

Can coffee certification schemes increase incomes of smallholder farmers? Evidence from Jinotega, Nicaragua

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Abstract This paper investigates the impact of Fairtrade and organic certification on household income of smallholder coffee farmers in the Jinotega Municipality of Nicaragua. Using a sample of 233 coffee farming households and employing endogenous switching regression model and propensity score matching method, the results found that Fairtrade and organic certification standards have different effects on the certified farmers; while Fairtrade farmers had experienced yield gains, organic farmers had the price advantage. However, the overall impact of these certification standards on the total household income is found to be statistically not significant. While some of the Fairtrade-certified cooperatives have used the social premium in creating community-level infrastructure, there is a need for more investment. The major constraint the organic-certified farmers face is lack of availability of adequate organic inputs such as manures and organic herbicides.

Keywords Fairtrade certification · Organic certification · Coffee farming cooperatives · Nicaragua · Endogenous switching regression · Propensity score matching

1 Introduction

Based on the idea that consumers are motivated to pay price premiums for coffee that meets certain precisely defined and assured standards and an increased interest in sustainable practices, the worldwide demand for socially and/or environmentally friendly certified coffee grows worldwide (Grote et al. 2007; Wissel et al. 2012). Price premiums are intended to promote social and economic change and environmental sustainability in

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the areas of production. Among the most widely used certification standards for coffee are Fairtrade according to Fairtrade Labelling Organizations International (FLO) and organic according to the International Federation of Organic Agriculture Movements (IFOAM).

The first Fairtrade labels, such as Max Havelaar, were launched in the 1980s in order to tackle poverty and empower producers in the poorest countries in the world. In 1997, the worldwide Fairtrade standards and procedures were harmonized under FLO International. One set of FLO standards particularly applies to smallholders organized in farmers' cooperatives. The Fairtrade system works with minimum prices as a safety net for farmers at times of low world markets prices. When world market prices are above these minimum prices, buyers have to pay the higher prices. However, producers and traders can also negotiate higher prices on the basis of quality and other attributes. In addition to the product price, a Fairtrade premium is paid to the cooperative and should be used to improve the local socioeconomic and environmental conditions (FLO 2015).

Organic agriculture certification schemes began to arise in the 1970s as a means of regulating organic agricultural practices and the use of organic labels. Since 1972, IFOAM has been setting organic certification landmarks. A family of standards, containing 51 standards (as of 2014), inducing the USA Organic Regulation and the EU Organic Regulation, is the core of the IFOAM certification system. One of IFOAM principles is that "organic agriculture should provide everyone involved with a good quality of life, and contribute to food sovereignty and reduction of poverty" (IFOAM 2015a). Prices farmers get for organic-certified products are normally higher than for non-certified ones and compensate for often lower yields and more labor input. Prices for organic-certified products are a result of negotiations between seller and buyer and are not regulated as, e.g., for Fairtrade-certified products (IFOAM 2015b).

Starting in Latin America, coffee certification according to Fairtrade and organic standards gained first significance in the 1980s. The fall of the International Coffee Agreement (ICA) in 1989 and the global coffee market crash in the early 2000s, spurred additional international interest and support in improving the livelihoods of coffee smallholders in developing countries (Bacon 2005; Petit 2007; Stellmacher and Grote 2011), such as in Nicaragua which is adopted as a case study in this paper. The Nicaraguan economy in general and the livelihoods of Nicaraguan smallholders in particular highly depend on coffee. Flores et al. (2002), as cited by Valkila and Nygren (2009), have estimated that 42 % of the rural workforce generates at least part of their income from coffee-related activities. More than 80 % of the coffee produced in Nicaragua is exported, having generated export revenues of around US\$ 430 million in 2010–2011 (ProNicaragua News 2011). Since the mid-1980s, Nicaragua acts as a showcase for pro-poor coffee certification (Bacon 2010). In 2005, 20 % of all coffee farmers in Nicaragua were members of Fairtrade-certified cooperatives, which is one of the highest figures worldwide (TransFair USA 2005). About half of the Nicaraguan Fairtradecertified coffee is Fairtrade–organic double certified (Valkila and Nygren 2009). However, Nicaragua is still the second poorest country in the Western Hemisphere. The poverty rate is 46 %—and almost twice as high in the coffee growing areas (UNDP 2009; IMF 2010; Murrugarra and Herrara 2011).

Given the tremendously high poverty rate in the Nicaraguan coffee growing areas on the one hand, and the long and substantial coffee production and certification endeavors on the other hand, Nicaragua is an illustrative case for analyzing the linkages between both, income generation and certification.¹ Based on primary survey data from rural Nicaragua,

¹ Certification is seen as only one of many actual and potential poverty alleviation tools, and its impacts are, and will be, always limited.

this paper analyses these linkages in detail. The paper has considered Fairtrade and organic certification schemes distinctly since they represent two different niche marketing channels with different buyers and sellers having their own bio-physical and financial characteristics.

The general empirical literature on impact evaluations related to certification in the coffee sector is mixed, and the results differ depending on the specific contexts. With respect to the methodologies applied, studies on the impact of certification range from qualitative analyses to econometric models like logit regressions, propensity score matching (PSM) and Heckman selection models. A meta-study by Blackman and Rivera (2011) using data from 20 empirical ex-post farm-level studies on coffee certification concludes that evidence that sustainable certification has significant benefits for farmers is limited. Studies that have used the qualitative methods such as Bray et al. (2002), Raynolds et al. (2004), Parrish et al. (2005) and Utting (2009) found that certification has an overall positive impact. Some other studies (Bacon 2005; Philpott et al. 2007; Jaffee 2008; Bacon et al. 2008; Valkila 2009) have used moderately rigorous quantitative methods such as ANOVA test and mean comparison test. Except Philpott et al. (2007), other studies show for Nicaragua that although Fairtrade and organic certification has the potential to improve the livelihoods of coffee smallholders, it cannot offset other factors that contribute to poverty. Taking an example in Mexico, Philpott et al. (2007) show how smallholder coffee farmers which are certified according to Fairtrade and organic standards reap significant economic benefits from certification.

Studies that have used rigorous quantitative methods are Arnould et al. (2009), Bolwig et al. (2009), Beuchelt and Zeller (2011) and Jena et al. (2012). Arnould et al. (2009) have used random sampling to create two groups of respondents such as treatment and control groups. They have then compared the outcome between these two groups. They have also used path analysis and binomial logistic regressions. The conclusions from their study were that although certification creates statistically and economically significant increment in prices and volumes of coffee sold, it has no impact on health and education. Bolwig et al. (2009) have used full information maximum likelihood (FIML) version of the Heckman selection model to compare the outcomes between the treatment and control groups. They have concluded that certification has significant social and economic benefits but cautioned that the benefits they identified are mainly due to an idiosyncratic design feature of the certification program they have studied. Beuchelt and Zeller (2011) have used gross margins, profits and break-even analyses to examine the economic profitability between certified and non-certified groups. They have also used a composite asset matrix to construct a long-term poverty measure using the factor analysis method. They have then compared this long-term poverty status between certified and non-certified farmers in Nicaragua to find that there is no significant difference between these two groups in terms of poverty. Jena et al. (2012) have used propensity score matching (PSM) method to assess the impact of certification on household incomes in Ethiopia. They have concluded that Fairtrade certification has no significant impact on household income.

The present study falls under the third group of studies discussed above, i.e., those who have undertaken rigorous quantitative analysis. There are two aspects in which our paper contributes to the existing knowledge base. First, we have studied the impact of both the Fairtrade and organic certification networks to examine the differential impact they may have on the smallholder coffee farmers which has not been done by many previous studies. Being market instruments, Fairtrade and organic certification creates a niche market wherein both producers and traders of certified coffee can negotiate prices. So, the study aims to understand whether the certified coffee producers are having higher monetary benefits being part of this network. Further, we have examined how the specific characteristics of each certification program have manifested into specific opportunities and constraints for the certified producers.

Secondly, our study by using endogenous switching regression model and propensity score matching method has dealt with the self-selection bias more appropriately and hence provides causal inferences. Considering the fact that self-selection bias is a common characteristic of observational data that misleads the impact evaluation, we have applied endogenous switching regression (ESR) models to compare between the actual scenario in which a group of farmers are certified and the counterfactual scenario in which the same group of farmers are not certified. This simulated counterfactual scenario provides a valid comparison between the impact of certification with it and without it.

The structure of the paper is as follows. The sample selection procedure, the survey site, the methodological framework and the methods for the empirical analysis are described in Sect. 2. Empirical findings of the paper are discussed in Sect. 3, and finally, the last section sums up with concluding remarks.

2 Materials and method

2.1 Study area and sample selection

Nearly 80 % of Nicaragua's coffee is produced in the Northern highlands, namely in Jinotega and Matagalpa Municipalities (IICA 2004). Jinotega alone accounts for around 65 % of the total Nicaraguan coffee production, and approximately 8000 out of the 139,000 coffee farmers in Nicaragua are located in Jinotega Municipality (UCA Soppexcca 2011). In 2009, the authors undertook a pre-study in Managua and Jinotega Municipality interviewing scientists and experts from cooperatives and non-governmental organizations (NGOs) working in the coffee certification sector.

In early 2010, a household survey of 233 coffee farmers was carried out in Jinotega Municipality. We followed a proportional stratified random sample selection. There are six umbrella cooperative unions in the Municipality. In the first step of the sample selection, four such umbrella cooperative unions are chosen based on the certification status of the cooperatives operating under their jurisprudence. Two of the cooperative unions in our sample are certified, and the remaining two are non-certified cooperative. In the second stage of the sampling, nine cooperatives are selected from the four cooperative unions; seven of which are certified and the remaining two comprise of conventional members.

When selecting the cooperatives, differences in terms of their number of members were taken into account. Generally, organically certified cooperatives have relatively smaller numbers compared to other groups of cooperatives. We selected those cooperatives that have more than 25 members. The numbers of members per cooperative vary between 26 and 83. Finally, in the last stage of the sampling process, we used proportional random sampling to select the members from each selected cooperative. For the cooperatives with less than 50 members, a 60 % sampling rate was used, and for the cooperatives above 50 members, a 40 % sampling rate was used.

The questionnaire developed for the survey was categorized into three sections—(1) household characteristics such as age, gender, education and occupation of each household member; (2) coffee production and marketing; and (3) cooperative structure and information regarding certification.

2.2 Econometric model and specification

Econometric application to cross-sectional data collected from household surveys meant for impact evaluation of development strategies, typically suffers from a non-experimental bias such as self-selection bias (Wooldridge 2002). Self-selection occurs when the observations based on certain parameters influence their probability of inclusion in the sample. Such bias is typically responsible for confounding the behavioral parameters of interest in the fitted regression with parameters of the function determining the probability of entrance into the sample. Self-selection bias is one form of omitted variable bias since the self-selection criterion which influences the likelihood of the observations being sampled was omitted from the regression as an explicit variable. If self-selection bias is not accounted for in the estimation and is related to the outcome variable, then it creates endogeneity in the cross-sectional data and can lead to inconsistent estimations in the ordinary least squares (OLS) regression.

2.2.1 Propensity score matching

The decision to join a certified cooperative is not exogenous since the possibility of selfselection creates the bias in non-experimental data. For such data, Rosenbaum and Rubin (1983) have suggested using propensity score matching (PSM) to correct for the selection bias. PSM uses nonparametric regression methods to construct the counterfactual under an assumption of a selection on observables. PSM finds a counterfactual that controls for all other factors except for the treatment. PSM is applied in two steps—in the first step, a logit or probit model is estimated with the binary treatment variable—decision to join certified cooperative in the present study as the selection variable conditional on basic characteristics of both the treatment and the control groups. From this first-stage regression, PSM estimates the propensity scores for each observation. The propensity score of each farmer measures the probability of an observation to be included in the sample.

In the next step, two balanced groups are formed based on their estimated propensity scores. Farmers in each group have similar propensity scores. Both groups can then be compared with respect to the performance based on several matching methods such as "nearest neighbor" or "radius" matching. Since similar groups have been found conditional on their basic characteristics, the only factor that causes the performance difference between them is the treatment variable. The difference in the performance between the matched treated and untreated observations follows a t test for the statistical significance.

2.2.2 Endogenous switching regression

Major criticism against PSM as a reliable impact evaluation method comes from its lacunae to deal with bias arising from unobservable variables. We have used two-stage endogenous switching regression (ESR) model to deal with the unobservable bias. ESR has been used in many impact evaluation studies. Kleeman et al. (2014) have used ESR to examine the profitability of organic certification in coffee in Ghana. Kassie et al. (2014) have used a multinomial endogenous switching regression model to study the production risks and food security under alternative technology choices in Malawi. Teklewold et al. (2013) have also used a similar method to study the impact of conservation agriculture in Ethiopia.

ESR specifies two regimes—the first regime corresponds to the households that adopt coffee certification, and the second regime is made up of the households that do not adopt

the certification. The two-stage estimation takes place as follows. In the first stage, the selection equation is estimated.

$$A_i^* = Z_i \propto + v_i \quad \text{where } A_i = \begin{cases} 1 & \text{if } Z_i \propto + v_i > 0\\ 0 & \text{otherwise} \end{cases}$$
(1)

A farmer *i* adopts certification if the expected utility from adoption is better than the corresponding utility from non-adoption. Let A_i^* captures the benefit from adopting certification by the *i*th farmer and is a latent variable. Z_i is a vector of explanatory variables explaining the selection into the regimes. α is the parameter vector and v_i be error terms.

The second stage estimates the outcome equation. Based on the first-stage selection equation observations select which of the two regimes to join. The outcome equations for two regimes, i.e., for certification and non-certification corrected for endogenous adoption, are given as:

Regime 1 :
$$Y_{1i} = X_{1i}\beta_1 + \sigma_{1u1i}\lambda_{1i} + u_{1i}$$
 if $A_i = 1$ (Certification) (2a)

Regime 2 :
$$Y_{2i} = X_{2i}\beta_2 + \sigma_{2u2i}\lambda_{2i} + u_{2i}$$
 if $A_i = 0$ (Non-certification) (2b)

where Y_{1i} and Y_{2i} , i = 1,..., N, denote the dependent variables in each of two regimes. X_{1i} and X_{2i} are the explanatory variables relevant to each regime, β_1 and β_2 are the parameters to be estimated, and u_{1i} , u_{2i} are the corresponding error terms. λ_{1i} and λ_{2i} are the inverse Mill's ratios (IMR) computed from the first-stage selection equation and are included in Eqs. (2a) and (2b) to correct for selection bias.

The second-stage outcome regressions compute four estimates such as (a) real scenario outcome from certification, (b) real scenario outcome from non-certification, (c) counter-factual outcome scenario from certification (i.e., outcome had the certified households decided not to certify) and (d) counterfactual outcome scenario for non-certification (i.e., non-certified households decided to certify). The situations (a) and (b) are observed from the survey data and hence are real scenarios, whereas (c) and (d) are the hypothetically expected situations (counterfactual scenarios) where the treated happened to be untreated, and the untreated happened to be treated. The average treatment effect on the treated (ATU) is computed as (a)–(c), and the average treatment effect on the untreated (ATU) is computed as (b)–(d).

Both the propensity score matching method and the endogenous switching regression model are employed to estimate the income impacts of Fairtrade and organic certification. As explained above, the endogenous switching regression is carried out in two steps. The first step is the probit model that uses the binary certification treatment variable as the dependent variable, and the second step is the outcome regression where income variables are used as outcomes. The first step probit model in fact provides the statistically significant factors that influence households' decision to adopt certification. Section 3.2 explains these estimated factors from the probit model.

2.3 Variable description

2.3.1 Outcome variables

As this study has set out with the objective to examine the income benefits of coffee certification, net total income of the households has been considered as the outcome variable. The net total income is the summation of net revenue from coffee, net income from any other farming activity and the non-farm incomes.

2.3.2 Explanatory variables

The variables used in the estimation are the following. Certification adoption (*Cert*) acts as an institutional resource (Jena et al. 2012). Certification through its contractual relation between the cooperative and the farmer specifies prices and adds a price mark-up which enhances the adopters' income (Bacon 2005; Valkila 2009). *Cert* variable pools together both the Fairtrade- and organic-certified farmers. In addition, both Fairtrade and organic certification variables have been used in alternative specifications in order to assess their individual impacts. This is because each certification scheme has its own market channel and the buyers and sellers of each scheme are different. Variables such as education (*Edu, Edusq*) of the household head, experience in coffee farming (*Exp*), extension services (*Training*) obtained for improved farming techniques and years of association with the cooperative (*Coopmember*) belong to human resources. These variables enhance a person's skills, knowledge, labor productivity and income (DFID 2000; Carter and Barrett 2006; Moser 2006).

Higher farm size (*Land*) provides the households with larger means to improve their livelihood (Bebbington 1999; Moser 1998, 2006). Access to non-farm income (*Non-farm income*) is considered a major strategy for income diversification and risk diversification (Ruben and van den Berg 2001; de Janvry and Sadoulet 2001; Haggblade et al. 2007). Furthermore, household income is also functions of key household characteristics such as age (*Age, Agesq*), gender (*Gender*), dependency ratio (*Dependency ratio*) and available family labor relative to household size. They may vary according to societal behavior and cultural contexts, so we keep their likely impact as open empirical question. The mean and standard deviation of variables used in the regressions are summarized in Table 1.

3 Results

3.1 Yield, farm gate prices and net revenue from coffee

About 98 % of the interviewed cooperative members depend on coffee production as their main source of income; 69 % of them possess no more than 5 ha of total land. Table 2 shows the area under coffee, the coffee yield and farm gate prices for certified and non-certified cooperative members. The figures illustrate that the average coffee yield² of all interviewed farmers is 1324 kg/ha. Valkila (2009, p. 2f) reported "a high variation in coffee yields in Nicaragua. A continuum of farms exists from low input/low yields to high input/high yields. Small-scale farmers in living conditions of rural poverty often grow coffee yields are typically around or less than 300 kg/ha both in organic and conventional production." Jinotega, however, is among the most productive coffee regions in the country. Table 2 compares the pairwise average yield of Fairtrade and non-certified as well as organic and non-certified groups. The Kruskal–Wallis test done for group mean differences shows that yield level of Fairtrade group is statistically significantly higher than the yield of the non-certified group. The average Fairtrade yield is 1561 kg/ha compared to

² All coffee yields in this paper refer to green bean.

Variable name	Description of variable	Mean	SD
Institutional resource			
Cert	1 = if the household is certified (either by Fairtrade or organic) and $0 =$ if non-certified	0.7*	0.46
Fairtrade (FT)	1 = if the household is FT certified; $0 = $ otherwise	0.34	0.47
Organic	1 = if the household is organic certified; $0 = $ otherwise	0.36	0.48
Human resources			
Edu	Education of the head of household in years	3.66	3.6
Edusq	Education of the head of household in years squared	26.3	45.88
Experience	Years of experience of head of household in coffee farming	12.46	9.45
Training	Whether the respondent has received any training (yes $= 1$ and otherwise $= 0$)	0.92	0.27
Coopmember	Number of years as a cooperative member	6.58	4.8
Natural resources			
Farm size	Size of farm in ha	5.07	7.07
Financial resource			
Non-farm income	Non-farm income in C\$ self-reported by correspondent	9585	20,694
Control variables			
Age	Age of the head of the household in years	47.33	13.05
Agesq	Age of the head of the household squared	2410.39	1320.17
Gender	Gender of the head of household (male $= 1$ and female $= 0$)	0.74	0.43
HHsize	Total number of household members	5.84	2.42
Family labor employed in coffee	Number of adult members of the household working in family coffee farming	0.67	0.71
Credit from cooperative	=1 if the respondent has obtained credit from his/her cooperative; otherwise = 0	0.87	0.34

Table 1 Summary of variables

The sample size for all variables is 233

Source: own calculations

* This is the combined mean of all certified farmers

1206 kg/ha of non-certified group. Informal discussions with farmers in the study area revealed that Fairtrade-certified farmers have undertaken considerably higher investment in chemical fertilizer and pesticides per ha compared to farmers in other groups. The average yield of organic-certified farmers stood at 1189.82 kg/ha which is not statistically significantly different from the yield of non-certified group, but it is significantly lower than the Fairtrade yield. Lower yield for organic farmers can be explained by the fact that farmers experience acute shortage of organic fertilizers and pesticides. The responses from the key informants reveal that some organic materials can be easily obtained as coffee pulp or cattle manure in the neighborhood; however, subsequent amount of organic materials are often located farther away and their transportation in mountainous areas with poor road conditions in many cases becomes infeasible.

All respondents have sold coffee to both their own cooperatives and private traders; however, there is a clear pattern; certified farmers sold a higher proportion of their coffee to their own cooperatives compared to their non-certified counterparts. On average,

Sample average	Non-certified	FT certified	Organic certified
233	70	79	84
1.72 (1.40)	1.78 (1.57)	1.52 (1.38)	1.86 (1.25)
1324 (989.5)	1206 (988)	1561.0** (1207.92)	1189.82 (806.24)
1235 (208)	1111 (124)	1112.36 (152.61)	1410.92*** (154.37)
975.42 (157)	975 (178)	987.5 (141.80)	941.18 (131.38)
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Table 2 Area, yield and farm gate prices in certified and non-certified farmer groups

Figures in parenthesis are standard deviations

[†] First, a Kruskal–Wallis test is performed to test for the equality of population between the certified and non-certified groups for non-normally distributed variable (Altman 1991). Thereafter, equality of median test is performed to find out the median distribution within each group (Wilcoxon 1945; Mann and Whitney 1947). Both tests are nonparametric, designed for non-normal distribution and high standard deviation. However, the figures shown under each group for the variable are the sample means. These methods are used for area under coffee and yield for coffee variables. For the other two variables, a *t* test has been performed for testing equality of means between two groups since these variables are normally distributed

*** Significant at 1 % level; ** significant at 5 % level; * significant at 10 % level. Standard errors are in parenthesis

^a These prices are average farm gate prices in each group as reported by the interviewed farmers just after the harvest. Standard deviations are provided in the parenthesis

certified farmers sold 82 % of their coffee to their respective cooperative, while non-certified farmers sold only 63 %.

The prices used in this analysis are self-reported prices by the farmers just after the harvest. Farmers use to sell their coffee in several tranches; however, the major part was sold directly after the harvest. Some farmers store and sell later in order to gain more profit. The price figures in our dataset are the average price as they were reported by the respondents. Cooperative prices are on average 27 % higher than those paid by private traders (see Table 2). It was observed that there is no statistically significant difference in farm gate prices received from their respective cooperatives between Fairtrade and noncertified groups, the Fairtrade farmers have received 1112.36 Nicaraguan Cordoba (C\$) per quintal (\$49.44 per quintal, using \$1 = 22.5 C), while the non-certified farmers have received 1111 C\$ per quintal (\$49.37) on average. Significant price difference however is observed between the non-certified and the organic farmers. The organic farmers have received an average farm gate price of 1410.92 C\$ (\$62.7) from their cooperatives which is significantly higher than both FT and non-certified farmers, in the order of 27 %. These findings are similar to those from other studies. Beuchelt and Zeller (2011), for example, show in their Nicaraguan case study that double-certified and organic-certified farmers earn significantly higher farm gate prices as compared to the conventional ones.

The analysis in Table 3 shows that the gross revenue from coffee is statistically significantly different between the certified and the non-certified groups. Both the Fairtrade and organic farmers have earned significantly higher gross revenues, 39,133.98 C\$ and 36,700.91 C\$, respectively, as compared to the non-certified group. However, the total cost incurred during farming per ha remains similar between the groups as it is not statistically significantly different. That renders the net revenue per ha higher for the certified groups. The Fairtrade group have earned an average net revenue of 29,027.18 C\$, while the organic group have earned 31,925.78 C\$. The last row of Table 3 shows the net revenue

Indicators	Non-certified	FT	Organic
Gross revenue (C\$ per ha)	24,722.7 (27,700.91)	39,133.98*** (39,004.64)	36,700.91*** (37,027.79)
Total cost (C\$ per ha)	5719.75 (12,552.19)	6374.30 (4978.78)	4403.39 (5847.39)
Net revenue (C\$ per ha)	19,093.28 (19,878.27)	29,027.18*** (26,343.09)	31,925.78*** (35,550.47)
Net revenue per capita (C\$)	8463.51 (1956.87)	13,825.42 (4827.25)	11,687.35 (2082.4)

 Table 3
 Net revenue from coffee

*** Significant at 1 % level; ** significant at 5 % level; * significant at 10 % level. Standard errors are in parenthesis

earned from coffee expressed in per capita terms. The figures show that the net revenue per capita for Fairtrade and organic farmers is higher than the non-certified farmers; however, this difference is not statistically significant. Although organic farmers have received significantly higher farm gate prices compared to the non-certified farmers, this advantage has not been reflected in their net revenue per capita from coffee. There can be two reasons for this—first, the yield for organic farmers is not higher than the non-certified farmers, and secondly, the household size for organic farmers is higher making the net income per capita smaller.

3.2 Adoption decision of farmers to join a certified cooperative

The decision to join a certified cooperative by the farmer households is estimated through a probit model using Fairtrade (FT) and organic as the dependent variables. It is worthwhile to mention that most coffee farmers in Nicaragua are members of some cooperative; they hardly remain individual business entities. Therefore, a study on certification has to consider membership of a cooperative as an important decision variable.

There is fair amount of consistency among the two specifications in terms of signs and statistical significance of the estimated coefficients (Table 4). The results have found out that both age and education have an inverted U relation with the adoption decision. Relatively younger and less educated household heads have chosen not to join a certified cooperative, while household heads that are more educated and matured in age have adopted certification. Other key variables that have positively influenced households to join either certification are-credit from the cooperative, number of years with the cooperative and the family labor relative to household size. All the three variables are positive and statistically significant at 1 % level of significance. There is a significant difference between the certified cooperative and the non-certified one in terms of providing credit to their respective members; hence, access to credit is a significant determinant. There is also a positive association between number of years with the cooperative and the cooperative being certified. Long-term association is taken as a variable to explain that certified cooperatives are expected to have formal institutional structures which benefit the members, and hence, the members do not switch membership. They remain in the same cooperative, whereas members of non-certified cooperatives may switch cooperative should they not find the membership beneficial. So, we expect that the duration of membership of the members of the certified cooperative is longer than the same for noncertified cooperatives because the certified cooperatives are better serving their members.

Variables	Marginal effects	
	FT	Organic
Age	-0.04*** (0.01)	-0.044*** (.009)
Age sq.	.0004*** (.0001)	.0004*** (.0001)
Education	-0.053* (0.029)	-0.030 (0.025)
Education sq.	0.004* (0.002)	0.003* (0.002)
Gender	0.019 (0.099)	0.065 (0.103)
Training	0.027 (0.167)	0.002 (0.147)
Land	-0.039*** (0.015)	-0.022** (0.011)
Off-farm income	-0.141 (0.098)	-0.039 (0.095)
Area under coffee	-0.014 (0.038)	0.0005 (0.030)
Family labor relative to hh size	0.374* (0.202)	0.540*** (0.170)
Experience in coffee farming	-0.0000 (.006)	0.005 (0.004)
Number of years with cooperative	0.089*** (0.020)	0.139*** (0.017)
Credit from cooperative	0.381*** (0.108)	0.359** (0.170)
Distance to market	0.016*** (0.004)	-0.006** (0.003)
Dependency ratio	-0.129* (0.073)	-0.104** (0.054)
Ν	149	154
Wald Chi ²	49.11***	48.42***

 Table 4
 Probit model for adoption decision

*** Significant at 1 % level; ** significant at 5 % level; * significant at 10 % level. Standard errors are in parenthesis

The third variable is adult members of the household self-employed in coffee farming relative to the total household size. This variable is also highly significant and positive showing that availability of labor is a significant determinant to join certification.

On the other hand, two variables are found to be negatively related to adoption decision such as farm size and dependency ratio. The non-certified farmers have a relatively higher farm size than the certified farmers. High dependency ratio means proportion of members of a household having age more than 65 and less than 15 (dependent members) are higher than the proportion of members of the age between 16 and 64 (earning members). So, if a household has more dependent members than earning members, the household head is less likely to join the certified cooperative. However, this variable is statistically significant only at 10 % level of significance. Furthermore, distance to market has been statistically significant but bears opposite signs with Fairtrade and organic certification. Higher distance from market dissuades farmers to join organic certification. But it has appeared with a positive sign with the Fairtrade certification. This could be because of the deep penetration of Fairtrade-certified cooperatives in the remote areas. The rest of the variables are statistically insignificant meaning that both groups of farmers do not substantially differ with respect to these variables (Table 4).

3.3 Impact of certification on income

The total income of coffee cooperative members consists of income from coffee, other crops (e.g., grains, fruits and vegetables), livestock and livestock products, as well as from non-farm activities including pensions and remittances. The composition of total

income shows that coffee is the major source of income for the interviewed coffee farmers contributing on average 66 % to their total cash income. The shares from other crops and non-farm activities are 12 and 22 %, respectively. Both certified and non-certified groups earned a substantial share of their income from coffee; the share for the certified group is 68 %, while the same for the non-certified group is 61 %. Only 43 % of all respondents in our sample have access to non-farm sources of income being equally true for certified and non-certified groups. This low access to non-farm income activities indicates a low degree of income diversification. At the same time, the income poverty incidence³ in our sample is quite high. More than 50 % of the respondents live below the extreme poverty line of 5811 C\$ (US\$ 456.25) per capita per year. Both the certified and non-certified farmers experience similar incidence of extreme poverty which is 50 and 57 %, respectively. Notwithstanding the understatement of income data often experienced in household surveys, such high level of income poverty incidence needs more attention.

The t test for mean difference shows that the log of total income of the organically certified farmers is statistically and significantly higher than the non-certified farmers, but the same is not true for the Fairtrade farmers. There is no statistically significant difference in log of total income between the Fairtrade-certified and the non-certified groups. However, since there is heterogeneity in individual characteristics and access to other sources of income, we carry out PSM and ESR models to gauge the reliable income effect of certification.

3.3.1 Results from PSM model

The PSM has used three matching methods such as 5-nearest neighbor, radius and kernel matching methods. Pearson's correlation coefficients among the exogenous variables used in the first-stage probit regression provide a test for possible multicollinearity in the model (see Table 7 in "Appendix"). All coefficients are below 0.5 which indicates no multicollinearity bias in the probit specification.

The balancing tests of matched samples using 5-nearest neighbor, radius and kernel matching are shown in Table 8 in "Appendix." These balancing tests show the statistical difference between the two groups for a specific variable before and after matching. For all of the explanatory variables of the first-stage probit model, this difference is statistically insignificant after matching which is a desired property for a good matching algorithm and shows that the results are reliable. Furthermore, whether the matching has produced statistically significant balanced groups having similar characteristics is gauged from the propensity score (PS) graph. The PS graphs are shown in Figs. 1, 2 and 3 for the three matching methods, respectively. They show a good balance between the certified and noncertified groups after matching.

Table 5 presents the estimated average treatment effects on log of total income for FTcertified and organic-certified groups. The average treatment effect on treated (ATT) from the three matching methods shows that there is no significant impact of any of the two

³ Here we use the income poverty incidence definition of 1.25\$ a day (extreme) and 2\$ a day (moderate) as defined by the World Bank. The dollar value has been converted into Nicaraguan Cordoba (C\$) by using the PPP exchange rate for 2005 and then adjusted for the national inflation levels to arrive at the equivalent PPP exchange rate for 2009 (year of survey). The latest PPP exchange rate figure for dollar in Nicaraguan currency is available for 2005. The translation into the PPP exchange rate and the inflation rate correction allowed to convert the 1.25 US\$ poverty line (extreme) into 15.92 C\$.



Fig. 1 PSM graph from kernel matching





certification marketing channels on total income of the farmers. The ATT for organic certification is positive for radius and kernel matching methods, but they are not statistically significant. For FT certification, the ATT is negative for radius and kernel matching methods though not statistically significant. The overall finding from these estimated ATTs shows that neither FT nor organic certification has a statistically significant income effect on the farmers.



Fig. 3 PSM graph from 5-nearest neighbor matching

Type of certification	Outcome variables	Matching methods	ATT	T value
FT	Log total income	Radius	-0.03 (0.15)	-0.20
		Kernel	-0.002 (0.167)	-0.01
		5-Nearest neighbor	0.05 (0.164)	0.30
Organic	Log total income	Radius	0.08 (0.16)	0.49
		Kernel	0.063 (0.235)	0.27
		5-Nearest neighbor	-0.009 (0.225)	-0.04

Table 5 Treatment effects from different matching algorithms

Bootstrapped standard errors are in parenthesis

3.3.2 Results from ESR model

As discussed earlier in order to correct the limitations of the PSM in accounting for unobservable bias, the ESR model has been estimated. The results for average treatment effect on treated (ATT), average treatment effect on untreated (ATU) as well as the adoption effects are furnished in Table 6. Further, Tables 9 and 10 in "Appendix" present the regression results for Regime 1 and 2 for Fairtrade and organic certification, respectively. ESR uses two scenarios—(1) the actual scenario wherein certified and non-certified incomes are observed, i.e., (a) and (b), respectively, in Table 6, and (2) the counterfactual scenario wherein income estimates are obtained for the certified group in the counterfactual scenario, i.e., had they not certified [(c) in Table 6]; and the same for the non-certified group [(d) in Table 6]. ESR model compares income of each group's actual and counterfactual scenarios. The average treatment effect on treated (ATT) is the difference between the certified group's actual scenario income and its counterfactual scenario income (ATT = a - c). The average treatment effect on untreated (ATU) is the difference

Certification	Outcome	Category	Decision	Adoption	
type	variable		Certification adoption	Non-certification	Effect
FT	Log total income	ATT	(a) 3.33 (0.06)	(c) 3.83 (0.11)	-0.49*** (0.13)
		ATU	(d) 3.52 (0.08)	(b) 3.50 (0.07)	0.02 (0.11)
Organic	Log total income	ATT	(a) 3.76 (0.06)	(c) 4.15 (0.09)	-0.38*** (0.11)
		ATU	(d) 3.474 (0.09)	(b) 3.478 (0.07)	-0.004 (0.11)

Table 6 Endogenous switching regression results

Standard errors in parenthesis

ATT average treatment effect on treated (certification adoption) [(a)-(c)]

ATU average treatment effect on untreated (non-certification) [(d)-(b)]

(a) = adopters with adoption (real scenario)

(b) = non-adopters with no adoption (real scenario)

(c) = adopters with no adoption (counterfactual scenario)

(d) = non-adopters with adoption (counterfactual scenario)

*** Significant at 1 %; ** significant at 5 %; * significant at 10 %

between the non-certified group's counterfactual scenario income and its actual scenario income (ATU = d - b).

The ESR results corroborate the finding from the PSM model. The adoption effects from the ATT, i.e., (a)–(c), are negative and statistically significant for both specifications. They are -0.49 for FT certified and -0.38 for the organic certified which suggests that none of the certification programs have increased the household income of certified farmers. The ESR result is essentially a comparison between the actual and counterfactual scenarios of a regime. So, the negative net effect of actual and counterfactual effects provides the indication that neither FT nor organic marketing channels could enhance the household total income. The ATU that gives the net adoption effect for the non-certified farmers is not statistically significant for any of the specifications.

3.4 Findings from the qualitative analysis

The quantitative results show that coffee certification has no significant effect on the total income of the certified farmers. However, the analysis is incomplete unless we triangulate the quantitative results with the qualitative findings which are equally illuminating. During the interviews, we asked the cooperative members as to what are the advantages and disadvantages of joining a certified cooperative. We further asked about the advantages to their community by joining a certified cooperative. From the total of 163 certified farmers, 138 responded to the question of individual benefits from certification, and 99 (72 %) of them stated that price margin is higher with the certified cooperatives. From the 99 that stated price margin is an advantage 57 (67.85 %) were organically certified, and the rest 42 (53 %) were FT certified. 14 respondents (10 %) revealed that they feel there is an environmental benefit from following the practices as described by the certification program; 12 of them were organic certified, and the rest 2 were FT certified. When asked about the disadvantages about certification, the majority (77 %) replied that they have no disadvantage by joining the certification program. However, during informal discussions

with organic-certified farmers, it was recorded that organic-certified farmers face a severe lack of organic fertilizer and pesticides. Either these materials are not available or not affordable by the farmers in sufficient quantities. This certainly contributes to the low yields of organic-certified farmers compared to all other farmer groups as shown in Table 2.

Regarding the question of benefits of certification to the community, 139 respondents from 163 certified farmers gave some responses, and the rest did not respond at all to this question. Among them, 72 respondents (52 %) stated that the benefits to the community are in the form of social projects such as building schools, providing scholarship to the school children, and providing medical facilities; 59 of these respondents were FT certified. This suggests majority of the respondents who felt there is some community development program undertaken by their certified cooperative were in fact the FT-certified respondents. So, some of the FT-certified cooperatives have invested the social premium earmarked for community development programs in building community-level infrastructure. However, the effectiveness of such investment depends on the organizational capabilities of the respective cooperatives. Sixteen respondents (12 %) thought that since the cooperative is located within their community, they have received benefits from the cooperatives' capacity building initiatives such as technical workshops and general meetings to give away information on inputs availability and market prices. Further, 14 respondents (10 %) stated that due to certification, there has been a reduction in environmental pollution which is a major benefit to the community; all these 14 respondents were organic certified. Others answered with benefits such as water conservation, higher price, better payments to the workers, support to the farmers in terms of credit and farm equipment and providing sources of employment.

4 Conclusion

Certification is a market-based instrument increasingly used to promote socioeconomic and environmental goals worldwide. Certified products and value chains have to adhere to predefined socioeconomic and environmentally sustainable standards. The objective of this paper is to empirically investigate the role of Fairtrade and organic certification in increasing the incomes of smallholder coffee farmers in Nicaragua. The study employed a three-stage sampling procedure that proportionately draws a sample from the relevant population structure and hence increases the reliability of the findings. By employing both the PSM and ESR models on the survey dataset of 233 certified and non-certified coffee smallholders from Jinotega Municipality, the study makes a significant value addition to the literature on coffee certification.

The descriptive analysis on yield, prices and net revenue from coffee reveals that FTcertified farmers have significantly higher yield compared to both organic-certified and non-certified farmers. For example, FT-certified farmers had 29 % higher yield than noncertified and 31 % higher than the organically certified farmers. Organically certified farmers have received the highest farm gate prices from their respective cooperatives; they have obtained 27 % higher farm gate price than the FT-certified and non-certified farmers. The price difference between the FT and the non-certified farmers appears to be insignificant.

The results from PSM and ESR models show no evidence of statistically significant impacts of either FT or organic certification standards on smallholder famers' total household income. Neither Fairtrade nor organic certification has been able to improve the incomes of the farmers significantly in Northern Nicaragua in recent times. This finding is shared by some of the previous studies conducted in Nicaragua (Valkila 2009; Wilson 2010; Beuchelt and Zeller 2011). Fairtrade has been successful in helping out distressed coffee farmers in Nicaragua during and after the coffee crisis that took place in 2001 as a result of sharp price plunge (Bacon 2005). However, as the prices started to rebound after 2006, the international price has become comparable or even exceeded the Fairtrade prices in recent years. Even though organic-certified coffee has fetched higher prices as shown in our study, this price premium is more than proportionately compensated by the lower yield of organic coffee. As the results show that though the prices for organic coffee is higher when the net revenue from coffee is expressed in per capita terms, there is no difference between organic-certified and conventional coffee producers because organic-certified farmers have on average a higher household size. Owing to these conditions, the living standards of the smallholder coffee farmers have not improved in Nicaragua as majority of the households in our study region are living below the poverty line. We must use some caveats while generalizing these findings since our study has some limitations in terms of data. Some of the important variables like the length of the extension training or the number of times training has been obtained, and the age of coffee plants is not considered in our analysis. So, there is further scope for research using more relevant variables applying to the endogenous switching regression models. Notwithstanding these limitations, our study has been able to find causal inferences.

Against this background, it must be re-investigated how far certification of smallholder producer cooperatives—often subsidized by foreign aid—in areas with deeply structural poverty is effective, efficient and sustainable to increase incomes. More alternative and accompanying non-agricultural programs and measures on the one hand, and direct investments into agriculture and diversification, making farmers less dependent on single export cash crops, on the other hand, might be superior measures. They may allow farmers to re-structure their livelihood portfolios, to strengthen their income and product portfolio and to increase their productivity and product quality, while reducing capital and labor constraints.

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Appendix

See Tables 7, 8, 9 and 10.

Table 7 Pearson's correlation among the independent variables used in probit model

	Age	Edu	Gender	Family labor	Train	Farm size	Off-farm income	Coop credit	Exp	Coop membership
Age	1									
Edu	0.27	1								
Gender	0.08	-0.08	1							
Family labor	0.23	-0.05	-0.03	1						
Train	0.03	-0.07	0.15	-0.03	1					
Farm size	0.25	0.13	0.19	0.07	-0.01	1				
Off-farm income	-0.07	0.37	-0.13	-0.03	-0.02	0.02	1			
Coop credit	0.11	0.05	0.07	0.04	0.17	0.25	-0.05	1		
Exp	0.47	-0.08	0.13	0.16	0.02	0.33	-0.05	0.06	1	
Coop membership	0.23	-0.21	0.12	0.02	0.04	0.16	-0.007	0.16	0.27	1
Standard errors can c	mly be calcu	ulated for pi	aired correlat	tions. Due to lack	of space, m	ultiple correlati	ion matrix is presented	instead of paired	1 correlatic	u

ffee certif	ficati	on sc	heme	es ir	ncre	ase	inco	ome	s of	••••					
		Matched	1.64 (0.103)	1.73 (0.084)	-0.73 (0.466)	-0.09 (0.929)	-0.14(0.889)	0.55 (0.58)	0.97 (0.331)	0.56 (0.575)	$0.52 \ (0.606)$	0.07 (0.94)	-0.25 (0.803)	0.19 (0.849)	-1.04(0.3)
	Nearest neighbor	Unmatched	0.79 (0.428)	0.45 (0.656)	-1 (0.318)	-0.29 (0.773)	0.11 (0.914)	-0.04 (0.969)	-1.21 (0.227)	0.65 (0.519)	5.05 (0)	1.88 (0.061)	-0.09(0.931)	1.41 (0.159)	$4.58(0)^{***}$
			872)	(722)	.857)	511)	(639)	396)	519)	_	.061)	931)	.159)		.07)*

Table 8 *t*-statistics of explanatory variables used in PSM before and after matching

	Kernel		Radius		Nearest neighbor	
	Unmatched	Matched	Unmatched	Matched	Unmatched	Matched
Age	0.79 (0.428)	1.43 (0.154)	0.79 (0.428)	-0.16 (0.872)	0.79 (0.428)	1.64 (0.103)
Age square	0.45 (0.656)	1.58 (0.115)	0.45 (0.656)	-0.36 (0.722)	0.45 (0.656)	1.73 (0.084)
Education years	-1.00(0.318)	-0.32 (0.747)	-1 (0.318)	0.18 (0.857)	-1 (0.318)	-0.73 (0.466)
Education years square	-0.29 (0.773)	0.19 (0.851)	-0.29 (0.773)	0.66 (0.511)	-0.29 (0.773)	-0.09 (0.929)
Off-farm dummy	0.11 (0.914)	-0.22 (0.822)	0.11 (0.914)	0.47 (0.639)	0.11 (0.914)	-0.14(0.889)
Area coffee	-0.04(0.969)	0.12 (0.905)	-0.04(0.969)	-0.85(0.396)	-0.04(0.969)	0.55(0.58)
Total land	-1.21 (0.227)	0.87 (0.388)	-1.21 (0.227)	0.65 (0.519)	-1.21 (0.227)	0.97 (0.331)
Years coffee	0.65 (0.519)	0.39 (0.696)	0.03 (0.977)	5.05 (0)	0.65 (0.519)	0.56 (0.575)
Years coop	$5.05 (0)^{***}$	0.64 (0.521)	1.55 (0.124)	1.88 (0.061)	5.05 (0)	$0.52 \ (0.606)$
Members coop	1.88 (0.061)	-0.22 (0.828	0.55 (0.583)	-0.09(0.931)	1.88 (0.061)	0.07 (0.94)
Distance sale	-0.09 (0.931)	-0.52(0.60)	-0.41 (0.685)	1.41 (0.159)	-0.09(0.931)	-0.25 (0.803)
Gender	1.41 (0.159)	0.38 (0.705)	0.97 (0.332)	4.58(0)	1.41 (0.159)	0.19 (0.849)
Coop credit	$4.58 (0)^{***}$	-0.91 (0.365)	$4.58 (0.00)^{***}$	1.81 (0.07)*	$4.58 (0)^{***}$	-1.04(0.3)
Training	$1.86 \ (0.065)^{*}$	0.85 (0.394)	$0.87 \ (0.383)$	-1.23 (0.221)	1.86 (0.065)	0.73 (0.465)
Dependency	-1.23 (0.221)	-0.07 (0.941)	-1.23 (0.221)	-0.74 (0.46)	-1.23 (0.221)	-0.17 (0.862)
Relative farmer	$2.93 (0.004)^{***}$	-0.01 (0.992)	2.93 (0.004)**	1.5 (0.135)	2.93 (0.004)	0.35 (0.724)
						ĺ

p value is in parenthesis

Exp. variables	FT-certified f	farmers	Non-certified f	armers
	Coef.	SE	Coef.	SE
Age	-0.03	0.03	0.16***	0.06
Agesq	0.0002	0.0003	-0.001^{**}	0.0006
Education	-0.08*	0.05	0.20**	0.09
Education sq.	0.01***	0.003	-0.009	0.008
Total farm size	0.007	0.05	0.12**	0.06
Gender	0.03	0.14	-0.04	0.18
Years in coffee farming	0.01	0.009	-0.007	0.008
Area under coffee	0.22*	0.12	0.26***	0.08
Years with cooperative	0.007	0.04	-0.19	0.18
Training	0.46*	0.27	0.28	0.20
Distance to main market	0.008	0.009	-0.05^{**}	0.02
Off-farm income	-0.07	0.19	0.38	0.30
Dependency ratio	-0.15	0.15	0.36	0.23
Credit from cooperative	0.68**	0.33	-1.28**	0.56
Family labor relative to hh size	0.16	0.39	-0.60	0.95
Mills1	0.63	0.54		
Mills2			-2.10**	1.04
Constant	2.26**	0.97	-0.90	1.31
No. of observation	79		70	
R^2	0.54		0.52	

Table 9 ESR results for log total income for FT certification

Table 10 ESR results for log total income for organic certification

Exp. variables	Organic-certifie	d farmers	Non-certified	farmers
	Coef.	SE	Coef.	SE
Age	0.03	0.03	0.09	0.06
Agesq	-0.0002	0.0003	-0.0008	0.0006
Education	0.11***	0.03	0.10	0.08
Education sq.	-0.003	0.002	-0.003	0.008
Total farm size	0.06***	0.01	0.04	0.04
Gender	0.23*	0.12	-0.06	0.26
Years in coffee farming	0.01*	0.007	-0.009	0.01
Area under coffee	0.20***	0.05	0.22***	0.09
Years with cooperative	-0.005	0.014	-0.11	0.27
Training	-0.58***	0.15	0.29	0.22
Distance to main market	0.003	0.003	-0.004	0.01
Off-farm income	0.18	0.12	-0.004	0.21
Dependency ratio	-0.12	0.08	0.10	0.18
Credit from cooperative	-0.79	0.51	-0.44	0.44
Family labor relative to hh size	-1.06^{***}	0.21	0.12	0.81

Exp. variables	Organic-certifie	ed farmers	Non-certified	d farmers
	Coef.	SE	Coef.	SE
Mills1	-0.69***	0.20		
Mills2			-0.67	0.96
Constant	4.05	0.85	0.56	1.24
No. of observation	84		70	
<i>R</i> ²	0.63		0.45	

Table 10 continued

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