

Study on the Impact of Agricultural Supply Chain Finance on Poverty Reduction: An Empirical Analysis Based on Nine Provinces in China's Border Region

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Abstract: This paper employs panel data from nine provinces and regions in China's border areas from 2011 to 2021 to empirically test the impact of agricultural supply chain finance in China's border areas on poverty reduction. The intermediary mechanism test model is used to investigate the underlying mechanisms. The findings of this research indicate that the development of agricultural supply chain finance has a significant effect on improving per capita disposable income in rural areas. There is, however, heterogeneity in the impact of this development across different border provinces and regions. The Southwest Border Region has the most pronounced effect in improving per capita disposable income in rural areas through agricultural supply chain finance. This research result provides strong theoretical support for the development of agricultural supply chain finance in China's border areas and also provides important reference basis for relevant policy formulation. As further research is conducted, it is anticipated that more results will emerge, which will facilitate the advancement of economic development and poverty reduction initiatives in China's border regions.

Keywords: China's Border Region, Agricultural Supply Chain Finance, Poverty Reduction.

1. Introduction

The implementation of agricultural supply structure reform and rural revitalisation strategy has led to a growing focus on the relationship between agricultural supply chain finance and rural poverty alleviation. Agricultural supply chain finance (ASCF) has become an essential component of rural revitalisation and the construction of a modern industrial system.

In recent years, numerous regions both within and beyond China have begun to introduce the concept of supply chain finance (SCF) into the agricultural field. This has led to a gradual realisation of the significant significance of SCF for rural finance. Some scholars posit that SCF represents the pinnacle of innovative rural financial solutions (Zhou et al., 2018) [1], while for small farmers, SCF represents the pinnacle of their financing plan evolution (Renée, 2014; Gashayie et al., 2015) [2] [3]. The rationale for this approach lies in the fact that Agricultural Supply Chain Finance (ASCF) can not only effectively alleviate credit constraints on farmers, but more importantly, it can achieve transformation, commercialisation, and sustainable development of agriculture [4]. This, in turn, will promote small farmers to develop upstream in the supply chain, and avoid their exclusion from the mainstream value chain under the trend of economic globalization [5].

It can be argued that ASCF is not only a key means to alleviate credit constraints on farmers, but also a good solution to promote agricultural production systems driven by small farmers. This financial model, which combines SCF and agriculture, is expected to provide new ideas and support for rural economic development and agricultural modernization. It is therefore of positive significance in promoting stable income growth and improving living conditions for small farmers. As the field of agricultural research and practice continues to evolve, ASCF is poised to assume an increasingly pivotal role in the agricultural sector,

offering a promising avenue for addressing rural financial challenges.

This study seeks to examine the potential of agricultural supply chain finance (ASCF) in alleviating poverty and, based on this analysis, propose targeted policy recommendations and implementation strategies. This study will investigate the impact of agricultural supply chain finance on poverty reduction through a comprehensive examination of practical cases and economic data. It will identify the positive effects of agricultural supply chain finance on poverty alleviation and elucidate the mechanisms and influencing factors.

2. Theoretical Hypothesis

The process of rural development has been facilitated by rural finance, which has promoted rural economic development and played an important role in rural revitalisation and rural supply structure adjustment. Agricultural supply chain finance represents a novel operational model that has emerged in recent years. This model provides financial support and risk management services to various links in the agricultural supply chain through financial means, with the objective of promoting the development of agricultural production, processing, circulation, and related industries. The implementation of agricultural supply chain finance has the potential to enhance farmers' income by reducing capital costs and expanding loan channels for farmers in border provinces and regions of China. This, in turn, could lead to an increase in per capita disposable income in rural areas of the nine provinces and regions in the border region. Hypothesis 1, therefore, proposes that agricultural supply chain finance can directly promote the increase of per capita disposable income in rural areas of the nine provinces and regions in the border region.

The implementation of digital inclusive finance has the potential to significantly reduce the cost of financial services,

improve the efficiency of financial services, and help alleviate the phenomenon of "financial exclusion" in rural areas of border provinces. This is due to the fact that digital inclusive finance can better conduct credit queries and ratings, covering a wider range of user groups. Furthermore, the development of agricultural supply chain finance has the potential to significantly reduce poverty. In order to further investigate whether the level of digital finance development has a moderating or partially mediating effect on the poverty reduction effect of agricultural supply chain finance, this article proposes hypothesis 2: Agricultural supply chain finance effectively promotes the increase of per capita disposable income in rural areas of China's border provinces through the transmission path of digital finance.

A significant proportion of migrant workers elect to return to their place of origin to establish businesses, which stimulates the growth of the rural economy, enhances farmers' income, and also enhances their quality of life. Concurrently, the integrated development of the three industries has effectively enhanced the utilisation rate of resources and factors in rural areas. This has involved the incorporation of agriculture into a broader social division of labour, enabling farmers to participate in non-agricultural work during non-agricultural seasons. This has resulted in increased income for farmers, and has facilitated the process of urban-rural integration. Based on the above analysis, hypothesis 3 is proposed: Agricultural supply chain finance increases per capita disposable income in rural areas by influencing urbanisation rates.

3. Research Design

3.1. Model Setting

This article constructs a benchmark model to explore the effect of agricultural supply chain finance on the per capita disposable income and Engel's coefficient of rural residents in China:

$$\ln PI_{it} = \alpha_0 + \alpha_1 \ln ASCF_{i,t} + \alpha_2 \sum X_{i,t} + u_i + \varepsilon_i \quad (1)$$

This study is based on the analysis of the mechanism of agricultural supply chain finance in Part 2 and the proposed research hypothesis. It explores the transmission mechanism of agricultural supply chain finance on poverty reduction in nine provinces and regions of China's border areas through the following model.

$$\ln PI_{it} = \beta_0 + \beta_1 \ln ASCF_{i,t} + \beta_2 K_{it} + w_1 \quad (2)$$

$$\ln DIF_{it} = \delta_0 + \delta_1 \ln ASCF_{i,t} + \delta_2 K_{it} + w_2 \quad (3)$$

$$\ln PI_{it} = \theta_0 + \theta_1 \ln ASCF_{i,t} + \theta_2 DIF_{it} + \theta_3 K_{it} + w_3 \quad (4)$$

$$\ln UR_{it} = \lambda_0 + \lambda_1 \ln ASCF_{i,t} + \lambda_2 K_{it} + w_2 \quad (5)$$

$$\ln PI_{it} = \theta_0 + \theta_1 \ln ASCF_{i,t} + \theta_2 UR_{it} + \theta_3 K_{it} + w_3 \quad (6)$$

The $\ln PI_{it}$ represents the per capita disposable income level of rural areas in nine provinces and regions, the $\ln ASCF_{i,t}$ represents the level of agricultural supply chain finance development in each province and region, the UR_{it} represents the urbanisation rate in Each province and region is represented by DIF_{it} , which denotes the level of digital finance development in that area. K_{it} is the control variable,

while α 、 β 、 δ 、 θ 、 λ represent the relevant coefficients to be estimated. Finally, ω is the error term.

To test for a mediating effect using the above model, it is first necessary to examine the overall effect of agricultural supply chain finance on the dependent variable, that is, the coefficient in (2) β_1 . The significance of 1 should then be tested. Secondly, the coefficients in (3) and (4) δ_1 、 θ_2 should be tested, with significance being used. To verify whether there is a mediating effect of the development level of digital finance, the coefficients in (5) and (6) (λ_1 、 θ_2) must be verified once more. The significance of 2 is used to test the mediating effect of the urbanisation rate. Finally, the coefficients in (4) and (6) θ_1 must be checked. The significance Finally, through stepwise regression and bootstrap testing, it was found that the development level of digital finance plays a completely mediating role in the role of agricultural supply chain finance in poverty reduction in the nine provinces and regions of China's border areas (4). The urbanisation rate plays a partial intermediary role in (6).

3.2. Variable selection

3.2.1. The dependent variable

This article selects the per capita disposable income (PI) of rural residents and measures this indicator using the standardized result of taking the logarithm of rural per capita disposable income.

3.2.2. The explanatory variables

The explanatory variables are the Development Level of Agricultural Supply Chain Finance (ASCF), which is measured by the balance of agricultural loans in different provinces and regions. This indicator effectively reflects the level of financial support and development in rural areas by various financial institutions in rural areas. Therefore, this article selects the balance of agricultural loans in nine provinces and regions of China as the main explanatory variable.

3.2.3. Adjusting variables

The level of digital finance development (DIF) is measured by the inclusive finance development indicators of China's nine border provinces and regions.

The ratio of foreign direct investment in each province and region (converted at the average exchange rate of USD to RMB in the current year) to the GDP of each province and region is employed.

3.2.4. The control variable

The following variables are employed in the analysis: population density (population), expressed as the number of people per unit area in each province and region; government intervention degree (gov), defined as the proportion of fiscal expenditure in each province and region to GDP; mechanisation level (mac), expressed as total mechanical power/rural population (10000 kilowatts/10000 people); and industrial structure (indu), defined as the output value of the tertiary industry/output value of the secondary industry.

3.3. Data Source

This paper selects nine border provinces and regions in China as the research objects. The data is derived from the China Statistical Yearbook, the China Financial Yearbook, and statistical yearbooks of provinces and regions from 2011 to 2021. The digital finance development level is adopted from the Inclusive Finance Research Center of China Institute of Digital Finance, Peking University. Furthermore, in order

to avoid heteroscedasticity and reduce errors, logarithmic preprocessing was performed on some variables. The

resulting descriptive statistical results are presented in Table 1.

Table 1. Descriptive Statistical Results

	Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent variable	lnPI	99	9.236	.343	8.361	9.864
Explanatory variables	lnASCF	99	8.437	.941	4.366	9.451
Adjusting variables	lnDIF	99	5.174	.733	2.786	5.878
	UR	99	.523	.12	.228	.728
control variable	indu	99	1.195	.373	.624	2.315
	fdi	99	.009	.013	0	.07
	gov	99	.391	.288	.156	1.334
	lnmac	99	7.856	0.621	6.059	8.841

4. Empirical Analysis of Poverty Reduction Through Agricultural Supply Chain Finance

4.1. Poverty reduction effect test

A regression analysis was conducted on panel data from nine provinces in China's border areas, based on model (1),

and it was found that the Hausman test significantly rejected the null hypothesis. In order to ensure the reliability of the empirical results, a fixed effects test model was ultimately used. This study employed the least squares method for dummy variable estimation (LSDV) with Liu fixed effects, fixed individual effects, and conducted benchmark regression tests. The results are presented in Table 2.

Table 2. Benchmark Regression Results

	(1) lnPI	(2) lnPI
lnASCF	0.5202*** (4.0147)	0.3753*** (8.9433)
indu		0.3502** (3.2252)
fdi		-3.9819 (-1.7022)
gov		-0.5439 (-1.8419)
lnmac		0.3072* (2.0701)
_cons	4.8468*** (4.4336)	3.4879** (3.0460)
Individual fixation	Yes	Yes
N	99	99
R2	0.7470	0.9024

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

4.2. Mechanism verification

4.2.1. Digital inclusive finance

When compared with the basic model, adjusting R2 slightly increases after the addition of new variables, indicating that the added digital finance development indicators are effective and useful. The inclusion of digital financial indicators has improved the percentage of coefficient of variation that can be explained by regression equations. Firstly, the overall effect of agricultural supply chain finance on the dependent variable, i.e. the coefficient in Model (2) β_1 . This indicates that the development of agricultural supply chain finance has a significant positive

impact on the per capita disposable income of rural areas in various provinces and regions of China's border areas. Secondly, after incorporating digital financial indicators, the coefficients in model (4) θ_2 are significant at the 1% level, indicating a significant indirect effect of agricultural supply chain finance on poverty reduction. The results indicate that agricultural supply chain finance has a significant direct effect on increasing farmers' income. Furthermore, the development of digital finance (DIF) plays a partial mediating role in promoting the increase of per capita disposable income of rural farmers in agricultural supply chain finance. This supports the hypothesis previously mentioned.

Table 3. Transmission mechanism of agricultural supply chain finance in poverty reduction through the role of digital finance

	(1) lnPI	(2) DIF	(3) lnPI
lnASCF	0.3753*** (8.9433)	106.8674*** (5.7920)	0.0520* (2.0417)
indu	0.3502** (3.2252)	119.9190*** (4.0761)	-0.0126 (-0.2908)
fdi	-3.9819 (-1.7022)	-1.4e+03** (-3.0142)	0.3872 (0.4562)
gov	-0.5439 (-1.8419)	-97.2886 (-1.0053)	-0.2496 (-1.5910)
lnmac	0.3072* (2.0701)	131.3454** (3.1298)	-0.0902* (-2.1550)
DIF			0.0030*** (18.3708)
_cons	3.4879** (3.0460)	-1.8e+03*** (-5.1985)	8.9728*** (37.3848)
Individual fixation	Yes	Yes	Yes
N	99	99	99
R2	0.9024	0.9162	0.9811

t statistics in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

4.2.2. Urbanisation rate

When compared with the basic model, adjusting R2 slightly increased after the addition of new variables, indicating that the increased urbanisation rate indicator is effective. Furthermore, stepwise regression and bootstrap methods were employed to test the mediating mechanism of urbanisation rate.

Based on the test results of model (6), the coefficient of interaction between urbanisation rate and the dependent variable was obtained as shown in Table 4. It was found that

the coefficient in model (5), λ_1 , was significant. Further analysis was conducted on the presence and magnitude of the mediating effect, and the bootstrap method was used to test the significance of the coefficient product. The results, as presented in Table 5, indicated that, at a 95% confidence interval excluding 0, the indirect effect was significant. This implies that the urbanisation rate was a significant mediating effect of agricultural supply chain finance on poverty reduction in the nine provinces of China's border regions. Hypothesis 3, previously mentioned, was thus confirmed.

Table 4. Path transmission of urbanization rate in poverty reduction through agricultural supply chain finance

	(1) lnPI	(2) UR	(3) lnPI
lnASCF	0.3753*** (8.9433)	0.0550*** (7.3859)	0.0805* (2.1860)
indu	0.3502** (3.2252)	0.0529** (2.6970)	0.0667** (2.5698)
fdi	-3.9819 (-1.7022)	-0.1612 (-0.4146)	-3.1173*** (-6.5336)
gov	-0.5439 (-1.8419)	-0.0362 (-0.6669)	-0.3498*** (-4.1164)
lnmac	0.3072* (2.0701)	0.0153 (0.5500)	0.2254** (3.1583)
UR			5.3628*** (7.8392)
_cons	3.4879** (3.0460)	-0.1077 (-0.5330)	4.0655*** (7.8657)
Individual fixation	Yes	Yes	Yes
N	99	99	99
R ²	0.9024	0.8688	0.9765

t statistics in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

Table 5. Bootstrap results of the mediating effect of urbanization rate

	Observed coefficient	Bootstrap Std. err.	z	p> z	Normal-based [95% conf. interval]	
bs 1	0.128	0.035	3.69	0.000	0.060	0.196
bs 2	0.161	0.035	4.83	0.000	0.099	0.235

4.2.3. Heterogeneity analysis

The objective of this analysis is to verify whether there are differences in the impact of agricultural supply chain finance on poverty reduction in border provinces across different border regions. This article refers to the analysis of Sun Jiuwen et al., which divides China's land border into Northeast Border, Northwest Border, and Southwest Border. The results are shown in Table 6. The regression results indicate a certain degree of heterogeneity in the impact of agricultural supply chain finance on poverty reduction in border provinces and regions of China. In the southwestern border region, the development level of agricultural supply chain finance has a significant positive effect on improving rural per capita disposable income, with a significant coefficient at the 1% significance level and a coefficient of

0.3929. This indicates that with the development of agricultural supply chain finance, for every unit increase, rural per capita disposable income increases by 0.3929 units.

In the northwest border region, the development level of agricultural supply chain finance has a significant positive effect on improving the per capita disposable income of rural residents. The coefficient is significant at the 5% significance level, and the coefficient is 0.3807. This indicates that with the development of agricultural supply chain finance, for every unit increase, the per capita disposable income of rural residents increases by 0.3807 units. In the northeastern border region, with the development of agricultural supply chain finance, for every 1 unit increase, the per capita disposable income of rural residents increases by 0.2333 units. Compared with the southwestern and northwestern border regions, the poverty reduction effect has decreased.

Table 6. Heterogeneity Regression Results

	Northeast Border Region	Northwest Border Region	Southwest Border Region
	lnPI	lnPI	lnPI
lnASCF	0.2333 (1.5761)	0.3807** (5.2271)	0.3929*** (53.9365)
indu	0.1122 (1.8852)	0.5034 (2.0823)	0.5124*** (29.0531)
fdi	-5.3017* (-3.4320)	-23.0056*** (-10.5388)	-6.5658* (-3.6926)
gov	0.9232 (0.8309)	-1.5972 (-1.4015)	-0.6062** (-8.3473)
lnmac	0.5780 (1.3157)	0.3090* (3.2204)	-0.1449 (-0.5241)
_cons	2.4013 (1.1561)	3.5213* (2.9589)	6.8486* (3.2694)
Individual fixation	Yes	Yes	Yes
N	33	33	33
R ²	0.9357	0.9678	0.9418

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

5. Conclusion and Recommendations

This article employs panel data from nine provinces and regions in China's border regions from 2011 to 2021, utilising fixed effects and intermediary effects models to empirically test the poverty reduction effect and transmission mechanism of agricultural supply chain finance. The following conclusions are drawn:

One is that agricultural supply chain finance has a direct impact on the increase of per capita disposable income in rural areas. Secondly, it can be posited that the transmission of agricultural supply chain finance is facilitated by the development of digital finance and the improvement of the urbanisation rate, thereby increasing the per capita disposable income of rural areas in various provinces and regions. Thirdly, based on the heterogeneity regression results of the nine provinces and regions in China's border areas, it can be concluded that the development of agricultural supply chain finance has a significant effect on the increase of per capita disposable income in rural areas. There is heterogeneity in the effect on different regions, with the most significant effect observed in the southwest border area, followed by the northwest border area, and finally the northeast border area.

This article will present the following policy

recommendations:

One is to continue to promote the development of agricultural supply chain finance. Based on the analysis of the development level of agricultural supply chain finance in China's nine border provinces and regions, it can be found that there is still a significant gap between different regions. Therefore, it is necessary to persist in promoting the deep integration of supply chain and financial services, and establish a win-win agricultural supply chain financial service system. This measure helps to narrow the development gap between regions, promote balanced development of agricultural financial services nationwide, and provide more precise and efficient financial support for farmers and agriculture in different regions. Furthermore, it is possible to establish a cross-departmental and cross-regional coordination mechanism for the development of agricultural supply chain finance, promote the integration and sharing of resources among all parties, and achieve maximum policy effectiveness.

Secondly, it is of paramount importance to fully utilise the synergistic effect of agricultural supply chain finance and other factors to provide greater assistance for rural development and revitalisation. With the rapid development of digital finance, financial institutions can be guided to

innovate their agricultural supply chain financing business, further breaking traditional models and innovating the development model of supply chain finance. Concurrently, the government can provide support and regulation for agricultural product e-commerce platforms, which can be used to optimise the agricultural supply chain. This will result in a reduction of intermediate link costs, an increase in agricultural product sales prices, and an increase in farmers' income.

Thirdly, it is of paramount importance to reinforce the construction of the credit system, enhance risk prevention mechanisms, and establish a credit system for the agricultural supply chain. By integrating credit data from upstream and downstream enterprises in the supply chain into the credit system, we can achieve online information sharing and real-time queries throughout the entire chain.

References

- [1] Zhou, Q. , Chen, X. , Li, S. Innovative Financial Approach for Agricultural Sustainability: A case study of Alibaba. *Sustainability*, 2018, 10(3) : 1 ~ 20
- [2] Gashayie, A. , Singh, M. Agricultural Finance Constraints and Innovative Models Experience for Ethiopia: Empirical Evidence from Developing Countries. *Research Journal of Finance and Accounting*, 2015, 6(7) : 39 ~ 49
- [3] Renée, C. B. Global Dynamics in Agricultural and Rural Economy, and Its Effects on Rural Finance. *Finance for Food: Towards New Agricultural and Rural Finance*(pp. 3 – 21) . Berlin, Heidelberg: Springer Berlin Heidelberg, 2014
- [4] Gouri, K. V. , Mahajan, V. Different models of financing small farmers' agricultural value chains. *Financing Agriculture Value Chains in India: Challenges and Opportunities*. Singapore: Springer Singapore, 2017 Africa agricultural value chain financing.
- [5] African Rural and Agricultural Credit Association (AF R ACA), Food and Agriculture Organization (FAO) of the United Nations, 2008