family	0.004 (0.008)	−0.005 (0.010)	0.023 (0.044)	0.139 ** (0.069)
Whether the farmers' households have separated	0.150 (0.115)	−0.030 (0.115)	−0.660 (0.583)	0.166 (0.920)
Household income level	−0.056 ** (0.027)	0.067 *** (0.025)	0.646 *** (0.133)	0.487 ** (0.210)
Income from family agriculture (logarithm)	0.056 *** (0.018)	−0.042 ** (0.017)	0.127 (0.089)	0.203 (0.140)
Proportion of farmers participating in land transfer in the village	3.789 *** (0.208)	0.203 (0.194)	1.844 * (0.957)	−0.594 (1.509)
Whether there is a land transfer market in the village	0.086 (0.210)	−0.567 ** (0.233)	1.529 * (0.915)	−0.423 (1.443)
Whether the land in the village has been confirmed	0.216 (0.305)	0.374 (0.291)	0.527 (1.337)	0.588 (2.110)
Whether the village adjusted the land	0.326 (0.236)	−0.569 * (0.333)	1.876 (1.215)	−1.049 (1.917)
Whether land transfer needs the approval of the village collective	0.030 (0.092)	−0.123 (0.089)	0.196 (0.455)	−0.865 (0.718)
Provincial dummy variable	controlled	controlled	controlled	controlled
Intercept term	−2.458 * (1.274)	−1.43 (1.201)	10.34 (6.359)	−5.771 (10.033)
Diagnostic and other information				
Log likelihood	−351.9703	−330.3324	−4244.4157	−4775.6798
Unilateral generalized LR test (H_0: $\sigma_u = 0$)	657.928 [0.0000]	58.721 [0.0000]	59.464 [0.0000]	17.65 [0.3450]
Sample size	1165	1165	1165	1165

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Standard errors robust to heteroskedasticity are in ( ), and probability *p*-values for the corresponding tests are in [ ].

This paper focuses on the core explanatory variable—farmers joining the AVC. Both the "land transfer decision" model and the "transfer area" model had positive estimated coefficients in the land transferring equation and passed the 5% and 1% significance tests, respectively. This result can be understood as follows: compared to farmers who had not joined the AVC and produced independently, farmers joining the AVC were more inclined to transfer in land and preferred to transfer in larger areas of land for large-scale development. As a comparison, the regression results also reported the estimated results of the AVC for the land transfer-out model of farmers, and its core explanatory variables were not significant. In reality, although there were cases of farmers joining the AVC and transferring out land, this was generally a land optimization based on the family's land resource allocation. Most likely, it involved the transfer-out of fragmented, inefficient land, which was less affected by the AVC.

In terms of controlling variables for household characteristics, the older the household heads were, the less likely they were to transfer in larger plots of land. The household income level had an adverse impact on the likelihood of transferring in land in the transfer equation but a positive correlation with the quantity of land transferred in the transfer quantity equation, with statistical significances of 5% and 1%, respectively. This indicates that households with higher income levels are not inclined to transfer in land but rather want to transfer out of land. However, once they decide to transfer land, they are likely to transfer in larger areas of land. Additionally, household agricultural income helps farmers transfer in land, but the amount and the area of land transferred are limited by many external factors, such as land adjustment, geographical location, and the willingness of other farmers to transfer. The estimated results were not significant.

Finally, we focus on the empirical results of village-level variables. The higher the proportion of farmers participating in land transfer in the village, the more conducive it was to the process of land transfer, which means that the more active the land transfer is in the village, the easier it is for farmers to transfer their land and the greater amount of land they are able to transfer. The land transfer trading market passed the 10% significance test in the equation for the number of transfers, indicating that the land trading market is more likely to transfer land, but it has little impact on land transfer behavior. This enlightens us to the fact that promoting the active development of the rural land transfer market through reasonable institutional arrangements can help promote the optimal allocation of land and achieve large-scale land operation in China.

4.2. Endogenous Discussion

To overcome the estimation bias caused by model selection and omitted variables, this paper uses the IV method to conduct a re-estimation. The average rate of farmers joining the AVC in other samples in the village excluding the farmer household in question was selected as the IV. As shown in Table 6, the IV passed the correlation and weak instrumental variable tests in both the "land transfer decision" model and the "land transfer area" model. Since the instrumental variable equaled the number of endogenous independent variables, it belonged to the exact identification and did not require a transitional identification test [61]. Using the indirect test method from the relevant research [62] for the exogenous test, the specific approach is to take the residuals of the second stage of two-stage regression as the dependent variable and the instrumental variable as the independent variable for the regression. If the instrumental variable is not significant, there is no statistical correlation between the instrumental variable and the regression residuals, which meets the exogenous requirement. The indirect test results showed that there was no significant statistical correlation between the IV and the residuals, which met the condition of exogeneity. The estimation results showed that the AVC had no significant impact on land transfer decisions, and the impact on the area of land transferred was positively significant at the 5% level. This may be due to the fact that the land transfer behavior of farmers was not completed within 2019, so the estimation results of the core explanatory variable in the "transfer or

not" model were not significant, while the AVC still had a significant impact on the area of land transferred by farmers, showing good robustness.

Table 6. Regression results of instrumental variable method.

	Land Transfer Decision Model		**Land Transfer Area Model**	
Explained variable	Whether to transfer in (Model 1)	Whether to transfer out (Model 2)	Area of transfer-in land (Model 3)	Area of transfer-out land (Model 4)
Core explanatory variable: Whether to join AVC (Join = 1)	−0.338 (0.246)	0.154 (0.309)	14.438 ** (5.746)	16.265 (18.480)
Significance of instrumental variables in the first stage Participation rate in AVC in the village [a]	1.004 *** (0.070)	1.004 *** (0.070)	0.982 *** (0.071)	0.982 *** (0.071)
Control variable	controlled	controlled	controlled	controlled
Provincial dummy variable	controlled	controlled	controlled	controlled
Kleibergen–Paap rk LM test	118.099 [0.0000]	118.099 [0.0000]	117.380 [0.0000]	117.380 [0.0000]
Cragg–Donald Wald F statistic	246.18	246.18	228.50	228.50
Stock–Yogo test 10%-level critical value	16.38	16.38	16.38	16.38
Indirect test (IV)	-1.09×10^{-15} [1.0000]	1.45×10^{-16} [1.0000]	9.09×10^{-14} [1.0000]	-3.26×10^{-14} [1.0000]
DWH test	2.281 [0.1084]	0.018 [0.892]	0.054 [0.8165]	1.989 [0.1587]
Sample size	1179	1179	1165	1165

Note: **, and *** indicate significance at the 5%, and 1% levels, respectively. The standard errors within ( ) are robust to heteroskedasticity, and the probabilities *p* within [ ] are the corresponding test values. The participation rate of the village in AVC does not include this farmer, and the average value of the answers from other farmers in the village is used as a proxy. The regression results are the regression results of the participation rate of the village in AVC and the core explanatory variables.

4.3. Robustness Checks

This paper mainly tested the samples by replacing the control variables and changing the measurement methods to verify the robustness of the estimated results.

1. Replacing control variables. The allocation of factors among farmers primarily relies on joint decision-making within the family, which is informed by the family's resource endowments [9]. In view of this, according to the research methods of the existing literature [27], the average number of years of education of family members, the average age of family populations, and the number of female workers in the labor force in the family were used to replace the household head characteristic variables in the benchmark regression and enter in the model regression. The estimated results are presented in Table 7. As the core variable, joining the AVC had no significant change in significance or sign and passed the test at the significance levels of 5% and 1%, respectively. The size of the estimated coefficient was also very close to the benchmark regression. Therefore, the original conclusion is robust.

Table 7. Robustness test: replacing control variables.

	Probit Model (Model 1)	**Tobit Model (Model 2)**
Explained variable	Land transfer-in behavior	Area of land transfer-in
Core explanatory variable: Whether to join AVC (Join = 1)	0.275 ** (0.132)	2.213 *** (1.009)
Control variable	controlled	controlled
Provincial dummy variable	controlled	controlled
Log likelihood	−350.80114	−4240.1759
Unilateral generalized LR test (H_0: $\sigma_u = 0$)	655.038 [0.0000]	55.264 [0.0000]
Sample size	1163	1163

Note: **, and *** indicate significance at the 5%, and 1% levels, respectively. Standard errors robust to heteroskedasticity are in ( ), and probability *p*-values for the corresponding tests are in [ ].

2. Changing the measurement method. When farmers take part in land transfer, they often make decisions first and then determine the area of land to be transferred based on their family endowments. We consider farmers' land transfer as an ordered and independent two-stage process. Drawing on the research ideas of relevant scholars [2,63], this paper adopts a two-part model [64] to re-estimate: in the first stage, the full sample was used to estimate whether farmers would transfer land; in the second stage, on the premise of deciding to expand the land area, a subsample composed of farmers who actually transferred land was used for the regression of the land area. This two-part model relaxes the requirements of homoscedasticity and normality assumptions, allowing independent variables to have separate impacts in the two models [65]. Two-part models usually assume that their two processes are independent of each other, but if this process is a case of sample selection, the estimates are still reliable [66].

Table 8 reports the estimated results of the two-part model for farmers' land transfer. By comparing with the previous benchmark estimates, it can be seen that the estimated coefficients of the key explanatory variables in the two-part model were not significantly different from the previous ones, having consistent directions and passing the 5% significance test. This shows that the empirical conclusions of this paper did not undergo substantial changes due to different measurement methods, demonstrating the robustness of the empirical results.

Table 8. Robustness test: changing the measurement method.

	Probit Model	**OLS Model**
Explained variable	Whether to transfer in land (Yes = 1)	Area of land transfer-in (Ln)
Core explanatory variable:		
Whether to join AVC	0.321 **	0.3137 **
(Join = 1)	(0.136)	(0.131)
Control variable	controlled	controlled
Provincial dummy variable	controlled	controlled
Log likelihood	−341.7056	—
Unilateral generalized LR test (H_0: $\sigma_u = 0$) (F)	678.457 [0.0000]	7.267 [0.0000]
Pseudo R^2 (Adj R^2)	0.4982	0.4079
Sample size	1165	316

Note: ** indicate significance at the 5% levels, respectively. The robust standard errors of heteroskedasticity are within ( ), and the corresponding test probability p-values are within [ ].

4.4. Heterogeneity Analysis

China spans vast regions, with significant economic resource and environmental disparities between the eastern, middle, and western regions. To understand the impact of the AVC on farmers' land transfer behavior and transfer area, this study divides the sample of farmers into these three distinct regions. To avoid missing observed values, the interaction term between the regional dummy variable and the AVC variable was introduced in the full sample regression to test the heterogeneity. The estimated results are shown in Table 9. In the eastern and middle regions, the AVC had a significant positive impact on both transfer behavior and transfer area. However, in the western region, this impact was not significant. This may be due to the relatively underdeveloped economy in the west, where farmers still rely primarily on traditional production methods, as well as the low level of agricultural industrialization and the limited ability of the AVC to drive farmers. Additionally, the geographical characteristics of the western region, which is dominated by high mountains and hills, lead to scattered and fragmented land parcels, making it difficult to operate on a contiguous scale. Coupled with the relatively low level of development of the land market in the western region, the scale effect of land transfer is not obvious. Overall, after considering the differences in economic development and land transfer markets in different regions, the regression conclusions show some heterogeneity. In

addition, there are certain thresholds for the AVC to drive the development of farmers [36]. Not all farmers and regions can be significantly affected by the "first-round effect" or "second-round effect" [10,11]. For example, whether the scale of the land and the quality of the soil are suitable for the needs of the development of agricultural industrialization is one of the obstacles to farmers joining the AVC [36]. The development of the AVC is a process of joint investment and collaborative development by various actors, and it also requires the intervention and coordination of government departments, associations, intermediaries, and international organizations to take multiple measures to help more farmers and regions integrate into the AVC.

Table 9. Results of heterogeneity test.

Explained Variable	**(Model 1) Land Transfer-In Decision**			**(Model 2) Land Transfer-In Area**		
Core explanatory variable:						
AVC × eastern region	0.360 ** (0.154)			2.231 ** (0.874)		
AVC × middle region		0.527 * (0.291)			3.659 ** (1.418)	
AVC × western region			−0.656 (0.506)			−0.573 (1.665)
Control variable	controlled	controlled	controlled	controlled	controlled	controlled
Provincial dummy variable	controlled	controlled	controlled	controlled	controlled	controlled
Log likelihood	−341.7573	−342.9515	−343.4531	−4245.2077	−4245.1372	−4248.3967
Unilateral generalized LR test (H_0: $\sigma_u = 0$) (F)	678.354 [0.0000]	675.965 [0.0000]	674.962 [0.0000]	57.880 [0.0000]	58.021 [0.0000]	51.502 [0.0000]
Sample size	1165	1165	1165	1165	1165	1165

Note: * and ** indicate significance at the 10% and 5% levels, respectively. The robust standard errors of heteroskedasticity are within ( ), and the corresponding test probability *p*-values are within [ ].

5. Mechanism Analysis

5.1. The AVC Improves the Agricultural Production Efficiency of Farmers Who Have Joined It

Due to the high efficiency of the AVC, it promotes land transfer and is conducive to linking farmers, expanding the area of land. Can the high efficiency of the AVC be passed on to joining farmers and improve the production efficiency of those farmers? Based on the Supplementary Materials, since the average land size of the households in this study is 18.37 acres (Table S1), most of the farmers' land size is far from the efficiency margin. According to the above theory this view, this paper uses the production efficiency of farmers as the dependent variable to estimate the relationship between the AVC and the production efficiency of farmers. The production efficiency of farmers is generally represented by the technical efficiency index (TE) of farmers' production technology [2], which reflects the production capacity of farmers. The TE value is often estimated using the stochastic frontier analysis method (SFA). This paper uses the Cobb–Douglas function to estimate it (Tables S2 and S3).

Firstly, the C-D production function passed the hypothesis of constant returns to scale (Table S4). Secondly, based on the estimation results of the SFA model, the agricultural production efficiency level α of each farmer (Table S5), represented by the technical efficiency index (TE), was obtained. Finally, the production efficiency was tested as the independent variable. Using the Tobit model for estimation, the results are shown in Table 10. The estimated coefficients of the core explanatory variables in the model were positive and passed the significance test at the 5% level. The estimated results indicate that the AVC significantly improved the production efficiency of joining farmers. Due to the heterogeneity of farmers' productivity levels, land allocation flows from low-productivity entities to high-productivity entities [2], a viewpoint that has been confirmed by relevant research and is no longer empirically tested in this paper. This can explain that the AVC has improved the land production efficiency of farmers who have joined and encouraged them to transfer land and expand their land areas, thus further promoting land transfers.

Table 10. Agriculture value chain and farmers' productivity.

	(Tobit Model)
Explained (independent) variable	Agricultural production efficiency α
Core explanatory (dependent) variable:	
Whether to join the AVC	0.026 **
(Join = 1)	(0.012)
Control variable	Controlled
Provincial dummy variable	Controlled
Log likelihood	386.81412
Unilateral generalized LR test (H_0: $\sigma_u = 0$)	1316.416 [0.1727]
Sample size	412

Note: ** indicate significance at the 5% levels, respectively. The robust standard errors of heteroskedasticity are within ( ), and the corresponding test probability *p*-values are within [ ].

5.2. The AVC Improves Joining Farmers' Agricultural Income

The AVC can empower farmers and motivate them to turn to land and develop large areas of land with the aim of improving their agricultural production and operation income. This paper draws on the ideas of similar research [23,67], employing a quantitative approach and utilizing the counterfactual framework method [68] in economics to measure the treatment effect of farmers' potential land output after they join the AVC [45,67]. In order to avoid the price impact of different agricultural products, this paper uses agricultural production income (net income from planting) to measure the level of agricultural output of farmers. In order to overcome the "self-selection" problem, whereby small farmers may choose to join the AVC due to external policy environments and their own heterogeneity, the PSM method is used as a means to estimate land production income.

This paper uses both propensity score matching (PSM) and the bias-corrected matching estimator (BME) to estimate the treatment effect (ATT) of land output[14]. The balance test (Table S6) and common support domain test (Figure S1) are seen in the Supplementary Material. Table 11 reports the estimation results of the two methods. Both methods produced positive results in terms of direction and significance, with small deviations in estimated coefficients and passing the test at the 5% significance level, indicating that the AVC has a positive impact on farmers' net income from planting if the average values are calculated using the two methods[15]. The average value of propensity score matching (PSM) obtained using the three methods was 0.464, which differed from the final average value in the last column by 0.35%. When applied to all sample farmers, it was found that participating in the AVC increased their agricultural production income (net income from planting) by 48.74% (exp (0.397) − 1). Of course, this estimation result is mainly due to the relative increase in agricultural income obtained by farmers participating in the AVC, including the effects of various production factors, rather than the income-increasing effect of the land area alone.

Table 11. Potential net benefits of farmers joining the Agriculture Value Chain for planting.

	PSM		**BME**		**Mean**
Net income of planting industry (logarithm)	Neighbor matching	0.457 ** (0.185)	Deviation correction	0.337 ** (0.165)	(0.457 + 0.337)/2 = 0.397

Note: The method of nearest neighbor matching is used with replacements and allows for parallel results, k = 4; the caliper matching and kernel matching in propensity score matching are significant, at least at the 10% level, which is not shown in the table due to space limitations; the bias-corrected matching is the standard error of heteroskedasticity robustness; ** indicate significance at the 5% levels, respectively.

5.3. The Mediating Effect of Agricultural Production Efficiency

The AVC promotes land transfer by improving the production efficiency of linking farmers, which promotes farmers to expand the area of their land. The increase in produc-

tion efficiency and the expansion of land area jointly increase the land production benefits of the farmers, with the mechanism being as follows.

Firstly, advanced technologies in the AVC are transmitted to the farmers through means of production, and technological progress promotes the improvement of farmers' production efficiency and ensures the implementation of technology through improved organization. Production efficiency is one of the important motivations for farmers' land transfer [2], which promotes the transfer of land from individuals with low production efficiency to individuals with high production efficiency, thereby improving the efficiency of land allocation and land transfer. The high efficiency of the AVC encourages farmers to transfer in land and expand the area of land operation. Production efficiency has become the driving force for the AVC to exert a "second-round effect" on land transfer.

In addition, the area of the land is also a reverse driver in the improvement of production efficiency. On the left side of the inverted U-shaped relationship between land area and production efficiency [48][16], there is a positive correlation between the land scale and farmers' production efficiency. Therefore, expanding land area can help improve agricultural productivity [20,48,67]. However, the logic of expanding land area to improve production efficiency is not the same as that of improving production efficiency in the AVC. An appropriate land area is conducive to applying advanced equipment and reducing unit costs to improve land productivity [27], while the AVC mainly relies on technological innovation to improve agricultural productivity through technological progress, mainly through the input of high-tech production materials and advanced agricultural technology, supplemented by professional production services and the improvement of farmer organization. The increase in production efficiency induced by land area expansion plays a supporting role in the AVC's use of technology to improve production efficiency, but the expansion of land area will further enhance the high efficiency generated by technological progress, releasing and expanding its effects. However, there is a limit value between land area and production efficiency, and there may be a so-called "inverted U-shaped" relationship [48]. The decisive factor affecting production efficiency is still the technological progress formed by technological innovation, with technology as the driving force. The progress of science and technology will shift the vertex of the inverted U-shaped curve to the right.

Finally, the high efficiency of leading enterprises promotes the value enhancement of the agricultural industry and helps farmers increase production yields. Production efficiency plays a mediating role in promoting farmers' income growth in the AVC. The estimated results are shown in Table 12. Agricultural production efficiency serves as a partial mediator in enhancing farmers' net income from planting, accounting for a mediating effect of 46.69%. For those farmers who join the AVC, the integration of their production efficiency with land areas manifests as the realization of economies of scale and the enhancement of product value. The AVC's high efficiency guarantees an increase in farmers' production, while its value-sharing mechanism further propels their income growth (Figure 2). It can also be said that the AVC improves farmers' production efficiency through technological progress, which in turn promotes farmers to expand the area of their land operations and develop towards large-scale development. Through the value-sharing mechanism of the AVC, farmers' land production income is further improved. However, the expansion of land area also helps to further improve farmers' production efficiency, thus expanding the income-increasing effect of the farmers and forming a circular development model.

It should be noted that the variable of production efficiency is mainly obtained based on the input–output model, which can better explain the effect of optimizing the allocation of the three major production factors of land, labor, and capital (including agricultural science and technology, agricultural machinery, etc.) on the increase in the income of farmers. Due to the mutual influence of the three major production factors, there is a substitution effect, and in reality, there is also a certain degree of the phenomenon of mutual carriers[17]. Therefore, it is not very scientific and not of practical significance to

forcefully isolate the influence of the other two factors through technical methods and only examine the impact of a single material factor on farmers' income.

Table 12. The mediating effect test for production efficiency.

Variable Name	Model (1) Agriculture Income	Model (2) Production Efficiency	Model (3) Agriculture Income
Joining the AVC	0.678 *** (0.205)	0.015 ** (0.007)	0.339 ** (0.156)
Production efficiency	/	/	19.371 *** (1.155)
Control variable	Controlled	Controlled	Controlled
Regional control variable	Controlled	Controlled	Controlled
Constant term	8.960 *** (2.177)	0.837 *** (0.080)	−6.801 *** (1.921)
Sample size	361	344	344
Adjust R^2	0.145	0.001	0.542
Mediation effect (Sobel) test		Z Value = 2.050, P > |Z| = 0.040	
Indirect effect		0.297 ** (0.145), P > |Z| = 0.040	
Direct effect		0.339 ** (0.155), P > |Z| = 0.029	
Overall effect		0.636 *** (0.211), P > |Z| = 0.003	
Proportion of mediating effect in total effect		46.69%	

Note: ** and *** indicate significance at the 5% and 1% levels, respectively. The robust standard error of heteroskedasticity is in ( ), and the confidence interval is in [ ]. The net income of the planting industry represents the agricultural income of farmers, and the production efficiency is replaced by the TE value of technical efficiency. According to the basic principles of mediating effect testing, the test results of the coefficients in this mediating effect equation set indicate that there is a mediating effect and that bootstrap testing is not required.

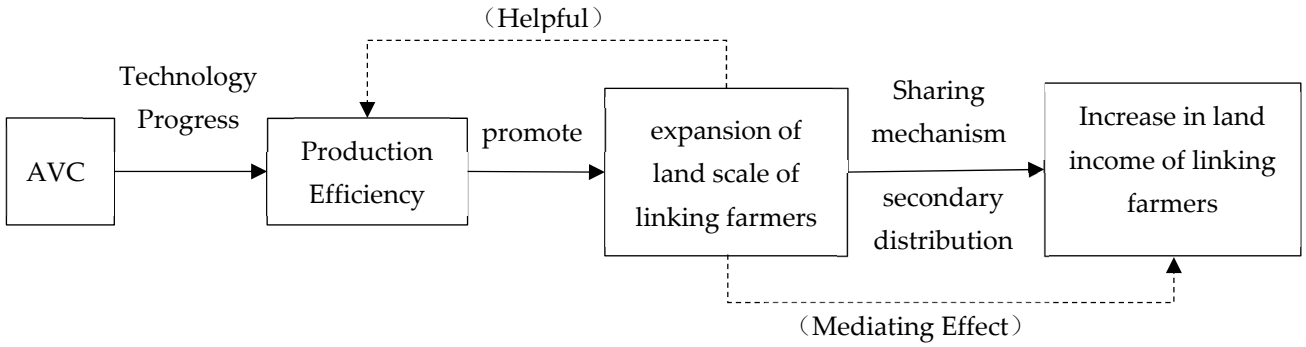

Figure 2. Mechanism of increasing farmers' land production income through the AVC.

6. Conclusions and Implications

6.1. Conclusions

This paper, utilizing survey data from 1193 land economy samples from 11 provinces in China, empirically analyzes the "second-round effect" of the AVC model, which is represented by the "leading enterprises + cooperatives + farmers" pattern on farmers' land transfer and agricultural income, as well as its impact mechanism. The main conclusions are as follows.

First, the AVC significantly promotes the large-scale development of farmers' land, although the impact on farmers in the western region in China to expand the area of land is not significant. Second, the AVC promotes the large-scale development of land by enhancing farmers' agricultural efficiency, and the subsequent expansion of land area further boosts their production efficiency. Third, the AVC significantly improves farmers' agricultural income, with production efficiency serving as a mediating factor. This is the "second-round effect" of the AVC, which enhances farmers' agricultural income.

6.2. Implications

In order to further leverage the "multi-round effects" of the AVC and enhance the welfare of farmers in the process of agricultural modernization, the following policy implications are drawn.

First, further strengthen land policy reform and promote the marketization of land factors in China. An open, sound, and free land transfer market is a prerequisite for the AVC to promote land transfer, expand the scale of land production of farmers, and improve production performance. Secondly, vigorously support technological innovation in the AVC. Scientific and technological progress is the source of technological efficiency improvement, the prerequisite for realizing economies of scale, and the key to value creation and value-sharing in the AVC. Support leading enterprises to jointly build technology transformation platforms with universities and scientific research institutions, increase their financial and tax support for technological innovation, and enhance the development level of the AVC. Thirdly, innovate the organizational carrier of the AVC and the benefit-link mechanism between farmers, continuously improve farmers' income through various forms of "secondary distribution" sharing mechanisms, drive more farmers to join the AVC, establish long-term cooperative relationships, and promote common prosperity. Finally, increase support for agricultural industrialization in the western region of China, improve the level of modernization in developments, further change the traditional production mode of farmers, increase farmers' income, and achieve coordinated development of the eastern, middle, and western regions in China.

6.3. Discussion

This paper selects "leading enterprises + cooperatives + farmers" as a representative of AVCs for focused research. However, in practice, the development model of AVCs varies according to local conditions, exhibiting flexibility and diversity. Therefore, the focus of further exploration may not solely be on whether farmers join modern AVCs, but rather on the selection of the organizational link to engage with (joining path), how to engage with it (value mechanism), and the precise measurement of the degree of farmers' involvement in AVCs. Additionally, investigating the resulting "multi-round effects" on farmers may be worthy of further research in the future.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/land13040490/s1, Figure S1: Probability density distribution map of PSM; Table S1: Agricultural Land Operation Situation of the Survey Sample in 2019; Table S2: Descriptive Statistics of Cobb-Douglas Production Function; Table S3: Descriptive Statistics of Farmers' Production Technical Efficiency; Table S4: Cobb-Douglas production function estimation results; Table S5: Stochastic frontier production function estimation results; Table S6: Test results of PSM balance hypothesis. References [69,70] are cited in Supplementary Materials file.

Author Contributions: Conceptualization, Q.J. and J.Z.; methodology, Q.J. and Y.G.; software, Q.J. and H.D.; validation, Y.G. and H.D.; formal analysis, K.A.; investigation, Q.J. and H.D.; resources, J.Z.; data curation, Q.J. and J.Z.; writing—original draft preparation, Q.J. and H.D.; writing—review and editing, Q.J., Y.G., H.D. and K.A.; visualization, J.Z. and K.A.; supervision, J.Z. and K.A.; project administration, J.Z.; funding acquisition, Q.J., Y.G. and J.Z. All authors have read and agreed to the published version of the manuscript.

Funding: Asian Development Bank Inclusive Agricultural Value Chain Development Project (RRP PRC 48358-001); the National Natural Science Foundation of China (No. 71973137); the China Agricultural University Professor Workstation (Nos. 20201301 and 20201302); Shandong Province Social Science Planning: Digital Shandong Research Special (No. 23CSDJ50).

Data Availability Statement: The original contributions presented in the study are included in the article; further inquiries can be directed to the corresponding author for signed data access contracts with the Asian Development Bank and the China Agricultural University.

Acknowledgments: Thanks to the reviewers, the editorial board, and the teachers of the editorial department for their comments and suggestions. The authors take full responsibility for their writing.

Conflicts of Interest: The authors declare that they have no conflicts of interest in this work.

Notes

1 http://www.12371.cn/special/sswgh/wen/#si (accessed on 6 June 2023).

2 http://www.xinhuanet.com/politics/2020-02/05/c_1125535347.htm (accessed on 1 January 2023).

3 The agricultural value chain generally refers to the whole chain of production, supply, and marketing integration from "field to table".

4 There is some overlap between the terms "industrial chain" and "value chain". While the concept of the value chain is more widely used in international research, the term "industrial chain" is more specific to the Chinese context.

5 Horizontal integration: when production factors are putted in leading agricultural value chain actors, but without engaging in agricultural production and operation. Vertical integration: farmers integrate production factors into leading agricultural value chain actors, serving as upstream entities in the agricultural value chain to carry out agricultural production.

6 The relationship between land size and production efficiency exists as a marginal relationship, which may be an inverse U-shaped curve.

7 Mu is a unit of land area in the Chinese market system, with one mu approximately equal to 666.667 square meters.

8 "Whether to transfer out land" and "Area of transferred land" are also used as dependent variables, forming the dependent variables of the land transfer-in model, and the estimated results are used as a comparison for the land transfer-in model.

9 According to the statistics of the State Administration for Industry and Commerce, nearly half of farmers have joined cooperatives. https://www.chinacoop.gov.cn/HTML/2017/09/05/122426.html (accessed on 1 August 2020).

10 The "secondary distribution" of the agricultural value chain in the production process not only includes the redistribution or secondary management dividends of the value-added income of agricultural value chain operation, but it also includes guaranteed purchase or higher-than-market-price purchase, production material subsidies, subsidies for agricultural machinery purchases, various forms of production services and training guidance, rotation income belonging to farmers, free infrastructure or technology research and development, and zero-sharing of application costs.

11 The horizontal linkage mode of agricultural value chains where farmers invest in single production factors without agricultural production is not empirically analyzed.

12 This variable has been used as a core alternative variable in studies on modern agriculture, industrial integration, industrial agglomeration, etc. and has a certain universality.

13 Leading agricultural enterprises generally have an integrated industrial platform for agricultural product production, processing, and sales.

14 Due to space limitations and research needs, this paper no longer estimates the effects of ATU and ATE and focuses on ATT.

15 The results of average values are based on the results of nearest neighbor matching, which are close to those obtained using other two methods of caliper matching and nearest neighbor matching.

16 According to Li Qi's (2023) estimation of the scale and efficiency of Shandong growers, land area has a significant inverted U-shaped impact on efficiency, with a maximum land area of 112.5 Mu, at which technical efficiency is highest. As the average land area of the surveyed samples in this article is 18.37 Mu, which is on the left side of the critical point, and according to the standard of 30 Mu or 50 Mu for land area at home and abroad, the sample average also includes the operations of small-scale farmers, so it is still in the marginal stage of increasing, which is reason enough to believe that there is a positive correlation between land area and technical efficiency.

17 Agricultural productive investment often uses seedlings, fertilizers, and other means of production as carriers, and the means of production must be carried by land to function.

References

1. Xu, Q.; Yin, R.; Zhang, H. Economies of Scale, Returns to Scale and the Problem of Optimum-scale Farm Management: An Empirical Study Based on Grain Production in China. *Econ. Res. J.* **2011**, *3*, 59–71.
2. Shi, C.; Luan, J.; Zhu, J. Allocation Efficiency and Welfare Effects of the Transfer of Rural and Management Rights in China. *South China J. Econ.* **2017**, *10*, 36–58.
3. Han, Z. Individual Farmers and Scale Farming: Reviews of the Theoretics of the Family Farm. *Econ. Res. J.* **2017**, *7*, 184–199.
4. Ye, X. China's Agricultural Management System in 40 Years: Historical Development and Future Directions. *Issues Agric. Econ.* **2018**, *6*, 8–17.
5. Yang, J.; Wang, X. The Impact of Cultivated Land Transfer on Agricultural Production Efficiency: Scale Effect or Selection Effect? *J. Agrotech. Econ.* **2022**, *12*, 43–55.
6. Gao, J.; Peng, C.; Shi, Q. Study on High Use of Chemical Fertilizers in China and Fertilization Behavior of Small Farmers—Findings Based on 1995–2016 National Rural Fixed Observation Point Data. *Manag. World* **2019**, *10*, 120–132.
7. Ma, X.; Cui, H. Establishing Land Transfer System to Promote Regional Agricultural Production Scale Operation. *Manag. World* **2002**, *11*, 63–77.

8. Deng, D. How Does the Agricultural Land Transfer Market Form—A Case Study of Hongqi Village, Liyuan Tun Village, Hu Village, and Xiaogang Village. *China Rural Surv.* **2009**, *3*, 26–35.
9. Hu, Y.; Yang, X.; Gao, M. The Logic of Farmers' Off-farm Employment Increasing Income under Factor Market Reform. *J. Agrotech. Econ.* **2022**, *7*, 78–95.
10. Kaplinsky, R.; Morris, M. *A Handbook for Value Chain Research*; Working Paper IDRC; IDRC: Ottawa, ON, Canada, 2001.
11. Wood, A. *North-South Trade, Employment, and Inequality: Changing Fortunes in a Skill-Driven World*; Clarendon Press: Oxford, UK, 1994.
12. Guo, Q. Small Farmers: Attributes, Types, Operational Status, and The Way of Embedding Modern Agriculture. *Issues Agric. Econ.* **2018**, *6*, 25–37.
13. Henson, S.; Masakure, O.; Boselie, D. Private Food Safety and Quality Standards for Fresh Produce Exporters: The Case of Hortico Agrisystems, Zimbabwe. *Food Policy* **2005**, *30*, 371–384. [CrossRef]
14. Porter, M. *Competitive Advantage of Nations*; CITIC Press: Beijing, China, 2012.
15. Chi, X.; Xuan, G. Summarization on the Research of Value Chain. *Foreign Econ. Manag.* **2000**, *1*, 25–30.
16. Hines, P.; Rich, N. The Seven Value Stream Mapping Tools. *Int. J. Oper. Prod. Manag.* **1997**, *17*, 46–64. [CrossRef]
17. Fan, S.; Chan-Kang, C. Is Small Beautiful? Farm Size, Productivity, and Poverty in Asian Agriculture. *Agric. Econ.* **2005**, *32* (Suppl. 1), 135–146. [CrossRef]
18. Wang, Y.; Wei, W.; Liu, R.; Ma, H. Analysis of Farmers' Land Transfer Decision-making Behavior from the Perspective of Organizational Form: Based on a Large Sample Survey of Farmers. *J. Agrotech. Econ.* **2017**, *4*, 38–49.
19. Carter, M.R.; Yao, Y. Local Versus Global Separability in Agricultural Household Models: The Factor Price Equalization Effect of Land Transfer Rights. *Am. J. Agric. Econ.* **2002**, *84*, 702–715. [CrossRef]
20. Wang, J.; Chen, Z.; Huang, Z.; Reardon, T. Re-examination of the Relationship between Land Productivity and Farm Household Operating Scale during the Transformation Period. *Manag. World* **2015**, *9*, 65–81.
21. Chand, R.; Prasanna, P.A.L.; Singh, A. Farm Size and Productivity: Understanding the Strengths of Smallholders and Improving their Livelihoods. *Econ. Political Wkly.* **2011**, *46*, 5–11.
22. Wang, H.; Hu, L.; Lu, Q. The Impact of Small Farmers' Participation in AVC Activities on Production Performance. *J. Northwest AF Univ.* **2021**, *2*, 130–139.
23. Li, J.; Lu, Q. Influence of joining cooperatives on farmers' land transfer-in behavior. *Resour. Sci.* **2022**, *6*, 1181–1195. [CrossRef]
24. Li, F.; Feng, S.; Lu, H.; Qu, F.; Haese, M.D. How Do Non-Farm Employment and Agricultural Mechanization Impact on Large-Scale Farming? A Spatial Panel Data Analysis from Jiangsu Province, China. *Land Use Policy* **2021**, *107*, 105517. [CrossRef]
25. Ji, X.; Qian, Z.; Zhang, L.; Zhang, T. Rural Labor Migration and Households' Land Rental Behavior: Evidence from China. *China World Econ.* **2018**, *26*, 66–85. [CrossRef]
26. Chu, Y.; Wu, F. Aging of Agricultural Workforce and Changes in Decision-Making on the Transfer of Farmland: Based on the Perspective of Intergenerational Transfer of Decision-Making Power of Household Contracted Farmland. *J. Agrotech. Econ.* **2023**, *9*, 1–21. [CrossRef]
27. Yao, Y. Empirical Study on Land System and Agricultural Performance. *China Rural Surv.* **1998**, *6*, 3–12.
28. Zhang, Y.; Han, J.; Wang, C. Multi-dimensional Inspection of Land Transfer, Appropriate Scale of Agriculture and Income Increase of Farmers—An Empirical Study based on Survey Data of 584 Agricultural Operators in Three Provinces. *Economist* **2019**, *4*, 89–102.
29. Li, G.; Feng, Z.; Fan, L. Is the Small sized Rural Household More Efficient? The Empirical Evidence from Hubei Province. *China Econ. Q.* **2009**, *1*, 95–124.
30. Bowles, S. *Microeconomics: Behavior, Institutions and Evolution*; Princeton University Press: Princeton, NJ, USA, 2004.
31. Barrett, C.B.; Bachke, M.E.; Bellemare, M.F.; Michelson, H.C.; Narayanan, S.; Walker, T.F. Smallholder Participation in Contract Farming: Comparative Evidence from Five Countries. *World Dev.* **2012**, *40*, 715–730. [CrossRef]
32. Huang, S.; Sun, J. The Impact of Compound Governance on the Performance of Agricultural Product Marketing Channels—A Case Study of the "Agricultural Leading Enterprises + Farmers" Model. *China Rural Econ.* **2016**, *4*, 17–30. [CrossRef]
33. Hong, Y.; Zheng, J. The Industrial Organization and the Market Organization that Repay Agriculture: An Analysis Based on the Value Chain of Agricultural Products. *Manag. World* **2009**, *5*, 67–79.
34. Xiao, J.; Luo, B. The Core Proposition of China's Agricultural Modernization: How Small Farmers Move towards Scale Operation of Land—Evidence from Returning Migrant Farmers. *Rural Econ.* **2023**, *2*, 10–22.
35. Henderson, H.; Isaac, A.G. Modern Value Chains and the Organization of Agrarian Production. *Am. J. Agric. Econ.* **2017**, *99*, w92. [CrossRef]
36. McCulloch, N.; Ota, M. *Export Horticulture and Poverty in Kenya*; Working Paper IDS; Institute of Development Studies: Brighton, UK, 2002; Volume 174.
37. Berry, R. Redistribution, Demand Structure and Factor Requirements: The Case of India. *World Dev.* **1981**, *9*, 621–635. [CrossRef]
38. Kumari, S.; Bharti, N.; Tripathy, K.K. Strengthening Agriculture Value Chain through Collectives: Comparative Case Analysis. *Int. J. Rural Manag.* **2021**, *17*, 40S–68S. [CrossRef]
39. Huang, Z. Construction of Modern Agricultural Operation System and Institutional Innovation—Discussion on the Modern Agricultural Operation System and Institutional Construction with Farmer Cooperatives as the Core. *Rev. Econ. Manag.* **2013**, *6*, 5–16.

40. Ye, J.; Dou, S.; Zhang, M. How Can Small Farmers Become Organically Involved in the Development of Modern Agriculture? *China Rural Econ.* **2018**, *11*, 64–79.
41. Jin, Q.; Dang, H.; Wang, H.; Zhang, Z. Exploring Cooperative Mechanisms in the Chinese Agricultural Value Chain: A Game Model Analysis Based on Leading Enterprises and Small Farmers. *Agriculture* **2024**, *14*, 437. [CrossRef]
42. Wang, Y.; Liu, Y. Research on the Impact of Agricultural Industry Agglomeration on Farmers' Income. *J. Agrotech. Econ.* **2011**, *9*, 50–57.
43. Zhang, X.; Mu, Y. Agricultural Industry Agglomeration and Its Income Growth Effect under the Spatial Perspective—Based on the Demonstration of Specialized Village. *J. Agrotech. Econ.* **2018**, *7*, 19–32.
44. Zhou, Z.; Zhang, C.; Zhong, Z. Innovation of Integration of Unification and Separation and the Agricultural Appropriate Large—Scale Management: Case Study of Xintiandi Planting Cooperative. *Issues Agric. Econ.* **2019**, *8*, 49–58.
45. Mao, P.; Xu, J. Land System, Land Operation Right Transfer, and Farmers' Income Growth. *Manag. World* **2015**, *5*, 63–74.
46. Carter, M.R. Identification of the Inverse Relationship Between Farm Size and Productivity: An Empirical Analysis of Peasant Agricultural Production. *Oxf. Econ. Pap.* **1984**, *36*, 131–145. [CrossRef]
47. Zhu, S.; Yang, R.; Wang, L.; Wu, B. Rural Land Transfer and Changes in Agricultural Production Patterns in China. *Manag. World* **2024**, *1*, 76–88.
48. Zheng, Z.; Gao, Y.; Huo, X. Re-exploration of the Relationship between Farm Operation Scale and Land Productivity: Evidence from the Third National Agricultural Census on Large-scale Farmers. *Manag. World* **2024**, *1*, 89–106.
49. Zhu, W.; Luo, B. Behavioral Capacity and Factors Matching in the Forming of Large-scale Farmer: An Empirical Study Based on National Sample Survey Data. *Acad. Res. J.* **2016**, *8*, 83–92.
50. Ton, G.; Thorpe, J.; Egyir, I.S.; Szyp, C. *Value Chain Governance and Children's Work in Agriculture*; Bristol University Press: Bristol, UK, 2023; pp. 141–173.
51. Lu, L.; Reardon, T. An Economic Model of the Evolution of Food Retail and Supply chains From Traditional Shops to Supermarkets to E-Commerce. *Am. J. Agric. Econ.* **2018**, *100*, 1320–1335. [CrossRef]
52. Kong, X. Improving Agricultural Socialized Service System Realizing the Organic Connection between Small Farmers and Modern Agricultural Development. *Agric. Econ. Manag.* **2017**, *5*, 20–22.
53. Liu, C.; Lv, J.; Fu, Y. A Study on the Articulation Model of Small Farmers Embedded in Modern Agriculture and Its Performance. *Rural Econ.* **2021**, *10*, 119–126.
54. Manida, M. The Future of Food and Agriculture Trends and Challenges. *Agric. Food* **2022**, *1*, 180.
55. Han, X.; Liu, W.; Gao, Z. Selection Preference and Preference Heterogeneity of Smallholders' Participation in Agricultural Industrial Chain: An Analysis Based on the Choice Experiment Method. *China Rural Surv.* **2020**, *2*, 81–99.
56. Nie, H. The Optimal Agricultural Contracts and the Models of Chinese Agriculture industrialization in China. *China Econ. Q.* **2013**, *1*, 313–330.
57. Song, H.; Gao, X. Green Supply Chain Game Model and Analysis Under Revenue-Sharing Contract. *J. Clean. Prod.* **2018**, *170*, 183–192. [CrossRef]
58. Yuan, P. Analysis of Four Agricultural Industrial Operation Models under the Framework of 'Company + Cooperative + Farmer': From the Perspective of Improving Farmers' Welfare. *China Rural Econ.* **2013**, *4*, 71–78.
59. Liu, T.; Yuan, P. Are Farmer Cooperatives Effective Pro-poor Organizations? *China Rural Econ.* **2020**, *5*, 39–54.
60. Zhang, L.; Chen, Z. Do Farmers' Specialized Cooperatives Increase Farmers' Social Capital? A Analysis Based on Survey Data from 506 Farmers in Yunnan Province. *China Rural Surv.* **2021**, *1*, 106–121.
61. Yuan, W. Endogeneity Test Methods, Procedures, and Stata Applications of Binary Selection Model. *Stat. Decis.* **2018**, *6*, 15–20.
62. Woodridge. *Econometric Analysis of Cross-Section and Panel Data*; Wang, Z., Translator; Renmin University Press: Beijing, China, 2007.
63. Yan, X.; Bauer, S.; Huo, X. Farm Size, Land Reallocation, and Labour Migration in Rural China. *Popul. Space Place* **2014**, *20*, 303–315. [CrossRef]
64. Cragg, J.G. Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. *Econometrica* **1971**, *39*, 829–844. [CrossRef]
65. Chen, Q. *Advanced Econometrics and Stata Applications*; Higher Education Press: Beijing, China, 2014.
66. Duan, N.; Manning, W.G.; Morris, C.N.; Newhouse, J.P. A Comparison of Alternative Models for the Dem for Medical Care. *J. Bus. Econ. Stat.* **1983**, *1*, 115. [CrossRef]
67. Ma, W.; Abdulai, A. IPM Adoption, Cooperative Membership and Farm Economic Performance: Insight from Apple Farmers in China. *China Agric. Econ. Rev.* **2019**, *11*, 218–236. [CrossRef]
68. Rosenbaum, P.R.; Rubin, D.B. The Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrika* **1983**, *70*, 41–45. [CrossRef]
69. Rosenbaum, P.R.; Rubin, D.B. Constructing a Control Group Using Multivariate Matched Sampling Methods that Incorporate the Propensity Score. *Am. Stat.* **1985**, *39*, 33–38. [CrossRef]
70. Rubin, D.B. Using Propensity Scores to Help Design Observational Studies: Application to the Tobacco Litigation. *Health Serv. Outcomes Res. Methodol.* **2001**, *2*, 169–188. [CrossRef]