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# Impact of Collective Marketing by Cocoa Farmers' Organizations in Cameroon

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## *Abstract*

The aim of this paper is to evaluate the impact of collective marketing by FO on cocoa farmer's price in Cameroun. This evaluation is done through the non-experimental method of impact evaluation which uses the techniques of "Propensity Score Matching". Data used come from 2006 IITA[1] cocoa baseline survey conducted between March 15 and April 15, 2006 and concern 601 cocoa farmers in Centre region in Cameroon during the 2005/2006 season. Results show that collective marketing has a positive and statistically significant effect on the net price received by farmers. This effect is estimated at 44 FCFA per kilogram of cocoa sold collectively, that means 8% increase on the individual sale price. The main recommendation is to promote the development of FO and collective marketing within FO. The development of FO requires a government policy to support the creation of FOs and by extension the effects of collective sales. Development of collective marketing can be done through creation of credit systems by FO to encourage farmers who sell to individual buyers under the constraint of credit received. This probably would increase significantly the share of supply captured by FO.

**Key words:** Collective marketing, Farmers' organization, farmer's price, cocoa

[1] International Institute of Tropical Agriculture

# 1. *Introduction*

Smallholder's access to the market is a permanent concern for development actors in developing countries. Indeed, various studies proved that the smallholder remains poorly connected to the agricultural market (Key and al. 2000; Gabre-Madhin 2001; Gabre-Madhin 2009). One of the solutions to improve their access to the market involves promoting collective marketing trough farmers organizations (FOs). However, it is noted that very few studies have so far been carried to point out the importance of FOs in the collective marketing of members' products in developing countries.

In Cameroun, after liberalisation, some farmers' organizations (FOs) appeared but only in some regions. The apparition of FOs in the Centre Region of Cameroon can be explained as ain attempt to fill the gap left by State in supplying farmers with inputs and marketing operations. But, According to Folefack and Gockowski (2004), only 40% of cocoa farmers in the Center region effectively take part in collective sales organized by FOs. One can thus wonder why in spite of the existence of FOs in the Center region, some of the cocoa farmers attend to the collective marketing while others do not. This implies our central question which justifies our study is the following: **what is the impact of collective marketing through FOs on cocoa farmer's price in Cameroun?** This question refers to the control of functional and operational costs of cocoa market in Cameroun through collective sales by FOs. Many studies which highlight the effects of collective marketing on farmers are generally biased (Bernard and Al 2008b). The impact analysis which arouses the interest of many economists has an important methodology debate. The particularity of this study is to try to isolate this bias by comparing cocoa farmers in Cameroun who sell collectively with those who sell individually (Both in the region where FOs are established and in the region without FOs) and which have some common characteristics.

In this study, we seek to highlight the impact of collective marketing by FOs on the price received by cocoa farmers of Centre region in Cameroun. Indeed, this study seeks to evaluate the effect of collective sales on the farmer's price through the non-experimental method of impact evaluation which uses "Propensity Matching score" techniques. To the best of our knowledge, just few empirical studies have so far analyzed the impact of rural organizations on farmers' marketing.

# *2. Literature Review of FOs and Cocoa Marketing in Cameroon*

This literature Review is presented in two points: First the general overview of FOs and the overview of the organization of cocoa marketing in Cameroon.

## *2.1 General overview of FOs*

The farmer organizations are organizations or federations of organizations, based on adhesion and which are managed by elected or appointed leaders who are responsible in the General Assembly or the Administration Board. They can take various legal forms, such as co-

operative or association[2]. Their functions can be classified in three categories (World Bank, 2008): i**) the organizations specific to a product**, which are focused on the economic services and the defense of interests of their members with regard to a particular product, cocoa, coffee or cotton; ii) **the pressure organizations,** which aim at representing the interests of farmers, such as national unions of farmers; iii) **Organizations with multiples aims**, which meet various economic and social needs of their members, often in the absence of local public authorities or efficient public services.

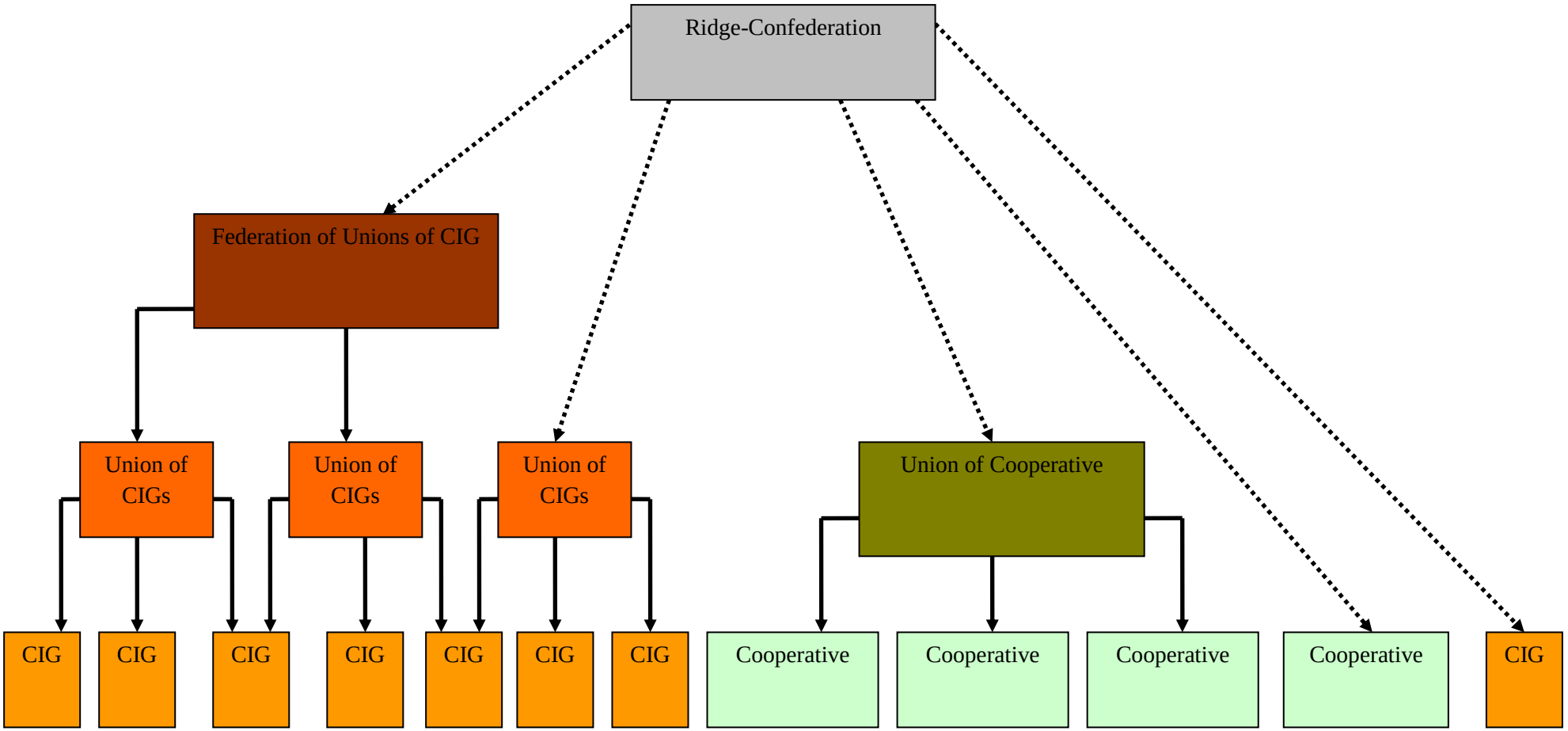
In the industrialized countries, FOs were of an essential contribution to agriculture family success. These organizations still represent the dominant form of production organizations'. In the United States, dairies cooperative control approximately 80% of the production of dairy products; in particular in California, most of farmers are gathered in cooperatives (World Bank, 2008). In France, 9 farmers over 10 belong to a cooperative, whose market shares are 60% for inputs, 57% for products and 35% for transformation (Mauget and Koulytchizky, 2003)[3]. In European Union, one counts approximately 30,000 cooperatives which gather in more than nine million farmers (Bernard, 2008a). These cooperatives control 50% of inputs market and 60% of products market.

In Cameroun, because of non-existence of organization gathering all the FOs, it is difficult to have statistics on FOs at national level. It is difficult to obtain statistics on FOs at national level (for FOs which have them). Nevertheless, one can count about 6400 FOs which are supposed to be gathered at national level in three different structures which are fighting for the leadership: i) Conseil des Fédérations Paysannes du Cameroun (CFPC); ii) Confédération Nationale des Organisations Paysannes du Cameroun (CNOP-Cam) and iii) Conseil National des Organisations Paysannes ds petits producteurs du Cameroun (CONOPROCAM). This high number of FOs is due to the fact that some FOs are created by the elite so that farmers of this area could get benefic of possible subsidies from NGOs or State. The grouping of FOs in national structures is not always achieved. We can distinguish two categories OP at the basic level: common initiative group (CIG) and cooperatives.

The organization of FOs in Cameroon is a more or less pyramidal. CIGs and cooperatives are the basic. CIGs and cooperatives can be grouped into union of CIGs or cooperative union, respectively. Then, federations are groups of unions of GIC. At the top there is a confederation ridge which is linked federations of unions of CIG, unions of CIG, unions of cooperatives, CIG and cooperatives (Figure 1).

[2] An association is a non-profit organization of services, information and representation of their members. In certain countries, the professional organizations are presented in the form of "companies" rather than like associations.

[3] **Mauget, R., Koulytchizky, S., 2003**. « Un Siècle de Développement des Coopératives Agricoles en France » dans Touzard, JM. & Draper, J.-F., Les Coopératives Entre Territoires et Mondialisation, Paris, L'Harmattan.




Source : Constructed by author

**Note:** _____ Dependency link; ----------Possible dependency link

**Figure 1: Organizational forms of cocoa farmers in Cameroon**

## *2. 2 Empirical Evidence of the impact of farmers' organizations*

The analysis of farmers' organizations impact is relatively new. Thus, studies that identify and evaluate the effects of collective action by farmers on their activity are very few. However, a number of empirical evidence studied in this field should be highlighted. First, if Gadzikwa et al. (2006) in their studies on FOs in South Africa and Hellin et al. (2009) through their study in Mexico showed that collective action of FOs enables fistly to facilitate access of their members to credit and inputs, and secondly to reduce transaction costs and production . Then, we note the study of Devaux et al. (2009) that examined the effect of collective action on innovations in marketing chain in Peru. This study lead to findings that collective action builds the capacity of commercial innovations, technological and institutional. Moreover, the study of Kruijssen et al. (2009) show that collective action of farmers in four countries (Thailand, India, Syria and Vietnam) enables to increase the added value of biodiversity products. In addition, the studies of Catacutan et al. (2009) in Philippines, and Gian Ruerd (2007) on FOs in Ethiopia, as well as those of Barham and Chitemi (2009) show that collective action of farmers in Tanzania increases their access to potential markets. The study of Bernard et al. (2008a) shows that the impact of FOs in Ethiopia (their members' access to credit and infrastructure) is limited on one hand by the low capacity management of FOs and on other hand by the availability of financial resources. Finally, the study of Bernard et al. (2008b) in Ethiopia shows that despite the fact that FOs can negotiate high prices to their members, FOs could not increase the quantity of products sold. In the same vein, the study of Bernard and Spielman (2009) in Ethiopia lead to findings that collective action of FOs generates profits even to non-members of FOs.

## *2. 3 Organization of cocoa marketing chain in Cameroon*

The cocoa marketing chain is organized in a fairly simple [Figure 2 from Kamdem (2010)]. Thus, according to the study of Kamdem (2010), farmers can either sell to "coxeurs" (who usually come to buy cocoa from farmers), or direct sale to approved buyers (though this often requires a long trip) or sell through FO (in the centre region only because there is not really FO in the other region of production, the South-west region).

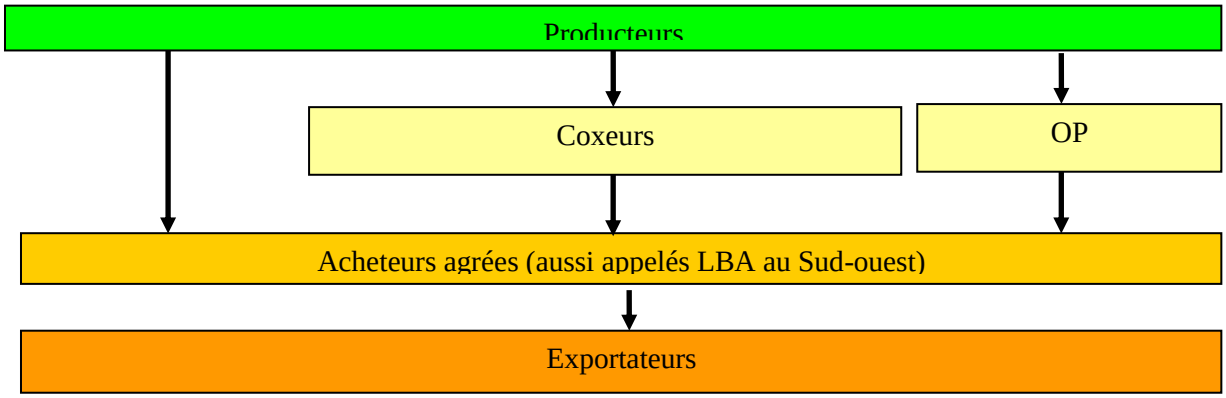



**Figure 2: Organization of cocoa marketing chain in Cameroon**

Source: Kamdem (2010)

The first channel of marketing (direct sale to approved buyers) is mostly the fact of the large farmers[4]. It is not very in the Centre region, but very widespread in the South-west region. The second channel (sale to coxeurs) is very widespread as well in the Centre region as in South-west region. The third channel (sale via FO) exists only in the Centre region. The approved buyers resell the cocoa bought to the exporters. Face to this multiple channels of marketing; it arises that farmers generally need to choice between selling collectively and selling individually. Thus, the consideration of various variables suitable for assign the farmer participation to FO generally enables to reduce bias of impact evaluation of. For this reason, in this study, we deployed the technique of "Propensity Score Matching" in order to reduce the possible effect of bias in the results.

# *3. Methodology*

The impact evaluation can be done through two types of methods: experimental method and non-experimental method. Experimental method consists of setting up in a random way two groups of the studied population: one without the program and other with the program. Thus the impact is measured by comparing the results of two groups. The experimental method is regarded as more robust but its implementation is very difficult or impossible[5].
The methodology will consist in presenting firstly the modeling framework, then the analysis method and finally the sampling strategy.

## *3.1 Modeling framework of "Propensity Score Matching"*

The propensity Score Matching (PSM) is a refined technique of pairing for economic impact. This technique consists in building a group of statistical comparison founded on the probability of participating to the program. $P(X) = \Pr(d = 1/X)$.

The technique of PSM which originality belongs to Rosenbaum and Rubin (1983) enables us to solve the problem of dimensionality[6] of direct pairing by showing that, under certain assumptions, pairing on the basis of P (X) is as good as direct pairing on the whole of X.

[4] What is convergent with the result of Fafchamps and Vargas (2004) according to which only the farmers who have significant quantities move to sell their product.

[5] This impossibility is related to the fact that impact analysis method of a given program is generally done after the program was implemented. However, to be effective, experimental method must be set up and part of data collected before the program. Since it is not generally the case, it is obviously impossible after the program to observe each participant in the situation where it wouldn't have followed of program. It is the case of our data which are out of cross-sections data and which are collected after the program.

[6] The dimensionality curse is related to the fact that there exists a great number of dependant variables or then the number of dependant variables is higher than the sample size

### *3.1.1 Method principles*

This method assumes that differences between both populations, treated and untreated populations come from their individual characteristics and the treatment. If one neutralizes the differences according to the characteristics, then there remains only the effect of the treatment. The participation in the program is represented by a random variable. For each individual $i$, we have $\begin{cases} T_i = 1 \ if \ \ individual \ \ participate \ \ \ in \ the \ program \\ T_i = 0 \ if \ \ no \end{cases}$

The effectiveness of the program is measured by the result variable which, $Y_i$ known as a latent variable:

$\begin{cases} Y_{Ti} \ \ if \ \ individual \ \ \ \ receives \ traitement \ T = 1 \\ Y_{NTi} \ if \ \ individual \ \ \ \ receives \ traitement \ T = 0 \end{cases}$

These two variables correspond to the potential results of the program. They are never simultaneously observed for the same individual. For a treated individual, $Y_{Ti}$ is observed while $Y_{NTi}$ is unknown. In this case, the variable $Y_{NTi}$ corresponds to the result which would have been carried out if the individual had not been treated (counterfactual). For an untreated individual, one instead observes $Y_{NTi}$, while $Y_{Ti}$ is unknown.

### *3.1.2 Propensity Score Matching assumptions*

**Assumption 1:** O*bservable selection and conditional independence.* The matching base on assumption that all the variables producing selection bias (control variables) are observed (Rosenbaum and Rubin, 1983; Rubin, 1996; Imbens, 2004; Dehejia and Wahba, 2002; Smith and Todd, 2005). Given Xi, the vector of observed variables. The assumption of selection on observables means that the latent result variables $(Y_{NT}, Y_T)$ are orthogonal to the conditional participation of characteristics (X). Under this assumption, it is possible to cancel selection bias by comparing individuals with identical observed characteristics.

**Assumption 2:** *Existence of common support*. The application of matching techniques is only possible if there exists untreated individuals with characteristics identical to those of treated individuals $0 < P(T = 1|X) < 1$. The test of this assumption is based on the estimation of common support zone (Todd, 2007). The assumption of common support means that the probability associated to the participation, noted $P(T = 1|X) < 1$ is not zero: for any i, there exists a positive probability to participate.

## *3.2 Estimating method*

The principle of estimating method is to use collected information about untreated individuals to build a counterfactual for each treated individual. Thus, the average treatment effect on treatment is:

$\Delta^{ATT} = E(Y_T - Y_{NT} | T = 1) = E(Y - Y | T = 1)$

$$= E[Y - E(Y|X, T = 0)|T = 1]$$

$$= [E(Y_T|T = 1, X = x) - E(Y_{NT}|X, T = 0, X = x)]$$

The estimator $\Delta^{ATT}$ is obtained as the average of all differences between the situation of treated individuals and the built counterfactual.

The problem becomes estimating $E(Y_{NT}|X = x_i, T = 0) = f(x_i)$, for each treated individual with characteristics $x_i$. To reach the result, one must first make pairing on the base of "Propensity Score Matching". Then the next step will just be a question of defining the common support and calculating the variations.

### *3.2.1 Propensity Score estimation*

Propensity Score Matching is used to select observable characteristics under the assumption of conditional inter-dependence. Hence this estimation is made from probit or logit model of participation to the program, by controlling all the variables X which affect in the mean time the "participation" and "result" variables. Indeed, estimators of PSM are less biased when X include variables which both affect the participation in the program and its result (Heckman and Al, 1998). Predicted values (*propensity score:* $P_i = P(T = 1/X)$) are then obtained. These values of propensity score represent the probability distribution for each farmer and for each transaction to participate in the program, i.e. selling through FOs. This predicted probability of participation is conditional to exogenous characteristics. The interest in estimating this predicted probability to take part in the program is to make the pairing of individuals having "propensity score", which are close; this explains the necessity to build a common support.

### *3.2.2 Common support determination*

After the estimation of propensity score for all individuals in the sample, one determines the common support to make sure that for each individual who participate in the program, one can find at least an individual who did not participate and who has the same propensity score. To build the common support of propensity score, two approaches can be adopted. The initial method of pairing from Rubin (1977)[7]. Though it looks simple, many critics point out the problems of dimensionality, the nature of process and the unknown properties of its estimators. More details can be found in Crepon (2000)[8]. This method corresponds to the method of pairing of nearest neighbor. The studies of Heckman et al, (1997; 1998) enable to wipe out-the limits of Rubin (1977) method through the method of Kernel and locally weighted regressions. This method consists in generating for each observation of the group of

[7] This method consists in associating with each treated observation, an untreated observation whose characteristics are identical

[8] Crepon B., 2000. Méthodes d'appariement dans l'évaluation des politiques de l'emploi. Communication aux Journées de Méthodologie Statistique, mimeo INSEE

treatment, an observation which is a weighted average of control group observations (either the unit, or a given interval). These weightings are inversely proportional to the distance between observation i (in terms of Pi) and control group observations. The results can be sensitive to the choice of interval and the weighting function. It is this method which will be used in this study.

### *3.2.3 Estimating of Standard Error*

The standard error estimation is obtained by applying the methods of "bootstrap", which consists in replicating the entire estimation procedure on a random sample with handing-over in the initial sample and determining the standard error of the entire distribution of estimators obtained. This estimation of standard error considers the fact that the "propensity score" has been estimated. Hence, each bootstrap must take into consideration not only pairing on the random sample, but also the estimation of the score.

### *3.2.4 Estimating the FO impact using a « naïve » approach*

After the estimation FOs impact by "Propensity Score Matching" method, it will be also necessary to estimate the impact of FOs using a simple approach called "naïve". This approach consists in making a simple comparison between collective sales and individual sales. The results obtained by this method will be then compared and discussed with those obtained by the method of "Propensity Score Matching".

## *3.3 Sampling strategy*

This study aims at evaluating the effect of cocoa collective marketing on cocoa farmer's price in the centre region in Cameroun. The sampling strategy that we adopted aims at circumventing the various sources of selection bias. Initially, the transactions on collective sales are different from the transactions on individual sales on a certain number of characteristics (which can have effects on cocoa farmer's price) which are linked to the transactions themselves on one hand and on the other linked to the farmers. Thus, the price differences between individual sales and collective sales can be completely or partially attributed either to the difference between these transactions, or to the effect of collective marketing. Then, the source of selection bias can come from certain non-observable characteristics at the regional, producers' or transactions' level. At the level of the region, a dynamics of FOs in marketing can come partly from the elites. At the level of farmer, there are entrepreneurial spirits and the relations which farmers can have with other FOs. Such biases are often considered by using the method of instrumental variables. But this method is limited when a treated observation significantly affects the result of another untreated observation by external effects. Lastly, the source of selection bias can come from externalities exerted by FOs on marketing capacity and/or the choice of non-members. With the aim of minimizing these biases, we use matching techniques (Jalan & Ravallion, 2003a). Our approach in one step consists firstly in matching collective transactions with the similar

individual transactions in the Center region on the one hand and on the other hand with the similar individual transactions in South-west region. Finally, to be sure of the validity of these techniques, it is necessary that the treatment sample and comparison sample both operate in the same market (Heckman et al., 1998). For our case, we make sure that in the matching framework, transactions are sufficiently similar by considering various price determinants (marketing quantities, farmer size in term of total quantity sold, farmer age, farmer level of education, roads quality, etc).

However, the limit of this method is that the application of Propensity Score Matching technique does not enable to minimize all the three categories of biases. Indeed, the second category of bias (i.e bias related to the unobservable characteristics), is not minimized by this technique. This technique enables only to minimize the first category of bias (i.e related to the observable characteristics) and the third category of bias (i.e related to the externalities).

In addition, the impact of collective sales on farmer's price depends particularly on the constraining variables such as credit received credit from the buyers, the distance between farmer and the sale place and start of the school year. One could expect the separated evaluation of effects of these variables on the farmer price. But the fact that these variables are integrated in the probit regression enable to considerate the effects of these variables in the impact evaluation of collective sales on the price.

This study use data collected on 904 producers having carried out 2487 cocoa transactions. For better apprehending the impact of collective marketing, we exploited only the data on 601 farmers from the centre region where there exist the individual and collective sales at the same time (Table 1). We followed different surveyors' teams in the field as supervisor and coordinated data entry survey.

**Table 1: Statistics of data collected by region and selling channel**

| Titles | Farmers | | | |
|---|---|---|---|---|
| | **Individual sales** | **Collective sales** | **Individual and Collective sales** | **Total** |
| **Number** | 369 | 214 | 18 | 601 |
| **Price mean (FCFA/kg)** | 529 | 592 | 549 | 552 |
| **Price Standard Deviation** | 54.81 | 55.79 | 39.53 | 62.35 |
| **Quantity per transaction** | 224,5 | 272,1 | 295,4 | 243,6 |
| **Total Quantity** | 515,8 | 642,7 | 844,8 | 570,8 |
| **Number of farmers who have received credit** | 113 | 61 | 8 | 182 |
| **Distance to market (km)** | 0,3 | 0,7 | 0,8 | 0,5 |

Source : IITA survey 2006

From the distribution of farmers by sales' category, we joint other statistics such as mean price and standard deviation of price (table 1)

Data collected have help to make a description of variables on farmers characteristics, transactions as well as variable result. Thus, one can distinguish the variable result (OUT) from the farmers and transactions characteristic variables (CAR) as well as participation variable for logit regression (BIN). In this study, the participation variable is collective sale or not, while the result variable is farmer's price. Concerning result variable, other variables (the inputs supplied by FO, training facilitated by FO ...) could be associated. But the fact that we only have data on farmer's price; we are obliged forced to use only this variable as a result variable.

**Table 2 : Description of the variables used in the analysis**

| Variables | Description of the variable | Unit | Categories |
|---|---|---|---|
| **Pp** | Price received by the farmer | FCFA/kg | OUT |
| **TypeTransac** | Type of sales: via a PO versus individual exclusively | 1= if Collective | PART |
| **Gender** | Gender of farmer | 1=if Male | CAR |
| **Age** | Farmer Age | | CAR |
| **Educ** | Farmer Level of Education | 1=if has been in school | CAR |
| **Farmsize** | Farm Size of Farmer | in hectare | CAR |
| **(Farmsize)2** | Farm Size of Farmer square | in hectare | CAR |
| **Hseholdsize** | Household Size | | CAR |
| **(Hseholdsize)2** | Household Size square | | CAR |
| **RentScol** | Selling during the period of start of the school year | 1= if Yes | CAR |
| **Cred** | Credit received from the buyer for those who sell individually | 1= if Yes | CAR |
| **TotInc** | Farmer total income | in 10000 FCFA | CAR |
| **IndDivers** | Index of the producer's income diversification (the smaller the index, the more the producer is diversified) | between 0 and 1 | CAR |
| **DistProd** | Distance from the house to the point of sale | Km | CAR |
| **QTransac** | Quantity per transaction | Kg | CAR |
| **NbTransac** | Number of transactions per producer during the campaign | | CAR |
| **NbBuyers** | Number of approved buyers in the village | | CAR |
| **HarvestSeason** | Season of abundance | 1= if Yes | CAR |
| **QTot** | Producer's production | Kg | CAR |
| **QTot** | Producer's production square | Kg | CAR |
| **InfoP** | Information about the CIF price (international market price)9 | 1= if Yes | CAR |
| **DistBuyer2_** | Number of non-tarmac km between the point of sale and the port of Douala | Km | CAR |
| **CVPCaf** | Monthly Variation Coefficient of CIF price | | CAR |

[9] CIF = cost, insurance and freight

## *4. Empirical results*

This study aims at measuring in a robust way the effect of farmers' organization through collective sales on cocoa farmer selling price. The challenge faced here consists in reducing considerably the measurement bias by using the technique of "propensity score matching". Our study enables us to quantify by minimizing bias, the impact of collective sales of farmer organizations on cocoa farmer's price in Cameroon. Table 3 presents descriptive statistics of variables used in the analysis.

**Table 3 : Descriptive Statistics of variables used in the analysis**

| | Individual sales | | | | | Collective sales | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Variables** | Obs | Mean | Std, Dev | Min | Max | Obs | Mean | Std-Dev | Min | Max |
| **Gender** | 369 | 0.88 | 0.318 | 0 | 1.00 | 214 | 0.957 | 0.2011877 | 0 | 1 |
| **Age** | 369 | 51.91 | 14.75 | 19 | 100.0 | 214 | 47.453 | 14.10874 | 20 | 88 |
| **Educ** | 369 | 0.91 | 0.277 | 0 | 1.00 | 214 | 0.95 | 0.2115526 | 0 | 1 |
| **Farmsize** | 369 | 1.76 | 1.619 | 0.5 | 22.00 | 214 | 2.177 | 1.997295 | 0.5 | 22 |
| **(Farmsize)2** | 369 | 5.73 | 26.78 | 0.25 | 484.0 | 214 | 8.7137 | 34.73092 | 0.25 | 484 |
| **Hseholdsize** | 369 | 4.46 | 1.90 | 1 | 7.00 | 214 | 4.71 | 1.9063 | 1 | 7 |
| **(Hseholdsize)2** | 369 | 23.51 | 16.91 | 1 | 49.00 | 214 | 25.803 | 16.75532 | 1 | 49 |
| **Cred** | 369 | 0.30 | 0.461 | 0.00 | 1.00 | 214 | 0.285 | 0.4524952 | 0 | 1 |
| **RentScol** | 369 | 0.56 | 0.496 | 0.00 | 1.00 | 214 | 0.61 | 0.4873009 | 0 | 1 |
| **TotInc** | 369 | 41.79 | 32.22 | 7.5 | 300 | 214 | 49.75 | 32.06665 | 7.5 | 185 |
| **IndDivers** | 369 | 0.58 | 0.307 | 0.00 | 1.00 | 214 | 0.61 | 0.2386325 | 0 | 1 |
| **DistProd** | 369 | 0.34 | 2.01 | 0.00 | 32.00 | 213 | 0.665 | 1.456645 | 0 | 10 |
| **QTransac** | 369 | 224.4 | 229.5 | 17.5 | 2000 | 214 | 272.06 | 249.5884 | 16.5 | 2000 |
| **NbTransac** | 369 | 2.17 | 0.99 | 1.00 | 6.00 | 214 | 2.80 | 1.152961 | 1 | 7 |
| **NbBuyers** | 369 | 3.29 | 2.55 | 1.00 | 10.00 | 214 | 6.574 | 3.71667 | 1 | 10 |
| **HarvestSeason** | 369 | 0.78 | 0.41 | 0.00 | 1.00 | 214 | 0.836 | 0.3707352 | 0 | 1 |
| **QTot** | 369 | 515.7 | 650.0 | 40.0 | 6320 | 214 | 642.65 | 503.6043 | 40.5 | 3315 |
| **(QTot)2** | 369 | 687473.5 | 2837148 | 1600. | 39900000.0 | 214 | 665431.2 | 1239015 | 1640.2 | 1.10E+07 |
| **InfoP** | 369 | 0.33 | 0.472 | 0.00 | 1.00 | 214 | 0.462 | 0.4997696 | 0 | 1 |
| **DistBuyer2_** | 369 | 21.57 | 32.95 | 1.00 | 90.00 | 214 | 18.574 | 24.94523 | 1 | 90 |
| **CVPCaf** | 369 | 0.019 | 0.012 | 0.009 | 0.046 | 214 | 0.0212 | 0.0137453 | 0.009 | 0.046429 |

## *4.1 Estimation of the probability propensity score*

The results of probit estimation of collective marketing participation are presented in Table 4. These results show that household size, average quantity per transaction, number of transaction, total quantity sold and information received by farmer on the international price significantly influence cocoa farmer's participation in collective marketing.

**Table 4: Probit Estimation of determinants of collective marketing participation**

| Variables | Coefficients | P-value |
|---|---|---|
| **Gender** | .2776767 | 0.232 |
| **Age** | -.002412 | 0.580 |
| **Educ** | .3727105 | 0.162 |
| **Farmsize** | -.2620487 | 0.045** |
| **(Farmsize)2** | .0360833 | 0.012** |
| **Hseholdsize** | -.1769992 | 0.280 |
| **(Hseholdsize)2** | .0135986 | 0.461 |
| **Cred** | .074649 | 0.596 |
| **RentScol** | -.2035555 | 0.193 |
| **TotInc** | .0025488 | 0.228 |
| **IndDivers** | .0324722 | 0.891 |
| **DistProd** | .0162815 | 0.569 |
| **QTransac** | .0007133 | 0.007*** |
| **NbTransac** | .1464832 | 0.036** |
| **NbBuyers** | .1786745 | 0.000*** |
| **HarvestSeason** | .181922 | 0.336 |
| **QTot** | .0012001 | 0.007*** |
| **(QTot)2** | -0.000005 | 0.001*** |
| **InfoP** | .2299558 | 0.071* |
| **DistBuyer2_** | .0023387 | 0.307 |
| **CVPCaf** | 1.750987 | 0.714 |
| **Constante** | -2.160721 | 0.000*** |
| **Observations** | | 582 |
| **Pseudo-$R^2$** | | 0.23 |

***Significant at 1% level, **significant at 5% level, and *significant at 10% level

The distribution of "propensity scores" between treatment and control groups is shown in Figure 3. This figure clearly shows that the two distributions are different.

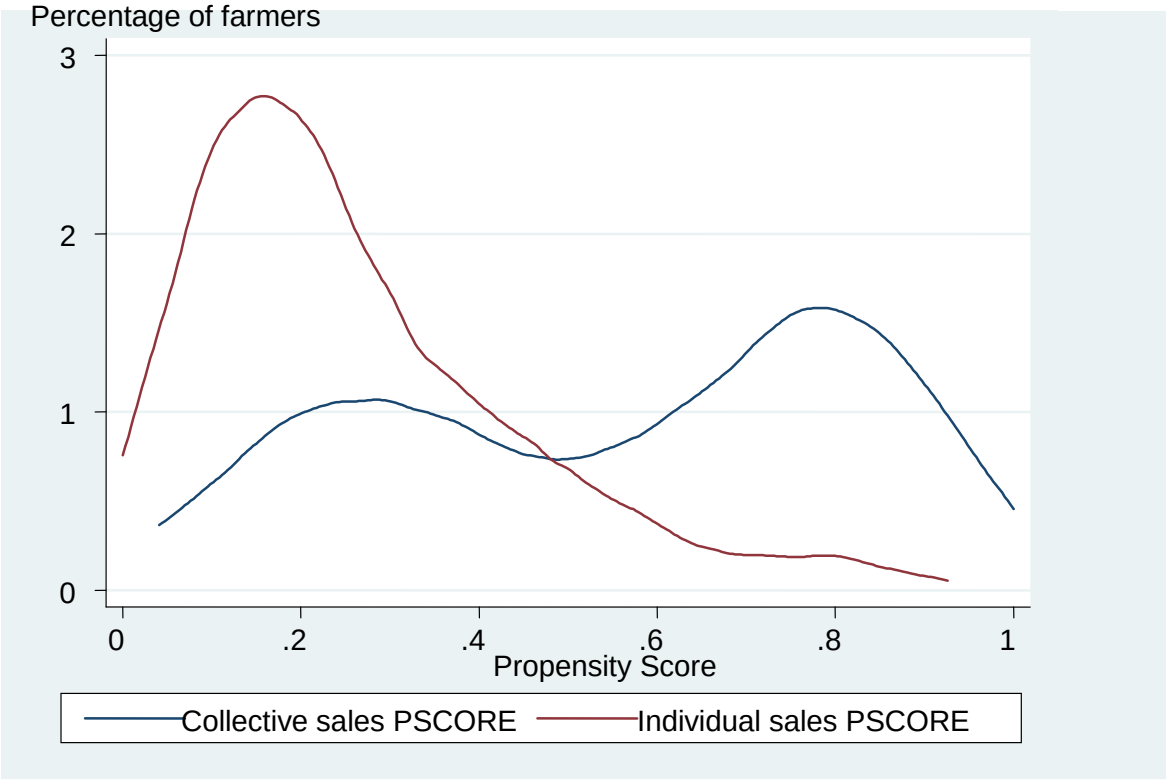



**Figure3: Propensity scores distribution among treatment and control groups**

To ensure the robustness of our estimations, several techniques can be used. We focus on two commonly used methods: nonparametric kernel regression matching proposed by Heckman (1998) and five nearest neighbors matching. In the first technique, each producer treaty is matched with the entire sample of comparison. However, for each observation in the treatment group, an observation which is the weighted average of observations in the control group is generated. Those weights are made inversely proportional to the distance between each observation concerned and the control group observations, on the base of "propensity score" distribution. In the second technique, each treated observation is paired with the average of its five nearest neighbors of comparison sample, always based on "propensity score" distribution. To ensure maximum comparability of treatment and comparison group, the sample is restricted to the region of common support defined by the values in the range of "propensity score" in which treatment and control observations can be found.

**Table 5: Balancing test of samples**

| | Unmatched sample | | | Kernel-based matching | | | 5 nearest neighbors matching | | |
|---|---|---|---|---|---|---|---|---|---|
| | Means | | P-value | Means | | P-value | Means | | |
| Variables | Treated | Control | | Treated | Control | | Treated | Control | P-value |
| **Gender** | 0.96244 | 0.88618 | 0.002 | 0.9619 | 0.94189 | 0.339 | 0.9619 | 0.94571 | 0.431 |
| **Age** | 47.498 | 51.913 | 0.000 | 47.467 | 48.126 | 0.647 | 47.467 | 48.829 | 0.344 |
| **Educ** | 0.95305 | 0.91599 | 0.093 | 0.95238 | 0.96598 | 0.482 | 0.95238 | 0.97333 | 0.258 |
| **Farmsize** | 2.1834 | 1.7654 | 0.006 | 2.0527 | 2.2158 | 0.235 | 2.0527 | 2.1692 | 0.381 |
| **Hseholdsize** | 4.7089 | 4.4607 | **0.131** | 4.7048 | 4.5077 | 0.283 | 4.7048 | 4.639 | 0.718 |
| **Cred** | 0.28638 | 0.30623 | **0.615** | 0.29048 | 0.18431 | **0.01** | 0.29048 | 0.19524 | **0.023** |
| **RentScol** | 0.61502 | 0.56098 | **0.204** | 0.61429 | 0.54809 | 0.17 | 0.61429 | 0.54476 | 0.15 |
| **TotInc** | 49.885 | 41.792 | 0.004 | 49.467 | 49.867 | 0.899 | 49.467 | 50.835 | 0.665 |
| **IndDivers** | 0.61962 | 0.58803 | **0.197** | 0.61751 | 0.61423 | 0.896 | 0.61751 | 0.61958 | 0.935 |
| **DistProd** | 0.66597 | 0.3496 | 0.045 | 0.66547 | 0.91788 | 0.462 | 0.66547 | 0.72499 | 0.845 |
| **QTransac** | 273.17 | 224.49 | 0.017 | 273.52 | 250.56 | 0.326 | 273.52 | 244.69 | 0.214 |
| **NbTransac** | 2.8169 | 2.1762 | 0.000 | 2.7857 | 2.6868 | 0.329 | 2.7857 | 2.7343 | 0.611 |
| **NbBuyers** | 6.5587 | 3.2981 | 0.000 | 6.5952 | 6.6929 | 0.782 | 6.5952 | 6.7038 | 0.757 |
| **HarvestSeason** | 0.83568 | 0.78049 | 0.109 | 0.83333 | 0.79129 | 0.271 | 0.83333 | 0.77619 | 0.141 |
| **QTot** | 644.16 | 515.76 | 0.013 | 644.76 | 720.57 | 0.158 | 644.76 | 718.68 | 0.161 |
| **InfoP** | 0.46479 | 0.33333 | 0.002 | 0.4619 | 0.42193 | 0.411 | 0.4619 | 0.39619 | 0.175 |
| **DistBuyer2_** | 18.484 | 21.577 | **0.236** | 18.31 | 26.325 | **0.001** | 18.31 | 25.861 | **0.001** |
| **CVPCaf** | 0.0213 | 0.01907 | 0.044 | 0.02125 | 0.02029 | 0.464 | 0.02125 | 0.02067 | 0.664 |

***Significant at 1% level, **significant at 5% level, and *significant at 10% level

The right way to test the validity of matching is to compare average characteristics of farmers in the treated sample with the corresponding characteristics of control group generated. Therefore, the absence of significant differences between treatment and control groups confirms the validity of matching. Thus, we undertook a series of statistical tests of farmer's characteristics and trading difference in three samples: the sample of unmatched farmers, the sample of farmers matched with kernel technique and the sample of farmers matched with five nearest neighbors technique. Table 5 shows the significant difference in the vast majority of characteristics in farmers sample unmatched (collective sales with those who sell individually). In addition, in the matched farmers samples (Kernel and five nearest neighbors), two characteristics (Credit received from the buyer and miles of dirt road between the producer and the port of Douala) are significantly different between those who sell collectively and those who sell individually. In summary, matched samples ensure the validity of comparability required.

## *3.2 Average effect of collective marketing*

The indicator of cocoa collective marketing impact is the net price received by farmers. The impact of collective marketing on net price paid to farmer's shows whether collective sales (compared to individual sales) enable farmers to have a higher price. This certainly goes through the reduction of transaction costs and the increase of bargaining power. Table 6 presents the results of average treatment effects estimation for collective marketing in terms of price received by cocoa farmers. To ensure the robustness of this estimation, we first calculated the difference in the output variable (net farmer cocoa price) between treatment group and the control group. Then, for the standard error, we made 100 replications bootstrap in Stata Program.

**Table 6: Average effect of collective marketing after two stapes replication**

| | **Kernel-based matching** | | **5 nearest neighbors matching** | | |
|---|---|---|---|---|---|
| **Outcome variable** | **ATT** | **Std. error** | **ATT** | **Std. error** | **Number of observations** |
| **Net Price received by the farmers** | 43.623 | 6.951*** | 45.672 | 5.584*** | 582 |

Note: Stratified bootstrap with 100 replications are used to estimate the standard errors

***Significant at 1% level, **significant at 5% level, and *significant at 10% level

The results of average effects estimation for both methods (for Kernel matching and matching five-nearest neighbors) show that farmers who sell collectively receive about 45 FCFA per kilogram more than those who sell individually, which represents a premium of 8%. This effect is statistically significant at 1% and robust across the two forms of matching.

Given these estimations, we find that the two matching methods (for Kernel matching and five-nearest neighbors matching) lead to similar results as much in the matching test as in the average effects estimation.

Moreover, whatever the matching technique used, a comparison of Propensity Score Matching method with the Naïve method is necessary to better assess the contribution of this method to impact evaluation of collective sales' (Table 7).

**Table 7: Comparison of the average effects using Naïve and PSM methods**

| Titles | Values |
|---|---|
| **Average Price in individual sales (FCFA per kg)** | 529 |
| **Average Price in collective sales (FCFA per kg)** | 592 |
| **Average effects using Naïve method (FCFA per kg)** | 63 |
| **Average effects using PSM method (FCFA per kg)** | 45 |
| **Average effects difference of two methods used (FCFA per kg)** | 18 |

The results in Table 7 show that the difference between the average effect by Naïve method and Propensity Score Matching method is 18 CFA francs per kg. Application of Naïve method is biased because of non consideration of individual characteristics of farmers and transactions. This difference is the result of bias reduction by applying Propensity Score Matching method.

## *5. Conclusion and recommendations*

The importance of collective marketing carried out by farmers' organizations (FOs) is to have farmer's positive benefit generated from externalities for those who participate. The objective was to assess the impact of cocoa collective marketing on the net price received by farmers. Analysis of data collected by STCP-IITA in 2006 enable us to draw the main conclusion: the impact of collective marketing on price received by cocoa farmers in the Centre Region of Cameroon is a reality. This effect is positive and statistically significant. It is estimated at 45 FCFA per kilogram by PSM method and representing an increase of 8% of average sale price (comparing collective with individual sale). This increase is the same order of magnitude as that found in other countries for other farmers (Bernard et al. 2008). Furthermore, the use of naïve method enables to be aware of the bias that this method contain. Thus, we note that there is a difference of 19 FCFA per kilogram between the two methods. This difference can be attributed to the existence of bias in the naïve method. However applying PSM enables to minimize only bias due to observed characteristics, while bias due to non-observed characteristics cannot be minimized. In spite of the fact that all the bias cannot be minimized, this does not affect the importance of collective marketing impact. In addition, other results variables out of price can explain the participation of farmer in FO. Examples of input supply, credit, and training facilitated by the FO...

Given this conclusion, the main recommendation is to promote the development of collective marketing by FO. The reason that some farmers do not sell through FO (although this would allow them to get a better price) may be partly related to credit access (Kamdem et al., 2009;

2010). Indeed, one can assume that farmers who need urgent cash advance cannot sell to FO because they need credit (private buyers only offer them) or because they cannot wait market days to sell their cocoa to FO. The development of credit system available to farmers (or the creation of credit systems by FO) obviously would increase significantly the share of supply captured by FO.

In addition, future studies may be conducted to analyze the conditions for the emergence of FO to understand why they appeared in some areas and not in others. It would also be appreciable in future studies to identify factors that lead farmers to join or not the FO. This may also help to identify the factors that guide farmers who are members of FO to choose selling through FO or not. Such studies would help to guide policies to facilitate the development of FO and strengthen their impact on prices received by Farmers.

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