Unpacking Side-Selling: Experimental Evidence from Rural Mexico

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Abstract

Producers of agricultural commodities in low and middle-income countries must decide every season whether to sell their production to local intermediaries or to organizations like agricultural cooperatives that offer stable prices, microcredit, technical assistance, or other services. Though agricultural cooperatives depend on relational contracts, the lack of formal enforcement of these contracts allows cooperative members to side-sell. Recent literature has proposed several theories for side-selling: income targeting, risk management, or heterogeneous valuation of cooperative services. We conduct a lab-in-the-field experiment with indigenous Mexican coffee farmers to understand the reasons behind side-selling. In our experiment, farmers choose how much coffee to allocate between a certain-price buyer and an uncertain-price buyer. The experiment randomizes harvest size, additional services offered by the certain-price buyer, the mean price of the uncertain-price buyer, and additional non-agricultural income. We find that poor coffee farmers have a strong preference for price certainty, and that it is more important than other services offered to farmers when deciding to whom to sell. Moreover, larger harvests and receiving extra income decrease the probability of allocating all the harvest to the certain-price buyer, suggesting the presence of income targeting.

JEL Codes: C91, C93, D81, O13, Q13.
Keywords: Lab-in-the-field experiment, Side-Selling, Price Risk, Cooperatives, Coffee, Mexico.

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1 Introduction

Producers in low and middle-income countries must decide every season whether to sell their crops to local intermediaries whose price varies throughout the growing season according to local, national, or international markets. Due to the lack of futures markets available to these farmers, agricultural organizations, like cooperatives, usually arise as an alternative to the intermediaries, offering not only a fixed price but also additional services such as short-term loans and technical assistance to members, usually in exchange for a membership fee. Cooperatives hedge volatile international prices over time by storing commodities, so their financial sustainability depends on buying enough quantities of commodities every season. Nonetheless, cooperatives usually lack formal enforcement to avoid cooperative members from selling to intermediaries when market prices are higher than the established cooperative price, a phenomenon known in literature as leakage or side-selling Fafchamps (2004).

What makes a cooperative more attractive to sell to than an intermediary? Do producers sell more to a cooperative because it is offering price certainty? Do complementary services such as microcredit and technical assistance impact the sales decision? In good seasons, do producers sell more of their production to a buyer offering a certain price? If a farmer's income is less dependent on the crop sales, do they sell more of their production to the buyer offering a certain price? We answer these questions by conducting a lab-in-the-field experiment with indigenous poor coffee farmers in Chiapas, Mexico.

We contribute to the literature by assessing side-selling experimentally, with a lab-in-the-field experiment, for the first time. Side-selling has been explored before only with non-experimental methods (Wollni and Fischer 2015; Gerard et al. 2021; Mujawamariya, D'Haese, and Speelman 2013). Moreover, we test the predictions of the Expected Utility Theory, specifically the preference for price certainty, and give some intuition about the applicability of other theories explaining producer behavior. Thus, by studying side-selling, a marketing decision separated from the planting decision, our study contributes to both the experimental literature focused in understanding producer behavior (Boyd & Bellemare, 2022) and the literature studying agricultural market failures in the developing world.

The literature has proposed many theories to explain agricultural household behavior, in general, and the appeal of cooperatives, in particular. Wollni and Fischer (2015) propose that producers market their agricultural products like investors choose assets: farmers must choose between a buyer that offers a certain price, that is a "safe asset" with a sure but low return, and a buyer that offers a higher mean but higher variance price that is a "risky asset." Mujawamariya et al. (2013) propose that producers seek out cooperatives because of the complementary services they provide. As in other decisions, like the growing decision, studied by Sandmo (1971), producers' price risk preferences could possibly play a role in marketing decisions. Finally, the income targeting behavior, proposed in the framework of Cumulative Prospect Theory by Tversky and Kahneman (1981), could also play a role.

We use a lab-in-the-field experiment because it allows us to test these competing theories on producer behavior by varying randomly and simultaneously the parameters of the marketing decision: the marketable quantity, the price and volatility of the two buyers, the auxiliary services they provide, and the presence of extra income. Moreover, in this type of experiment, farmers answer to hypothetical situations similar to what they have lived before or can potentially face in the future, which allows us to observe side-selling behavior during many rounds of a decision that in real life only happens once a year. This approach not only allows to recover internally valid results but it proves superior to a randomized control trial which would be unfeasible due to the presence of self-selection into cooperatives and the fact that the selling decision happens only once a year.

Our lab-in-the-field experiment was conducted, individually, with 273 indigenous coffee farmers in Chiapas, Mexico. Participants reside in all ten regions served by the coffee cooperative Yomol A'tel, but nearly half of them were non-cooperative members. Each participant plays 20 rounds of each one of three games and must choose, in each round, how much of their harvested coffee to allocate to each one of two buyers: one that offers a certain price (with different characteristics per game) and another one that offers a variable price (with three different known distributions). In the first game, the certain-price buyer offers a fixed price; in the second, she offers a fixed price and microcredit; and in the third, she is described as a cooperative that offers a fixed price, microcredit, and technical assistance. In every round of all three games, participants face a different combination of the coffee harvest and the mean uncertain price offered by the second buyer. In addition, one-half of the participants randomly receive extra income at the beginning of the experiment which adds to their earnings in each round.

Our results show there is a strong preference for price certainty. In all rounds, the average harvest share allocated to the certain price buyer is above 80%; in 56.1% of rounds, participants allocate all their harvest to the certain price buyer, and 22.0% of participants only allocate their harvest to the certain-price buyer in all three games. Moreover, the results are not significantly different between games, suggesting that the preference for price certainty is more important than the additional services offered when deciding whether to sell to a cooperative. The difference between the mean price of an uncertain-price buyer and the fixed price of a certain-price buyer is not very important in the decision to side-sell and the direction of its effects suggests a portfolio-rebalancing approach, contrary to the predictions of the Expected Utility Theory. Harvest levels are more important in the decision to side-sell: larger harvests decrease the probability to sell all to the certain-price buyer, suggesting an income-targeting behavior (Tversky and Kahneman, 1981). Nonetheless, receiving (experimental) non-farm income does not influence the decision to side-sell. Risk aversion, age, and gender do not make a difference in the decision to side-sell either.

Understanding which characteristics of agricultural cooperatives are more important to farmers and, as a consequence, to maintain cooperative sustainability is even more compelling nowadays. For coffee producers in Mexico, until the global COVID-19 pandemic, these cooperatives could offer a higher price than local intermediaries because they in turn relied on contracts for roasted coffee sales with large-scale buyers further up the value chain. The pandemic upended these contracts, however, and in the past two years, these cooperatives' supply of green coffee has exceeded the demand for roasted coffee. Thus, they have struggled to offer a higher price than local intermediaries. Although members have always sold some coffee to these intermediaries, since the pandemic, these sales have increased. Because the cooperative's price depends on economies of scale, this side-selling decreases the price it can offer even further, creating a moral hazard.

Our paper proceeds as follows. In section 2, we present the design of the experiment. Section 3 describes the data. Section 4 presents the empirical strategy. Section 5 presents the results. Section 6 concludes.

2 Experimental Design

Our lab-in-the-field experiment aims to study the marketing decisions of coffee producers as they choose to allocate their harvest between two buyers, one offering a certain price and another one offering an uncertain price. All participants must be coffee growers and be involved in coffee sales decisions in real life. Participants' main task in the experiment is to allocate their harvest between a certain-price buyer and an uncertain-price buyer, while we vary the certain-price buyer characteristics, the uncertain-price buyer mean price, harvest, and extra non-farm income the farmer receives.

Each participant plays ten rounds of a practice game and 20 rounds of each one of three games, where each round represents a selling period after a harvest. The three games are played in random order and only differ in the framing of the certain-price buyer. In the first game, this buyer is framed as only offering a certain price of 50 MXN per kilogram of coffee. In the second game, it is framed as offering a certain price (50 MXN) and microcredit. In the third game, the certain-price buyer is framed as a cooperative offering a certain price (50 MXN), microcredit, and technical assistance.

In every game, the second buyer is framed as offering an uncertain price with a given distribution. In each round, we randomly vary the price distribution of the uncertain price offered. Specifically, the price mean can take three values: 45 MXN (scenario 1), 50 MXN (scenario 2), or 55 MXN (scenario 3), i.e., below, equal, or above the certain price offered by the other buyer; while the standard deviation of the three distributions is the same. In each distribution, only five prices are possible, and they are 5 MXN or 10 MXN above or below the mean (see Figure 1). The prices are similar to the prices received by the farmers in previous years.

In each round, we also randomly vary the harvest, which can be 2, 4, 6, or 8 quintals (60 kilograms of coffee bags) of coffee, similar to the farmers' actual quantities produced. Moreover, we assess risk-aversion using an Eckel and Grossman (2008) type of lottery with five lottery choices, going from no risk to very risky, which allows us to recover five ranges of constant relative risk aversion (CRRA) coefficients (see Figure 2). This lottery is played either before or after the three games. In addition, half of the participants are randomly assigned 3,000 MXN of extra non-farm income.

A participant starts the experiment by being assigned 3,000 MXN of extra non-farm income or not. Then, the participant answers three arithmetic and probability questions.[1] Next, the order in which the three games and the lottery will be played is randomized, and the games and lottery are played. Within each round, the harvest and the price distribution of the uncertain-price buyer are randomized; afterward, the participant is shown a table that summarizes the possible round payoffs (see 3); with this information, she chooses how much of the harvest to allocate to the certain-price buyer and how much to allocate to the uncertain-price buyer; finally, the actual price and the round payoff are realized. Figure 4 summarizes the overall flow of the game.[2] After the lottery and all rounds of three games are played, participants respond to an end-of-experiment questionnaire that asks about household characteristics, farm production, food security, and other sources of income.

To make sure participants maximize utility and behave in the experiment as they would in real life, they were offered in-kind compensation. Participants' payoffs from every round are accumulated and, at the end of the experiment, they are converted into the dry goods (cooking oil, sugar, laundry detergent, salt, and rice) of their choice.

3 Data and Descriptive Statistics

Data come from individual lab-in-the-field experiments, which design is described in Section 2, conducted with 273 indigenous Tseltal coffee farmers in northeast Chiapas in June, July, and August of 2022. During this period, we scheduled eleven field visits to all the regional centers in

[1] Participants answered these three questions initially designed as filter questions (they should respond correctly to two out of three questions): (1) "What is 40% of 100 MXN?", (2) "If you produce 17 bags of coffee and sell 9, how many remain?", (3) "Imagine that there are 3 blue balls and 7 red balls. You pick a ball at random. Is it more probable that it is red or blue?". However, due to the community approach we took, it seemed inappropriate to exclude anyone from the experiment. The three variables are reported in Table 2 and show that most of the participants would have passed the filter to participate.

[2] All randomization is done with a 12-sided die, except for the extra non-farm income assignment, which is assigned only to participants with even identification numbers.

Figure 1: Buyer 2 Price Distribution

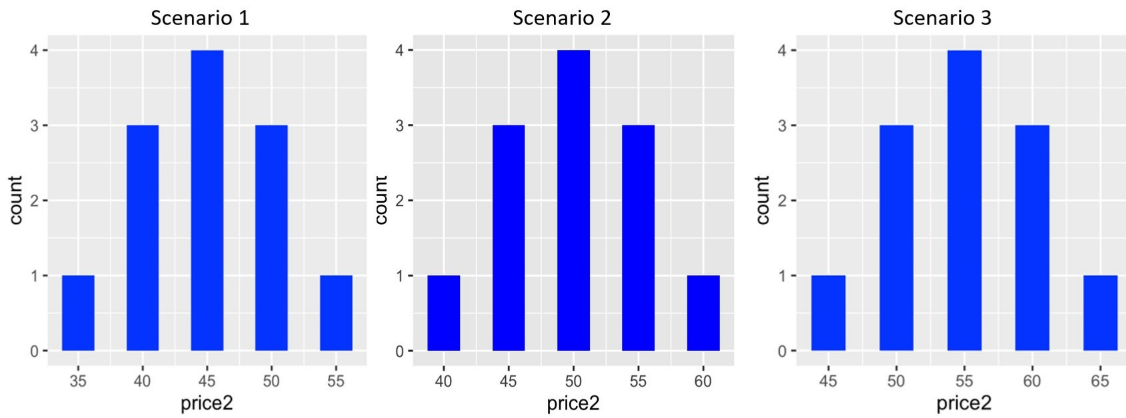


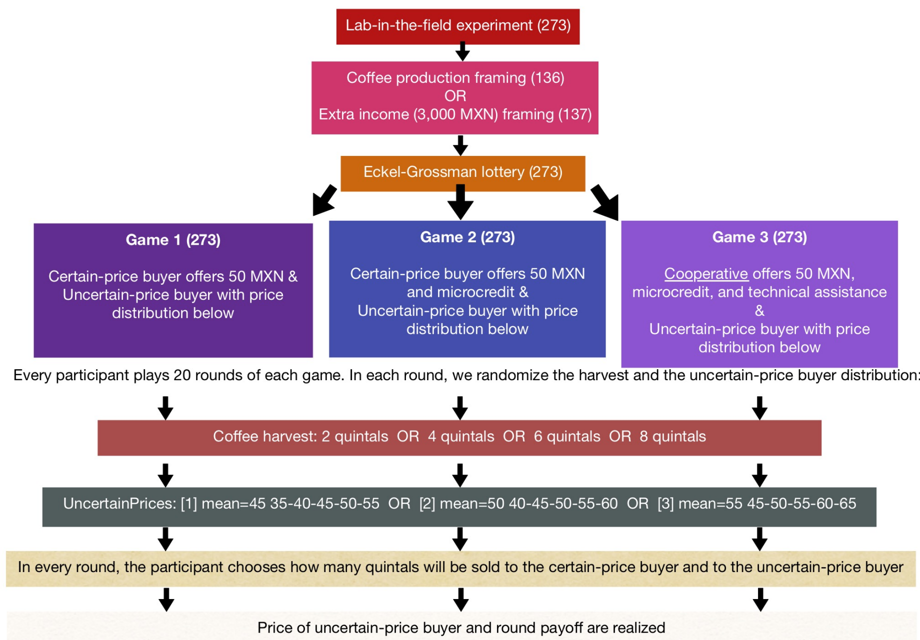
Figure 2: Lottery

Lottery	Event	Probability (%)	Payoff (MXN)
1	A	50%	10,000
	B	50%	10,000
2	A	50%	15,000
	B	50%	7,500
3	A	50%	20,000
	B	50%	5,000
4	A	50%	25,000
	B	50%	2,500
5	A	50%	30,000
	B	50%	0

Figure 3: A Representative Payoffs Table

	Quintals sold to Buyer 1								
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Quintals sold to Buyer 2								
	8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
	Revenue from Sales								
	Revenue from Buyer 2 (50 MXN per Kg.)								
	0	3,000	6,000	9,000	12,000	15,000	18,000	21,000	24,000
Price per Kg. of Buyer 2	Revenue from Buyer 1 (Price per Kg. depends on die result)								
45	21,600	18,900	16,200	13,500	10,800	8,100	5,400	2,700	0
50	24,000	21,000	18,000	15,000	12,000	9,000	6,000	3,000	0
55	26,400	23,100	19,800	16,500	13,200	9,900	6,600	3,300	0
60	28,800	25,200	21,600	18,000	14,400	10,800	7,200	3,600	0
65	31,200	27,300	23,400	19,500	15,600	11,700	7,800	3,900	0

Figure 4: Experiment Flow Diagram



the area served by the Yomol A'Tel coffee cooperative. The field visit dates were announced and arranged through local churches and community centers, so cooperative members and non-members were equally aware of the opportunity to participate. Although farmers self-selected to participate in the experiment, unlike other experiments, our study has extensive geographic coverage, allowing for a better representation of the preferences of the group under study (Tseltal coffee farmers).

Table 1 presents summary statistics at the subject-round level. The table shows that the randomization of price scenarios and harvest was similar across the three games. More importantly, it shows that on average participants allocate 81.8% of their harvest to the certain-price buyer in game 1, 82.3% in game 2, and 81.5% in game 3. Figure 5 shows the distribution of harvest shares allocated to the certain-price buyer in every game. Table 1 also shows that participants choose to allocate all their harvest to the certain-price buyer in 81.8% of rounds in game 1, 82.3% of rounds in game 2, and 81.5% of rounds in game 3.

Table 2 presents summary statistics at the subject level. The table shows that 50.2% of participants received the extra non-farm income and that 47.3% of the participants played the Eckel-Grossman lottery after the three games. Moreover, it shows that 55.6% of the participants choose the most risky lottery. Nearly 75% of the participants know how to read and write. Almost all the participants answer correctly simple questions about percentages and arithmetic, while 74.7% of them answer correctly a question about probabilities. More importantly, 46.9% of participants are members of the Yomol A'tel cooperative. Participants are on average 43 years old, 49.8% are female, and 75.1% of them have completed primary education. Finally, the table shows that participants choose to allocate all their harvest to the certain-price buyer in 81.8% of rounds in game 1, 82.3% of rounds in game 2, and 81.5% of rounds in game 3.

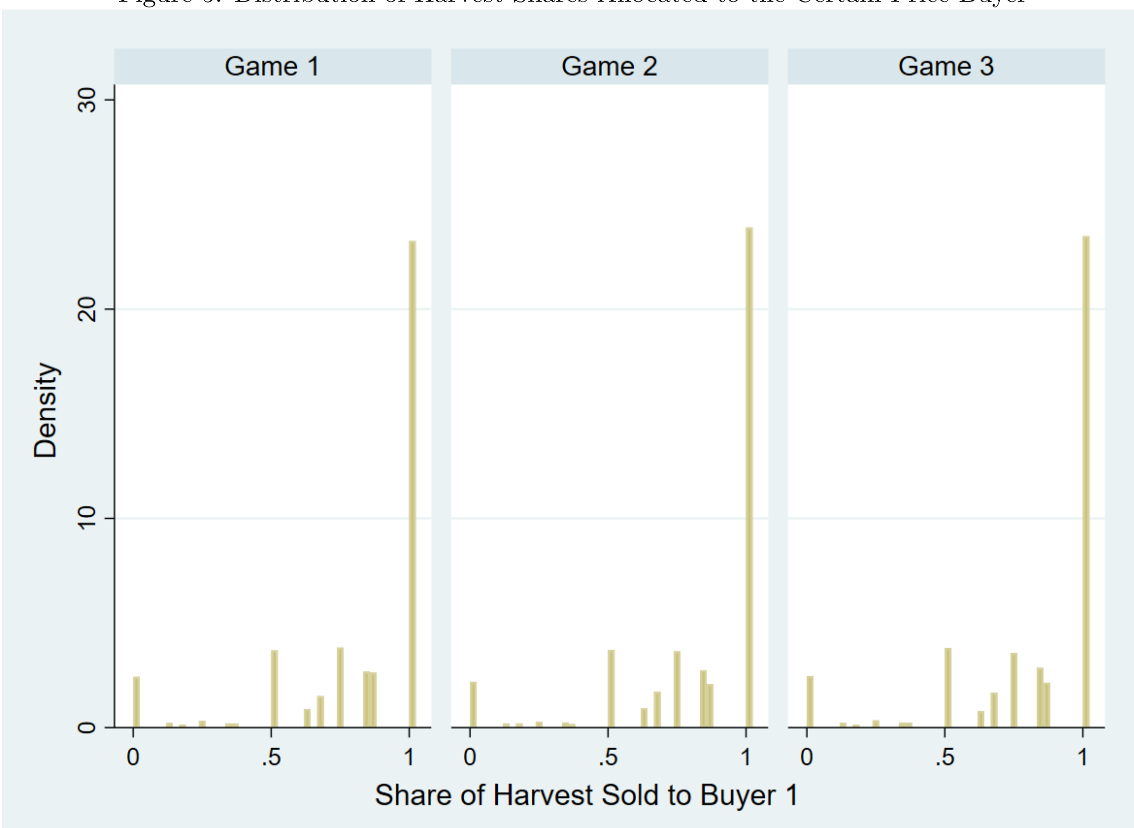
4 Empirical Strategy

We aim to estimate the effect of different mean prices offered by the uncertain-price buyer (above, equal, or below the fixed price offered by the certain-price buyer), harvest quantity, additional services offered by the certain-price buyer, and the presence of extra non-farm income on the share

Table 1: Descriptive statistics at the subject-round level

Round-level variables	Game 1	Game 2	Game 3
Price Scenario 1 (1=Yes)	0.204	0.212	0.202
(Mean price < certain price)	(0.403)	(0.409)	(0.402)
Price Scenario 2 (1=Yes)	0.429	0.426	0.419
(Mean price = certain price)	(0.495)	(0.495)	(0.493)
Price Scenario 3 (1=Yes)	0.367	0.361	0.379
(Mean price > certain price)	(0.482)	(0.480)	(0.485)
Harvest 2 quintals (1=Yes)	0.157	0.155	0.151
	(0.364)	(0.362)	(0.359)
Harvest 4 quintals (1=Yes)	0.197	0.207	0.192
	(0.398)	(0.405)	(0.394)
Harvest 6 quintals (1=Yes)	0.304	0.316	0.326
	(0.460)	(0.465)	(0.469)
Harvest 8 quintals (1=Yes)	0.342	0.322	0.330
	(0.474)	(0.467)	(0.470)
Share to certain-price buyer	0.818	0.823	0.815
	(0.276)	(0.272)	(0.28)
Allocates 100% to certain-price buyer (1=Yes)	0.554	0.569	0.559
	(0.497)	(0.495)	(0.497)
Observations (rounds)	5,460	5,460	5,460
Subjects	273	273	273

Figure 5: Distribution of Harvest Shares Allocated to the Certain-Price Buyer



of harvest allocated to the certain-price buyer. To allow for non-linear effects, we use dummies for the harvest quantities and the mean prices of the uncertain-price buyer distributions. Specifically, we estimate equation 1 separately for each game, using participant fixed effects and clustered standard errors at the participant level.

$$\delta^g_{i,t} = \alpha^g_i + \sum_{s \in \{45,55\}} \beta^{pg}_s I^g_1[p^p_{i,t} = s] + \sum_{h \in \{2,6,8\}} \beta^{qg}_h I^g_2[q_{i,t} = h] + \lambda^g t + \epsilon^g_{i,t} \tag{1}$$

where $\delta^g_{i,t}$ is the share of harvest allocated to the certain-price buyer in game g by participant i in round t. α^g is a constant. I^g_1 is an indicator of whether the (randomly assigned) mean of the price distribution of the private (uncertain-price) buyer p^p is equal to 45 MXN (Scenario 1) or 55 MXN (Scenario 3), while we use the scenario where the mean price of the uncertain-price buyer and the fixed price of the certain-price buyer are equal to 50 MXN (Scenario 2) as the reference case. I^g_2 is an indicator of whether the (randomly assigned) harvest is 2, 6, or 8 quintals, while we use 4 quintals (the average produced by farmers in the study area) as the reference case. λ^g is a linear time trend to control for the effect of round order and ϵ^g is the remaining error.

Similarly, we estimate equation 2 for the pooled sample of all games:

$$d_{i,t} = a_i + \sum_{s \in \{45,55\}} b^p_s I_1[p^p_{i,t} = s] + \sum_{h \in \{2,6,8\}} b^q_h I_2[q_{i,t} = h] + \sum_{g \in \{2,3\}} c_g I_3[g_{i,t} = c] + lt + e_{i,t} \tag{2}$$

where d is the share of harvest allocated to the certain-price buyer by participant i in round t, α is a constant, I_1 is the indicator for the different means of the price distributions of the uncertain-price buyer, I_2 is the indicator of harvest quantity, I_3 is an indicator of the second or the third game, while we use the first game as the reference case, l is the linear time trend, and e is the remaining error.

To show robustness, and to be able to include participant-level characteristics (randomly allocated extra non-farm income and the order in which the three games and lottery were played), we also estimate equation 1 and equation 2 with random effects. Futhermore, we estimate the same equations using additional non-random participant-level characteristics as covariates (risk preference as indicated by the Eckel-Grossman lottery choice, age, and gender). Moreover, we use an additional outcome variable: the dummy that indicates that 100% of the harvest was allocated to the certain-price buyer in a given round.

All the estimated parameters in equations 1 and 2 are causally identified because we randomly assigned the uncertain-price buyer's price distributions, harvest, and extra non-farm income variables in our experiment.

5 Results and Discussion

5.1 Results

Tables 3, 4, and 5 show the estimation results of Equation 1 and Equation 2, where the outcome variable is the share of harvest allocated to the certain-price buyer. Table 3 shows the results using participant-fixed effects and standard errors clustered at the participant level. Table 4 shows the results using random effects, standard errors clustered at the participant level, and adds random participant-level covariates (extra non-farm income and game order dummies). Table 5 shows the results of the same model used in 4 but adding three additional participant-level covariates that were not randomly assigned: lottery choice (a measure of risk aversion), age, and gender.

Table 3 shows that, in game 1, under the uncertain-price buyers' first price scenario (where the mean price is less than the certain price), the share of harvest allocated to the certain-price buyer is 2.6 percentage points significantly smaller than under the second price scenario (where the mean price and the certain price are equal). It also shows that under the third price scenario (where the mean price is greater than the certain price), in game 1, the share of harvest allocated to the certain-price buyer is not significantly different than under the second price scenario. The results are similar for game 2 and game 3, where the share of harvest allocated to the certain-price buyer is 2.7 percentage points and 1.8 percentage points smaller under scenario 1 than under price scenario 2, respectively; and not significantly different under price scenario 3, compared to price scenario 2. Moreover, these results, with very similar point estimates, remain for the specifications presented in Tables 4 and 5.

Table 3 also shows that the share of harvest allocated to the certain-price buyer is 3.1 percentage points smaller when facing a harvest of 2 quintals than when facing an average harvest of 4 quintals in game 1, 2.9 percentage points smaller in game 2, and not significantly different in game 3. The share of harvest allocated to the certain-price buyer when the harvest is 6 quintals is not significantly different than when the harvest is 4 quintals in games 1 and 2. But in game 3 the share of harvest allocated to the certain-price buyer when the harvest is 6 quintals is 1.7 percentage points significantly larger than when the harvest is 4 quintals. The share of harvest allocated to the certain-price buyer when the harvest is 8 quintals is 2.2 percentage points significantly smaller than the base case of a 4-quintal harvest in game 1, 1.9 percentage points significantly smaller in game 2, and 1.4 percentage points significantly smaller in game 3. These results remain, with very similar point estimates, for the corresponding specifications of Tables 4 and 5.

Regarding the participant level variables, Tables 4 and 5 show that the randomly assigned extra non-farm income does not have a significant impact on the share of harvest allocated to the certain-price buyer, in any of the games. Moreover, game order dummies do not have a significant impact and do not affect the main results. Table 5 shows that choosing the most risky lottery, gender and age do not have an impact on the share of harvest allocated to the certain-price buyer either.

Across Tables 3, 4, and 5 the linear time trend (round order) is not significant in any of the three games, nor for the pooled sample. More importantly, when pooling the sample of the three games, specification 4 in Tables 3, 4, and 5 show that the results are not significantly different in games 2 and 3, compared to game 1.

Tables 6, 7, and 8 show the estimation results of Equation 1 and Equation 2 with the dummy indicating whether all harvest is allocated to the certain-price buyer as the outcome variable. Table 6 shows the results using participant-fixed effects and standard errors clustered at the participant level. Table 7 shows the results using random effects, standard errors clustered at the participant level, and adds random participant-level covariates. Table 8 shows the results of the same model used in 7 but adds three non-random covariates (lottery choice, age, and gender).

Table 6 shows that, in game 1 and game 2, when the mean price is less than the certain price, the probability of allocating all the harvest to the certain-price buyer is 2.2 percentage points smaller than when the mean price and the certain price are equal (reference case) and significant at the 5% level. It also shows that under price scenario 3 (where the mean price is greater than the certain price), in game 1 and game 2, the probability of allocating all the harvest to the certain-price buyer is not significantly different than the reference case. In game 3, however, under price scenario 3, the probability of allocating all the harvest to the certain-price buyer is 2.9 percentage points greater than under scenario 2. For the specifications in Tables 7 and 8, the impact of price scenario 1 is only significant at the 10% level in games 1 and 2, and the impact of price scenario 3 remains similar than in Table 6.

Table 6 also shows that the probability of allocating all the harvest to the certain-price buyer is 5.4 percentage points significantly greater when facing a harvest of 2 quintals than when facing an average harvest of 4 quintals in game 1, 5.7 percentage points greater in game 2, and 7.7 percentage points greater in game 3. The probability of allocating all the harvest to the certain-price buyer when the harvest is 6 quintals is 4.2 percentage points significantly smaller than when the harvest is 4 quintals in game 1, 4.8 percentage points smaller in game 2, and 3.0 percentage points smaller in game 3. In addition, when the harvest is 8 quintals, the probability of allocating all the harvest to the certain-price buyer, compared to the reference case (average harvest of 4 quintals), is 9.7 percentage points significantly smaller in game 1, 8.3 percentage points smaller in game 2, and 7.1 percentage points smaller in game 3. All these results, significant at the 1% level, remain with very similar point estimates for the corresponding specifications in Tables 7 and 8.

Tables 7 and 8 show that the randomly assigned extra non-farm income does not have a significant impact on the probability of allocating all the harvest to the certain-price buyer in any of the games. Game order dummies do not have a significant impact and do not affect the main results. Table 8 also shows that choosing the most risky lottery, gender and age do not have an impact on the probability of allocating all the harvest to the certain-price buyer either. Across Tables 6, 7, and 8, however, the linear time trend (round order) increases the probability of allocating all the harvest to the certain-price buyer in 0.2 percentage points in game 1, at the 5% significance level, but it decreases the same probability in 0.2 percentage points in game 2, at the 5% significance level, while it has no significant impact in game 3, nor for the pooled sample. Similar to Tables 3, 4, and 5, when pooling the sample of the three games, specification 4 in Tables 6, 7, and 8 show that the results are not significantly different in games 2 and 3, compared to game 1.

5.2 Discussion

The results for the different uncertain-price scenarios are counter-intuitive. According to the Expected Utility Theory, if the expected (mean) price of the uncertain-price buyer is smaller than a certain price (price scenario 1), and the individual is risk-neutral, she would allocate all the harvest to the certain-price buyer. Similarly, a risk-neutral individual would allocate all the harvest to the uncertain-price buyer if the expected (mean) price is larger than a certain price (price scenario 3). Furthermore, when the average uncertain price and the certain price are equal, a risk-neutral individual is indifferent between allocating any shares of harvest between a certain-price buyer and an uncertain-price buyer (price scenario 2). In addition, nearly half of the participants in our experiment are risk-loving, according to the Eckel-Grossman lottery choice they made. Thus, we would expect that participants, by being risk-loving, would allocate even more of their harvest to the uncertain-price buyer. Nonetheless, participants have a strong preference for price certainty: on average, over 80% of the harvest was allocated to the certain-price buyer, and in more than half of the rounds participants allocated all their harvest to the certain-price buyer. Moreover, the variable indicating the participant is risk-loving is never significant. Also, instead of finding an increase of the share allocated (or of the probability of allocating all) to the certain-price buyer when facing price scenario 1, we find a decrease, compared to the base price scenario 2; and we find no significant results or increases of the share allocated (or of the probability of allocating all) to the certain-price, instead of the expected increase, when facing price scenario 3, compared to price scenario 2.

These results can be explained by the portfolio rebalancing theory proposed by Wollni and Fischer (2015). For example, consider the reference harvest size of 4 quintals for a participant who is inclined to side-sell. In scenario 2, this participant would allocate 3 quintals to the certain-price buyer for a value of 9000 MXN and 1 quintal to the second buyer for a value of 3600 MXN. The total value of the sale of his harvest would be 12600 MXN, with 75% "invested" with the certain-price buyer and 25% "invested" with the uncertain-price buyer. Now consider scenario 1, in which the mean of the price of the uncertain-price buyer drops to 45 MXN. The participant has the same harvest of 4 quintals. The point estimate of 4% above implies that in this situation, the participant will invest 71% with the certain-price buyer for a value of 8520 MXN and 29% with the uncertain-price buyer for a value of 3132 MXN. The total value of the assets is 11652 MXN, and the portion of the value invested with the certain-price buyer and the uncertain-price buyer is 73% and 27%, respectively. If the participant had kept the same asset allocation of 3 quintals with the certain-price buyer and 1 quintal with the uncertain-price buyer in the changed market environment, then the portion of value invested with each buyer would have been 77% and 23%, respectively. Thus, in situations of average harvest, even though the certain-price buyer offers a higher price, participants invest more with the uncertain-price buyer in order to maintain the same value invested with both buyers.

The impact of different harvest levels on the share of harvest allocated to the certain-price buyer does not follow a pattern, but their impact on the probability of allocating all the harvest to the certain-price buyer does. Although the results in tables 3, 4 and 5 for harvests of 2 quintals and 6 quintals, compared to the average harvest of 4 quintals, do not follow a clear pattern, the results show that when the harvest is the largest possible harvest in the experiment (8 quintals), participants sell a significantly smaller share to the certain-price buyer, than when the harvest is 4 quintals, suggesting the presence of income targeting, proposed by Tversky and Kahneman (1981). The presence of income-targeting behavior is clearer when assessing the impact on the probability of allocating all the harvest to the certain-price buyer. Tables 6, 7 and 8 show that a harvest below average (i.e., 2 quintals) increases the probability of selling all to the certain-price buyer, compared to the average harvest of 4 quintals; while the larger the harvest, the more the decrease in the probability of selling all to the certain-price buyer, compared to the average harvest. Furthermore, the increase in the probability of allocating all the harvest to the certain-price buyer when facing a lower-than-average harvest is larger the more additional services the certain-price buyer offers (i.e., from game 1 where no additional services are offered to game 3 where a cooperative offers microcredit and technical assistance); and the magnitude of the decrease of that probability is smaller when facing an above-average harvest. These results suggest not only the presence of income targeting but a slightly higher preference for the certain-price buyer when she offers additional services and it is framed as a cooperative.[3] [4] Nonetheless, the income-targeting behavior is not reflected in the impact of the extra non-farm income randomized among participants: the impact of receiving the extra income is not significantly correlated to the share of the harvest allocated to the certain-price buyer, nor to the probability of selling all the harvest to the certain-price buyer.

Finally, other variables at the participant level are not impacting significantly the share allocated to the certain-price buyer, nor the probability of allocating all the harvest to the certain-price buyer. Age and gender are not significant for any specification in Tables 3−8, against what the previous literature suggested. Also, game order dummies are not significant and do not affect the results, showing that there is no order effect in the experiment.

[3]Note, however, that when using the three-games pooled sample, we find no significantly different results for games 2 and 3, compared to game 1.

[4]The framing of the certain-price buyer was done verbally, while all other randomizations had a visual clue, which might have made the auxiliary services distinction clearer. In real life, microcredit smooths consumption and technical assistance affects harvest quantity.

Table 2: Descriptive statistics at the subject level

Subject-level variables	N	Mean	Std. Dev.
Extra 3000 MXN non-farm income (1=Yes)	273	0.502	0.501
Lottery played after games (1=Yes)	273	0.473	0.500
Lottery preference risk-loving (1=Yes)	270	0.556	0.498
Can read/write (1=Yes)	273	0.744	0.437
Understands percentages (1=Yes)	273	0.993	0.085
Understands arithmetic (1=Yes)	273	1.000	0.000
Understands probability (1=Yes)	273	0.747	0.435
Cooperative member (1=Yes)	273	0.469	0.500
Age	273	43.341	15.667
Education level (1=Primary)	273	0.751	0.433
Gender (1=Female)	273	0.498	0.501
Allocates 100% to certain-price buyer in all rounds (1=Yes)	273	0.212	0.409

Table 3: Impact on Harvest Shares Allocated to the Certain-Price Buyer: Participant Fixed Effects

	Dependent variable:			
	Share of Harvest Allocated to the Certain-Price Buyer			
	Game 1	Game 2	Game 3	All Games
	(1)	(2)	(3)	(4)
Scenario 1 (1=Yes)	−0.026***	−0.027***	−0.018**	−0.024***
	(0.008)	(0.007)	(0.007)	(0.005)
Scenario 3 (1=Yes)	−0.004	0.003	−0.001	−0.002
	(0.006)	(0.006)	(0.006)	(0.004)
Harvest 2 quintals (1=Yes)	−0.031***	−0.029***	−0.014	−0.028***
	(0.009)	(0.010)	(0.010)	(0.007)
Harvest 6 quintals (1=Yes)	0.003	0.004	0.017***	0.008**
	(0.006)	(0.006)	(0.006)	(0.004)
Harvest 8 quintals (1=Yes)	−0.022***	−0.019***	−0.014*	−0.016***
	(0.008)	(0.007)	(0.007)	(0.006)
Linear Time Trend	0.000	−0.000	0.001	−0.001
	(0.001)	(0.000)	(0.000)	(0.000)
Game 2 (1=Yes)				0.006
				(0.005)
Game 3 (1=Yes)				−0.002
				(0.006)
Constant	0.835***	0.840***	0.794***	0.836***
	(0.008)	(0.013)	(0.022)	(0.007)
Game order dummies	Yes	Yes	Yes	Yes
Observations	5,460	5,460	5,460	16,260
Subjects	273	273	273	271
R^2	0.010	0.012	0.010	0.010

Note: Standard errors clustered at the participant level — *p<0.1; **p<0.05; ***p<0.01

Table 4: Impact on Harvest Shares Allocated to the Certain-Price Buyer: Random Effects and Participant-Level Random Covariates

	Dependent variable:			
	Share of Harvest Allocated to the Certain-Price Buyer			
	Game 1	Game 2	Game 3	All Games
	(1)	(2)	(3)	(4)
Scenario 1 (1=Yes)	−0.025***	−0.025***	−0.019**	−0.024***
	(0.007)	(0.007)	(0.007)	(0.005)
Scenario 3 (1=Yes)	−0.004	0.003	−0.001	−0.002
	(0.006)	(0.005)	(0.006)	(0.004)
Harvest 2 quintals (1=Yes)	−0.032***	−0.032***	−0.016*	−0.028***
	(0.009)	(0.010)	(0.010)	(0.007)
Harvest 6 quintals (1=Yes)	0.004	0.004	0.017***	0.008**
	(0.006)	(0.006)	(0.006)	(0.004)
Harvest 8 quintals (1=Yes)	−0.022***	−0.019***	−0.014**	−0.016***
	(0.008)	(0.007)	(0.007)	(0.006)
3,000 MXN extra non-farm income (1=Yes)	0.013	0.000	−0.001	0.004
	(0.026)	(0.026)	(0.027)	(0.026)
Linear Time Trend	0.000	−0.000	0.001	−0.000
	(0.001)	(0.000)	(0.000)	(0.000)
Game 2 (1=Yes)				0.006
				(0.005)
Game 3 (1=Yes)				−0.002
				(0.006)
Constant	0.834***	0.834***	0.756***	0.820***
	(0.046)	(0.055)	(0.061)	(0.051)
Game order dummies	Yes	Yes	Yes	Yes
Observations	5,420	5,420	5,420	16,260
Subjects	271	271	271	271
R^2	0.010	0.012	0.010	0.010

Note: Standard errors clustered at the participant level — *p<0.1; **p<0.05; ***p<0.01

Table 5: Impact on Harvest Shares Allocated to the Certain-Price Buyer: Random Effects and Participant-Level Covariates

	Dependent variable:			
	Share of Harvest Allocated to the Certain-Price Buyer			
	Game 1	Game 2	Game 3	All Games
	(1)	(2)	(3)	(4)
Scenario 1 (1=Yes)	−0.025**	−0.025***	0.019***	−0.024***
	(0.007)	(0.007)	(0.007)	(0.005)
Scenario 3 (1=Yes)	−0.004	0.003	−0.001	−0.002
	(0.006)	(0.005)	(0.006)	(0.004)
Harvest 2 quintals (1=Yes)	−0.032***	−0.032***	−0.016*	−0.028***
	(0.009)	(0.010)	(0.010)	(0.007)
Harvest 6 quintals (1=Yes)	0.004	0.004	0.017***	0.008**
	(0.006)	(0.006)	(0.006)	(0.004)
Harvest 8 quintals (1=Yes)	−0.022***	−0.019***	−0.014**	−0.016***
	(0.008)	(0.007)	(0.007)	(0.006)
3,000 MXN extra non-farm income (1=Yes)	0.014	0.000	−0.001	0.005
	(0.026)	(0.026)	(0.027)	(0.026)
Most risky lottery chosen (1=Yes)	−0.017	−0.002	−0.004	−0.008
	(0.027)	(0.027)	(0.028)	(0.027)
Age in years	−0.000	−0.001	0.000	−0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Gender (1=Female)	−0.009	−0.012	−0.004	−0.008
	(0.028)	(0.028)	(0.029)	(0.028)
Linear Time Trend	0.000	−0.000	0.001	−0.000
	(0.001)	(0.000)	(0.000)	(0.000)
Game 2 (1=Yes)				0.006
				(0.005)
Game 3 (1=Yes)				−0.002
				(0.006)
Constant	0.851***	0.862***	0.760***	0.836***
	(0.064)	(0.072)	(0.077)	(0.068)
Game order dummies	Yes	Yes	Yes	Yes
Observations	5,420	5,420	5,420	16,260
Subjects	271	271	271	271
R^2	0.010	0.012	0.010	0.010

Note: Standard errors clustered at the participant level $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 6: Impact on the Probability of Allocating All Harvest to the Certain-Price Buyer: Participant Fixed Effects

	Dependent variable:			
	Allocates All the Harvest to the Certain-Price Buyer (1=Yes)			
	Game 1	Game 2	Game 3	All Games
	(1)	(2)	(3)	(4)
Scenario 1 (1=Yes)	−0.023**	−0.023**	0.001	−0.012*
	(0.011)	(0.012)	(0.011)	(0.007)
Scenario 3 (1=Yes)	0.012	0.007	0.029***	0.016**
	(0.012)	(0.011)	(0.010)	(0.007)
Harvest 2 quintals (1=Yes)	0.052***	0.058***	0.078***	0.060***
	(0.016)	(0.015)	(0.016)	(0.011)
Harvest 6 quintals (1=Yes)	−0.043***	−0.048***	−0.029***	−0.038***
	(0.014)	(0.012)	(0.011)	(0.009)
Harvest 8 quintals (1=Yes)	−0.097***	−0.084***	−0.070***	−0.075***
	(0.016)	(0.014)	(0.014)	(0.011)
Linear Time Trend	0.002**	−0.002**	0.001	−0.000
	(0.001)	(0.001)	(0.001)	(0.000)
Game 2 (1=Yes)				0.016
				(0.012)
Game 3 (1=Yes)				0.007
				(0.012)
Constant	0.573***	0.663***	0.539***	0.592***
	(0.014)	(0.027)	(0.043)	(0.015)
Observations	5,460	5,460	5,460	16,260
Subjects	273	273	273	271
R^2	0.028	0.028	0.028	0.022

Note: Standard errors clustered at the participant level $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 7: Impact on the Probability of Allocating All Harvest to the Certain-Price Buyer: Random Effects and Participant-Level Random Covariates

	Dependent variable:			
	Allocates All the Harvest to the Certain-Price Buyer (1=Yes)			
	Game 1	Game 2	Game 3	All Games
	(1)	(2)	(3)	(4)
Scenario 1 (1=Yes)	−0.022*	−0.023*	0.001	−0.012*
	(0.011)	(0.012)	(0.011)	(0.007)
Scenario 3 (1=Yes)	0.010	0.006	0.027***	0.015**
	(0.012)	(0.011)	(0.010)	(0.007)
Harvest 2 quintals (1=Yes)	0.054***	0.057***	0.077***	0.061***
	(0.015)	(0.015)	(0.016)	(0.011)
Harvest 6 quintals (1=Yes)	−0.042***	−0.048***	−0.030***	−0.039***
	(0.014)	(0.012)	(0.011)	(0.009)
Harvest 8 quintals (1=Yes)	−0.097***	−0.083***	−0.071***	−0.075***
	(0.016)	(0.014)	(0.014)	(0.011)
3,000 MXN extra non-farm income (1=Yes)	0.038	−0.004	−0.011	0.008
	(0.049)	(0.050)	(0.051)	(0.048)
Linear Time Trend	0.002**	−0.002**	0.001	−0.000
	(0.001)	(0.001)	(0.001)	(0.000)
Game 2 (1=Yes)				0.016
				(0.012)
Game 3 (1=Yes)				0.007
				(0.012)
Constant	0.632***	0.714***	0.552***	0.632***
	(0.073)	(0.085)	(0.093)	(0.077)
Game order dummies	Yes	Yes	Yes	Yes
Observations	5,420	5,420	5,420	16,260
Subjects	271	271	271	271
R^2	0.027	0.028	0.028	0.022

Note: Standard errors clustered at the participant level — *p<0.1; **p<0.05; ***p<0.01

Table 8: Impact on the Probability of Allocating All Harvest to the Certain-Price Buyer: Random Effects and Participant-Level Covariates

	Dependent variable:			
	Allocates All the Harvest to the Certain-Price Buyer (1=Yes)			
	Game 1	Game 2	Game 3	All Games
	(1)	(2)	(3)	(4)
Scenario 1 (1=Yes)	−0.022*	−0.023*	0.001	−0.012*
	(0.011)	(0.012)	(0.011)	(0.007)
Scenario 3 (1=Yes)	0.010	0.006	0.027***	0.015**
	(0.012)	(0.011)	(0.010)	(0.007)
Harvest 2 quintals (1=Yes)	0.054***	0.057***	0.077***	0.061***
	(0.015)	(0.015)	(0.016)	(0.011)
Harvest 6 quintals (1=Yes)	−0.042***	−0.048***	−0.030***	−0.038***
	(0.014)	(0.012)	(0.011)	(0.009)
Harvest 8 quintals (1=Yes)	−0.097***	−0.083***	−0.071***	−0.075***
	(0.016)	(0.014)	(0.014)	(0.011)
3,000 MXN extra non-farm income (1=Yes)	0.038	−0.008	−0.013	0.006
	(0.049)	(0.050)	(0.051)	(0.048)
Most risky lottery chosen (1=Yes)	−0.006	0.050	0.055	0.033
	(0.049)	(0.051)	(0.051)	(0.049)
Age in years	−0.001	−0.001	−0.000	−0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Gender (1=Female)	−0.018	0.018	0.024	0.008
	(0.050)	(0.051)	(0.051)	(0.049)
Linear Time Trend	0.002**	−0.002**	0.001	−0.000
	(0.001)	(0.001)	(0.001)	(0.000)
Game 2 (1=Yes)				0.016
				(0.012)
Game 3 (1=Yes)				0.007
				(0.012)
Constant	0.674***	0.731***	0.525***	0.642***
	(0.113)	(0.119)	(0.128)	(0.112)
Game order dummies	Yes	Yes	Yes	Yes
Observations	5,420	5,420	5,420	16,260
Subjects	271	271	271	271
R^2	0.027	0.028	0.028	0.022

Note: Standard errors clustered at the participant level $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

6 Conclusion

We use a lab-in-the-field experiment with 272 indigenous coffee farmers in Mexico to understand which features of a coffee cooperative are the most attractive to farmers when deciding whom to sell. Our experiment design allows us to test the importance of the difference in prices, harvest levels, non-farm income, and auxiliary services (microcredit, technical assistance, and other services offered by cooperatives) in the decision of side-selling. We contribute to the literature by assessing, for the first time, the side-selling phenomenon experimentally.

Our results suggest, first, that farmers have a strong preference for price certainty: on average, more than 80% of the harvest was allocated to the certain-price buyer, although almost half of them have a risk-loving behavior when playing a lottery a la Eckel and Grossman (2008). Second, the difference between a certain price and the mean of an uncertain price plays a small role in the decision of whom to sell. Moreover, the effects go against the Expected Utility Theory predictions and can be explained by the portfolio rebalancing theory proposed by Wollni and Fischer (2015). Third, harvest levels play a more important role, specifically in the decision of selling all to the certain-price buyer: the larger the harvest, the smaller the probability to sell all to the certain-price buyer, suggesting the presence of income targeting, proposed by Tversky and Kahneman (1981). Nonetheless, receiving (experimental) non-farm income does not influence the decision to side-sell. Fourth, the income targeting behavior slightly decreases the more auxiliary services, besides a certain price, are offered. However, we do not find significantly different results when adding auxiliary services to price certainty (i.e., by game), for our pooled sample. Finally, risk-aversion (the most risk-loving choice in the Eckel-Grossman lottery), age, and gender do not make a difference in the decision to side-sell.

The main limitation of our study is that, like any other experiment, the participants answer hypothetical questions. To overcome this issue, we use previous data for the target population to frame the experiment within harvest and price values that are the closest possible to their real-life experiences.

Our findings also have important implications for policy. Understanding that there is a strong preference for price certainty should make policy-makers aware of the need to provide farmers with less volatile prices, especially in bad harvest years, when price certainty becomes more important. For cooperatives, as for avoiding side-selling, our results suggest that they should focus on maintaining a fixed price for farmers every year, instead of investing more in auxiliary services, which would allow financial sustainability of the cooperative.

7 References

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