The Driving Forces and Economic Impact of Co-operative Membership: Empirical Evidence from the Mexican Coffee Sector

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We identify key factors influencing membership of co-operative organisations in Mexico's coffee sector. We also determine the impact of membership on the incomes that are derived from coffee cultivation. Factors at all levels are found to be relevant: individual factors, family characteristics, farm type and regional factors. Data come from a survey of 1,396 coffee farmers held in 2004 in eight major producer states in Mexico and complemented with information from the National Coffee Census. We apply regression models that control for selection bias and endogeneity to identify driving forces as well as the economic effects of co-operative membership. Co-operatives are typically joined by older male farmers, on medium sized farms, who have access to electricity and are located at higher altitudes and in larger municipalities. Private land ownership reduces the probability of co-operative membership. There is consistent evidence that participating in co-operatives has a positive effect on the individual coffee prices and per capita coffee income. This effect is mostly due to the additional coffee processing offered by co-operatives.

Introduction

There are two types of farmer organisation in the Mexican coffee sector: grassroots organisations and co-operatives. These are differentiated by their ability to mobilise support for farmers' needs related to coffee production and trade. The former are unions or affiliations of farmers that represent them in the national organisation of the sector, the so-called Coffee Product System (CPS), and in other regional and national governmental institutions. The affiliations include organisations of small groups of farmers that are usually labelled as co-operatives. These co-operatives mainly focus on mobilising economic support from projects initiated by the national or state government; some co-operatives also apply to (inter)national donors or non-governmental organisations for support.

Under the erstwhile controlled coffee market, until 1993, producers were typically organised in Economic Production and Marketing Units (UEPCs). At the end of the controlled coffee market era almost 70% of the total Mexican coffee producers were member of these UEPCs. They were operating as small solidarity groups in which all members were responsible for the coffee supply of any individual member of the group. After the demise of the state-controlled coffee market in 1993 however, growers were free to set up or participate in any kind of farmers' organisation. The question therefore arises as to which farmers organised themselves in this way, and what benefits this might have brought them.

More in particular, this article addresses the following questions:

(1) What characteristics distinguish the farmers who are members of the coffee co-operatives?

(2) What are the main factors that determine their participation in these organisations?

(3) Do coffee co-operatives help farmers find a better market outlet and receive better coffee prices?

(4) What are the factors that influence the level of per capita coffee income, and to what extent do these factors differ between member and non-members of co-operatives?

The main objectives are to identify the variables that promote membership of an organisation, and to examine the significance, relative importance and direction of some of the most important variables influencing per capita coffee income. We distinguish four categories of variables:

(a) Individual factors, like age, gender, education and ethnicity.

(b) Family characteristics, like family size, housing conditions.

(c) Farm factors, including farm size, distance to road and altitude.

(d) Regional factors such as location and agro-ecological conditions, population density and number of traders in the municipality.

We will discuss how these variables influence farmers' marketing choices in terms of the type of coffee that is delivered, the price received for the coffee and the per capita coffee incomes. We will compare farmers participating in co-operatives with otherwise identical individual farmers to guarantee unbiased results. We use information collected in a representative field survey, conducted in 2004 throughout the eight major coffee-producing states, and additional village-level data from the coffee census database, retrieved from 2002 to 2008.

The remainder of this chapter is organised as follows. The next section reviews the most important theories related to farmers' preferences and constraints regarding rural co-operation and presents the main characteristics of the Mexican coffee market. We then outline the field survey data and the statistical methodologies used for data analysis. Next, we discuss the main variables affecting membership of coffee co-operatives. This is followed by a discussion of the effects of co-operative membership on prices obtained and on income effects. In these analyses we present different specifications of probit, multinomial logit and ordinary least squares estimates. We conclude with a discussion on the implications for policy and outreach vis-à-vis co-operatives in the Mexican coffee sector.

Rationale for Co-operative Membership in Coffee Production and Trade

In Mexico, economic dependence on coffee has fallen over the last decades. Coffee was brought this country in the late eighteenth century and was initially grown on large plantations, but over the first decades and at the early part of the nineteenth century it became a smallholder crop. Coffee has been the most important source of agricultural export revenues for many decades. It generated 413 million dollars of foreign exchange per year in the 1990s but decreased to 230 million dollars of foreign exchange annually during the last decade (Banco de México, 2010). In 2008, coffee was the fifth agricultural production commodity in terms of value added, just after tomatoes, fresh vegetables, avocados and peppers. Although coffee's relative economic importance has declined, it still is the country's largest single export crop (Pérez et al, 2001; Calo and Wise, 2005).

The Mexican coffee census, updated in July 2008, reports a total of 493,497 coffee farmers and a similar number of families that at least partly depend on coffee production for their sustenance. The producer households generate direct employment in coffee-related activities for 1,547,210 persons. Coffee-producing farms are located in some of Mexico's poorest provinces. The major coffee-producing areas are mountainous, with poor communication and limited public services. Around 84% of the rural communities where coffee growing is the primary agricultural activity, report high or very high poverty rates. Furthermore, 60% of the coffee producers live in extreme poverty and more than half belong to one of Mexico's 52 ethnic groups (Pérez et al, 2001; Avalos-Sartorio, 2009).

Regional and local characteristics determine the prospects for coffee processing. Many farmers process their own coffee in small processing plants owned by individual coffee growers; larger processing facilities are owned by farmers or farmer co-operatives. These generally do humid processing of coffee. Dry processing is feasible only in regions with enough volume of coffee, little rainfall and good road conditions. 87% of the Mexican coffee producers rely on wet processing and 13% on dry processing (Sistema de Información Agrícola y Pecuaria, 2008).

The wet process consists of four steps:

1) Hulling, done by moving the coffee through a hulling machine operated by hand or with a motor.

2) Fermentation, for which coffee seeds are left to ferment in wooden or cement tanks for 20 to 36 hours, depending on local weather conditions

3) washing, manually or mechanically done in a tank

4) Drying the coffee seeds, either by putting them on concrete, fibre or synthetic materials on the ground or by using drying machines (Pérez et al, 2001).

In the dry process the coffee is spread out to dry in the sunshine without removing any skin. Hereafter, the coffee is transformed from dry beans to green beans using milling machines.

Over the past two decades, the role of the government in the Mexican coffee sector was gradually taken over by private companies. Before 1993, under the controlled coffee market regime firms bought raw coffee mainly directly from governmental warehouses. The current regime enables these firms to buy raw material also from wholesalers, small-scale companies and small-scale farmers. In this setting, farmer co-operatives can play an important role in collecting coffee from their members (and some non-members), processing it and selling it in larger quantities, thus offering better marketing opportunities for their members. In recent years, government and non-governmental organisations promoted co-operative participation as a strategy to overcome organisational, processing and marketing problems. This role of co-operatives in commercialisation is addressed by Bernard et al (2008) and, as a way to promote equity, by Basu and Chakraborty (2008).

Defining rural co-operatives as “an association of persons who work together to achieve certain objectives” (LeVay, 1983), we can distinguish co-operatives from other economic organisations in the sense that co-operatives are voluntary associations of people, where decisions are taken based on member participation and representation and not based on capital voting power. Since smallholders tend to face large diseconomies of scale in processing and marketing — due to the high transaction costs per unit sold (Bernard and Taffesse, 2012) — the main role of marketing co-operatives is to reduce these costs per unit so as to improve the bargaining power of smallholders vis-à-vis middlemen (Francesconi, 2009).

In the present decade, additional objectives for joining farmer organisations are to improve access to funding from the banking system, to access support from (non-)governmental institutions, to receive resources for acquiring machinery to process coffee and to comply with the rules and regulations of standards in the coffee markets. In addition, coffee co-operatives are increasingly promoted by state agencies as a way to sell products more directly at the domestic market, to do so at higher prices thanks to improved product quality and, more generally, to upgrade coffee production systems and technologies. In sum, being part of a co-operative organisation enables coffee farmers to improve their income and reduce the risks in marketing coffee.

Factors such as the farmer’s age, level of education, the size of the coffee farm, and location and altitude of the coffee plantation are found to be important determinants of membership of co-operative organisations (see LeVay (1983) for a concise overview). In addition, it is expected that member farmers are more likely to get higher prices and to generate a higher per capita coffee income compared to their non-organised counterparts. In the following, we will investigate these issues using comprehensive data on the Mexican coffee sector.

Data and Methods

We use data from the coffee census, held in 2002 and updated until 2008 (Sistema de Información Agrícola y Pecuaria, 2008), and from a large-scale coffee survey held in 2004. For this survey, a stratified random sample of coffee farmers was drawn from the census, with a broad distribution of individual, family and farm characteristics contained in the original

database.[1] A sample of 1,396 farmers was taken from a list of 353,696 coffee plots that had benefited from the "productive development and coffee quality improvement programme" (this amounted to virtually all farmers). Coffee farmers from the eight coffee-producing states of Mexico were included. The sample selection took place in two steps: first municipalities were selected according to their proportion of coffee production; secondly farmers were selected from each municipality according to farm strata (Ramírez et al, 2004). This resulted in a stratified sample that is considered representative for the Mexican smallholder coffee sector.

Face-to-face interviews were held with each coffee farmer in the sample, using a structured questionnaire. This questionnaire included farmer's characteristics (such as age, sex, literacy, training and education); household characteristics (such as household size, family labour, emigration, income and total land owned); and coffee orchard's characteristics (such as tree density, yield, production, type of farming system, input use and organic certification). In addition, questions were included on the relationship with the market, the type of coffee sold and the price received, as well as on institutional factors, such as co-operative membership and the types of support for producing coffee that they received from the state. Descriptive statistics for members and non-members are given in Table 1. For all relevant variables, we report a t-statistic to indicate significant differences between farmers who participate in a coffee co-operative and those who did not.

To answer the research questions we followed the following approaches. First, a probit model was estimated to identify the individual, family, farm and regional factors influencing co-operative participation. Secondly, we analysed the prices obtained by farmers for coffee of different types. This was followed by a multinomial logistic regression to identify the variables determining the type of coffee delivered by producers. Finally, we used ordinary least squares regressions to identify the factors influencing per capita coffee income and the possible differences between co-operative and individual coffee farmers.

Factors influencing farmers' participation in a co-operative

Variables that are likely to influence co-operative affiliation are grouped into four categories: individual, family, farm and regional factors. We will discuss these variables (see Table 1) and identify their potential role in the decision-making process towards co-operative collective action

The age of the coffee farmer captures experience and work capacity. Most household heads in the sample were between 30 and 60 years old, with an average of 47.6 years for co-operative members and 50.2 years for individual farmers. Gender is another individual characteristic to influence membership. A quarter of all household heads in the sample were female. Even though women's participation in coffee production has been increasing in the last decades, their participation in the Mexican agricultural sector is still low. Women are consistently underrepresented in co-operatives. Literacy and education are key variables that influence labour productivity and business orientation. The survey shows that 24% of coffee farmers are illiterate, but the degree of illiteracy is substantially lower amongst co-operative members. The education variable takes years of formal schooling as an indicator, starting at primary school. About a quarter of the coffee farmers recorded no education level, 62% had between one and six years of schooling and only 12% enjoyed more than six years of schooling. Schooling levels of co-operative members were substantially higher than those of independent farmers. Considering that people with a certain level of education may be more open to institutional change or to innovation of production systems, it is expected that they will be more inclined to participate in co-operatives as a vehicle for such change. This is further reinforced by their receptiveness to targeted training courses, which co-operatives offer to their members.

There are several family or household factors included in the survey as possible determinants of co-operative participation. Per capita farm size reflects the available land resources for coffee production, which turned out to be almost three times higher at co-operative farms. Small-scale subfamily coffee farms tend to be less interested in coffee as a commercial activity. On the other hand, very large multifamily farms are quite capable of running their business on their

own. The members of coffee co-operatives thus typically operate farm units of median size. The household size provides an indication of labour availability. Almost 35% of all coffee farmers are nuclear families without other family members present; 50% reported between two and six members in the household. The availability of family labour is important for regular coffee maintenance and production activities. Co-operatives are more (family) labour intensive, as less family labour is involved in coffee production despite larger coffee areas. The lower incidence of labour migration from co-operative farms might indicate improved livelihood conditions. The availability of sufficient rural employment options is considered an incentive for co-operative membership.

Table 1. Variables for membership of a co-operative (descriptive statistics and t-test).

Variable	Unit	Co-operative (N=427)		Non-co-operative (N=969)		T-test	Signif-icance level
		Mean	SD	Mean	SD		
Individual factors							
Farmer's age	Years old	47.57	14.82	50.18	14.96	3.015	***
Farmer's sex	1 if the farmer is male	0.80	0.40	0.72	0.45	-3.135	***
Ethnicity	1 if the farmer speaks any indigenous tongue	0.54	0.49	0.44	0.50	-3.391	***
Literacy	1 if the farmer can read and write	0.82	0.38	0.73	0.44	-3.733	***
Education	Schooling level	4.25	3.48	3.46	3.38	-3.980	***
Training	1 if the farmer has received training courses related to coffee	0.52	0.50	0.20	0.40	-12.52	***
Institution	1 if the farmer has a relation with government institutions	0.34	0.47	0.51	0.50	5.928	***
Family factors							
Farm size	Coffee area per household member	2.06	11.69	0.69	1.13	-3.581	***
Household size	Number of members in the farmer's family	3.00	2.54	3.85	2.45	5.905	***
Family labour	Number of family members working in coffee	1.88	1.52	2.31	1.61	4.698	***
Emigration	1 if a family member emigrated to work	0.42	0.49	0.62	0.48	6.981	***
Land property	1 if the farmer owns ejidal* or communal land	0.84	0.36	0.55	0.50	-10.79	***
Cement house	1 if the house has a cement roof, wall or floor	0.28	0.45	0.50	0.50	7.674	***
Electricity	1 if the farmer's house has electricity	0.44	0.50	0.67	0.47	8.345	***
Type of access road	1 if the farmer's community has access to paved road	0.17	0.37	0.24	0.43	3.135	***
Transport	1 if the manner of transportation is by car	0.63	0.48	0.72	0.45	3.338	***
Farm factors							
Altitude	Metres above sea level	1,163	785	878	626	-7.229	***
Type of farming system	1 if coffee is produced in a mountainous or traditional polycultural system[2]	0.32	0.47	0.43	0.49	3.757	***
Machinery to process coffee	1 if the household has machinery to process coffee	0.47	0.50	0.28	0.45	-6.956	***
Regional factors							
Farmers in the village	Number of coffee farmers in the farmer's municipality	3,682	3,082	2,890	2,491	-5.076	***
Intermediaries in the village	Number of intermediaries in the farmer's municipality	5.3	10.7	4.0	6.3	-2.9	***
Organisation in the village	Proportion of organised coffee farmers in the farmer's municipality	21.7	18.3	7.6	11.0	-17.8	***
Coffee sales to intermediaries	Proportion of coffee farmers in the farmer's municipality who sell to an intermediary	62.5	30.6	80.5	21.6	12.6	***

*Note: *ejidal land is communal land with limited private title for the tiller; *** refer to significance at 1%.*

Land ownership is usually considered a key factor for stable rural livelihoods. The survey

shows that 43% of the farmers has ejidal property, 21% operates on communal land and 36% owns private land. Co-operative members are more often found to have common land. These properties are usually located in more isolated and poorer areas than private properties are, and ejidal and communal properties are typically cultivated by medium- and small-scale coffee farmers, the same that often rely on co-operative organisations to improve their market access. The wealth of coffee-producing households is characterised by the type of housing. On average, 43% of houses have a cement roof, floor or walls, which indicates relatively greater wealth. While 50% of the individual farmers belong to this category, only 28% of the co-operative farmers have cement houses. Similarly, access to electricity, paved roads and transport facilities are consistently higher for non-member farmers. In general, access to roads is extremely low, reflecting the marginal conditions of many poor coffee farmers living in remote rural areas. Co-operative organisations might help to overcome these adverse conditions.

Farming factors refer to the agro-ecological environment and farming system characteristics of coffee production. The altitude above sea level is of key importance for improving coffee quality. From the sample, 20% of the farmers had their plantation below 600 metres, 32% between 600 and 900 metres, 25% between 900 and 1,200 metres, and 23% above 1,200 metres.[3] Whereas possibilities to engage in other agricultural activities are decreasing with higher altitude, coffee quality and options for specialisation in coffee production tend to improve. As specialisation is favourable for joint marketing, we expected a positive correlation between the altitude and the degree of co-operative membership. This was indeed confirmed in the sample. We distinguished four types of farming system: sunlight (3.5%), specialised (36%), traditional (0.5%), and mountain (60%). Co-operative farmers were usually more specialised in coffee, whereas among the independent farmers, mountain or traditional polyculture prevailed. Farmers located in better areas for producing coffee tended to farm their orchards in more environment-friendly ways, relying on self-produced inputs and more labour-intensive methods. Co-operative farmers more often applied on-farm processing of coffee and thus owned more processing machinery, whereas other farmers rely on centralised processing (thus increasing also their potential for quality improvement). Participation in co-operatives also helps in getting access to processing equipment.

Regional factors refer to the conditions outside the farms, particularly at municipal level. From the coffee census, we retrieved the number of farmers per municipality. Co-operatives typically exist in larger villages where more private intermediaries were active. Although co-operative farmers sold significantly less coffee to private intermediaries, these sales were still high even in villages with a strong degree of co-operative organisation. Co-operatives were likely to reduce the proportion of side sales, but the presence of intermediaries might also enhance local competition and push up farm gate coffee prices.

Outcomes that are influenced by co-operative participation

Co-operative membership may affect farmers in many ways, but here we focus on important economic variables, income, production and price. We compare farmers who are members of a co-operative with independent coffee producers. The results of this comparison are presented in Table 2.

The household income on a per capita basis was generally 50% higher for co-operative members (12,000 compared to 8,000 Mexican pesos for individual farmers), and the same difference applied to per capita coffee income. For both co-operative and independent farmers, coffee represented about 20% of the full household income. For 30-40% of the farmers, coffee was considered a secondary income source. The economic effects of coffee production on the household income tended to be stronger for farms that are more specialised in coffee. Co-operative membership might enable further specialisation, since additional risk diversification mechanisms are available at group level. In addition, their coffee production may benefit from improved access to yield-increasing inputs and possibilities for quality-improving processing equipment. Both effects are likely to generate positive household income effects.

This is further supported by access to public subsidy and support programmes that are implemented in the Mexican countryside to assist poor people and known under labels of procampo, prodesca and oportunidades. Co-operative farmers are substantially more frequently supported by these programmes. On average, 67% of the farmers in the sample received some kind of benefits from these programmes, while the coverage of co-operative members rose to 77%. Co-operative membership may thus provide a mechanism for increased access to public support services.

Table 2. Variables influenced by co-operative membership (descriptive statistics and t-test).

Variable	Unit	Co-operative (N=427)		Non-co-operative (N=969)		T-test	Signif-icance level
		Mean	SD	Mean	SD		
Household income							
Per capita annual income	Per capita annual income that farmer received in Mexican pesos in 2004	11,969	20,641	8,121	9,322	-4.775	***
Per capita coffee income	Per capita coffee income (coffee income divided by household members) in Mexican pesos in 2004	2,547	4,112	1,634	1,885	-5.564	***
Importance of coffee income	1 if the coffee income is the second source of income for the household	0.31	0.47	0.42	0.49	3.563	***
Support from programmes	1 if the farmer received support of “procampo”, “prodesca” or “oportunidades” programmes	0.77	0.42	0.62	0.48	-5.617	***
Coffee production							
Age of coffee orchard	Age of coffee orchard in years in 2004	13.89	8.21	15.27	10.77	2.359	**
Coffee yield	Quintals per hectare in 2004	6.57	4.61	5.88	5.59	-2.557	**
Organic production	1 if the coffee orchard is registered as organic	0.07	0.25	0.01	0.09	-6.038	***
Chemical fertiliser use	1 if the farmer applies chemical fertiliser in the coffee plantation	0.03	0.16	0.09	0.29	4.360	***
Marketing							
Type of coffee	1 if the farmer sells processed coffee (parchment, green, roasted or ground)	0.78	0.41	0.56	0.41	-7.992	***
Selling through the co-operative	1 if the farmer sold the coffee through the co-operative	0.47	0.50	0.16	0.36	-13.430	***
Coffee sales to intermediaries	1 if the farmer sold the coffee to intermediaries	0.49	0.50	0.83	0.38	14.049	***
Selling to the consumer or export	1 if the farmer sold the coffee to the consumer or export	0.03	0.16	0.01	0.10	-2.462	**
Timing of payments	1 if the farmer received the coffee payment at the delivery of the product	0.83	0.37	0.90	0.34	3.440	***
Coffee price	Coffee price in Mexican pesos per quintal in 2004	518	183.92	478	135.15	-4.421	***

*Notes: ** and *** refer to significance at 5% and 1%, respectively. A quintal is 245 kg of cherry coffee, 57.5 kg of parchment coffee, 80 kg of natural dry or 46 kg of green coffee.*

Coffee yields depend strongly on the age of the coffee plantation, plant density and input applications. Co-operative farmers had slightly younger coffee trees but made less frequent use of chemical fertiliser inputs. On average, only 7.5% of the farmers reported using chemical fertilisers, indicating that most production systems are still rather traditional. On the other hand, more co-operatives were engaged in organic coffee production but this system is still rarely used, as in the total sample of 1,396 farmers only 35 had their coffee orchard certified for organic production. Co-operative farmers have 12% higher coffee yields, probably due to higher labour intensity.

Coffee farmers use various market outlets, depending on the type of coffee processing. Co-operatives sold considerably more processed coffee in parchment, green or roasted form. Co-operative members were inclined to sell a larger proportion of their crop through the co-operative channel, even while some 49% was still sold to other intermediaries (compared to 83% for individual farmers).

The timing of payment is of considerable importance for the food security of rural households. Independent farmers were more likely to receive direct payment upon delivery (90%), whereas some co-operative members had to wait for their final payment until the co-operative had processed and sold the coffee. These delayed payments — usually due to internal financial constraints — resulted, however, in a higher average coffee price received by co-operative members.

Results of the Multivariate Analyses

We first analyse the factors that influence farmers' participation in co-operative organisations, using a probit regression model. Then we proceed with an analysis of coffee price differences between organised and non-organised farmers per type of coffee that is delivered. We then investigate which variables play a role in selecting the type of coffee delivered by the two types of producer, using multinomial logistic regression estimates. We will conclude with an analysis of the determinants of per capita coffee income, applying an ordinary least squares regression on the pooled sample and for each of the two subsamples of co-operative and non-co-operative farmers.

Probability of co-operative membership

Table 3 shows the results of the probit model for co-operative membership. Male farmers were considerably more likely to become a co-operative member. The likelihood of co-operative membership increases by around 9% if the grower is male. In addition, literacy strongly enhances co-operative affiliation. Literacy increased the probability of joining a co-operative by 7%. Farmers with a larger per capita farm size proved to have a higher chance of joining coffee co-operatives. Also, the type of land property was significant in all models, showing that farmers who owned ejidal and communal land were more likely to participate in a co-operative compared to farmers who owned privately. Farmers located at a higher altitude were more likely to participate in coffee co-operatives compared to those located at a lower altitude. Similarly, having access to electricity produced a positive effect on the probability of participation in co-operatives, enabling farmers to engage in more advanced coffee processing activities. At the regional level, we see that the number of intermediaries in the municipality positively affected the likelihood of co-operative membership.

It should be noted that some commonly used individual and family factors (like farmer's age, education and family size) turned out to be not significant in the present model specification.

Regional dummies for the states of Veracruz, Puebla, Hidalgo Nayarit and San Luís Potosí generally showed a significant negative effect on the probability of participation in co-operatives. This is likely due to better access conditions in these states (and thus strong competition with traditional intermediaries) compared with the default state of Guerrero.

Table 3. Factors determining membership of a co-operative (marginal effects after probit estimations).

Variable	Marginal effects
Farmer's age	0.001 (0.209)
Farmer's sex	0.091 (0.004)***
Literacy	0.065 (0.094)*
Education	0.002 (0.666)
Per capita farm size	0.014 (0.094)*
Size of household	0.008 (0.280)
Land property	0.117 (0.000)***
Cement house	-0.059 (0.126)
Electricity	0.113 (0.012)**
Altitude squared and divided by one million	0.047 (0.020)**
Type of farming system	-0.015 (0.630)
Intermediaries in the village	0.005 (0.008)***
Chiapas	-0.017 (0.800)
Oaxaca	0.095 (0.212)
Veracruz	-0.315 (0.000)***
Puebla	-0.278 (0.000)***
Hidalgo	-0.287 (0.000)***
Nayarit	-0.162 (0.007)***
San Luís Potosí	-0.205 (0.000)***
Constant	-1.382 (0.000)***
Observation numbers	1,251
Pseudo R squared	0.267
Log Likelihood	-567

*Notes: P-values in parenthesis. *, ** and *** refer to significance at 10%, 5% and 1%, respectively.*

Price differences between co-operative and non-co-operative coffee farmers

We found important differences in mean coffee prices between farmers integrated in co-operatives and independent farmers. We looked at price differences between groups of farmers that supply the same type of coffee, viz cherry, dry, parchment and green coffee. And we looked at differences in prices per quintal between one type of coffee and the next in the line of processing. This comparison was done separately for co-operative farmers and farmers who are not participating in the co-operative trade. Note that the use of quintals already accounts for the differences in weights of the types of coffee.

Taking four types of coffee sold by farmers, cherry, natural dry, parchment and green-and-ground, the t-tests find some differences between groups. Considering all farmers in the sample, the figures show that farmers who were members of a co-operative sold their coffee at a higher price than those who did not belong to a co-operative (see Table 4).

The mean coffee prices reported show that the prices received by farmers who belonged to co-operatives and sold cherry coffee, were higher than those who sold parchment and green-and-ground coffee. This is an unexpected result, but the explanation is found in the fact that organised farmers deliver cherry coffee to the co-operative firm that processes and sells the coffee directly at the national or external markets. The co-operative pays the final price to their members, based on the price that the organisation received minus the processing and

administrative costs. This implies that co-operative farmers can compete with larger plantations in selling parchment, green, roasted or ground coffee.

Prices received by co-operative members were significantly higher than the prices paid to non-organised farmers who sold cherry and parchment coffee. Only for natural dry coffee non-organised farmers had a price advantage, but the number of co-operatives engaged in this process was small. Prices received for green-and-ground coffee did not differ significantly between organised and non-organised coffee farmers.

Table 4. Price differences between co-operative and non-co-operative members (t-test by type of coffee).

Type of coffee sold by farmers	Organisation	Price*	SD	T-test	Group	T-test with next stage
Cherry	Co-operative (N=60)	586.42	324.70	-5.298	1	(1 vs. 5) 2.742
	Non-co-operative (N=305)	448.82	141.15		2	(2 vs. 6) -5.259
Natural dry	Co-operative (N=24)	346.79	131.37	2.026	3	(3 vs. 7) -4.014
	Non-co-operative (N=81)	427.88	182.30		4	(4 vs. 8) -4.194
Parchment	Co-operative (N=306)	516.89	136.79	-2.181	5	(5 vs. 7) -0.745
	Non-co-operative (N=442)	497.30	115.99		6	(6 vs. 8) -2.533
Green-and-ground	Co-operative (N=22)	539.75	191.52	-0.246	7	
	Non-co-operative (N=93)	530.89	141.19		8	

*The price is in Mexican pesos per quintal.

The results for prices of natural dry coffee are unexpected. A possible explanation is that in the usually remote places where farmers sell this type of coffee, the local co-operatives work with low volumes and scarce resources, making them less competitive vis-à-vis private buyers.

The price differences between different types of coffee make clear that further processing can be quite attractive. This can be seen by comparing the different coffee processing pathways, following either wet or dry processing techniques[4]. Farmers who sold cherry coffee consistently received a higher price compared to those who sold parchment coffee (groups 2 vs 6). Comparison of group 1 with 5 deviates, probably due to high prices paid by co-operatives to cherry-supplying farmers precisely because the co-operative had processed the cherry coffee. The price differences of those who sold natural dry and green-and-ground coffee were very favourable for the latter category of farmers (groups 3/4 vs. 7/8). This is particularly the case for co-operative farmers. Regarding non-organised producers' prices, comparisons of the prices of those who sold cherry and parchment (groups 2 and 6), parchment and green-and-ground (groups 6 and 8) and natural dry and green-and-ground coffee (groups 4 and 8) all resulted in significantly different prices.

Clearly, organising into groups helps coffee producers receive higher coffee price only if the co-operative processes the product and sell it more downstream in the supply chain. The collective processing enables them to reduce transaction and processing costs that makes them competitive with private processors.

Factors affecting the mode of coffee selling by farmers

To obtain more insight into the factors that play a role in the type of coffee that coffee farmers normally deliver, we did a multinomial logistic regression analysis for the four types of coffee: cherry, natural dry, parchment, and green-and-ground. The coffee-processing stage variable was regressed against relevant individual, family, farm and regional factors. In addition, being a co-operative member was included as a dummy variable to test whether this factor is influencing the choice of the type of coffee sold.

The marginal effects after multinomial logistic regression were obtained and outcomes are presented in Table 5. Co-operative membership, farmer education and cement house ownership do not show a significant influence on any of the coffee selling choices included in the model. Otherwise, support received from public agencies negatively affects cherry selling and favours processing into parchment. This might indicate that farmers assisted by the national coffee programme enjoy certain advantages regarding further advanced processing modes. More traditional farmers belonging to ethnic groups, who have ample household labour resources and received less training, still opt for cherry marketing. Similarly, natural drying is preferred by larger families that are in transition from a coffee poly- to a mono-culture.

Individual factors that influence the coffee processing choice refer to farmer's age (positive for cherry and negative for parchment coffee), gender (female-headed farmers prefer cherry selling), ethnicity (indigenous communities prefer natural dried coffee) and training (favourable for parchment coffee, but with a negative sign for cherry selling). Family factors also play an important role in the selection of preferred coffee processing modes. The choice for cherry coffee is favoured by household size and the availability of electricity, while coffee support programmes have a negative effect. Natural dry coffee is preferred by larger households that lost people through migration, have private land ownership and receive some general institutional support. For parchment coffee, household size, altitude and access to electricity and public coffee support programmes are important enabling factors. Green-and-ground coffee is mainly selected by larger farmers located at average or below average altitudes.

Table 5. Probability estimates of the type of coffee sold by farmers (marginal effect after multinomial logistic regression).

Variable/type of coffee sold	Cherry		Natural Dry		Parchment		Green and ground	
	dy/dx	Signi-ficance	dy/dx	Signi-ficance	dy/dx	Signi-ficance	dy/dx	Signi-ficance
Co-operative (1/0)	-0.023		0.000		0.033		-0.010	
Farmer's age	0.002	*	0.000		-0.003	**	0.000	
Farmer's sex	-0.066	*	-0.010		0.073	**	0.000	
Ethnicity	-0.111	***	0.015	*	0.092	**	0.061	
Training	-0.110	***	-0.009		0.101	***	0.012	
Education	0.006		-0.002		-0.005		0.000	
Per capita farm size	0.000		-0.002		-0.000		0.002	**
Size of household	0.016	**	0.004	**	-0.023	***	0.002	
Land property	-0.018		0.011	*	-0.012		0.019	
Electricity	0.140	***	0.009		-0.150	***	0.002	
Cement house	-0.047		0.013		0.043		-0.008	
Emigration	0.006		0.013	*	-0.032		0.013	
Institutional support	-0.025		0.021	**	0.016		-0.011	
Support from public								
coffee programme	-0.140	***	0.002		0.140	***	-0.002	
Altitude squared and divided by one million	-0.050		-0.008		0.083	***	-0.026	*
Type of farm system	0.088	***	-0.031	***	-0.049		-0.007	
Machinery	-0.120	***	-0.060	***	0.200	***	-0.018	
Chiapas	-0.169	***	-0.013		0.239	***	-0.056	*
Veracruz	0.171	***	-0.049	***	-0.115	**	-0.007	

*Notes: *, ** and *** refer to significance at 10%, 5% and 1%, respectively.*
Observation numbers 1,249. Pseudo R square = 0.355. Log likelihood = -897.

The states of Chiapas and Veracruz were included as dummy variables. In Veracruz, cherry coffee is preferred because natural dry is hardly feasible due to high rainfall. In Chiapas, parchment coffee is the main delivery mode, whereas green-and-ground coffee is chosen less often, as can be understood from the prevailing mountainous conditions.

Determinants of coffee income per capita

The analysis of what influences per capita coffee income is based on OLS regression models. First a pooled regression was done using all observations of the sample. Secondly, using the probit regression (see Table 3), we defined a Heckman selection model to test for potential selection bias. The results of this latter analysis indicate that this problem was not present. Thirdly, two additional regressions were performed, one considering only farmers that were co-operative members and one with individual (non-co-operative) farmers. We used the Chow test to evaluate the significant and structural differences in parameter and function estimates and to test whether (non-)pooling is warranted. This resulted in significant statistical differences between both regressions that justify non-pooling. Therefore, we present the results from three types of regression: the pooled sample, the co-operative subsample and the non-co-operative subsample (see Table 6).

All individual factors, with the exception of ethnicity, had significant effects in the pooled sample, while literacy and education showed significant parameters in the income equation of the co-operative group. Otherwise, education proved to be the only significant individual factor for the non-co-operative members group.

Among the family factors, farm size, the availability of machinery and electricity influenced income levels in the pooled sample. Membership of co-operatives had — as expected — a positive impact on the incomes per capita; its coefficient indicates that affiliation to a co-operative increases per capita coffee income with 314 Mexican pesos, equivalent to 2.6% of the average income. Within the co-operative subsample, education, farm size and private land property tended to increase income. Within the non-member sample, farm size had a positive income effect, whereas machinery and electricity showed negative effects, implying that increasing the public and private infrastructure may coincide with lower per capita coffee incomes.

For the group of farm factors, the age of the coffee plantation and type of coffee system favoured coffee income in the pooled and non-member subsample. For the co-operative subsample, income was lower at higher altitude, whereas for the non-co-operative subsample income increased with altitude. This is probably related to the reduced options for coffee processing in high altitude areas, and the increased orientation of private farmers towards high-quality segments of coffee that are favoured by higher altitude.

Of the regional factors, the number of coffee farmers and the proportion of organised farmers in the municipality negatively affected per capita incomes in the pooled sample. This points to trade-offs between the number of suppliers (competition effect) and the degree of farmers' organisation (bargaining effect). An increase in the number of intermediaries could raise per capita coffee income as the result of a more intensive competition. This became more apparent in the co-operative subsample.

Table 6. Factors determining per capita coffee income (OLS estimates).

Variable	Pooled sample	Co-operative	Non-co-operative
Farmer's age	9.068 (0.096)*	20.20 (0.166)	3.294 (0.429)
Ethnicity	-131.8 (0.433)	-319.9 (0.512)	-104.3 (0.413)
Literacy	-573.7 (0.004)***	-1,749 (0.003)***	-151.5 (0.304)
Education	116.0 (0.000)***	255.3 (0.000)***	54.40 (0.010)**
Per capita farm size	395.6 (0.000)***	376.4 (0.000)***	378.2 (0.000)***
Type of road	148.1 (0.390)	493.2 (0.379)	7.110 (0.954)
Land property	190.5 (0.219)	1,292.5 (0.019)**	-44.81 (0.686)
Machinery	-425.2 (0.007)***	-611.7 (0.132)	-282.5 (0.025)**
Electricity	-1,580 (0.000)***	-1,860 (0.000)***	-1,282 (0.000)***
Co-operative	313.9 (0.071)*		
Support from programmes	4.569 (0.977)	-43.24 (0.927)	-96.38 (0.420)
Altitude	-0.135 (0.225)	-0.448 (0.093)*	0.169 (0.072)*
Age of coffee trees	15.35 (0.026)**	39.47 (0.111)	9.593 (0.046)**
Type of coffee	446.6 (0.007)***	1,326 (0.021)**	400.9 (0.001)***
Farmers in the municipality	-0.082 (0.009)***	-0.061 (0.453)	-0.073 (0.005)***
Intermediaries in the village	75.69 (0.000)***	140.9 (0.000)***	2.121 (0.813)
Coffee sales to intermediaries	0.897 (0.810)	-2.996 (0.771)	-2.757 (0.392)
Farmers organised in the municipality	-19.18 (0.010)**	-41.47 (0.009)***	-1.667 (0.825)
Chiapas	1,479 (0.000)***	2,059 (0.011)**	1,048 (0.000)***
Guerrero	1,538 (0.001)***	1,511 (0.118)	1,930 (0.000)***
Veracruz	413.0 (0.067)*	676.2 (0.465)	348.4 (0.029)**
Constant	1,211 (0.021)**	139.0 (0.919)	1,772 (0.000)***
Observation numbers	1,297	397	900
R square	0.319	0.346	0.395

*Notes: P-values in parenthesis. *, ** and *** refer to significance at 10%, 5% and 1%, respectively.*

Conclusions and Outlook

This study identified key factors for the participation of coffee farmers in co-operative organisations. Gender (being male), literacy rate, farm size, communal land property, availability of electricity, higher altitude and number of intermediaries in the municipality all favour co-operative affiliation. Better-off farmers with more resources were less likely to engage with co-operative organisations. Regional differences are substantial.

Some of our results are broadly in line with findings from earlier studies (Ruben and Lerman, 2005; Karli et al, 2006; Basu and Chakraborty, 2008; Bernard et al, 2008; Francesconi, 2009; Bernard and Taffesse, 2012). On the effect of gender, we can confirm the findings by Karli et al (2006) and Bernard et al (2008). This implies that Mexican coffee co-operatives display a rather male-biased membership. In a similar vein, the positive influence of literacy on co-operative participation is confirmed, in line with results reported by Bernard and Spielman (2009).

We find consistent evidence that co-operative farmers get better coffee prices, especially when delivering cherry and parchment coffee. This is likely due to the processing done by the co-operative. On the other hand, our results show a negative effect of co-operative participation

on the average price when delivering natural dry coffee. This implies that co-operatives are effective only if some additional processing services can be included.

As part of the analysis regarding farmer's choices for different types of coffee processing, we elaborated a typology based on specific intrinsic and extrinsic factors that influence the degree of processing. Older farmers with a larger household size and less institutional support are more likely to sell cherry coffee. Otherwise, indigenous farmers with more common property farm land and some emigrated family members tend to prefer delivering natural dry coffee. Parchment coffee is typically delivered by younger and smaller households located at higher altitudes, which received training and possess some machinery that enables deliveries of parchment coffee. Finally, larger farms located at a lower altitude select deliveries of green-and-ground coffee. Contrary to our expectation, we did not find clear evidence that the co-operative participation affects the type of coffee that farmers sell. Our results confirm again that growers in Veracruz mainly sell cherry coffee and those in Chiapas parchment coffee.

As to the factors that are important for per capita coffee income, we find an overall positive effect of co-operative membership. But as neither the richest nor the poorest coffee farmers are member of co-operatives, it is the middle groups that are affected. This effect would be reinforced by any improved access to external infrastructure (roads, but mainly electricity) that enables further progress in coffee processing. Only when the coffee co-operatives support upgrading and value added activities, significant price advantages can be generated.

Finally, we indicate some limitations of the analysis. First, given the available field data, we can only draw conclusions about relevant coffee activities and are unable to infer full household income effects. Higher prices will however lead to more attention for the coffee fields and should eventually increase the coffee income share of rural households. Secondly, differences in coffee production systems and technologies are only marginally accounted for. Co-operative membership may lead to an improved input efficiency and lower average input costs that positively affect net farm income, but these effects were not fully included in the data set.

Our results provide a sound motivation for further promotion of co-operative coffee production in rural Mexico, particularly in areas where options for economies of scale and further processing are available. In addition to individual factors that enhance co-operative membership (literacy, training), there is considerable scope for supporting co-operative development through institutional programmes that strengthen the external infrastructure. Moreover, local and regional economies of scope readily emerge in communities where more farmers adhere to co-operative organisations, thus potentially generating a kind further effects.

It is likely that membership has effects that go beyond what we can measure in a single survey. Observations over a longer time span of matched samples of member and non-member households from the same area would make this possible. In principle, the census and linked surveys in later years enable this. Our material suggests that under the current wave of market liberalisation in Mexico, coffee co-operatives received a new impetus towards progress in processing, marketing and supply chain upgrading.

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References

Ávalos-Sartorio, B (2009) “Coffee, Policy, and Stability in Mexico” In: Pinstrup-Andersen, P and Cheng, F (Eds), *Food Policy for Developing Countries: Case Studies*. Cornell University, Ithaca, NY.

Banco de México (2010) *Informe Anual.* http://www.banxico.org.mx/publicaciones-y-discursos/publicaciones/informes-periodicos/anual/%7BE2479C99-47CB-19B8-92A7-D011876E8FCA%7D.pdf.

Basu, P and Chakraborty, J (2008) “Land, labour, and rural development: analysing participation in India’s village dairy co-operatives.” *The Professional Geographer,* 60(3): 299-313.

Bernard, T, Taffesse, A S and Gabre-Madhin, E (2008) “Impact of cooperatives on smallholders’ commercialization behavior: evidence from Ethiopia.” *Agricultural Economics*, 39(2): 147–161.

Bernard, T and Spielman, D J (2009) “Reaching the rural poor through rural producer organisations? A study of agricultural marketing co-operatives in Ethiopia.” *Food Policy*, 34(1): 60-69.

Bernard, T and Taffesse, A S (2012) “Returns to scope? Smallholders commercialisation through multipurpose co-operative in Ethiopia.” *Journal of African Economies*, 31(3): 440-464

Calo, M and Wise, T A (2005) *Revaluing peasant coffee production: organic and fair trade markets in México.* Global Development and Environment Institute, Tufts University, Boston, Ma.

Francesconi, G N (2009) *Cooperation for competition: linking Ethiopian farmers to markets*. PhD thesis, Wageningen University.

Karli, B, Bilgic, A and Celik, Y (2006) “Factors affecting farmers’ decision to enter agricultural cooperatives using random utility model in the South Eastern Anatolian region of Turkey.” *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 107(2): 115-128.

LeVay, C (1983) “Agricultural co-operative theory: a review.” *Journal of Agricultural Economics*, 34(1): 1-44.

Pérez, G V, Cervantes, E and Burstein, J (2001) *Case study of the coffee sector in México.* Cornell University, Ithaca, NY, [Online], Available: http://ip.cals.cornell.edu/courses/iard4010/documents/Mexico_coffee.pdf.

Ramírez, M P, Villaseñor, L A, Torres, R J M, Sala, G J M and Ramírez, F G A (2004) *Evaluación del programa de apoyo a la competitividad por ramas de producción 2003 y 2004.* Programa de fomento productivo, reconversión y mejoramiento de la calidad del café. Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA) y Centro de Investigación y Docencia Económica AC (CIDE), México DF.

Ruben, R and Lerman, Z (2005) “Why Nicaraguan peasants stay in agricultural production co-operatives.” *Revista Europea de Estudios Latinoamericanos y del Caribe*, 78: 31-47.

Sistema de Información Agrícola y Pecuaria (2008) *Base de datos del censo nacional de productores de café.* Actualizado a julio de 2008, Sistema de Información Agrícola y Pecuaria, México DF.

Notes

1 The national coffee census was held by several government and non-government agencies. The database built until 2008 contains technical, economic, and social data from more than 493,000 coffee growers and includes detailed information about 776,000 coffee plots. Information refers to farm size, farmer age, size of household, market outlets, household’s assets, members of household and their individual characteristics, type of coffee system and regional characteristics.

2 The traditional polycultural system is defined as the farm where, additional to coffee, growers farm a mix of other trees such as orange, avocado, lemon, macadamia, etc to get some products that are used as a complement of their diet and sell the surplus in the regional market.

3 This variable was measured in metres above sea level, and its square was included to permit a non-linear shape of its effect.

4 Note that coffee sold as natural dry can neither be compared with cherry, nor with parchment because this type of coffee is processed using the dry way, whereas processing from cherry to parchment coffee follows the wet way. Similarly, for green-and-ground coffee no further processing at farm level is considered, since this is done at factory level.