The Impact of Product Quality Certification on Cooperative Business Performance—— An Empirical Analysis Based on STATA Software

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Abstract. Based on the questionnaire survey data of 260 farmer cooperatives in Sichuan Province, this paper adopts the least square estimation method (OLS) to study the impact of product quality certification on the business performance of cooperatives, and uses the STATA software to conduct propensity score matching processing(PSM) to solve the problem of endogenous bias that may exist in the model. The results show that product quality certification can significantly improve the operation performance of cooperatives through reputation effect, signal display effect and reduction of operation cost. In this paper, the propensity score matching method is used to solve the endogenous problems, and the common support area and equilibrium test are carried out. The empirical results still show that product quality certification has a significant positive impact on cooperative performance.

Keywords: Product Quality Certification · The Cooperative · Business Performance · Propensity Score Matching

1 Introduction

The quality and safety of agricultural products is an urgent problem to be solved in the process of China's economic development from total quantity to quality. To this end, the central document put forward with "three products one standard" as the main framework of agricultural products quality attestation system. This is a strategic choice for agricultural development to enter a new stage, an important symbol of the transition from traditional agriculture to modern agriculture, and an inevitable result of the development of consumption level, product production and market. By the end of 2020, there were 724 product quality, system and service certification agencies nationwide, and a total of 790,000 enterprises had been certified.

Product quality certification is mainly in two aspects of consideration: one is to control the source of production, improve product quality;Second, product quality certification can build the link between government regulation and agricultural products market and improve the competitiveness of agricultural products market [17]. No matter

which kind of product quality certification is, it can minimize the impact of information asymmetry on buyers and sellers to a certain extent through the function of signal display, so that enterprises can significantly save costs, improve customer satisfaction with products and promote enterprises to enter new markets smoothly [18]. He et al. studied relevant data in China and found that many Chinese enterprises still adopt ISO 14001 product quality certification mainly because it can improve the export ratio of enterprises, overcome the green entry barriers set by developed countries, and serve as a positive signal of environmental compliance to avoid the government's mandatory environmental inspection [5]. In the long run, quality certification has a positive impact on the improvement of enterprise economic performance [16]. However, a considerable number of scholars have found that quality certification does not significantly promote the business performance of enterprises, and the main reason is the problem of operating cost. Under the complicated and strict quality certification management system, product quality certification will bring double effects to farmers or enterprises: one is the negative impact of higher capital input, constraints of inputs and output loss; Second, the positive impact of the improvement of market performance brought about by the expansion of sales channels and the increase of product prices.

A review of the existing literature shows that scholars' studies mainly focus on the impact of product quality certification on farmers and the impact of product quality certification on enterprises, and there are few studies on the impact of product quality certification on cooperatives.

Product quality certification on the impact of peasant households. The certification of green food and organic agricultural products has a significant positive effect on the improvement of farmers' technical efficiency [7]. Bac et al. also believe that farmers will inevitably have an impact on their new technology adoption behavior during the process of product quality certification [1]. Using empirical data from Vietnam, Duc Tran&Daisaku Goto pointed out that farmers with green tea certification could obtain higher average sales price and sales value [14]. In addition, Rijsbergen, B. et al. conducted a study on coffee farmers in central Kenya and pointed out that farmers with coffee quality certification could obtain higher prices by raising the price of coffee than those without coffee quality certification, but the benefits brought by such certification would weaken over time [10]. Yan Gongan et al. studied 398 kiwi farmers in Xixia, Henan and concluded that the farmers with green kiwi certification have more development potential than those without certification [19].

Product quality certification to the impact of the enterprise. Most scholars have found that product quality certification has a positive impact on the performance of enterprises [3, 11]. It is also believed that the acquisition of international quality certification can promote the performance of enterprises through efficiency improvement and quality signal [4]. At the same time, some scholars found that international quality certification did not promote the performance of enterprises, or had a negative impact on the performance of enterprises [2, 6]. The main reason is that the cost of applying for international quality certification and the maintenance cost of obtaining.

Product quality certification will also have an impact on the export of enterprises. On the one hand, obtaining international quality certification can improve the information asymmetry in market transactions, improve management efficiency, and promote the

export of enterprises. On the other hand, it may increase the cost of enterprises, thus reducing the export of enterprises. Therefore, the influence of obtaining international quality certification on enterprises depends on the comprehensive effect of these two factors [12]. Zheng Yanyan and Li Lei et al., however, believe that having international quality certification can improve the export trade of enterprises [21]. The increase of ISO 9000 certification in both exporting and importing countries is conducive to the growth of export, especially the export from developing countries to developed countries l[13]. Yang Lijuan also believes that the increase of both domestic and international standards has a positive effect on the scale of China's foreign trade [20]. Tao Zhongyuan and Ma Lielin believed that the increase of international standards had a negative effect on China's export trade in the short term, but had a positive effect on China's export trade in the long term [15]. Liu Yang and Meng Xia found that the ISO 9000 certification of importers and exporters significantly promoted the export of manufactured products in the region [8]. In addition, Li Houjian also mentioned that international quality certification can improve the market recognition of enterprises' product brands through a low-cost signal display mechanism, so that enterprises are more likely to obtain financing support from external institutions and promote innovation activities of enterprises [9].

From the above content, in the existing literature, there are many researches on the impact of product quality certification from the perspectives of farmers and enterprises, and the researches are relatively comprehensive, but there are few literature from the perspective of cooperatives. As a new type of agricultural main body, cooperatives have developed rapidly in recent years, which not only promotes the increase of farmers' income, but also drives the development of rural industry and stimulates the new driving force of agricultural and rural development. A product quality authentication effect on cooperative study, through research and analysis to participate in cooperative product quality certification to influence whether the operating performance, and how the combined effect of impact, according to the result of its reality to provide Suggestions for the future management of the cooperatives, cooperative development, and create conditions for increasing farmers' income, to solve the problem of agriculture, rural areas and farmers has very important practical significance. At the same time, this study also has important theoretical significance to make up for the shortcomings of the existing research. For this reason, this article will be on the basis of previous studies, use of planting industry in sichuan in 2017 farmers cooperatives on-the-spot questionnaire survey data, the ordinary least squares method is adopted to product quality certification to empirical studies of cooperative effect, and using the method of tendency to match score to counterfactual framework to eliminate the problem of the endogenous bias mutual support domain and balance to the inspection at the same time, make the results more credible. The following structure is arranged as follows: The Sect. 2 is the theoretical analysis of this paper; The Sect. 3 is the measurement model and variable setting; The Sect. 4 is the empirical analysis; The Sect. 5 is the conclusion and policy implications.
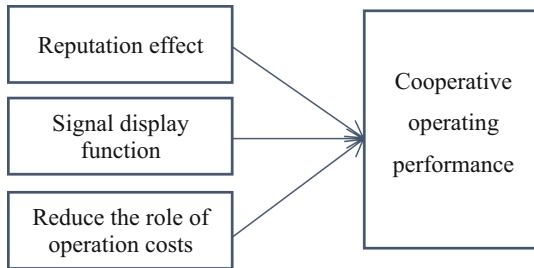
Fig. 1. Operating performance mechanism of cooperatives

2   Theoretical Analysis

Although there are few research subjects involved in cooperatives in the existing researches, we can learn from scholars' researches on enterprises to study cooperatives upside down. Product quality certification can improve the operating efficiency of cooperatives mainly through the following three aspects, as shown in Fig. 1.

Firs: Reputation reduces the transaction cost between producers and consumers due to information asymmetry and improves the operating efficiency of cooperatives. For example, after the cooperatives carry out product quality certification and obtain the corresponding quality certification certificate, the reputation of the cooperatives will slowly spread in the society, and then attract more consumers and gain the recognition of consumers, which can effectively improve the business performance of the cooperatives. Moreover, the cooperatives with product quality certification will not only be competitive in the domestic market, but also improve the recognition of the cooperative products in the international market. In the gradually internationalized trade, this is conducive to the expansion of the cooperatives overseas.

Second: the signal display function establishes the signal mechanism that cooperatives can produce high quality products. Enterprises through a low-cost signal display mechanism to improve the market recognition of the product brand, so that enterprises are more likely to obtain financing support from external institutions, promote the sustainable development of enterprises. After product quality certification, cooperatives can also attract more investors through this signal display function to provide more financing channels for cooperatives. Product quality certification can also, to a certain extent, minimize the impact of information asymmetry on buyers and sellers through the function of signal display, so that cooperatives can significantly save costs, improve customer satisfaction with products and promote cooperatives to enter new markets smoothly.

Third: international certification can also improve the efficiency of enterprises. Similarly, after product quality certification, cooperatives will carry out production according to certain standards. Standardization will improve the production efficiency of cooperatives, improve the efficiency of management and make full use of existing resources of cooperatives, and finally have a positive impact on the operation performance of cooperatives.

In fact, product quality upgrading not only has a positive impact on the operation performance of cooperatives, but also has a negative effect, that is, it reduces the operation performance of cooperatives. For cooperatives, product quality certification means higher requirements for different stages of product production. In order to meet such requirements, the operation cost of cooperatives will increase, which is not conducive to the improvement of operation performance of cooperatives. At the same time, the quality certification application process is cumbersome, which involves a lot of procedures, the cost incurred during this period is not small for the cooperative. Moreover, after obtaining product quality certification, cooperatives still need to pay a higher cost for subsequent maintenance. If the certification cost and maintenance cost of product quality certification are higher than the income brought by product quality certification to cooperatives, then the business performance of cooperatives will be reduced. Therefore, the effect of product quality certification on cooperative performance depends on the comprehensive effect of positive and negative effects. In the following part, an empirical analysis will be made on the comprehensive effect of product quality certification on the operation performance of cooperatives.

3 Measurement Model, Data Source and Variable Determination

3.1 The Construction of Econometric Model

In this paper, OLS regression was firstly used to estimate the impact of product quality certification on the operation performance of cooperatives. On the basis of referring to the studies of many scholars, the benchmark model was set as follows:

$$\text{Performance}_i = \lambda + \beta \, \text{Qual}_i + \gamma' X_i + \varepsilon_i \tag{1}$$

In formula (1) ,"i" is an individual, that is, a cooperative. "Performance" is the variable of cooperative operating Performance. On the basis of research, this topic will study the operating efficiency of cooperatives from the aspect of profit per mu. That is, the operating performance of the cooperative is measured by the Profit per mu (ten thousand yuan) in 2017, and represented by Profit. The profit per acre in 2017 also became the explained variable. "Qual" is the variable of product quality certification (explanatory variable). If the cooperative has carried out product quality certification, the value of Qual is 1. Otherwise, the value is assigned to 0. " λ" is the constant term of the equation and "ε" is the random error term of the equation.

3.2 The Data Source

The data used in this paper came from the field questionnaire survey conducted by the research group in Luzhou, Meishan, Liangshan, Guangan and Chengdu of Sichuan Province in 2018 on farmers' cooperatives in planting industry. The objects of this survey questionnaire are cooperative presidents or members who are in the know. As a major agricultural province, Sichuan also ranks among the best in China in terms of the development of its cooperatives. By the end of 2019, there were 103,605 farmer cooperatives registered for industry and commerce in the province, mainly engaged in

Table 1. Variable selection and definition.

The variable name	Variable definition description
President of age(X1)	Actual age (assigned between 1 and 5)
President of gender(X2)	Male = 1 female = 0
Educational level of president(X3)	Years of education received (assigned between 1 and 4)
External social network size of the president(X4)	Number of people known to the president, excluding internal members (assigned between 1 and 4)
Current scale of cooperatives(X5)	Planting area of cooperative products (assigned between 1 and 6)
Whether the relevant technical personnel have been hired(X6)	Yes = 1 No = 0

planting and animal husbandry, with the latter accounting for 47% and the latter 30.2%. Therefore, it is representative to use the data of planting industry cooperatives in Sichuan Province to carry out research. The survey was conducted by random sampling. The total number of questionnaires was 261. After eliminating invalid questionnaires, the number of valid questionnaires was 260, with an effective rate of 99.62%.

3.3 Variable

In the above benchmark model, X is the control variable, including the control variable at the cooperative level and the cooperative president level. In reality, in addition to the influence of product quality certification on the operational performance of cooperatives, there are also some fixed variables, as shown in Table 1. Since the operation performance of cooperatives is affected by many factors, we learn from the relevant research results of some scholars and combine with our own cognition to select variables and assign values to them from the dimensions of the basic characteristics of cooperatives, the basic status of the president and whether the relevant technical personnel have been hired.The fixed effects of industries and cities need to be taken into account.

4 Empirical Analysis

Firstly, a simple descriptive statistical analysis is made on the cooperatives with product quality certification and those without product quality certification. It is learned that, for the indicator of Profit per mu in 2017, the average value of the cooperatives with product quality is 3757.94, while the average value of the cooperatives without product quality certification is only 2660.43. Therefore, on the whole, the business performance of cooperatives with product quality certification is much better than that of cooperatives without product quality certification. However, whether this difference is significant or not needs to be verified by the subsequent empirical analysis in this paper.

Table 2. Product quality certification and cooperative business performance.

	Model1	Model2	Model3	Model4
Qual	1097.513* (0.078)	1419.28** (0.023)	1344.411** (0.033)	1395.243** (0.032)
X_1				−91.684 (0.833)
X_2				X2-368.245 (0.678)
X_3				27.191 (0.974)
X_4				40.732 (0.912)
X_5			X579.05878 (0.606)	85.7165 (0.587)
X_6			X6514.1889 (0.482)	473.7421 (0.526)
Urban fixed effect	No	Yes	Yes	Yes
Industry fixed effect	No	Yes	Yes	Yes
Observations	259	259	259	259
R2	0.0120	0.2147	0.2176	0.2187

Note: ***, ** and * indicate that the results are significant at the level of 10%, 5% and 1%, respectively

Table 3. Balance test results of explanatory variables before and after matching

Matching method	PseudoR2	LR statistic	P values	Mean deviation (%)	Median deviation (%)
Before the match	0.060	21.12	0.007	20.8	21.2
Nearest neighbor matching (1–4 matching)	0.005	1.52	0.992	4.0	2.5
Radius matching (0.05)	0.001	0.33	1.000	1.9	1.6
Nuclear match	0.001	0.40	1.000	2.3	2.5

4.1 Ordinary Least Squares Estimation (OLS)

Before to return samples of all the paper has selected variables multicollinearity test, through the test results indicate that almost all variables 2 VIF is based (variance inflation factor) at around 1.2, far less than 10, so that does not exist between the selected variables multicollinearity, satisfy the basic precondition of regression analysis.

Table 4. Calculation results of the impact of product quality certification on cooperative performance

Matching method	2017 annual profit per mu (yuan)		
	Experimental group	Control group	ATT
Nearest neighbor matching (1-4matching)	3791.029	2377.541	1413.488
Radius matching (0.05)	3791.029	2478.658	1312.372
Nuclear match	3791.029	2493.313	1297.716
The average	3791.029	2449.837	1341.192

In Model 1 of Table 2, when only one variable, product quality certification, is controlled for cooperatives, it can be seen from the regression results that product quality certification promotes the business performance of cooperatives. The coefficient in front of Qual is positive and significant at the 10% level. In terms of this sample, the profit per mu of cooperatives with product quality certification is 1097.513 higher than that of cooperatives without product quality certification. Therefore, it can be said that product quality certification significantly improves the operation efficiency of cooperatives.

Model 2 in 1 model on the basis of the influence of the fixed effects and control of the city industry, by the regression result can know the product quality certification has significant effects on the performance of cooperatives, significant from under the 10% level significantly to the 5% significance level, the product quality authentication of cooperative than not in terms of product quality certification of cooperative profit much more per acre.

Model 3 reports the results after controlling the cooperative status, city and industry fixed effects. It can be seen that after adding the control variables at the cooperative level, product quality certification is still positively correlated with the cooperative operating performance, and it is significant at the level of 5%. The two added control variables, namely the current scale of the cooperative (X_5) and whether it has hired relevant technical personnel (X_6), are positively correlated with the operation performance of the cooperative, but the influence is not significant.

In Model 4, in addition to the control variables at the cooperative level and fixed effects of cities and industries, the control variables at the cooperative level are also added at the president level, such as the age of the president (X_1), the gender of the president (X_2), the educational level of the president (X_3) and the scale of the external social network of the president (X_4). The influence of each control variable on the operation performance of cooperatives is different. After adding the control variable and fixed effect at the two levels of cooperatives and cooperative president, the influence of product quality certification on the operation performance of cooperatives is still positively significant, and the significance has been greatly improved. The control level and the cooperative president level have no significant effect on the cooperative performance. Therefore, product quality certification significantly improves the operation performance of cooperatives.

4.2   Propensity Score Matching (PSM)

After data processing, the results of nearest neighbor matching, radius matching and kernel matching are the same, which indicates that most of the observed values of the experimental group and the control group are within the same value range. In this case, the loss of sample size is small and will not affect the external validity of the research conclusion.

In addition, there will be some overlap between cooperatives with product quality certification and those without product quality certification, and this overlapping area is called the common support domain. For example, the larger the area of overlapping parts (common support area), the less likely the sample is to be lost in the matching process. Different matching methods will produce different amount of sample loss. In order to make full use of cooperative samples, this paper will choose three matching methods. The sample loss of the cooperative under these three methods is 1, so the loss is small, so the condition of the common support area is good. In addition, the standard deviations of explanatory variables were greatly reduced after matching, and the standard deviations of explanatory variables were all within 10%. As can be seen from Table 3, the value of Pseudo R2 decreased significantly from 0.06 before the match to 0.005–0.001 after the match.The LR statistic of 21.12 decreased significantly to 1.52 – 0.33.The mean deviation of explanatory variables decreased from 20.8% before matching to 4.0%–1.9%.The median bias decreased from 21.2% before matching to 2.5%–1.6% after three matching methods, and the total bias was greatly reduced.The above verification results indicate that the matching between propensity score estimation and sample is completely successful.

After the treatment of the above methods, we can get the measurement results of the impact of cooperative product quality certification on its business performance. In Table 4, annual profit per mu of the experimental group and the control group in 2017 and the average treatment effect ATT value of the two plus or minus respectively obtained by using the matching method in 3. As can be seen from the table, the results obtained by various matching methods are basically very close, and ATT values are all significant at the 10% level. From the average of the three matching results, if the cooperative did not carry out product quality certification, its annual profit per mu in 2017 was 2449.837; if the cooperative carried out product quality certification, its annual profit per mu in 2017 rose to 3791.029, an increase of 1341.192 respectively. The empirical results show that product quality certification plays a positive role in promoting the operation performance of cooperatives, reflecting that the cooperatives with product quality certification as the trend are gradually developing, and to a certain extent, it has brought income growth for the cooperatives in local areas and industries.

4.3   The Empirical Results

The existing scale of cooperatives and the employment of relevant technical personnel also have a certain impact on the performance of cooperatives, but the age of the president and the education level of the cooperatives have no significant impact on the performance of cooperatives. After using propensity score matching to solve the problem of endogenous bias, the empirical results still show that product quality certification

has a positive impact on the business performance of cooperatives. According to the results of this data, the improvement of cooperative business performance brought by product quality certification can effectively offset a series of certification costs caused by certification.

5   Conclusions and Policy Implications

In this paper, by constructing a product quality certification to improve cooperative performance analysis framework, using survey data from 260 cooperatives, sichuan province, from the perspective of empirical propensity score analysis method and the least-square method was used to matching method to verify the product quality certification to cooperative business performance, and analyzes the impact on its path. Generally speaking, the product quality certification of cooperatives can improve their business performance through reputation effect, signal display function and reducing the operating cost of cooperatives. Product quality certification plays a positive role in boosting the business development of cooperatives.

The following policy implications are drawn: as the main body, cooperatives can take the initiative to participate in product quality certification of cooperatives, keep up with the changes of The Times, adhere to high-quality development, enhance the market competitiveness of cooperatives through product quality certification, expand the operation scale of cooperatives, and create favorable conditions for farmers to increase their income; cooperatives can also actively introduce relevant technical personnel, from the source of the product. In addition, the government can actively improve the policy system matching product quality, and actively encourage more cooperatives to participate in product quality certification work; give cooperatives more policy support or subsidies for product quality certification to promote cooperatives to carry out product quality certification; establish and improve the traceability system for product quality certification to improve the recognition of product quality certification.

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