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Choice of agricultural cooperative marketing channel and economic returns among members: Evidence from rice farmers in Vietnam

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ABSTRACT

This study aims to investigate the impact of using agricultural cooperative channel for output sale on the economic returns of members' farms in Vietnam's Mekong River Delta. The primary data were gathered from 293 members of agricultural cooperatives, including 113 members using a cooperative channel for output sale and 180 members not using the cooperative channel. Propensity score matching was employed to adjust the possible selection bias generated by systematically different observable and unobservable attributes between cooperative channel users and non-users. The results showed that using the cooperative channel for paddy sale had a statistically significant impact on economic performances, such as selling price, gross margin, and return on investment, which suggests that agricultural cooperatives could serve as an effiective marketing channel for rice farmers in Vietnam.

***Keywords**: Agricultural cooperative; marketing channel; member; economic return.*

1 Introduction

The agricultural cooperative is considered a crucial instrument that helps farmers enhance their outcomes and adopt advanced technologies. Indeed, dairy farmers participating in cooperatives increase their yield and profit of milk cow farming in India (Kumar et al., 2018). Afolabi and Ganiyu (2021) report that participants in cooperatives obtain remarkably higher income than non-participants in Nigeria. Wang et al. (2021) prove that cooperative members achieve higher profit as compared to non-members in China. Similarly, Nhan et al. (2022) demonstrate that cooperatives significantly enhance profitability of rice farms in Vietnam's Mekong River Delta. Agicultural cooperative also enhances farmers' accessibility to and adoption of advanced technology (Wossen et al., 2007; Zhang et al., 2020). As a consequence, farmer members of agricultural cooperatives tend to have higher technical efficiency as compared to non-members (Ma et al., 2018; Neupane et al., 2022; Olagunju et al., 2021),

Also, agricultural cooperative can be seen as an effective means of facilitating smallholder farmers' access to markets, and strengthening their economic position by enabling them to collectively bargain with both input suppliers and purchasers of farm products. However, some members may choose to sell only part of their production through cooperative channel, and other may not choose to use this marketing channel due to weaknesses in management structure (Ebata and Hernandez, 2017; Hao et al., 2018; Liu et al., 2019). Using agricultural cooperative as a marketing channel can help farmers gain better selling price that contributes to higher farm income (Liu et al., 2019). Indeed, the copperatives play significantly important roles to farmers such as providing market information which may help farmers sell their product with a higher price (Hao et al., 2018; Hoken and Su, 2018; Ma and Abdulai, 2017; Wollni and Zeller, 2007), bargain for better price (Cropp and Ingalsbe, 1989), access markets for members' products, take reliable payment (Hovhannisyan et al., 2005), and reduce transaction cost (Ha et al., 2013).

Most previous studies have investigated the role of agricultural cooperative in contributing to rural economic growth and farm's income by comparing economic performance between cooperative members and non-members, such as research results of Chagwiza et al. (2016), Shumeta and D'Haeseb (2016), Ma and Abdulai (2017), Wossen et al. (2017), Mojo et al. (2017).

To the best of our knowledge, little is known about impact of using agricultural cooperatives as a channel for output sale on farm members' economic returns. Hence, the core objective of this study is to estimate the impact of using the cooperatives as a channel for output sales on household members' selling price and profitability. This study contributes to the literature on factors influencing cooperative members' choice to sell their product through cooperatives. It also helps further understand how much marketing channels improve the farm profitability of cooperative members. To estimate the actual effect of cooperative marketing channel, the study used data collected in the Mekong River Delta, the rice bowl of Vietnam (Vietnam General Statistis Office, 2021), as a case study in Vietnam.

2 Methods

2.1 Method used for impact estimation

The present study attempts to estimate the impact of whether or not to use agricultural cooperative channel for paddy sales on the economic performance of farm members. Hence, it needs to compute the mean difference of outcomes between the same member in two states, being a user and a non-user of cooperative marketing channel simultaneously, which can be displayed in Equation (1).

$$ATT = E[Y_{1i} - Y_{0i}|C_i = 1] = E[Y_{1i}|C_i = 1] - E[Y_{0i}|C_i = 1] \quad (1)$$

Where *ATT* can be referred to as a difference value between Y_{1i} and Y_{0i}; Y_{1i} and Y_{0i} denote outcome variables (e.g. selling price; gross margin; and return on investment or ROI) for the same member with and without using cooperative marketing channel, respectively; C_i equals 1 if a member sells its paddy through a cooperative, and 0 otherwise.

Unfortunately, it is impossible to observe both outcomes of the same member/household with and without using the cooperative channel simultaneously. Using the average outcome of actual non-users as a proxy is not a wise strategy since users and non-users of a cooperative channel may systematically differ even without treatment (Caliendo and Kopeinig, 2008). Since members' decision whether to choose a cooperative channel for output sale was not randomly assigned but their decision is apparently based on their attributes. In fact, these attributes and using cooperative channel may affect the outcomes of the subject simultaneously. Thus, the actual impact of using a cooperative channel for paddy sales may be over- or under-estimated. Fortunately, propensity score matching (PSM) that may helpfully adjust selection bias was employed to estimate the impact of agricultural cooperative channel use on economic returns, such as selling price, gross margin and ROI that were measured in this investigation.

The PSM model was employed following two steps. The first step uses a probit model to generate propensity score which is referred to as probability or likelihood of choosing a cooperative marketing channel. The probit model was presented in Equation (2).

$$p(X_i) = Pr(C_i = 1|X_i) = \alpha + \rho_i X_i + \varepsilon \quad (2)$$

where $p(X_i)$ is defined as the likelihood of choosing cooperative channel for paddy sale for each member; X_i is a vector of covariates influencing members' decision to choose the cooperative markeing channel; α is a intercept; ε is a error term.

The second step calculates ATT by matching the treatment group and control group based on similar propensity scores generated from a probit model as presented in Equation (3).

$$ATT_{PSM} = E[E\{Y_{1i}|p(X_i)\} - E\{Y_{0i}|p(X_i)\}|C_i = 1] \quad (3)$$

where ATT_{PSM} can be defined as the mean difference values in selling price, gross margin and ROI between treatment group (users) and control group (non-users) appropriately matched by the propensity score $p(X_i)$.

It was used the nearest neighbor matching (NNM) and kernel matching (KM) to match users with non-users of cooperative marketing channel by propensity scores. Two matching methods were often used since they are fully complementary (Becerril and Abdulai, 2010).

It was remarkable that the quality of matching process should be checked carefully before and after matching. The mean standardized bias after matching should be less than 25% (Stuart and Rubin, 2007) and the pseudo-R2 values should be tremendously low after matching. These suggest the elimination of systematic differences among covariates between users and non-users (Maertens and Velde, 2017)

2.2 Definition of variables used in empirical model

The definitions of all variables used in the study were described in Table 1. This paper employed PSM method since three types of variables were used. Firstly, treatment variable was defined as a dependent variable showing cooperative members choosing cooperative channel for paddy sales.

Table 1.
Definitions of selected variables

Variable	Description
Treatment variable	
Cooperative channel use	1 if the member uses the cooperative channel for paddy sales, and 0 otherwise
Explanatory variables	
Age of head	Age of household head in years
Education of head	Schooling of household head in years
Family labor	Number of family labor for rice cultivation (person)
Working for local authority	If the household has a member working for local authorities
Rice land area	Farm land area for rice cultivation (ha)
Agro-machinery ownership	If the household has agro-machinery, and 0 otherwise
Social media use	If the household head uses social media (e.g. Zalo, Facebook, Youtube), and 0 otherwise
Distance to main road	The closest distance from household to vehicle road in which truck can transport (km)
Close business with collector	1 if the household has closed business relationship with paddy collector, and 0 otherwise
Duration of membership	Duration of member's participation in cooperative (years)
Access to extension	1 if the household has access to agricultural extension services, and 0 otherwise
Loan	1 if the household takes a loan, and 0 otherwise
Outcome varibales	
Selling price	Selling price for paddy at farm-gate (VND/kg)
Gross margin	Difference between total revenue and input cost (million VND/ha)
ROI	Ratio of net return and input cost

Secondly, covariates were used in the probit model to generate the propensity scores. Based on previous studies by Hao et al. (2018), Behera (2019), Fischer and Qaim (2012), Ma and Abdulai (2017), Liu et al. (2019), Marcos-Matas et al. (2018), Liu et al. (2019), Abebaw and Haile (2013), Gong et al. (2016). Rao and Qaim (2011), twelve covariates were selected for the probit model.

Thirdly, outcome variables were used to estimate the impacts of using cooperative marketing channel. The economic returns in this study were measured through three indicators, including selling price, gross margin and ROI (return on investment).

3 Data collection

Data collection was carried out through multistage sampling procedure between April 2021 and May 2022**.** First, three provinces of Hau Giang, Soc Trang and Tra Vinh were purposely chosen from twelve provinces and a city in the Mekong River Delta. Those provinces are considered the most important paddy production regions. Second, two districts were selected as the sampling sites from each of the three provinces. The selection of two districts from each selected province was based on secondary data on agricultural cooperatives in the Mekong River Delta and suggestions from the representatives of the provincial Department of Agriculture and Rural Development. Third, three rice cooperatives established for at least 2 years from each of the six districts were purposively selected to investigate household members. Lastly, around 15 to 20 members from each of eighteen selected rice cooperatives who have been a membership for at least 2 years were randomly selected for household surveys.

A total of 293 cooperative members, including 113 members using cooperative channels and 180 members who did not use cooperative channels for output sales were finally interviewed face-to-face. A structured questionnaire containing questions on demographic and farm characteristics, rice production costs, output market, selling price, and yields was used to collect primary data.

4 Empirical results and discussion

4.1 Summary of descriptive statistics results

In this section, we also report the descriptive statistics results of farm and household characteristics. The surveyed members were categorized into treatment (members used cooperative channel for marketing output) and comparison (members did not use cooperative channel) groups. Results showed that 113 (38.6%) members used cooperative channel for output sale and 180 (61.4%) members did not use this channel.

Findings showed that the characteristics between the two groups were likely similar (Table 2). With regard to demographic characteristics, the users of cooperative channel for outlet and non-users were around 54 years old. The users and non-users had approximately 7 years of schooling. Both groups had around two family members for agricultural activities. The user and non-user groups had family members working for local authorities and accounted for 12% and 15% of the surveyed households, respectively. Regarding farm size, the rice land area of the users and non-users was likely similar, with each owning approximately 2.03 ha and 2.26 ha, respectively. The user group tended to have less agro-machinery than the other group. Interestingly, results indicated that both groups have used social media like Zalo, Facebook and Youtube, which accounted for more than 50% of the investigated households. It was found that more than 80 % of the households of both groups had access to agricultural extension services.

However, results revealed some considerable and significant differences between the two groups. The non-user group was more likely to reside nearer the main road on which a car or truck can be driven. Interestingly, 87% of non-users reported that they had a close relationship in business with collectors or middlemen for long periods of time, whereas this was just 48 percent for users. As regards credit access, the users tended to take more bank loan than non-users.

In summary, there exist some remarkable differences in socio-economic attributes between the user and non-user groups of cooperative channel for paddy sales, which may also affect the economic performances of members beside impact of marketing channel.

Results showed that selling price, gross margin and ROI obtained by users of cooperative marketing channel were significantly higher than those generated by non-users (Table 3). However, those comparisons did not include different characteristics between the two groups of households, which may influence the choice of using cooperative marketing channel and the outcomes simultaneously.

Table 2.
Farm and household characteristics between cooperative channel users and non-users (t-test results)

Variable	Cooperative channel users	Cooperative channel non-users	Mean difference
Age of head	53.65	54.27	-0.617
Education of head	7.78	7.37	0.407
Family labor	2.37	2.19	0.177
Working for local authority	0.12	0.15	-0.035
Rice land are	2.03	2.26	-0.225
Agro-machinery ownership	0.29	0.38	-0.091
Social media use	0.59	0.55	0.043
Distance to main road	1.64	1.31	0.325**
Closed business with collector	0.46	0.87	-0.412***
Duration of membership	7.24	5.91	1.327
Access to extension	0.85	0.82	0.027
Loan	0.35	0.23	0.115***

Source: Authors' analysis; Note: ** $p < 0.05$, *** $p < 0.01$.

Table 3.
Differences in crop outcomes of users and non-users of cooperative channel using a t-test

Variable	Cooperative channel users	Cooperative channel non-users	Mean difference
Selling price	6,392	6,134	258***
Gross margin	28.11	23.94	4.17***
ROI	1.36	1.18	0.181**

Source: Authors' analysis; Note: ** $p < 0.05$, *** $p < 0.01$.

4.2 Results of probit model

The probit regression model was used to generate propensity scores which were used to match users and non-users of cooparative marketing channel in the second step of the PSM procedure. Although the core objective of this step is to estimate the propensity scores, the results from the probit model are also interesting. The results showed that three determinants out of twelve covariates were significantly associated with cooperative channel use of members (Table 4). Specifically, distance between the farm and main road was positively associated with the probability of cooperative channel use, which suggests that if household members reside far from the main road they are more likely to choose cooperative channel to sell paddy. Closed relationships with collectors was negatively associated with the likelihood of cooperative channel use, implying that if members have a good business relationship with collectors they did not tend to choose cooperative channel to sell paddy. Members who have taken loan were more likely to use cooperative channel for paddy sales. Taking bank loans was positively associated with the probability of cooperative channel use.

These findings suggest that it remained biased for marketing channel choice among cooperative members. In other words, farm members' selection of channel for paddy sales were not random and was influenced by some farm and household characteristics that may cause biased results when estimating the impact of agricultural cooperative channels on the economic performance of rice households.

4.3 Results of checking matching quality

Propensity scores derived from the probit model (the first step) were used to match users of cooperative channel for output sales to non-users with similar values of propensity scores. After matching, the mean differences of estimated outcome indicators between the two groups can be referred to as ATT values.

Prior to interpreting the effect results estimated by PSM, the quality of matching must be taken into account (Caliendo and Kopeinig, 2008). Figure 1 depicts the distribution of propensity scores between the treated and control groups before and after matching. The dash-lines of propensity score distributions for treated and control groups before matching were considerably different. However, both dash-lines were almost overlapping or similar after matching, suggesting that the mean differences of covariates between the two groups may be eliminated. This implies that distribution of covariates is relatively balanced after matching between the treated and untreated groups.

Table 4.
Probit analysis results

Variable	Coefficient	Std. Err.	z	*p*-Value
Age of head	-0.004	0.008	-0.41	0.678
Education of head	0.020	0.028	0.72	0.469
Family labor	0.109	0.083	1.31	0.190
Working for local authority	-0.137	0.251	-0.54	0.587
Rice land area	-0.049	0.041	-1.20	0.231
Agro-machinery ownership	-0.113	0.177	-0.64	0.525
Social media use	0.149	0.188	0.79	0.427
Distance to main road	0.107*	0.062	1.72	0.085
Closed business relationship	-1.307***	0.191	-6.84	0.000
Duration of membership	0.040	0.025	1.58	0.115
Access to extension	0.376	0.241	1.56	0.120
Loan	0.448**	0.185	2.42	0.016
Constant	0.139	0.638	0.22	0.828
LR Chi^2 (12)	77.65			
Prob > Chi^2	0.0000			
Pseudo R^2	0.1997			
Log likelihoods	-155.585			

Source: Authors' analysis

Similar to the distribution of covariates, reduction of mean absolute standardized bias before and after matching was also examined. As presented in Table 5, the standardized mean bias for all confounding covartiates used in the probit model was decreased from 22.8 to approximately 6.7 and 7.7 after matching for kerkel and nearest methods after matching. Table 4 shows considerable reduction in the pseudo-R2 values after matching. The *p* value of probability ratio tests was significant before matching, but this value was not statistically significant after matching, suggesting that mean values of the covariate of the treated and control groups after matching are silmilar. These results imply that the presence of some biases for the covariates is eliminated after matching and the covariate distributions between the two groups are balanced. Hence, the ATT estimated values are quite accurate (Rosenbaum and Rubin 1983).

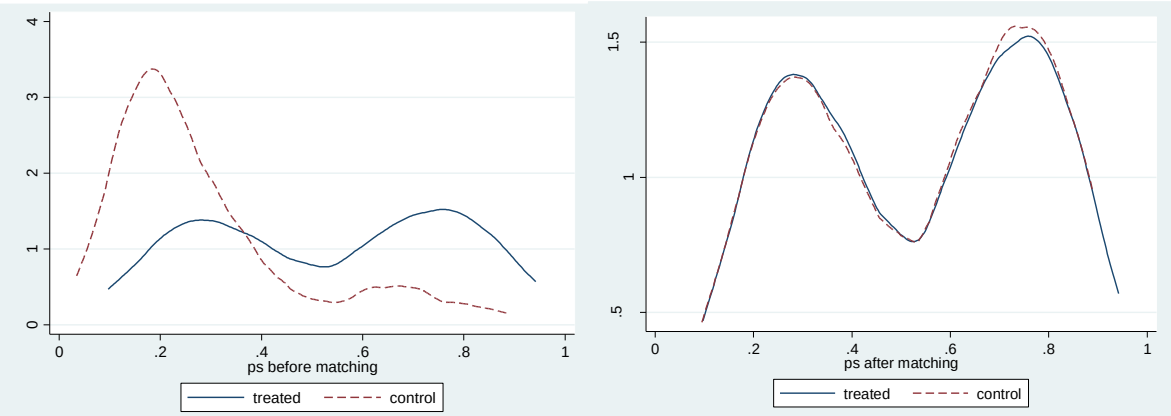

Figure 1. Propensity score distributions before and after matching (Source: Authors' analysis)

Table 5.
PSM quality indicators before and after matching

Item	Before Matching	After matching	
		Three-Nearest	Kernel
Pseudo R^2	0.200	0.020	0.019
p > Chi^2	0.000	0.870	0.886
Mean standardized bias	22.8	7.7	6.7

Source: Authors' analysis

4.4 Impact results of using agricultural cooperative channel

Impacts of cooperative channel use for output sales was estimated by using PSM with nearest neighbor matching and kernel matching methods. The impact results examined by using both matching techniques were similar (Table 6). Findings revealed that members using cooperative channel for paddy sale significantly increase selling price (3% increase), gross margin (21% increase) and ROI (18% increase), which suggests that farmer members selling their paddy through cooperative channel may remarkably enhance farm economic performance in Vietnam's Mekong River Delta. These findings are in line with the research of Liu et al. (2019). They reported that members using agricultural cooperatives as a marketing channel could significantly improve both farm and household income in China.

Table 6.
The impact of using cooperative marketing channel (PSM results)

Outcome	Algorithms	Treated	Control	ATT	*t*-values
Selling price	Unmatched	6,396	6,134	261	3.86***
	Neighbor	6,396	6,194	201	2.02**
	Kernel	6,396	6,171	224	2,46**
Gross margin	Unmatched	28.157	23.946	4.211	3.75***
	Neighbor	28.157	22.835	5.322	3.25***
	Kernel	28.157	23.284	4.873	3.21***
ROI	Unmatched	1.367	1.181	0.185	2.58**
	Neighbor	1.367	1.133	0.233	2.25**
	Kernel	1.367	1.156	0.210	2.17**

Source: Authors' analysis; Note: ** $p < 0.05$, *** $p < 0.01$.

5 Conclusion

The results showed that distance between the member's house and main road, closed relationship with collectors and loans are crucial factors that influence members' decision to choose agricultural cooperative channel for paddy sales, which suggests the presence of selection bias due to systematic differences of attributes between the two groups of members. This difference was perfectly reduced by the PSM model.

The results estimated from the PSM demonstrated that the cooperative channel used for paddy sale has a positive and significant impact on output price, gross margin and ROI for household members in Vietnam's Mekong River Delta. These findings suggest that the cooperative channel used for output sale tremendously increases farm economic performance for rice household members.

Using agricultural cooperative channel for output sale plays a crucial role in improving farm economic performance, suggesting that members should sell their paddy through agricultural cooperative channel to maximize returns. This implies that rice farmers in Vietnam should participate in agricultural cooperative and use its marketing channel for output to help enhance their economic performance and to improve the household incomes. An important policy implication of this study is that the government should continue to support agricultural cooperatives to improve their marketing services, which help encourage members to choose cooperative channel for their output marketing that may enhance farm economic performance.

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