

Does the Reform of Supply and Marketing Cooperatives Improve the New Quality Productive Forces of CO-OP Enterprises?

—An Empirical Test Based on Listed Enterprises

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Abstract

The report to the 20th National Congress of the CPC proposes “comprehensively promoting rural revitalization and developing new rural collective economies”. As an important part of the supply and marketing cooperatives system, China’s CO-OP enterprises will lead rural revitalization and promote the high-quality development of agriculture by improving their productivity. This study employs a double difference mode to investigate whether the reform of supply and marketing cooperatives can promote the new quality and productivity of CO-OP enterprises with a sample comprising listed CO-OP enterprises from 2013 to 2023. The results demonstrate that: (1) Following the implementation of the reform of supply and marketing cooperatives, the new quality productive forces of CO-OP enterprises in which supply and marketing cooperatives participate increased significantly; (2) The reform policy of supply and marketing cooperatives is effective in improving the operating capacity of CO-OP enterprises through the optimization of internal organization, thereby promoting the improvement of new quality productive forces; (3) The implementation of the reform policy of supply and marketing cooperatives increases the innovation inputs and innovation activities of CO-OP enterprises, which in turn promote the improvement of new quality productive forces. (4) The implementation of the reform policy for supply and marketing cooperatives reduces the level of financing constraints faced by enterprises and promotes the development of new quality productive forces in CO-OP enterprises. (5) There is significant heterogeneity in the impact of the reform on enterprises with different asset sizes and regions, with the reform having a stronger effect on the promotion of new quality productive forces in enterprises with smaller sizes and in the eastern region.

Keywords

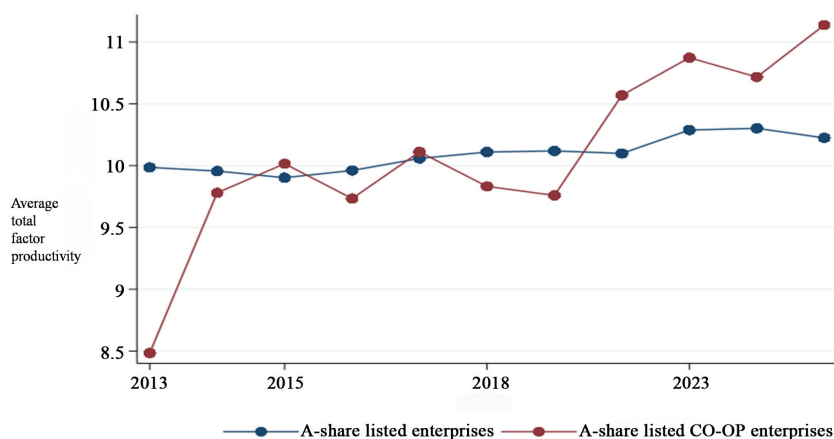
Supply and Marketing Cooperatives Reform, CO-OP Enterprises, New Quality Productive Forces, Rural Revitalization, Total Factor Productivity

1. Introduction

On September 7, 2023, General Secretary Xi Jinping clearly put forward the concept of “new quality productive forces” at the Symposium on Promoting Comprehensive Revitalization of Northeast China in the New Era: new quality productive forces is the advanced productivity quality that innovation plays a leading role in breaking away from the traditional mode of economic growth and the development path of productive forces, and that has the characteristics of high technology, high efficiency and high quality, and is in line with the new development concept. It is the result of revolutionary breakthroughs in technology, innovative allocation of factors of production, and in-depth transformation and upgrading of industries. The basic connotation is the leap in the combination of laborers, means of labour, objects of labour, and their optimal combination, while the core symbol is a significant increase in total factor productivity (Xinhua News Agency, 2024). At the Third Plenary Session of the Twentieth Central Committee on July 18, 2024, General Secretary Xi Jinping further proposed: accelerating the formation of relations of production that are more compatible with the new-quality productive forces, facilitating the agglomeration of all kinds of advanced factors of production towards the development of the new-quality productive forces, and significantly raising total factor productivity.

Rural revitalization strategy is the general grasp of the Party Central Committee to solve the “three rural” problems in the new era, and industrial development is the key path of rural revitalization. In the face of the new round of scientific and technological revolution and industrial change, leading rural revitalization with new productivity is an inevitable choice to promote the high-quality development of agriculture and accelerate rural revitalization. The cultivation of new productivity in agriculture must build new production relations that are compatible with the development of new productivity, and ensure the healthy interaction between production relations and productivity. Attaching importance to the research and development and application of agricultural science and technology, promoting the transformation of agriculture from traditional to modernization, as well as ensuring the smooth development of new-quality productivity through institutional reforms (Huang, 2024). Supply and marketing cooperatives are collective economic organizations with the characteristics of government, commerce and agriculture, and in 2015, the Central Government Document No. 1 proposed for the first time to “comprehensively deepen the comprehensive reform of supply and marketing cooperatives”, and in 2021, the Central Government Document No. 1 once again proposed the “trinity” of production, supply and marketing and

credit, making supply and marketing cooperatives an integral reform. The comprehensive reform has resulted in the transformation of supply and marketing cooperatives into a typical embedded organization. At the same time, supply and marketing cooperatives at all levels have been established as public management institutions, while CO-OP enterprises have been set up by supply and marketing cooperatives at all levels in the form of equity participation. This has enabled their participation in market operations (Tang, 2014: pp. 8-9). CO-OP enterprises play a leading role in supporting agricultural economic development. Relying on the reform of supply and marketing cooperatives to promote new quality productive forces improvement of CO-OP enterprises is an important part of rural modernization. As shown in Figure 1, the total factor productivity of A-share listed CO-OP enterprises has achieved a greater degree of growth compared to other enterprises during the period of 2013-2023, and the total factor productivity of CO-OP enterprises has shown a fluctuating leap in 2015, 2017 and 2021 after the release of the supply and marketing cooperatives reform policy. This trend is in line with the ‘techno-economic paradigm’ of qualitative changes in productivity (Schumpeter, 2011). It shows that the reform of supply and marketing cooperatives is a key factor in the rise of new productivity in CO-OP enterprises, and analyzing its influence mechanism is of great significance to cultivating new productivity in the agricultural sector.



Source: <https://www.resset.com/>

Figure 1. Average total factor productivity of A-share listed companies.

2. Literature Review, Theoretical Analysis and Research Hypotheses

2.1. Literature Review

At the present time, there are approximately three distinct perspectives in academics regarding the new quality productive forces. One approach is to take Marx’s theory of productive forces as the primary lens through which to examine the new connotations of the three elements: workers, means of labour and objects of labour. This entails elucidating the fundamental nature and theoretical innovations of new-

quality productive forces, as well as proposing the formation of new types of production relations and the development of new-quality productive forces from the vantage point of the interaction between productive forces and relations of production. (Liu, 2024: pp. 4-11; Meng & Han, 2024: pp. 29-33). Secondly, from the perspective of technological change and innovation theory, especially from the perspective of productivity change triggered by successive industrial revolutions, academics discuss the nature and development law of the new quality productive forces in the new round of scientific and technological revolutions and industrial changes, and explain the connotation that the essence of the new quality productive forces is the quality of the advanced productive forces (Fang & Yang, 2024: pp. 20-28). Third, focusing on the development lineage of Xi Jinping's economic thought, it discusses the logical relationship among the new quality productive forces, the new development concept, high-quality development, and Chinese-style modernization, and explains that the new quality productive forces are the productivity in line with the new development concept (Huang & Sheng, 2024: pp. 15-24; Ren, 2024: pp. 12-19). From the perspective of technological change and innovation theory, there is already a literature that suggests that the development of new-quality productivity needs to be driven by technological innovation through empirical research on TFP total factor productivity (Huang & Sheng, 2024: pp. 15-24).

CO-OP enterprises promote the development of agricultural productivity by transforming production methods, improving the level of social services, promoting agricultural technological innovation, and alleviating financing constraints. Firstly, "focusing on improving total factor productivity" is an important direction to promote the high-quality development of agriculture with new quality productive forces (Luo, 2024: pp. 2-26). Nevertheless, the conventional approach to agricultural growth, which relies on the expansion of labour, land and output through the intensive and often indiscriminate use of chemical fertilizers, pesticides and water resources, is no longer viable. In light of this, the promotion of enhanced productivity through technological advancement has assumed greater significance. The concept of technology has become fundamental to the transformation of agricultural production methods and the process of agricultural modernization. (Luo & Geng, 2024: pp. 13-26). Secondly, from the perspective of socialized services, supply and marketing cooperatives link the government and farmers, and take CO-OP enterprises as the carrier to serve the scale of operation. Adapting to the reality of China's agricultural scale operation, is the inevitable requirement of the organic connection between small farmers and modern agricultural development (Ji, 2018: pp. 9-15), but also an important way for supply and marketing cooperatives to develop new quality productive forces. The socialized service of CO-OP enterprises as an advantageous service mode has generally emerged and shown accelerated development in various places (Zhang & Hu, 2021: pp. 75-81). Compared with general socialized services, the socialized service model of CO-OP enterprises has the advantage of retaining farmers' land contracting

rights and flexible service forms (Li & Zhang, 2023: p. 6). The development of agricultural production trusteeship has gradually become the main service mode of socialized services. By pursuing a dual strategy of scale and specialization, CO-OP enterprises are able to achieve reductions in service costs, improvements in operational efficiency and technical efficiency, and enhanced effectiveness in the provision of services to the agricultural sector (Gu & Zhou, 2022: pp. 106-116).

Furthermore, from the perspective of general-purpose technology research and development, supply and marketing cooperatives play a pivotal role in guiding the application and advancement of general-purpose technologies within CO-OP enterprises. General-purpose technologies are technologies that initially have great scope for improvement (technological dynamism) and eventually become widely used in the economy, and such technologies have important complementation with other technologies (Bresnahan et al., 1992). Following the division of Lipsey et al. (2005), general-purpose technologies can be divided into three categories: products, processes and organizations. Smart agriculture is an agricultural development model that uses a new generation of information technology, such as the Internet of Things, big data, artificial intelligence, etc., to achieve intelligent management of the whole process of agricultural production. It is of great significance to improve the market competitiveness of agricultural products, enhance the efficiency of agricultural production, and promote the sustainable development of agriculture (Yang et al., 2024: pp. 3-6). Li (2012: pp. 1-7) pointed out that the Internet of Things is the main technical support for smart agriculture. Sensing technology, interconnection technology and intelligent technology make the operation of agricultural systems more effective, intelligent and smart. The research and application of agricultural IoT technology is the need for the development of modern smart agriculture, and is also an important symbol for measuring a country's comprehensive scientific and technological strength and the level of agricultural development (Chen et al., 2015: 65-82). Zhao (2021: pp. 1-7) mentions that the "No. 1 Document of the Central Government" of the past 10 years has consistently emphasized the role of information science and technology in modernizing agriculture and rural areas. The concept of smart agriculture can be understood as a combination of advanced factors of productivity that lead to a transformation in the mode of agricultural production.

From the perspective of financing constraints, the difficulty of lending to agribusiness has been a worldwide problem (Bian, 2015: pp. 25-27), due to the relatively poor qualifications and creditworthiness of agribusiness and the lack of bank-approved collateral, etc., they have historically been at a disadvantage in terms of lending when compared with large enterprises. Over the past few years, China's digital finance has made great progress and has had a great impact globally (Huang & Huang, 2018: pp. 1489-1502). Du (2006: pp. 70-73, 78) and others were the first to introduce the concept of inclusive finance to China, arguing that inclusive finance is an integral part of the country's mainstream financial system, providing high-quality financial services to satisfy the financial needs of large-

scale groups, and focusing mainly on expanding the client base in poorer and more remote areas, reducing the costs of both the financial demand group and the service provider. From the perspective of financial development, inclusive finance embodies financial fairness, emphasizes the concept of equal access to modern financial services for all, and is a reflection on and improvement of the existing financial system (Jiao & Chen, 2009). From the perspective of economic development, inclusive finance can raise people's income, eliminate poverty, and then expand domestic demand and improve the dual structure of urban and rural areas, which is of great significance to the change of China's economic growth mode and sustainable development (Wang & Wang, 2011: p. 136).

2.2. Research Hypotheses

As a comprehensive cooperative economic organization providing agricultural services under the leadership of the Party, supply and marketing cooperatives undertake the fundamental task of guaranteeing the stable and safe supply of food and important agricultural products. Steadily promoting the strategy of rural revitalization through the reform of supply and marketing cooperatives is an important deployment of the Party and the government to do a good job in the work of the "three rural areas" (Zhang & Zhang, 2024: pp. 94-105). The reform objectives of supply and marketing cooperatives include enhancing the vitality of the development of CO-OP enterprises, optimizing the means of providing services to farmers and upgrading the capacity to provide services to farmers. As the main implementer of the business of supply and marketing societies, socially owned enterprises are an indispensable part of the system of supply and marketing society relations and network structure (Xu & Jin, 2024: pp. 2, 80-93), and a bridge for supply and marketing cooperatives to promote the reform of the traditional agricultural model. Statistical analyzes also show that the total factor productivity of CO-OP enterprises has risen significantly after the reform of supply and marketing cooperatives (see Figure 1).

Hypothesis 1: Supply and marketing cooperatives reform can enhance the new quality productive forces of CO-OP enterprises.

The reform of supply and marketing cooperatives has accelerated the development of agricultural socialized services, promoted the formation of agricultural socialized service alliances between backbone CO-OP enterprises of the system and agricultural socialized service main bodies that are in a position to do so, and promoted land trusteeship modes tailored to the different geographic conditions, crop cultivation structures, and levels of economic development of each region. CO-OP enterprises provide agricultural socialized services to improve operational efficiency mainly through the logic of scale effect and specialization effect (Han & Zhang, 2020: pp. 32-41). The reform of supply and marketing cooperatives has achieved the promotion of the land trusteeship model, the optimization of the internal organizational structure of CO-OP enterprises, and the improvement of the operational efficiency of CO-OP enterprises and thus the improvement of the

new quality productive forces of the enterprises.

Hypothesis 2: The reform of supply and marketing cooperatives improves the operational efficiency of CO-OP enterprises, thereby increasing their new quality productive forces.

The comprehensive reform of supply and marketing cooperatives in 2021 strengthens agricultural science and technology innovation, promotes agricultural modernization and focuses on the development of smart agriculture. As an advanced intelligent mode of agricultural development, smart agriculture is a new mode of high integration of information technology and agriculture, which helps to realize the development of agricultural refinement, high efficiency and green development, and is of great significance to improve the competitiveness of agricultural products in the market, enhance the efficiency of agricultural production, as well as promote the sustainable development of agriculture. The underlying logic for achieving the development goals of precision, high efficiency and low carbon is to shift the agricultural production control mode from “relying on simple labour inputs” to digital twins guided by artificial intelligence (Yin et al., 2021: pp. 95-103). Supply and marketing reforms narrow the digital and economic divide between urban and rural areas by strengthening research and development efforts to modernize agriculture, and enhance the potential for the development of the agricultural digital economy and new quality productive forces.

Hypothesis 3: Supply and marketing cooperatives reforms increase the new quality productive forces of CO-OP enterprises by enhancing their R&D efforts.

On the one hand, the reform of supply and marketing cooperatives has expanded the scale of agricultural financing for CO-OP enterprises and linked government departments to provide subsidies to CO-OP enterprises. On the other hand, it has expanded the coverage of inclusive finance through digitization, creating more financing channels for CO-OP enterprises. First, digital technology has brought more convenient financial services to the less financially developed CO-OP enterprises, connecting low-income people to the digital information superhighway, improving the availability of their markets, services and information, and enabling financial services to be delivered more accurately to those in need (Yu & Jiao, 2016: p. 2; Ma & Wu, 2014: pp. 5-11; Xie et al., 2018: pp. 1557-1580); Secondly, inclusive finance reaches farmers through the mobile Internet, which rapidly reduces the cost of financial services. This may result in a reduction in the demand for traditional financial services, as evidenced by innovations in credit, business, wealth management, means of payment and settlement, and supply chain financial services. These innovations significantly improve the efficiency of traditional financial institutions (Wang & Yang, 2017: pp. 19-24); thirdly, the development of financial inclusion in e-commerce has stimulated the enhancement of the new needs of the rural areas, and expanded more consumption and service methods, giving rise to a large number of new types of financial service demand. The development of inclusive finance has also begun to have a significant impact on the upgrading of rural residents' consumption structure (Zhang & Tu, 2017: pp. 70-83).

Hypothesis 4: Supply and marketing reforms reduce the financing constraints of CO-OP enterprises and increase their new quality productive forces by promoting financial inclusion in rural areas.

3. Empirical Research Design

3.1. Data Sources and Sample Processing

This paper aims to examine the impact of the reform of supply and marketing cooperatives on the new quality productive forces of CO-OP enterprises in 2021. To achieve this, an empirical analysis will be conducted using the difference-in-differences (DID) method. The sample data will be selected as the annual financial data of listed companies in the A-share markets during the period of 2013-2023. The data will be obtained from the RESSET Database, which is a data platform that provides professional services for model testing and investment research. The RESSET financial database adheres to the international common database design standards. By the end of 2018, hundreds of domestic and foreign universities and research institutes had adopted RESSET database products. Additionally, thousands of journal and magazine papers, as well as master's and doctoral theses, cited the RESSET database annually, with many of these being core journals at home and abroad. To ensure the comparability of the data, the preliminary data are processed as follows: financial industry enterprises, ST, *ST and other data are excluded; to ensure the robustness of the panel fixed effects, samples with a gearing ratio greater than 1 are excluded; samples with negative total assets of enterprises are excluded. Additionally, a 1% two-sided tailing is conducted for the primary variables, and Stata 17.0 is employed as the analytical software.

3.2. Selection of Variables

For the dependent variables, total factor productivity is used as a new quality productive forces measure with reference to the group of the *Institute of Economic Research of the Chinese Academy of Social Sciences* (2024: pp. 4-23). For total factor productivity measurement, this paper used the LP method and the ACF method, respectively, to measure the total factor productivity of listed enterprises each year (Levinsohn & Petrin, 2003: pp. 317-341; Akerberg et al., 2006: pp. 411-425; Akerberg et al., 2007: pp. 4171-4276). Since firms' intermediate inputs may depend on capital, labour and productivity, the LP method suffers from estimation non-identifiability as well as endogeneity problems. Therefore, we borrow the ACF method from the Akerberg et al. (2006: pp. 411-425) and Akerberg et al. (2007: pp. 4171-4276) to estimate the production function and measure productivity, which better handles the simultaneity bias problem. For robustness analysis, we used the LP method to calculate total factor productivity.

For the independent variables, we take CO-OP enterprises as the treatment group (Treat = 1) and non-CO-OP enterprises as the control group (Treat = 0); we take 2021 as the point in time of the supply and marketing cooperatives reform, and set a time dummy variable for 2021 and before 2021 (Reform2021 = 0) and

set a time dummy variable for after 2021 (Reform2021 = 1), adopting the double difference method (DID) to isolate the impact of supply and marketing cooperatives reform on the new quality productive forces of CO-OP enterprises.

As is shown in **Table 1**, TFP, calculated using the ACF method, reflects the overall efficiency of firms in utilizing inputs to produce outputs. The average TFP is 10.0908, with a standard deviation of 1.0638, indicating that productivity is relatively consistent across firms, with minimal dispersion around the mean. This suggests that most companies operate at similar efficiency levels, likely due to shared industry conditions or technologies. A higher TFP value points to better performance in optimizing input usage, making it a crucial measure of overall firm productivity. Other variables, including enterprise size, short-term debt changes, and the proportion of independent directors, display moderate variability, reflecting differences in firm characteristics across the sample.

Table 1. Descriptive statistics for key variables.

Variable type	Variable name	Variable symbol	Variable Definition	Average value	Standard deviation
Dependent variables	New quality productive forces	TFP	ACF method Total Factor Productivity	10.0908	1.0638
Independent variables	Treated and control groups	Treat	Whether it is a socially owned enterprise, yes takes the value 1, otherwise 0	0.0024	0.0494
Interaction term	Interaction term	Treat _j × Reform 2021	Impact of Supply and Marketing Reform on the New Quality Productive Forces of CO-OP enterprises (SOEs)	0.0007	0.0262
Control variable	Enterprise size	Size	Natural logarithm of total assets	22.1161	1.4331
	Changes in short-term debt	ΔSd	Change in liabilities/total assets	0.1079	0.0955
	Management size	DirNum	Number of board members	10.2848	3.7252
	Number of R&D staff	R_people	Number of R&D staff	600.1486	2104.204
	Capital expenditure	Expen	(Cash paid for acquisition of property, plant and equipment, intangible assets and other long-term assets—net cash recovered from the disposal of property, plant and equipment, intangible assets and other long-term assets)/total assets	0.0443	0.0448
	Corporate investment opportunities	Growth	Revenue growth rate	15.2718	32.2895
	Time fixed effect	θ	Time dummy variable		
Firm fixed effect	μ	Enterprise virtual variable			

3.3. Modelling

In order to test the impact of supply and marketing reform on the new quality productive forces of CO-OP enterprises in 2021, this paper constructs the following DID double difference model:

$$TFP_{i,t} = \alpha_0 + \alpha_1 Treat_j \times Reform2021_t + \alpha_2 X_{i,t} + \mu_i + \theta_t + \varepsilon_{i,t} \quad (1)$$

In model (1), i denotes the firm, j denotes the group (whether it is a socially owned enterprise or not), and t denotes the year. The dependent variables $TFP_{i,t}$ represent the new quality productivity of firm i in year t ; $Treat_j \times Reform2021_t$ is the coefficient of the interaction term between the grouping dummy and the policy implementation dummy, reflecting the policy effect of supply and marketing reform policies on the new quality productive forces of CO-OP enterprises; $X_{i,t}$ denotes the control variable data for firm i in year t . Specifically, the group of control variables contains Enterprise size (Size), Changes in short-term debt (ΔSd); Management size (DirNum), Number of R&D staff (R_people), Capital expenditure (Expen), Corporate Investment Opportunities (Growth) (Li & Wu, 2024: pp. 1-19, 30; Yue & Xiao, 2023: pp. 51-67). μ and θ denote firm fixed effects and time fixed effects, respectively. Regarding the endogeneity of the econometric model, this paper adopts a propensity score matching approach based on the pairwise method to mitigate the estimation bias caused by endogeneity.

4. Analysis of Empirical Results

Table 2 reports the empirical results of the effect of supply and marketing cooperative reforms on the total factor productivity (TFP) of CO-OP enterprises. Column (1) shows the effect of supply and marketing cooperative reform on the new quality productive forces (TFP) of CO-OP enterprises when controlling only for individual firms and time fixed effects, and the regression coefficient of the interaction term $Treat \times Reform2021$ is significant at 0.399 with a standard error of 0.161 and is statistically significant at the 5 per cent level of significance. This indicates that the reforms of the supply and marketing cooperatives significantly increase the new quality productivity (TFP) of CO-OP enterprises. Column (2) introduces control variables based on the results of column (1). The coefficient of the explanatory variable $Treat \times Reform2021$ is 0.480, with a standard error of 0.0292. This remains statistically significant at the 1% level of significance. This indicates that, following the reform of supply and marketing cooperatives in 2021, the average increase in total factor productivity of CO-OP enterprises, in comparison to other enterprises, will be 0.480. The hypothesis 1 is valid.

Table 2. The impact of supply and marketing cooperative reforms on the total factor productivity of CO-OP enterprises: results from the DID benchmark regression.

Variable	(1)	(2)
	TFP	TFP
Treat \times Reform2021	0.399**	0.480***

Continued

	(0.161)	(0.0292)
Size		0.380***
		(0.0287)
ΔSd		-0.285**
		(0.114)
DirNum		-0.000544
		(0.00208)
R_people		8.76e-06*
		(5.30e-06)
Expen		0.0814
		(0.165)
Growth		0.00292***
		(0.000210)
Constant	10.25***	1.631**
	(8.22e-05)	(0.644)
Firm fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Sample Size	9,772	9,772
R ²	0.909	0.927

Robust standard errors in parentheses ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

5. Robustness Tests

5.1. Parallel Trends Test

The use of the double difference method (DID) needs to satisfy the parallel trend test hypothesis that the impact of the supply and marketing cooperatives reform on the new quality productive forces of CO-OP enterprises will only occur after the implementation of the policy, while before the implementation of the policy, the control group and the experimental group do not have significant differences.

The supply and marketing cooperatives reform document was released in 2021, and this paper takes the year before the release of the document, i.e., 2020, as the base period of policy implementation, and generates the interaction terms $Treat \times time_i$, i for the year, i.e., the policy dummy from 2014 to 2023, respectively, for the time dummy variable and the policy dummy variable in 2014, 2015, 2016, 2017, 2018 and 2019, i.e., the policy dummy variable is 0, and the policy dummy variable from 2020 to 2023 is 1. In consideration of the issue of covariance and in accordance with the prevailing academic practice, this study excludes the period prior to the implementation of the policy. As is shown in **Figure 2**, the parallel trend test using the baseline regression equation regression shows that the coefficients of $Treat \times time_{2018}$, $Treat \times time_{2017}$, $Treat \times time_{2016}$, $Treat \times time_{2015}$, $Treat \times time_{2014}$ are insignificant, while the coefficients of $Treat \times time_{2020}$, $Treat \times time_{2022}$ are significantly positive, indicating that the control group and the experimental group were not significantly different before the supply and marketing cooperatives reform, but there was a significant change after the implementation of the reform of the supply and marketing cooperatives, which meets the hypothesis conditions used in the double-difference method.

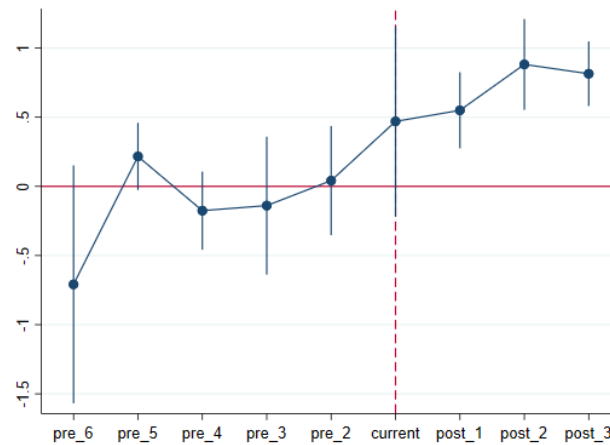


Figure 2. Parallel trends test.

5.2. Placebo Testing

This study employs a counterfactual methodology to evaluate the efficacy of placebo treatments, thereby ensuring the robustness of the empirical findings. In particular, this is achieved by assuming that the reform of the supply and marketing cooperatives is implemented in 2018 and 2019, respectively, with a value of 1 in the year of and after the implementation of the policy and 0 in the year before the implementation of the policy. This generates two sets of dummy variables (explanatory variables), namely $Treat \times Reform\ 2018$ and $Treat \times Reform\ 2019$. The above two cross-multiplication terms are then performed in a baseline model (1) regression. As seen in **Table 3**, the estimated coefficient for the $Treat \times Reform2017$ interaction is -0.233 , corresponding to a standard error of 0.0874 . This is significantly negative at the 1% level of significance. In contrast, the estimated coefficient for the $Treat \times Reform2018$ interaction is 0.138 , corresponding to a standard error of 0.206 . This is not significant at the 10% level of significance. This further indicates that the empirical results of this paper are reliable.

Table 3. Placebo test.

Variable	(1)	(2)
	TFP	TFP
Treat \times Reform2018	0.138 (0.206)	
Treat \times Reform2017		-0.233^{***} (0.0874)
Size	0.379^{***} (0.0287)	0.379^{***} (0.0287)
ΔSd	-0.293^{***} (0.114)	-0.290^{**} (0.114)
DirNum	-0.000552 (0.00208)	-0.000605 (0.00208)
R_people	$8.70e-06$ ($5.29e-06$)	$8.68e-06$ ($5.30e-06$)
Expen	0.0825	0.0819

Continued

	(0.165)	(0.165)
Growth	0.00291***	0.00292***
	(0.000210)	(0.000210)
Constant	1.636**	1.644**
	(0.644)	(0.645)
Firm fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Sample Size	9,772	9,772
R ²	0.927	0.927

Robust standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1

5.3. Replacement of Explanatory Variables

To test the robustness of the total factor productivity measure in the baseline regression results, this study further uses other methods of total factor productivity measurement that are widely recognized in the academic community.

This study further measures total factor productivity using other methods that are widely recognized in the academic community. In this study, total factor productivity (TFP_LP) calculated by LP method is used as the dependent variable, and Treat × Reform 2021 cross-multiplier, a dummy variable of supply and marketing reform policy, is used as the independent variable, and enterprise size (Size), changes in short-term debt (ΔSd), management size (DirNum), number of R&D staff (R_people), capital expenditure (Expen), and corporate investment opportunities (Growth) are used as the explanatory variables to build a double difference model. As seen in **Table 4**, following the replacement of the explanatory variables, the coefficient of the cross-multiplier term Treat × Refrom2021 is 0.430, which remains significantly positive at the 1% level of significance. This suggests that, following the reform of the supply and marketing societies in 2021, CO-OP enterprises are expected to demonstrate an average increase in total factor productivity of 0.430 relative to other enterprises. The direction and significance of the coefficients of Treat × Reform 2021 are basically the same as those of the benchmark regression results, which can further verify the robustness of the benchmark regression structure in this paper.

Table 4. Replacement of explanatory variables regression.

Variable	(1)
	TFP_LP
Treat × Reform2021	0.430***
	(0.0236)
Size	0.347***
	(0.0291)
ΔSd	-0.310***
	(0.115)
DirNum	-0.000626
	(0.00208)
R_people	7.99e-06

Continued

	(5.45e-06)
Expen	0.0518 (0.167)
Growth	0.00293*** (0.000213)
Constant	1.674** (0.655)
Firm fixed effects	Yes
Time fixed effects	Yes
Sample Size	9,772
R ²	0.923

Robust standard errors in parentheses ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

6. Mechanism Testing and Heterogeneity Analysis

In order to study the role of supply and marketing reforms on the new quality productive forces channels of CO-OP enterprises, this study analyzes the three main aspects of production and operation efficiency, R&D effects and financing constraint effects. (See [Table 5](#))

6.1. Mechanism Testing

6.1.1. Operational Efficiency of Production

In the context of the reform of supply and marketing cooperatives, supply and marketing cooperatives have carried out a series of internal organizational reforms, which have led to significant changes in their internal organizational structure. Existing studies have pointed out that the optimization of the internal organization of supply and marketing cooperatives significantly reduces the management costs of enterprises, which represent the internal and external regulatory costs of enterprises, and effectively overcomes the high management costs of traditional enterprises as well as the regulatory costs that may be generated by the principal-agent problem, thus improving the productivity of enterprises. Based on this, in order to measure the production and operation efficiency of enterprises, with reference to [Shen et al. \(2024: pp. 5-25\)](#) practice, this paper selects the indicators of the management expense ratio (Manage_cost) and total asset turnover (Asset_turn) as the mediating variables. The regression results presented in column (1) of [Table 5](#) demonstrate that the estimated coefficient of the core explanatory variable is -5.275 , corresponding to a standard error of 2.816 . This is significantly negative at the 10 per cent statistical level, indicating that the reform policy of supply and marketing cooperatives can effectively reduce the management costs of socially owned enterprises. The regression results in column (2) of [Table 5](#) demonstrate that the estimated coefficient of the core explanatory variable is 0.146 , corresponding to a standard error of 0.0547 . This is significantly positive at the 1 per cent statistical level, indicating that the reform policy of supply and marketing cooperatives is capable of markedly enhancing the total asset turnover ratio

of enterprises. The total asset turnover ratio reflects the operating capacity of enterprises, indicating that the supply and marketing cooperatives reform policy can enhance the operating capacity of CO-OP enterprises through internal organizational optimization, taking advantage of embedded organizational strengths, thus enhancing their new quality productive forces.

6.1.2. Research and Development Effects

R&D innovation input and innovation output are one of the key determinants of a firm's total factor productivity (Cao et al., 2022: pp. 65-82). The literature has already used R&D investment to characterize absorptive capacity (Qu & Li, 2020: pp. 14-29) that absorptive capacity includes not only the ability of enterprises to acquire new external technologies, but also the ability of digestion, absorption, imitation and re-innovation, and that absorptive capacity is crucial to the enhancement of enterprises' innovation capacity (Zahra & George, 2002: pp. 185-203). In the context of the reform of supply and marketing cooperatives, CO-OP enterprises have increased their research and development of agricultural products and agricultural equipment, bringing new changes to the new quality productive forces in agriculture (Qu, 2024). In order to explore the specific impact of the reform of supply and marketing cooperatives on the R&D efforts of CO-OP enterprises and the final direction of the R&D effect, this paper adopts the logarithm of enterprise R&D investment ($\ln r_d$) to express it. The regression results in column (3) of Table 5 show that the estimated coefficient of the core explanatory variables is 0.593, corresponding to a standard error of 0.0379, which is significantly positive at the 1 per cent statistical level, suggesting that the implementation of the supply and marketing cooperatives reform policy has significantly increased the innovation inputs of the enterprises and promoted their innovation activities, thus enhancing their new quality productive forces.

6.1.3. Financing Constraint Effects

Financing constraint effect means that, in the case of suffering from financing constraints, the external financing cost and adjustment cost of the enterprise's R&D activities are higher, and it is difficult to improve productivity through R&D activities. (Ren & Lu, 2014: p. 187) Therefore, when easing the financing constraints, enterprises can improve their new quality productive forces. In order to explore the specific impact of the reform of supply and marketing cooperatives on the financing constraints of CO-OP enterprises and the final direction of the effect of financing constraints, this paper adopts the SA index (Hadlock & Pierce, 2010: pp. 1909-1940), WW index (Whited & Wu, 2006: pp. 531-559) to measure the financing constraints faced by firms, and substituting them as explanatory variables in the regression of model (1). The regression results presented in columns (4) and (5) of Table 5 demonstrate that the estimated coefficients of the core explanatory variables are -0.119 and -1.001 , respectively, corresponding to standard errors of 0.0443 and 0.134, respectively. Both of these coefficients are significantly negative at the 1 per cent level of the statistic, indicating that the reform of

the CPSC significantly reduces the level of financing constraints of firms and induces an increase in firms' new-quality productivity through the financing constraint effect.

Table 5. Mechanism testing.

Variable	(1)	(2)	(3)	(4)	(5)
	Manage_cost	Asset_turn	lnr_d	SA	WW
Treat × Reform2021	-5.275* (2.816)	0.146*** (0.0547)	0.593*** (0.0379)	-0.119*** (0.0443)	-1.001*** (0.134)
Constant	7.342*** (0.122)	2.467*** (0.308)	18.31*** (0.0684)	-19.28*** (0.162)	0.192 (0.147)
Control Variable	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

6.2. Heterogeneity Analysis

In order to deeply investigate the impact of the reform of supply and marketing cooperatives on the new quality productive forces of CO-OP enterprises, heterogeneity is analyzed from two aspects. First, the sample is divided into two groups according to the size of the logarithm of total assets (Size) as a criterion. The effect of supply and marketing cooperatives reform on the new quality productive forces of firms of different sizes and the extent of the effect is examined. As is shown in **Table 6**, in the regression of the sample firms with larger total assets, the estimated coefficient of the cross-multiplier term Treat × Reform 2021 is 0.365 and is statistically significant at the 1 per cent level of significance. Furthermore, in the regression of the sample enterprises with smaller total assets, the estimated coefficient of Treat × Reform2021 is 0.399 and is also statistically significant at the 1% level of significance. This indicates that the reform of supply and marketing cooperatives has a significant upgrading effect on both larger and smaller enterprises, with the greatest utility for smaller enterprises. Secondly, taking the region as the standard, the sample is divided into two groups according to region. The group located in Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, and Hainan is determined as the eastern region group, and the group in Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Ningxia, Qinghai, Xinjiang is determined as the western region group in order to examine the impact and extent of supply and marketing cooperatives reform on enterprises in different regions. In the regression for the sample firms in the eastern region, the estimated coefficient of Treat × Reform2021 is 0.541, and the result is statistically significant at the 1 per cent level of significance. In the regression of the sample firms in the western region, the estimated coefficient of Treat × Reform2021 is 0.351 and is also statistically significant at the 1 per cent level, indicating that the reform of the supply and marketing cooperatives has a significant upgrading effect on the firms in both the eastern and western regions. Furthermore, the upgrading effect of the reform of the supply and marketing cooperatives is greater on the firms in the eastern region.

Table 6. Heterogeneity analysis.

Variable	Enterprise size		Area	
	Big	Small	Eastern region	Western region
Treat × Reform2021	0.365*** (0.0277)	0.399*** (0.0419)	0.541*** (0.0302)	0.351*** (0.0812)
Size	0.388*** (0.0415)	0.187*** (0.0432)	0.404*** (0.0322)	0.287** (0.133)
ΔSd	-0.304** (0.142)	-0.0270 (0.195)	-0.338*** (0.126)	0.215 (0.363)
DirNum	-0.000841 (0.00241)	-0.00111 (0.00372)	-0.00157 (0.00244)	0.00799 (0.00672)
R_people	5.65e-06 (4.86e-06)	0.000115 (0.000119)	8.02e-06 (4.93e-06)	5.57e-05 (4.30e-05)
Expen	-0.00617 (0.229)	0.659*** (0.250)	-0.0898 (0.180)	0.651 (0.499)
Growth	0.00275*** (0.000239)	0.00317*** (0.000388)	0.00298*** (0.000263)	0.00292*** (0.000575)
Constant	1.516 (0.969)	5.564*** (0.913)	1.168 (0.722)	3.335 (3.016)
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Sample Size	6,192	3,242	6,995	1,117
R ²	0.939	0.852	0.930	0.911

Robust standard errors in parentheses ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

7. Conclusion and Insights

This study uses the annual financial data of A-share listed companies to empirically test the effect and mechanism of the reform of supply and marketing cooperatives on the new quality productive forces of CO-OP enterprises, and draws the following conclusions: (1) After the implementation of the reform of supply and marketing cooperatives, the new quality productive forces of the CO-OP enterprises has been significantly increased; (2) The reform policy of supply and marketing cooperatives can significantly increase the turnover rate of total assets of the enterprises, the operating capacity of the enterprises. It indicates that the reform of supply and marketing cooperatives, through internal organizational optimization, develops the advantages of embedded organizations, enhances the operating capacity of CO-OP enterprises, and promotes the improvement of their nature productivity; (3) The implementation of the reform policy of supply and marketing cooperatives significantly increases the innovation inputs of enterprises, promotes the innovation activities of enterprises, and explains the improvement of their new quality productive forces; (4) The implementation of the reform of supply and marketing cooperatives significantly policy reduces the level of financing constraints on enterprises, and through the effect of financing constraints on the enterprises' financing constraints level, and through the effect of financing constraints on the development of new quality productive forces of

enterprises played a promotional role; (5) The impact of supply and marketing cooperative reform is significantly influenced by the firms' size and the regional differences. It has been observed that the reform of supply and marketing cooperatives has a greater effect on the smaller, eastern region of the enterprise, where new quality productive forces are promoted.

The research insights of this paper are as follows. (1) The reform of supply and marketing cooperatives has significantly increased the new quality productive forces of enterprises by improving the effect of research and development. In accordance with the principles of economic and social evolution, the advancement of modern agriculture necessitates the active integration and implementation of contemporary scientific and technological advancements, a modern industrial system, ecological and recycling agriculture, and other innovative approaches. Additionally, there is a pressing need to continuously advance traditional agriculture in a sustainable and environmentally conscious manner. It is, therefore, necessary to pursue more efficient and sustainable modes of production. As the gap between China's technological level and that of developed countries narrows, the space for the introduction and imitation of foreign technology is also shrinking. This creates a pressing need for China to rely on and independently promote scientific and technological innovation. The advancement and implementation of intelligent agricultural technology, encouraged and advocated in the reform of supply and marketing cooperatives, is conducive to enhancing the efficiency of agricultural production, upgrading the quality of agricultural products, and improving the innovative productive forces of agriculture. Therefore, it is imperative to actively explore the research and development of this technology. The transformation and practical application of scientific and technological innovations, including the utilization of general technologies such as cloud computing, artificial intelligence, brain-like intelligence, blockchain and others, to traditional agriculture represents a promising avenue for advancement. As these two domains continue to converge and evolve, the potential for fostering the modernization of the traditional agricultural industry is significant. It effectively promotes the transformation and upgrading of the traditional agricultural industry in the direction of high-end, intelligent and green. (2) The reform policy of supply and marketing cooperatives can significantly improve the total asset turnover rate of enterprises and promote the improvement of new productivity. The development of modern large-scale agriculture is a response to the characteristics of traditional small-holder production, such as inefficient allocation of resources, low specialization, and outdated production methods and techniques. The primary objective is to address the issue of the "big country, small farms" phenomenon. This will be achieved by adopting contemporary scientific and technological advancements, along with innovative development concepts and management models. The aim is to transform traditional, decentralized and inefficient small-scale agriculture into modern, intensive and highly efficient large-scale agriculture. This will optimize the allocation of resources and relations of production, while significantly enhancing the new quality productive forces. The reform of supply and marketing

cooperatives emphasizes the necessity to accelerate the development of agricultural social services. The empirical results demonstrate that the formation of horizontal and vertical divisions of labor in the context of agricultural services enables CO-OP enterprises to reduce the cost of services and enhance operational efficiency. Consequently, it is imperative to continue exploring the potential of service operations on a larger scale, with social services as a core component, in order to align with the scale of agricultural operations in China. (3) The implementation of the reform policy of supply and marketing cooperatives has significantly reduced the level of financing constraints of enterprises and helped them develop new quality productive forces. Finance is the core of the modern economy, and comprehensively promoting rural revitalization cannot be separated from the effective support of finance. Following the 18th National Congress of the CPC, the development of new rural cooperative finance has become a key policy objective for the central government. Empirical evidence suggests that fostering close collaboration between supply and marketing cooperatives and financial institutions is a crucial step in addressing the funding challenges faced by the agricultural sector. Furthermore, the collaboration between supply and marketing cooperatives and financial institutions in the development of financial science and technology products can reduce the transaction costs of CO-OP enterprises, address the funding challenges on the supply side of agriculture, and alleviate the financing constraints faced by CO-OP enterprises, thereby providing a catalyst for their growth and development. (4) In the test of heterogeneity, it is found that the impact of the reform of supply and marketing cooperatives on different types of enterprises has a significant difference, in which the promotion effect is stronger on smaller-scale enterprises in the eastern region. It precisely demonstrates the effectiveness of the reform of supply and marketing cooperatives in promoting the transformation and upgrading of traditional smallholder production. The reform of supply and marketing cooperatives can make use of the network resources of supply and marketing cooperatives to empower traditional agriculture, helping to gradually get rid of the past development model and shift to a modern and sustainable development path that pays more attention to quality and efficiency. Therefore, the path of supply and marketing cooperatives reform should continue to be explored to accelerate the cultivation of new quality productive forces and to create an integrated platform to serve farmers' production and life.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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