Unpacking Side-Selling: Experimental Evidence from Rural Mexico *

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Abstract

With the rise of market-led development, marketing cooperatives have emerged that offer smallholder producers a guaranteed minimum price for their cash crops. Their existence is threatened when members side-sell a part of their harvest to outside buyers. We conduct a lab-in-the-field experiment with indigenous coffee producers in southern Mexico to examine the effect of four factors in the marketing decision: additional income, the presence of microcredit and/or technical assistance, average outside buyer price, and harvest quantity. Our results show that participants allocate on average 82% of their harvest to the certain-price buyer. Changes in harvest quantity and outside-buyer price have minimal effects. The offer of complementary services has a null effect. Moreover, 21% of the participants always allocate their entire harvest to the certain-price buyer. Extra income increases this probability by 11%. Subgroup analysis reveals that this effect is limited to existing cooperative members.

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1 Introduction

Smallholder agricultural producers face a variety of market imperfections that reduce the welfare they receive from the sale of their cash crops: output price volatility, monopsony power by traders, and transaction costs.[1] In many developing countries, state-backed organizations, such as commodity boards, alleviate these market imperfections by providing price insurance and other services to producers. However, in recent years, governments have reduced or eliminated these agricultural support programs. As a result, market-based organizations such as producer cooperatives have emerged in their place. Since they lack state support, however, these producer cooperatives depend on the continued loyalty of their members to finance their services, which often improve welfare over the medium and long term. When members sell a portion of their harvest to outside traders in the short term, this side-selling threatens the economic viability of cooperatives.

Empirical estimates of the incidence of side-selling vary widely: 12% (Keenan et al., 2024; Woldie, 2010; Wollni & Fischer, 2015), 20% (Ewusi Koomson et al., 2022), 30% (Alemu et al., 2021; Arana-Coronado et al., 2019), 40% (Gerard et al., 2021) or 55% (Fischer & Qaim, 2014; Geng et al., 2023). Moreover, the amount of side-selling varies both among producers in the same cooperative and within the same producer over different marketing years. Wollni and Fischer (2015) find that side-selling behavior follows the U-shaped pattern first reported by Fafchamps and Hill (2005) regarding producer marketing decisions. Farmers with low or high production are more loyal to a cooperative. The former cannot pay the fixed cost of side-selling and the latter are not as affected the liquidity constraints that often drive side-selling. In addition, production shocks (Keenan et al., 2024) and liquidity shocks (Geng et al., 2023) can also increase side-selling from one year to the next in the same producer. Finally, risk aversion (Binswanger, 1980), tenure (Bhuyan, 2007), and the presence of complementary services like microcredit or technical assistance (Mujawamariya et al., 2013) are also associated with side-selling.

In this paper, we use a lab-in-the-field experiment to determine the effect of four factors on side-selling: production shocks, income shocks, transaction cost shocks, and nudge reminders of

[1] Thanks to an anonymous reviewer for suggesting that we frame the paper in this way

complementary services. Participants play 60 rounds of a game in which each round corresponds to a marketing year. In a given round, they must allocate their harvest across a certain-price and an uncertain-price buyer [2] In order to estimate the value participants place on the services offered by the certain-price buyer, we vary its description: price insurance; price insurance and microcredit; price insurance, microcredit, and technical assistance. Moreover, we vary the size of the harvest and the average price of the uncertain-price buyer to see the effect of production shocks and transaction cost shocks, respectively, on marketing behavior. Finally, we give half of the participants additional income from another source to see the effect of an income shock. Our experiment integrates the separate sources of variation that prior work has associated with side-selling. To our knowledge, we are the first to use an experiment to study side-selling.

Our results are as follows. First, price certainty matters at both the intensive and extensive margins. At the overall margin, producers allocate on average 82% of their harvest to the certain-price buyer. At the extensive margin, 21% of the producers (58 of 273) allocate their entire harvest to the buyer of a certain price in each round. This estimate of an 18% incidence of side-selling matches the lower bound of the empirical results above. It suggests that in cases where cooperatives offer a fixed price and outside traders over a variable price, side-selling behavior, or its inverse, producer loyalty to cooperatives, is associated with producer risk preferences.

Second, additional income influences side-selling at the extensive margin but not at the intensive margin. At the extensive margin, it increases by 10.8% the probability of selling the entire harvest to the certain-price buyer. At the intensive margin, it does not affect round-level performance. When we estimate the extensive margin of the effect of the additional income separately for cooperative members and non-members, we find significant heterogeneity in the treatment effects: 16.3% for members and 2.5% for non-members. The former effect is significant at the 5% level and the latter is not significant. Two additional analyses give additional information on the mechanisms behind the effect of additional income for cooperative members. First, the treatment effect decreases with the number of years of cooperative membership: for a new member it is 42% and decreases by 3% for each year of membership. Second, the treatment effect increases with risk-aversion, as measured

[2]Thanks to Marc Bellemare for pointing out that technically the uncertain-price buyer is a risky price buyer since the distribution of the outside buyer price is known.

by a no-loss lottery based on Eckel and Grossman (2008). For the least risk-averse members, the effect is 13.5%; for the most, it is 7%.

Third, production shocks affect the marketing decision by at most 3% in either direction. Thus we confirm the U-shaped behavior reported by Wollni and Fischer (2015) and Keenan et al. (2024). Though our point estimates are small, they are similar in magnitude to these results. Finally, nudge reminders of complementary services do not affect the marketing decision. This result differs from that of Mujawamariya et al. (2013) and suggests that behavioral economics may not offer a solution to side-selling Wuepper et al. (2023).

Our results contribute to three distinct strands of literature. First, we contribute to the literature on marketing decisions of agricultural producers. Previous literature has examined the determinants of participation in cooperatives (Bernard & Spielman, 2009; Mojo et al., 2017) and intensity of participation (Bhuyan, 2007; Fischer & Qaim, 2014; Klein et al., 1997; Mujawamariya et al., 2013) using reduced-form models on cross-sectional data sources. Fafchamps and Hill (2005), Woldie (2010), and Wollni and Fischer (2015) propose structural models and test their predictions, once again on cross-sectional data. Instead of the likelihood or intensity of cooperative participation, here we examine the demand for the services that cooperatives typically provide. Our results provide insight into the mechanisms behind cooperative patronage.

Second, we contribute to the literature on the use of experiments to understand producer decision making. Palm-Forster and Messer (2021) provides a recent review of the use of experiments to study the behavior of agricultural producers. Lab-in-the-field experiments are not new, as the pioneering work of Binswanger (1980) demonstrates. However, they are still as relevant today as ever. They improve on the internal validity of the cross-sectional research above at a fraction of the cost of a RCT. Moreover, they allow the study of more variation. Casaburi and Reed (2022) pays bonuses to a random subset of traders to examine effects further down the value chain. We too could have randomly subsidized coffee producers with additional income, but at the expense of losing the three other sources of variation in our experiment. The subsidies alone would have cost as much as the entire budget of our experiment.

Our experiment is most similar to three recent experiments. Bellemare et al. (2020) tests the

prediction of Sandmo (1971) that producers reduce production in situations of price risk and finds that this prediction does not hold. Boyd and Bellemare (2022) both corroborate this finding and also find that the provision of insurance causes producers to increase production in situations of price risk. Mattos and Zinn (2016) finds evidence for the existence of producer reference prices in marketing decisions. These experiments survey a mix of 119 college students and producers, 101 producers, and 75 producers, respectively. Our sample size of 268 producers improves their external validity.

Third, we contribute to the small literature on price risk (Boyd & Bellemare, 2020). In situations of output price risk, Newbery and Stiglitz (1981) propose methods for evaluating the welfare effects of commodity price stabilization programs. Their work and much of the following work focus on the differential effects of such programs depending on whether agricultural households are net buyers or sellers of the good in question (Barrett, 1996; Bellemare et al., 2013; Finkelshtain & Chalfant, 1991). Our situation differs for two reasons. First, coffee is a cash crop, not a staple, so we need not consider the producers' own welfare as a consumer. Second, coffee is usually not stored year by year. Thus, there is no opportunity for arbitrage across growing seasons, like the Kenyan roses that Macchiavello and Morjaria (2015) study.

Our paper proceeds as follows. Section 2 gives background on coffee production worldwide and in Mexico and describes the context where we conducted the experiment. Section 3 describes the design of the experiment and relates it to previous work. Section 4 describes our data and descriptive statistics. Section 5 presents the empirical strategy we use to test the effect of the four additional factors on the marketing decision. Section 6 presents and discusses the results. Section 7 gives policy implications and concludes.

2 Context

In this section, we first describe the situation of smallholder coffee producers in Mexico. Next we describe two different development strategies that have sought to improve the welfare of them and other smallholder farmers in the developing world: state-led development and market-led devel-

opment [3]. We touch briefly on the macroeconomic factors that led to a transition from state-led development to market-led development in the early 1990s. Third, we describe the particular institutional features of our partner cooperative. Finally, we describe the challenge that side-selling poses to the cooperative.

Worldwide, coffee is cultivated on approximately 12.5 million farms. 95% of coffee farmers are no larger than 5 hectares, and 84% only contain two hectares. For many farmers, coffee is their primary cash crop, and thus their annual income depends on two factors: the yield of their harvest and the world price of coffee. Mexico is the tenth largest coffee producer in the world.[4]

Though our analysis focuses on Mexican smallholder coffee farmers, the issues here are not limited to Mexico or coffee. The picture we paint here is broadly similar to the situation of smallholder producers of specialty crops in Latin America and elsewhere who are members of cooperatives (Pitts, 2023). Side-selling has been observed with coffee farmers in Peru (Keenan et al., 2024), coffee farmers in Burundi (Gerard et al., 2021), coffee farmers in Costa Rica (Wollni & Fischer, 2015), banana farmers in Ethiopia (Woldie, 2010), dairy farmers in Kenya (Geng et al., 2023), sorghum producers in Kenya (Nyamamba et al., 2022), and barley farmers in Ethiopia (Alemu et al., 2021). In all of these contexts, cooperatives offer value chain integration and quality upgrading to smallholder agricultural producers but the provision of these services is hindered by producer-members who do not market their output through the cooperative.

2.1 Smallholder Mexican Coffee Production

Our setting is a group of indigenous Mexican coffee producers in the state of Chiapas in southern Mexico. Coffee is the primary cash crop for these producers. They typically produce 4 quintals (240 kilos) on 1-2 hectares of land and sell their coffee for 70-80 pesos (approximately $3.50 US) per kilo. Thus, they earn around $1000 USD, which they use to purchase everything they do not grow for themselves [5] Typically, they grow corn and vegetables for their own production.

Coffee has been grown in Mexico since the nineteenth century (Bobrow-Strain, 2007). Initially,

[3] We are grateful to the lead article in a special issue of *Food Policy* for this distinction (Markelova et al., 2009)
[4] Wright et al. (2024) gives a recent systematic literature review.
[5] This profile comes from previous work in this region by Pitts (2019)

Mexican peasants worked as hired labor on large coffee plantations. In the early twentieth century, as a result of the land redistribution associated with the Mexican Revolution (1910-1920), these smallholder producers received their own plots of land, nearly all of which were less than 5 hectares.

Green coffee is only the first stage in the coffee value chain. Figure 1 provides a high-level overview of the entire coffee value chain. A smallholder farmer sells to a local intermediary (either a village trader or in our case, a coffee cooperative). This local intermediary in turn sells to a national intermediary. Finally, that national intermediary sells to a multinational corporation.

Smallholder coffee producers face substantial output price volatility at the first level of the value chain. Because of this output price volatility, they do not produce an optimal amount of coffee. In addition, they do not make long-term investments in coffee production through quality improvement that would allow them to increase the welfare they receive from coffee production. The past hundred years have seen two different approaches to improve the welfare that smallholder coffee producers receive from their harvest: state-led and market-led development.

2.2 State-Led Development for Mexican Coffee Producers

In the first approach, state actors provided increased support for small-holder coffee farmers as coffee production developed in Mexico through the early and middle of the twentieth century. At the international level, in 1962 the coffee producing nations of the world formed the International Coffee Organization in order to stabilize the world market for coffee after a series of boom-bust cycles. With the establishment of the ICO, a series of agreements (the International Coffee Agreement) used export quotas to stabilize the international price of coffee. These agreements lasted until the collapse of the ICA in 1994.

At the national level, in 1973 the Mexican government founded a state agency to support coffee farmers (the Mexican Coffee Institute) (Renard & Breña, 2010). This agency provided direct support to coffee farmers, subsidized inputs, technical assistance, and a guaranteed purchase price. In turn, it helped Mexican coffee farmers sell their coffee internationally for almost twenty years.

The life cycle of the Mexican Coffee Institute overlapped with the external debt crisis faced by Mexico and other Latin American countries during the 1980s. As part of the Baker Reforms

in 1986, Mexico agreed to reduce the level of agricultural support for domestic producers in order to receive international financing to cover its external debt. As a result, beginning in 1990, the administration of Mexican president Carlos Salinas phased out the Mexican Coffee Institute as part of a larger series of market-based reforms. Since then, Mexican smallholder coffee producers have been exposed to the international price of green coffee from the commodity markets. Figure 2 shows the price per kilogram of green coffee in US cents from 1990 to the present.

2.3 Market-Led Development for Mexican Coffee Producers

With the elimination of the Mexican Coffee Institute, producer cooperatives emerged in Mexico in the 1990s that provide the same services to smallholder farmers: a guaranteed purchase price, technical assistance, and microcredit (Folch & Planas, 2019). These cooperatives are often associated with the fair trade movement (Dragusanu et al., 2014). In addition, they frequently promote organic farming practices. Typically, members have three years from joining the cooperative to adopt organic farming practices.

Producer cooperatives improve the welfare of coffee farmers by taking advantage of upstream contracts in the value chain. These contracts use economies of scale to spread the fixed marketing costs faced by smallholders across a larger sales volume to reduce the per-unit costs. With the additional savings, cooperatives can finance the guaranteed purchase price, as well as complementary services such as microcredit and technical assistance.

The ability of producer cooperatives to finance complementary services depends on a guaranteed volume of green deliveries from members, They finance their services —the guaranteed purchase price, technical assistance, and the provision of credit —through upstream contracts with buyers. As a condition of membership, these cooperatives often require that their members sell all their coffee through the cooperative.

2.4 Our Partner Cooperative: Batsil Maya

Producer cooperatives provide a variety of services and operate in a variety of ways, so we describe the particular way our partner cooperative operates and the particular services it provides.

The producer cooperative Batsil Maya has existed since 2000. It has evolved to provide price insurance, emergency loans, and technical assistance to its producer members. In October, at the beginning of each marketing year, the executive board of the cooperative sets the purchase price for the coming year. The members of Batsil Maya agree to deliver their coffee to the cooperative during the harvest season. Unlike other cooperatives, which pay their members at the end of the marketing year, Batsil Maya pays on delivery. Local intermediaries or traders are also active in the region. They compete with Batsil Maya and buy coffee at the world price, which varies daily, as Figure 2 indicates. Though Batsil Maya stipulates that its members market their coffee through the cooperative, it cannot enforce this requirement. Thus, when local traders offer a higher price than Batsil Maya, members face the temptation to market their coffee through these local traders instead of the cooperative.

Figure 3 shows the Batsil Maya price and the world price for the past five marketing years. Figure 4 summarizes administrative data to show the number of members who delivered their coffee to Batsil Maya in each marketing year and the total amount of coffee delivered.

In the marketing year after the pandemic, the world price of coffee (and thus the price offered by local traders) increased above the price offered by the cooperative for an extended period of time. First, a decrease in demand among the cooperative's customers left it with excess inventory and reduced the price it could offer the following year. Second, higher transaction costs and labor issues across the worldwide coffee industry caused an increase in the market price and thus the price of the local intermediary.

Nevertheless, coffee deliveries decreased by half during 2021 and 2022, a phenomenon that affected the viability of the cooperative. Figure 5 shows that more of the decline occurred in the intensive margin than in the extensive margin. Although the total number of members who delivered coffee to the cooperative decreased, many members continued to deliver coffee to the cooperative, but substantially reduced the amount of coffee they delivered. Because members do not disclose the total amount of their coffee harvest to the cooperative, the cooperative cannot know whether members are side-selling or how much they are side-selling.

In order to continue serving its members, the cooperative sought external financing to increase

the price it could offer its members. By 2023, the world price of coffee declined, and so cooperative members no longer faced a temptation to side-sell. However, the cooperative partnered with us to understand more deeply the causes of side-selling behavior and explore potential policy responses to a future situation where the price of the world market exceeds the price of the cooperative.

3 Experimental Design

3.1 Experiment Overview

In this section, we describe our experimental protocol that examines the marketing decision of coffee producers. As discussed in Section 2, we present participants with a simplified version of the marketing decision they face in real life. Within the taxonomy of field experiments, our experiment is an framed field experiment (Harrison & List, 2004) or a lab-in-the-field experiment (Eckel & Londono, 2021) because we invite members of the target population to replicate a concrete task that they perform in their daily lives. We simplify the decision in four ways to better understand the core mechanism at work.

1. Ideally, any side-selling by members would be punished by expulsion from the cooperative. Thus the cooperative would be able to force its members to always deliver their entire harvest to the cooperative. This sort of punishment is infeasible for two reasons.

   (a) First, in this region, as in many regions with a substantial population of smallholder producers, nearly all of the cooperative members have social ties that stretch back for generations. Punishing members who side-sell would negatively affect these ties in ways that would spill over to religious, cultural, or other economic interactions.

   (b) Second, the cooperative does not record the total harvest of members, so they cannot verify the fraction of members' harvest that they are marketing through the cooperative. For this reason, we model side-selling as an isolated decision that producer members make independently each year.

2. Many estimates of side-selling in the literature come from contexts with variation in the timing of payment. Smallholder producers may choose between a local trader that will pay them immediately and a cooperative that pays them at the end of the growing season. In this case, a producer's time preferences would influence the decision to side-sell. To eliminate this potential confounder, in our experiment, participants are paid immediately by both the certain-price and the uncertain-price buyer

3. The presence of transaction costs also varies depending on the context In some contexts, producers who side-selling to a local trader incur a fixed cost compared to selling to the cooperative. In other contexts, producers who sell to the cooperative incur a fixed cost compared to selling to the local trader. To consider both situations, we vary the mean of the uncertain price buyer either above, below or the same as the certain price buyer. These three options correspond to contexts where there is a fixed cost to side-selling, no fixed cost to either marketing decision, or a fixed cost to selling to the cooperative.

4. Finally, institutional arrangements with respect to complementary services vary tremendously. In some contexts, local traders provide microcredit and possibly even technical assistance. In other contexts, only cooperatives provide these services. In addition, institutional arrangements vary in terms of eligibility for either of these services. The strictest possible arrangement would restrict complementary services to cooperative members. Spillover effects among neighbors, some of whom are cooperative members, and others are not, often prevent the enforcement of this sort of restriction. Thus we just provide nudge reminders as used by recent literature in behavioral economics (e.g. Wuepper et al. (2023) to test for the effect of the provision of these services.

In the experiment, participants market their coffee sixty times over three games of twenty rounds apiece. Through these sixty rounds, we vary four factors to determine their effect on the marketing decision.

1. Half of the participants receive **additional income** at the start of the experiment that increases their earnings in every round of the three games they play.

2. By game, we vary the presence of **complementary services**: a certain price (game 1); a certain price and microcredit (game 2); a certain price, microcredit, and technical assistance (game 3). All participants play all three games in a random order.

3. By round, we vary the **harvest size of the participants** and the **mean price of the uncertain-price buyer**. All participants play 20 rounds of each game.

The experiment has six steps. We describe each step conceptually in detail below: both the antecedents in the literature and the practical details in our experiment. In Section 4 we introduce the notation for the different pieces of the experiment and provide the payoff function.

1. Additional Income Treatment
2. Preliminary Activities
3. Eckel-Grossman Lottery
4. Order of Games
5. Each Game
6. Final Activities

3.2 Additional Income Treatment

At the beginning of the experiment, half of the participants receive 3000 MXN in fake money that serves as additional income in each round of the three games and contributes to their overall earnings. The treated participants are selected based on their identification number within the sample: participants with odd numbers receive the money and participants with even numbers do not receive the money.

The additional income in the game is meant to proxy for the real-world effect of income from another source, e.g. the sale of another cash crop, income from off-farm labor, or support from a Mexican government program. We choose a comparable amount (3000 MXN) to what producers could conceivably earn from these sources in a month.

1. **Another cash crop**. The main alternative cash crop in the region is honey. According to records from a honey cooperative in the region, producer members earned on average 20000 MXN from honey sales during the three and a half months of the honey season the year before the experiment, or just under 6000 MXN per month.

2. **Income from off-farm labor**. Similarly, weekly pay is 1500 MXN in manufacturing plants on the US/Mexico border, where many producers report migrating seasonally. With one to two months of work, minus expenses, a producer could earn about 6000 MXN.

3. **Support from a Mexican government program**. Finally, participants in this region are eligible for a Mexican government agricultural support program (Sembrando Vida), in which smallholder farmers can earn up to 6000 MXN per month by planting trees on their land parcels (*Reglas de Operación Del Programa Sembrando Vida*, 2022).

Randomly assigning this treatment allows us to determine the effect of additional income on the marketing decisions of participants who receive it. To our knowledge, we are the first to experimentally test the effect of additional income on the marketing decision of a cash crop. Pfeiffer et al. (2009) examined the effect of additional income on the decision to produce cash crops and found that additional income causes producers to increase production in the presence of a credit market failure because they use it to finance the purchase of production inputs. Woldeyohanes et al. (2017) find that farmers market less of staple goods in the presence of off-farm income in order to keep a food reserve and insure consumption. Here, there is no benefit to keeping a reserve of coffee to sell in a subsequent year since there is no storage in the game. Any effect of the additional income will indicate deviation from purely profit-maximizing behavior. Wollni and Fischer (2015) hypothesize that non-agricultural income will increase member deliveries to cooperatives. In their model, however, cooperatives deliver patronage refunds at the end of the marketing year, so the non-agricultural income merely allows for consumption smoothing across time periods.

3.3 Filter Questions

After receiving their treatment assignment, the participants answer three preliminary arithmetic and probability questions. We use questions similar to those in (Boyd & Bellemare, 2022).

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?

These questions allow us to determine if side-selling behavior is associated with poor multiplication, subtraction, or probability skills. Originally, we intended to exclude participants who missed more than one of the questions. However, based on the guidance of our implementing partner, we did not exclude any participants due to local social norms. The three variables are reported in Table 3 and show that almost all the participants would have qualified to participate.

Next, the order in which the three games and the lottery are played is randomized by a roll of a 12-sided die. Table 4 shows the results of this randomization. Half of the participants complete the lottery before the three games and the other half complete it after the three games.

3.4 Eckel-Grossman Lottery

Participants complete an Eckel-Grossman lottery to measure their risk preferences. Eckel and Grossman (2008) propose a simple task for measuring risk preferences similar to that of Binswanger (1980, 1981). Subjects choose one of five gambles, each with a low payoff and a high payoff that occur with 50% probability. The gambles are increasing in both expected payoff and risk, as measured by the standard deviation between the two payoffs. After subjects choose their preferred gamble, they roll a die and receive the corresponding payoff.

An advantage of the Eckel-Grossman lottery compared to other lotteries such as Holt and Laury (2002) is its simplicity (Charness et al., 2013). This simplicity allows its use in other settings in Latin America with a population similar to our indigenous coffee growers (Cardenas & Carpenter,

2013; Moya, 2018). Moreover, despite its simplicity, the subject's choice of gamble can be used to estimate his or her risk preferences in the form of a CRRA parameter of the power utility function $U(x) = x^{(1-r)}/(1-r)$.

Table 2 shows the Eckel-Grossman lottery that we present to our participants. The authors provide two sets of gambles: one with negative payoffs (to test for loss aversion) and one without. For simplicity, we use the no-loss lottery and scale the payoffs ($16 = 10000 MXN) so that the first gamble has a guaranteed payoff of 10000 MXN. We choose 10000 MXN because it is the average payoff in a round of the game (4 quintals · 60 kilos per quintal · 50 MXN per kilo = 10000 MXN).

3.5 The Presence of Complementary Services

After the preliminary activities, participants complete 10 rounds of game 1 for practice. The results of this practice game are not recorded [6]. Next they complete games 1-3 in a random order. The games vary the framing of the certain price buyer by describing two complementary services that the participant could have received last year from the buyer. In addition, in the third game the certain price buyer is described as a cooperative.

Game 1 Certain price buyer offers a fixed price of 50 MXN per kilo.

Game 2 Certain price buyer offers a fixed price of 50 MXN per kilo **and gave the participant microcredit in the past year**.

Game 3 **A cooperative** offers a fixed price of 50 MXN per kilo **and gave the participant microcredit and technical assistance last year**.

Microcredit and technical assistance are provided by the cooperative that operates in this region. Their welfare-enhancing effects are confirmed by a recent systematic review (Liverpool-Tasie et al., 2020). Providing these services, however, imposes additional costs on the cooperative that lower the guaranteed minimum price they can offer members for their coffee. Here we are interested in whether the producers value these services enough to market at least a fraction of their coffee

[6] Because of enumerator error, some of the participants did not complete the practice game

through a buyer that offers these services even if they could earn more by marketing it through a buyer that does not.

3.6 Harvest Quantity

Each round corresponds to a marketing year. At the beginning of the round, the producer's harvest quantity for that year is determined randomly by the roll of a 12-sided die. Each of the four possibilities for the quantity of harvest —- 2, 4, 6, or 8 quintals – appears with equal probability (25%). A quintal is a local unit that corresponds to 60 kilos of green coffee. Once the harvest quantity is realized, participants receive a corresponding number of miniature burlap bags.

Under a profit-maximizing framework, harvest quantity should not impact the marketing decision. Profit-maximizing producers should sell their entire harvest to the buyer who gives them the best price. However, previous studies indicate that quantity affects the marketing decision; moreover, it affects it differently for poor producers and rich producers. Fafchamps and Hill (2005) examine the binary decision to sell coffee at the farmgate or market by Ugandan coffee producers. They find a U-shaped relationship: the very poor and very rich are more likely to sell at the farmgate, because of lack of transportation for the former and a higher opportunity cost of time for the latter. Wollni and Fischer (2015) also allow producers to allocate their coffee harvest across two buyers. They too find a U-shaped relationship between farm size and coffee deliveries. Initially, the relative profitability of marketing to outside buyers increases with farm size and so farmers with medium-size farms sell more to outside buyers. As farm size continues to increase, however, the discount rate for patronage refunds decreases as well because larger farmers have more access to other sources of income to insure, consumption, however. Thus large farmers sell a smaller share of their harvest to outside buyers than medium-sized farms.

3.7 Certain vs Uncertain Price Buyer

In each round, producers are told that a certain price buyer offers them 50 MXN per kilo for their coffee and that an uncertain price buyer offers them a randomized price for their coffee harvest. The description of the certain price buyer is varied according to the description above.

They allocate their harvest between the certain price and the uncertain price buyer. Before the allocation decision, the mean price of the uncertain price buyer is randomized: below (45 MXN), the same (50 MXN), or above (55 MXN) the price of the certain price buyer. Figure 7 shows the three possibilities. In all three situations, there are five possibilities assigned to the twelve faces of the die. The mean appears four times; the next values above and below the mean three times apiece; and the leftmost and rightmost value one time. This allocation allows the roll of a die to approximate drawing from a normal distribution.

Once the mean price of the uncertain price buyer is revealed, producers allocate their coffee harvest between the two buyers in increments of one quintal. They must sell the entire harvest and cannot store coffee for subsequent rounds. They are shown a payoff table, such as the table in figure 7 specific to the coffee harvest and the distribution of the uncertain price buyer of their particular round.

Under an expected utility framework, a risk-neutral producer would sell the entire harvest to the certain price buyer (50 MXN) in the first situation (45 MXN), be indifferent in the second situation (50 MXN), and sell the entire harvest to the uncertain price buyer in the third situation (55 MXN). Notably, in all three situations, depending on the realization of the price of the uncertain price buyer, a producer could potentially make more revenue selling to the uncertain price buyer.

Producer's allocation decisions reveal their risk preferences. Examining allocation decisions in the situation where the mean of the uncertain price buyer is 50 MXN, the same price offered by the certain-price buyer, allows us to determine producers' preferences for price certainty. Adding the other two situations tests the effect of small changes in the market environment on these preferences. For example, these changes could reflect transaction costs.

Participants allocate their coffee harvest between the two buyers. Next, they learn the price that the uncertain price buyer gave them. It is revealed by the roll of a die. Finally, they learn their earnings for the round, including the additional income if applicable.

Final Activities Those participants that did not complete the Eckel-Grossman lottery before the three games complete it now. All participants complete an exit survey with socio-demographic information.

Compensation We compensate participants based on their performance in the experiment. At the advice of our implementing partner, we do not give cash payments, in order to distinguish ourselves from the representatives of the Mexican government who distribute various support programs. Rather, we provide vouchers redeemable on-site for dry goods: a bottle of cooking oil, laundry detergent, a bag of sugar, a bag of salt, or a bag of rice. Each voucher corresponds to earnings of 250000 MXN in the game. Participants can earn between three and six vouchers. The possible compensation is nearly the same for treated and non-treated participants. Recall that treated participants receive 180000 MXN of additional income across sixty rounds. At most, they receive one voucher more compared to a counterfactual scenario with identical performance in the game but without the treatment.

This compensation fulfills the three criteria proposed by Eckel and Londono (2021). It is *monotonic* because participants who do better in the game receive more compensation. It is *salient* because participants understood how their actions in the experiment translated to their level of compensation. It is *dominant* because the market value of these products corresponded to the opportunity cost of a day's wages that participants gave up to participate in the game.

4 Data and Descriptive Statistics

4.1 Sample Selection

Data come from individual lab-in-the-field experiments that we conducted with 268 indigenous coffee farmers in northeast Chiapas in summer 2022. During this period, we scheduled eleven field visits to eight of the ten regional centers in the area served by the Batsil Maya coffee cooperative. For logistical reasons, we were unable to visit two of the regions. 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. At three regional centers, more participants volunteered than we could accommodate in a single day, so we returned for a second day to those sites in order to accommodate all participants. After all field visits were completed, we used the Batsil Maya cooperative membership roster to determine which participants came from

families that marketed their coffee through the cooperative and classified them accordingly. Table 1 gives an overview of the field visits and a breakdown of the number of cooperative members and non-members who participated in the experiment at each regional center.

We discuss briefly the external validity of the study. The external validity of our study refers to the extent to which results are representative of those of the population under study, indigenous coffee farmers. Frijters et al. (2015) found selection bias into an artefactual field experiments in rural China. We try to minimize any possible selection bias here for the following reasons:

1. Any coffee grower can participate in the experiment. We do not allow more than one individual from the same family to participate due to the limited amount of dry goods we bring on the field visit for compensation.

2. Participation is not associated with on-farm economic opportunities. We conduct the experiments in the summer between the planting season and the harvest season. Their coffee harvest would not be affected if they neglect it for one day to participate in the experiment. Similarly, it is unlikely that their neighbors would request their help with their coffee fields at this time. Thus there is no social or financial opportunity cost to participating in the experiment.

3. Participation is not associated with off-farm economic opportunities. Though some indigenous in this region internally migrate to work off-farm in the summer months, whole families do not. Thus if one member of a family is away pursuing off-farm work, then a family can send another member to participate. In fact, some did.

4. Our sample of 268 farmers is larger than the sample for similar experiments. It is slightly larger than Binswanger (1980), who surveyed 240 Indian farmers, and it is considerably larger than Mattos and Zinn (2016), who surveyed 75 grain producers in Manitoba; Bellemare et al. (2020), who surveyed a combination of 119 US undergraduates and Peruvian potato farmers; and Boyd and Bellemare (2022), who surveyed 101 Peruvian potato farmers.

The external validity of our study also includes the extent to which our results generalize to other populations. As we describe in more detail in Section 2, this population of Chiapas coffee

farmers is representative of coffee farmers worldwide, most of whom are smallholders. In addition, with the breakdown of the International Coffee Agreement, cooperatives are operative in coffee-producing regions around the world with a variety of institutional arrangements. The literature on side-selling shows that weak enforcement of cooperative rules is common. Moreover, cooperative struggle to compete with local traders as they provide value-added services.

4.2 Descriptive Statistics at the Subject Level

Table 3 presents summary statistics at the subject level. The first group of characteristics comes from the exit survey that participants complete after the experiment. All participants grow coffee and 74% report being able to read and write. The sample is evenly balanced between men and women. The mean age of participants is 44 years old with a standard deviation of 16 years old. In addition to gender, we also report the education level of participants. Mexico requires nine years of compulsory education: six of primary school and three of secondary school. Most participants (75%) report only a primary school education. 14% report only a middle school (secondary school) education. 10% have completed high school (preparatory school) as well.

The second group of characteristics comes from administrative data from the cooperative. As we mention above, after completing all of the field visits, we matched participant names to the Batsil Maya cooperative member roster to label 126 participants as cooperative members. For 124 of these members, the cooperative could provide us with the number of years in the period 2013-24 that these members delivered coffee to the cooperative. We use this value to measure members' loyalty to the cooperative.

The third group of characteristics come from the preliminary activities: filter questions, treatment assignment, and lottery. Participants answer three preliminary questions before participating in the experiment to assess their understanding of basic mathematical concepts. Section 3.3 gives more information. All 268 answer the arithmetic question correctly, 266 answer the percentage question correctly, and 200 answer the probability question correctly. After the preliminary questions, they are randomly assigned 3000 MXN extra non-farm income. We see an equal number of treatment (n=134) and control (n=134) participants.

After the preliminary activities, participants complete three games of 20 rounds apiece. The games differ in how they frame the certain-price buyer. Section 3.5 gives more information. We randomize game order and lottery placement using a 12-sided die. Table 4 shows the results of this randomization.

Participants complete an Eckel-Grossman risk preference elicitation lottery either before or after the games. Section 3.4 gives more information. Eckel and Grossman (2008) find gender differences in lottery preferences. Men's preferences are right-skewed with the highest preference for gamble 5. Women's preferences follow a normal distribution with the highest preference for gamble 3. In contrast, we do not find gender differences in lottery preferences. Figure 8 shows participant gamble choices broken down by gender. In our results, men and women display the same preferences with the highest preference for gamble 5.

4.3 Descriptive Statistics at the Subject-Round Level

Table 5 presents summary statistics at the subject-round level. In each round, the size of the participant's harvest and the mean of the price offered by uncertain price buyer both vary randomly according to a role of a 12-sided die. We code both of these experimental variables as dummy variables with four and three possibilities, respectively. Perfectly randomized experimental variables would exhibit means of 0.25 for the harvest and 0.33 for the mean of uncertain price buyer. Our sample slightly favors a harvest of 6 or 8 quintales and a Mean of Uncertain Price Buyer of 50 MXN because of physical idiosyncrasies with the die.

4.4 Outcomes of Interest

The outcome of interest is the share of the harvest that participants allocate to the certain price buyer in each round of the experiment. We compute it as follows. Let i denote the participant, $g \in \{1, 2, 3\}$ denote the game, and $t \in \{1, 2, \ldots, 20\}$ denote the round. In each round, participants learn the size of their harvest, $q^g_{i,t} \in \{2, 4, 6, 8\}$, and the mean price of the outside buyer $p^{pg}_{i,t} \in \{45, 50, 55\}$. They choose how many quintals $z^g_{i,t} \in \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$ to allocate to the certain price buyer. We compute the share as $\delta^g_{i,t} = z^g_{i,t}/q^g_{i,t}$.

When we pool all three games across the same participant, the notation above changes slightly. Here we denote the round as $1 \leq t \leq 60$ and drop the g superscript from the harvest and outside buyer price, so they are $q_{i,t}$ and $p^p_{i,t}$ respectively. The participant's choice is $z_{i,t}$. We compute the share as $d_{i,t} = z_{i,t}/q_{i,t}$ For round-level regressions, our outcome of interest is precisely the game-level allocation $\delta^g_{i,t}$ or the pooled allocation $d_{i,t}$. Pooling the allocations does not change their cardinal values. It just maps them from $\delta^g_{i,t}$ space where $g \in \{1, 2, 3\}$ and $t \in \{1, 2, \ldots, 20\}$ to $d_{i,t}$ space where $t \in \{1, 2, \ldots, 60\}$. Table 5 gives descriptive statistics for this outcome.

For the subject-level regressions, we aggregate the pooled subject-round allocation $d_{i,t}$ across rounds as follows. Because one quarter of the sample (n=58) allocate their entire harvest to the certain price buyer in every round, we break down the total margin into the extensive and intensive margin so that we can analyze them separately. Table 3 gives descriptive statistics for these outcomes.

1. The **overall margin** is the average allocation for a participant over 60 rounds, or $d_i = \frac{1}{60}\sum_{t=1}^{60} d_{i,t}$.

2. The **extensive margin** is an indicator variable of whether the participant allocates their entire harvest to the certain-price buyer in all rounds, or $\bar{d_i} = I[d_i = 1]$.

3. The **intensive margin** is the average allocation of those participants who do not allocate their entire harvest to the certain-price buyer in all rounds.

Figure 12 presents a histogram of the overall margin broken down into participants who received the 3000 MXN additional income treatment and those who did not. The left shift in the allocation of the additional income group suggests that the treatment is associated with a decrease in the overall margin.

Figure 13 presents a histogram of the overall margin broken down by cooperative membership status. The right shift in the allocation of the non-members suggests that cooperative membership status is associated with an increase in loyalty to the cooperative and a decrease in the incidence of side-selling.

4.5 Payoff Function

We put the payoff function of the experiment below. We suppress the i subscript for each participant and consider the arrangement of the data where the three games are pooled together into sixty rounds per individual. Each round is denoted by t. In round t, the harvest quantity is denoted by q_t, the price of the outside buyer by p_t^p, and the fraction of the allocation to the certain-price buyer by δ_t. The payoff of the Eckel-Grossman lottery is denoted by L. The indicator variable extra_i is 1 if the participant receives the additional treatment and 0 otherwise.

$$\Pi = L + \sum_{t=1}^{60} (3000 \cdot \text{extra} + \delta_t \cdot q_t \cdot 50 + (1 - \delta_t) \cdot q_t p_t^p) \tag{1}$$

5 Empirical framework

We now describe our empirical framework. First, we discuss our estimation strategy at the subject-game-round level, the subject-round level, and the subject level. Next, we discuss our identification strategy. Finally, we discuss subgroup analysis among cooperative members and non-members.

5.1 Estimation Strategy

We estimate the effect of the presence of additional income, the framing of the certain price buyer, the harvest quantity, and mean price of the uncertain price buyer on the marketing decisions of participants. Since these four factors vary at three levels, we estimate at each of these levels. First, we estimate the effect of harvest quantity and uncertain buyer price at the round level for each game. Next, we pool all three games and estimate the effect of harvest quantity, uncertain buyer price, and game framing, once again at the round level. Finally, we aggregate subject performance across all 60 rounds and estimate the effect of the additional income treatment at the subject level.

5.1.1 Subject-Round Estimation

Recall from section 4.4 that we denote round-level outcomes in two ways to distinguish between the estimation in this section, which separate allocations by game, and the estimation in the next

section, which pools allocations across all three games. Table 5 gives descriptive statistics for both outcomes of interest.

1. The expression $\delta_{i,t}^{g}$ denotes the share that individual i allocates to certain price buyer in round t of game g. Here $g \in \{1, 2, 3\}$ and $1 \leq t \leq 20$.

2. The expression $d_{i,t}$ denotes the share that individual i allocates to certain price buyer in round t. Here $1 \leq t \leq 60$.

3. The expressions $s \in \{45, 55\}$ refer to the mean of the price offered by the uncertain-price buyer (compared to a reference price of 50) and $h \in \{2, 6, 8\}$ refer to participant harvest (compared to a reference harvest of 4).

We estimate the following equation for each game:

$$\delta_{i,t}^{g} = \alpha_{i}^{g} + \sum_{s \in \{45,55\}} \beta_{s}^{pg} I[p_{i,t}^{pg} = s] + \sum_{h \in \{2,6,8\}} \beta_{h}^{qg} I[q_{i,t}^{g} = h] + \lambda^{g} t + \epsilon_{i,t}^{g} \tag{2}$$

To allow for non-linear effects, we code the uncertain buyer price and the harvest quantity using dummy variables. For the uncertain buyer price, we use two dummy variables for the situations in which the mean price is below (45 MXN) and above (55 MXN) the price offered by the certain price buyer (50 MXN). The reference case is the situation in which the mean price of the uncertain price buyer is the same as the price offered by the certain price buyer.

Similarly, we code the harvest quantity with three dummy variables for a harvest of 2 quintals, 6 quintals, and 8 quintals, respectively. Recall that 1 quintal is 60 kilograms. We use 4 quintals (240 kilograms) as a reference case because it is the closest to the typical harvest size of participants. The exit survey indicates that their mean coffee harvest is 371 kilograms and the median coffee harvest is 270 kilograms.

We include a linear time trend λ^{g} to control for the effect of later rounds, either positive (learning) or negative (fatigue). As we discuss in the identification section below, we include subject fixed effects α_{i}^{g} to control for unobserved subject-level heterogeneity that does not vary by round. Following Boyd and Bellemare (2022) and Abadie et al. (2023), we cluster standard errors

at the subject level to allow for correlation among unobservables within rounds played by the same subject.

5.1.2 Round-Level Estimation Pooled Across All Games

Next, we pool results across all three games and estimate Equation 3, a modified version of Equation 2 that includes the framing of the game (the complementary services provided by the certain price buyer). Here Latin letters correspond to the same parameters as the Greek letters in equation 2. The coefficients on the dummies for the mean price of the uncertain price buyer are denoted by b^p_{1s}. The coefficients for the harvest quantity are denoted by b^{1q}_h. As before, we include subject fixed effects a_{1i} and the linear time trend l_1. We include game dummies for games 2 and 3 and denote their coefficients with c_{1g} These coefficients capture the effect of the framing of game 2 and game 3 compared to game 1.

$$\begin{aligned} d_{i,t} = a_{1i} + \sum_{s\in\{45,55\}} b^p_{1s} I[p^p_{i,t} = s] + \sum_{h\in\{2,6,8\}} b^q_{1h} I[q_{i,t} = h] \\ + \sum_{g\in\{2,3\}} c_{1g} I[g_{i,t} = c] + l_1 t + e_{1i,t} \end{aligned} \tag{3}$$

5.1.3 Subject-Level Estimation

Finally, we aggregate the sixty rounds per subject to construct a measure of overall participation in the game: the average allocation to the certain-price buyer across all 60 rounds, which we denote by d_i below. Wollni and Fischer (2015) use a similar outcome of interest: the fraction of coffee harvest sold to one buyer. They note that this dependent variable is a fractional variable bounded between 0 and 1. For this reason, they use the quasi-likelihood estimator proposed by Papke and Wooldridge (1996). We do not follow their approach. Instead, we estimate equation 4 separately for the total margin, the extensive margin, and intensive margin. This method resembles the double-hurdle model used by Shumeta et al. (2018) with the added benefit that the point estimates are directly interpretable.

Section 4.4 describes the construction of these outcome variables in more detail.

$$d_i = \theta_1 \text{extra}_i + \beta_1 X_i + \epsilon_{1i} \tag{4}$$

The coefficient of interest is θ_1, the effect of the additional income on these three outcomes. In addition, as controls, we include the same subject-level covariates as in equation 3: age, sex, education level, CRRA calculated based on the Eckel-Grossman lottery, completion of the practice game, correct answer on the probability filter question, game order and lottery position. Since the unit of analysis is the subject and the treatment is at the subject level, we do not cluster the standard errors. We simply compute heteroskedacity-robust standard errors.

We use an augmented version of equation 4 to examine the effect of the treatment mediated by risk aversion (as measured by the Eckel-Grossman lottery for the full sample) and by cooperative loyalty (as measured by the number of years that the participant sold to the cooperative)

$$d_i = \theta_2 \text{extra}_i + \gamma Z_i + \tau \text{extra}_i Z_i + \beta_2 X_i + \epsilon_{2i} \tag{5}$$

One coefficient of interest is θ_2, the overall treatment effect of the extra income. The covariate Z_i is either loyalty or CRRA. The coefficient γ measures the effect of this covariate. Then the coefficient τ measures the interaction between the extra income treatment and the covariate – the additional treatment effect of of a one unit increase in CRRA or one more year of loyalty to the cooperative, respectively.

5.2 Identification Strategy

Identification of the effect of the four parameters of interest is straightforward because we randomize them within the experiment. At the round level, we randomize the harvest size and the mean of the uncertain price buyer, so the corresponding parameters in equations 2 and 3 are causally identified. Basically, the order of the game is randomized and all subjects play all three games, so we argue that the corresponding parameters in equation 3 are also causally identified.

Two concerns remain for causal identification. First, we consider the potential correlation between the allocated share in each round and subject-level unobservables such as risk preferences or skill at playing the game. We use subject-level fixed effects to control for these unobservables. Second, earlier rounds and later rounds might differ in unobservable ways, due to participant learning or fatigue. For this reason, all participants play ten rounds of a practice game that are not counted, either in their score or our regression results. The practice game controls for participants who learn the game faster than others. Moreover, we include a linear-time trend to control for boredom or fatigue.

Finally, we turn to the subject-level equations 4 and 5. Here the additional income treatment is randomized at the subject level, so the parameters θ_1 and θ_2 are causally identified. Moreover, CRRA and loyalty are considered to be exogenously fixed before the experiment, so we argue that the parameters γ and τ are also causally identified.

5.3 Subgroup Analysis

Half of our participants are cooperative members, and we would like to compare the effect of the four factors above for cooperative members and non-members. Cooperative membership is a time-invariant participant characteristic, so we cannot include a membership dummy in equation 2 or 3 because it would be absorbed in the fixed effects. Moreover, it is a choice variable based on observed and unobserved characteristics, so we cannot add it to the vector of controls X in Equations 3 and 4.

For this reason, we use subgroup analysis. We estimate equations 3 and 4 separately for cooperative members and non-members and present the results side-by-side to allow for a comparison of the estimated parameters. We argue that the parameters in these estimated results are causally identified for the reasons we discussed in the previous section. The only drawback to this approach is the reduced sample size, which limits the statistical power of the associated hypothesis tests.

6 Results and discussion

In this section, we present results of subject-round estimation of the effect of varying harvest size, uncertain buyer price, and framing of the certain-price buyer on the share of their harvest that participants allocate to the certain-price buyer. We first present estimates by game and then we pool them across all games. Next, we present results of subject-level estimation of the overall treatment effect of additional income and the treatment effect mediated by CRRA as measured by the Eckler-Grossman lottery. Finally, we present subanalyses of the treatment effect of additional income for cooperative members and non-members. Here, too, we examine the overall treatment effect and the treatment effect mediated by CRRA. For cooperative members, we examine the mediated association of additional income with member loyalty to the cooperative.

6.1 Subject-Round Results

Table 6 presents the results of the estimationn of equation 2. Recall from table 5 that the baseline allocations to the certain-price buyer for games 1, 2, and 3 are 0.820, 0.826, and 0.818 respectively. The strong preference for price certainty across all participants stands out as the most important result at the subject-round level. This result places our estimate in the lower bound of the literature in terms of the incidence of side-selling, roughly the same as Keenan et al. (2024) and Wollni and Fischer (2015) but much less than many other studies. Moreover, this high baseline estimation give context to the point estimates below. The point estimates of the effect of harvest size, mean of uncertain price buyer, or framing are between 1% and 4% at most. These effect sizes may seem small but we argue that they are still important relative to an overall incidence of 18% of side-selling.

When we look at the influence of varying harvest size, we find the same U-shaped phenomenon that Wollni and Fischer (2015) and Keenan et al. (2024) find in the cross section and in the panel, respectively. Halving the harvest from a reference 4 quintals to 2 quintals increases side-selling by 3% and doubling it 4 quintals from to 8 quintals also increases side-selling, this time by 2%. These point estimates are comparable in magnitude to those of Keenan et al. (2024). We see the same general trend in Wollni and Fischer (2015) and Gerard et al. (2021), though their use of different

econometric specifications makes direct comparison of point estimates difficult.

Wollni and Fischer (2015) and Keenan et al. (2024) differ in the signs of the U-shaped effect of harvest size on side-selling behavior. We can use the overall framework of Fafchamps and Hill (2005) to interpret the difference as related to the distinction between selling at the farmgate and going to the market. They suggest that producers only travel to market when they have a sufficient quantity to justify the fixed cost: in other words, producers with a medium-sized harvest tend to travel more to the market than producers with a small harvest. On the other hand, producers with large harvest do not travel to the market as frequently because the opportunity cost of time for them is too large. In our study context, local traders come to the farmgate while the cooperative recollection points are at a distance. Thus, our study participants will only deliver their harvest to the cooperative if they have enough to justify the trip but not so much that the opportunity cost of time is too large. Thus, our results correspond with Wollni and Fischer (2015). In contrast, in the context of Keenan et al. (2024), the cooperative is nearby and the local traders are far away, so they find the opposite trend.

Next, we examine the effect of varying the mean price of the uncertain price buyer, which is a proxy for a change in market conditions or a change in transaction costs. We see that a 5 MXN reduction is associated with a 2% increase in side-selling. This result does not match profit-maximizing behavior, and we do not find an easy explanation for it. Our hypothesis is that this result reflects a feature of the local context: perhaps hearing about a reduction in the price of the local trader

When we compare the effects across the three games (columns 1, 2, and 3), we find that neither the harvest size parameters nor the parameters for the changing mean of the uncertain price buyer vary much across the three games. The baseline allocations for the three games are very close. Moreover, neither the harvest size parameters nor the parameters for the changing mean of the uncertain price buyer vary much between the three games. These two results suggest that the game framing does not make a difference. These results contrast with those of Mujawamariya et al. (2013), which studies side-selling in a context where some local traders offer credit and others do not, so the provision of credit by some traders induces producers to market their production through

these traders. Similarly, Ewusi Koomson et al. (2022) find that access to extension services (credit and technical assistance) reduces the incidence of side-selling.

Table 7 presents results from estimating equation 3, a specification that pools results across all three games with individual fixed effects. The parameter estimates here do not differ meaningfully from the those in the previous specification. This specification includes dummies for game 2 and game 3. The framing of the certain price buyer in game 2 (microcredit) appears not to affect the allocation decision. The framing in game 3 (cooperative with microcredit and technical assistance) causes participants to allocate 1% less coffee to the certain price buyer. This result lacks statistical significance. The policy implications of these null results means that unless producers directly benefit from the complementary services, the provision of these services will not affect their loyalty to the cooperative.

6.2 Subject Results

Table 8 presents the results of the estimation of equation 4 on the aggregate results at the subject level. The inclusion of the covariates substantially reduces the baseline share that is allocated to the certain-price buyer from over 80% above to 61% here. This difference indicates substantial heterogeneity at the subject level. At the upper bound, recall from Table 3 that 58 of 273 participants do not vary their allocation decision. They allocate the entire harvest to the certain price buyer in every round. Thus we break down the total margin into the extensive and intensive margin.

One result stands out in particular from the extensive margin estimation. The presence of additional income increases the likelihood by 10.8% that a participant will not side-sell at all to the cooperative. This result differs from that of Keenan et al. (2024), who find that non-farm income only reduces side-selling within the same producer (variation on non-farm income over the three year panel) but not across producers. Moreover, our treatment effect of 10.8% is much higher than theirs of 1.5%. It matches that of Shumeta et al. (2018), who finds a larger effect of off-farm income at the extensive margin than at the extensive margin. It also matches that of Geng et al. (2023), which finds that unexpected income shocks in certain weeks increase side-selling for producers.

Three covariates are associated with allocation decisions at the subject level: only middle school

education, understanding probability, and completing the practice game. All increase side-selling behavior. We present these as associations that warrant further study. Wollni and Fischer (2015) and Keenan et al. (2024) also find an association between increased education of producers and side-selling behavior.

Table 12 presents results from the estimation of equation 5 at the subject level. Recall that equation 5 augments the base subject-level equation 4 with an interaction term with the participants' CRRA as measured by the Eckler-Grossman lottery. Half of participants completed the lottery before the experiment and half after the experiment. As figure 10 shows, we find the same distribution of lottery choice for both groups so we argue that lottery placement does not affect measured CRRA. In general, we find that increased risk aversion decreases side-selling, consistent with Woldie (2010). When we consider the combination of additional income and risk aversion, we find a baseline effect of the additional income of 6.7% at the extensive margin that increases by 7.5% with each one-unit increase in the CRRA. Table 2 shows the estimated CRRA range given by each lottery choice. The treatment effect for lottery choice 1 (CRRA = 2) is 13.5%. The treatment effect for lottery choice 5 (CRRA = 0.2) is 7.4%. These results imply that additional income reduces side-selling more for more risk-averse participants. They match those of Boyd and Bellemare (2022) and Bellemare et al. (2020), who both used risk-elicitation lotteries to find differential effects of the provision of crop insurance. They lack statistical significance.

6.3 Breakdown by Cooperative Membership Status

Finally, we estimate the round-level outcomes and the subject-level outcomes separately for cooperative members and non-members. Recall that Figure 13 shows a histogram of the subject-level outcomes broken down by cooperative membership status. Throughout this section, the smaller sample size (126 members and 142 non-members) of the two subgroups limits the statistical power of the hypothesis tests. However, we argue that the differences in the point estimates warrant the analysis.

Table 9 presents results from estimating the round-level outcomes with individual fixed effects. We see differential effects for changes in harvest size and uncertain price buyer between members

and non-members. For non-members, the point estimates that we saw in the overall sample double for the case of the 8 quintal harvest. For members, we see no effect in this situation. This indicates that non-members are more interested in profit-maximization than price-certainty. Both groups exhibit a small effect in the case of the 2 quintal harvest: it causes members to side-sell 2.5% more of their harvest and non-members 3.6% respectively. In interpreting these coefficients, we note that participants in the experiment only have three choices to allocate their harvest: 2 quintals, 1 quintal, or 0 quintal to the certain-price buyer. Thus, instead of an average increase in side-selling of 2.5%, a better interpretation would be that 1 in 50 participants changed their allocation decision in this case.[7]

Unlike in the pooled results, we find an effect of the experiment framing here. Access to microcredit decreases side-selling by 1.3%, indicating that cooperative members value this service. In the same vein as above, a better interpretation might be that on the order of 1 in 100 cooperative member participants change their behavior when reminded of access to microcredit. In contrast, when the certain-price buyer is described to non-members as a cooperative, it reduces their allocation by 3.2% (or 1 in 33). This reduction possibly indicates a dislike for cooperatives.

Tables 10 and 11 present results for the subject-level outcomes on the cooperative members and non-members respectively. The smaller sample size (126 members and 142 non-members) limits the statistical power of the hypothesis tests. Nevertheless, we see that the point estimate of the additional income treatment at the extensive margin is 16.3% for the cooperative members and 2.5% for the non-members. This result suggests that the additional income may relieve a budget constraint that allows cooperative members who already prefer price certainty to pursue it even more.

Tables 13 and 14 present the results for the differential effect of the additional income for cooperative members and non-members, respectively. Recall that Figure 9 shows a breakdown of lottery choice by members and non-members. Members are slightly more risk-averse than non-members. The baseline effect of additional income for cooperative members is comparable to the overall effect (4% vs 6%). We find that the differential effect by unit of CRRA is double for

[7]Thanks to David Rosencranz for pointing this out

members than the pooled sample (18.2% vs 9.2%). Moreover, when we examine non-members, we find an effect in the opposite direction. A one unit increase in the CRRA increases the likelihood of side-selling by 11%. For two non-members with the same risk preferences, additional income allows one to sell to the local trader, with the possibility of earning more money than the certain-price buyer. These point estimates with opposite signs indicate different underlying preferences at work. Cooperative members would like to stay loyal to the cooperative except when they are liquidity constrained and sell to the local trader by necessity. Non-members would like to maximize their profit and sell to the local trader except when they are liquidity constrained and sell to the certain-price buyer out of necessity.

Finally, we use administrative data from the cooperative to examine the differential treatment effects of additional income by member loyalty, as measured by the number of years in the past 12 (2012-24) that the member has sold anything to the cooperative. Figure 11 shows the distribution of member loyalty. Table 15 shows these results. Just like the differential treatment effects, they are estimated with Equation 5. At the baseline, we find that additional income is associated with a decrease in side-selling a hypothetical new member (loyalty of 0) by 49%. This association decreases by 4% per year. At the mean value of loyalty (9.3%), it is 12%. These results suggest that the more a member sells to the cooperative, the less a liquidity constraint affects the decision to side-sell.

6.4 Limitations

This experiment is the first that we know of to examine smallholder producer behavior. It suffers from at least two limitations. First, we designed the state space of the experiment to correspond to the number of rounds (60), so that all participants would face all possible scenarios. New technology in adaptive experiments would allow us to expand the state space: for example to test more than three possibilities for outside price, four possibilities for harvest quantity, or different amounts of additional income. A larger state space would allow us to measure the effects of this variation by adapting subsequent rounds to participant preferences in the initial rounds.[8].

[8]For example, the Bayesian adaptive choice experiment software developed by Neal Thrakal

Second, the framing of the certain price buyer was done verbally[9], while the other randomization was done physically: small coffee bags for the coffee harvest, a die for the price of the uncertain price buyer monopoly money for the additional income. This indigenous population may understand tactile variation better than verbal variation.

Third, the services offered by the framed buyers (microcredit and technical assistance) did not affect outcomes in the game. In real life, microcredit would smooth consumption and technical assistance would affect harvest quantity. Subsequent experiments could improve on both of these areas: by developing a richer game that could use a cell phone or tablet software platform.

Finally, participants' decisions did not affect each other. In real life, this is not true: a cooperative survives or fails based on the joint decision of its members. Hopfensitz and Miquel-Florensa (2017) provides an example of an experiment in which cooperative member behavior varies depending on the behavior of non-members and the presence of a punishment mechanism for side-selling. Their work provides examples of elements that we could incorporate into a future experiment as well.

7 Conclusion

In the past thirty years, developing countries have shifted from state-led development to market-led development. As a result, agricultural cooperatives have emerged that offer many of the same services to their members as state commodity boards of the past: a guaranteed purchase price, microcredit, and technical assistance. The big difference is that agricultural cooperatives depend on the continued patronage of their members to finance their services. Weak institutions often prevent them from enforcing this condition. Moreover, many of the services like microcredit and technical assistance help members over the long-run, but because of liquidity constraints members often seek to maximize profit over the short-run. Thus side-selling affects cooperatives' ability to offer services, and understanding the drivers of side-selling behavior is imperative for their continued existence.

[9]Enumerators read from a standardized script.

We have presented the results of an experiment to examine four possible determinants of side-selling behavior for indigenous coffee farmers in Mexico. Our results extend beyond coffee and beyond Mexico. The experiment abstracts the most important decision of many smallholder producers for their household economy: how and to whom they market their cash crops. In our experiment, participants can market as much as their harvest as they like to each of a certain-price and an uncertain-price buyer. Unlike many previous studies, our experiment does not employ the distinction between the delayed-payment of a cooperative and the immediate payment of a local trader. Nor do we restrict participants options in subsequent rounds based on their performance in the present round.

Our results provide several concrete policy recommendations to cooperatives to reduce the incidence of side-selling among their members. First, we find an overall lower incidence of side-selling (18%) than in many contexts, which confirms smallholder producers' preference for price certainty. Since eliminating delayed payments reduces the incidence of side-selling, we encourage cooperatives to find upstream financing so that they can pay their members at the moment of delivery just like local traders.

Second, the incidence of side-selling is affected slightly by harvest size. This effect is consistent with the distinction between selling at the farmgate or at the market originally proposed by Fafchamps and Hill (2005). It means that cooperatives must be attentive to the fixed costs associated with their members' marketing decision and eliminate these fixed costs through the use of regional collection points or even visits to the farmgate.

Third, access to credit and technical assistance do not affect producer behavior in the short term. In the medium term, however, access to microcredit can help producers weather unexpected shocks. Moreover, over the long term, technical assistance has the potential to dramatically improve producer yields. Liverpool-Tasie et al. (2020) point out that in a situation without formal contracts, cooperatives or producers may need subsidizes to realize these long-term benefits.

Fourth, our additional income treatment confirmed the effectiveness of producer-level subsidies. In the Mexican context, our subsidies are not implausible; they are the same magnitude as past and present conditional cash transfer programs. The differential effects that we have presented suggest

that these subsidies would be especially effective for ensuring the loyalty of cooperative members in the early years of their membership.

Finally, cooperatives need to find mechanisms to enforce sanctions on members who do not market their harvest through the cooperative. Michler and Wu (2020) provides a framework of relational contracts to understand situations without formal contract enforcment. Casaburi and Macchiavello (2015) suggest that the mere threat of sanctions can be as effective as sanctions themselves.

Governments and NGOs alike implemented market-based reforms with great enthusiasm and promise. Several decades later, they still face challenges in realizing their potential in improving the welfare of smallholder producers. The results we present here suggest a few tweaks to improve their effectiveness and long-term sustainability.

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Exhibits

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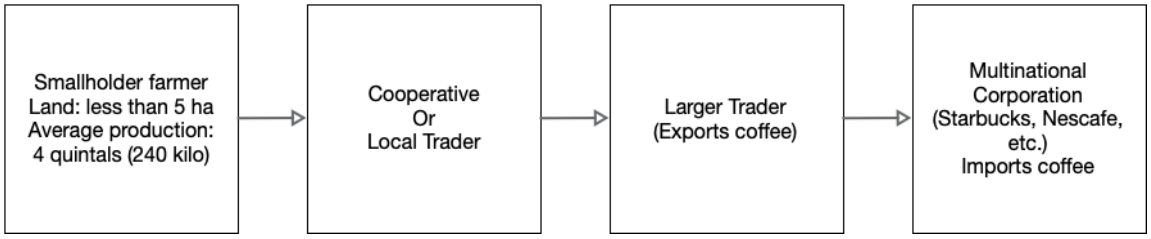


Figure 1: Coffee Value Chain

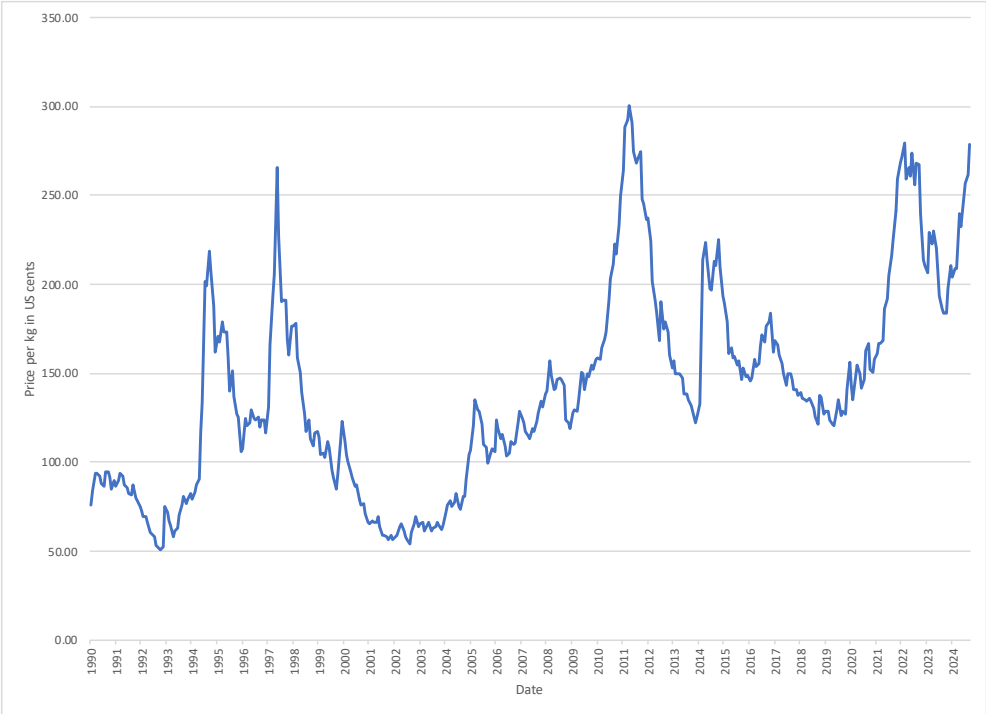


Figure 2: World Price of Coffee. Source: International Monetary Fund.

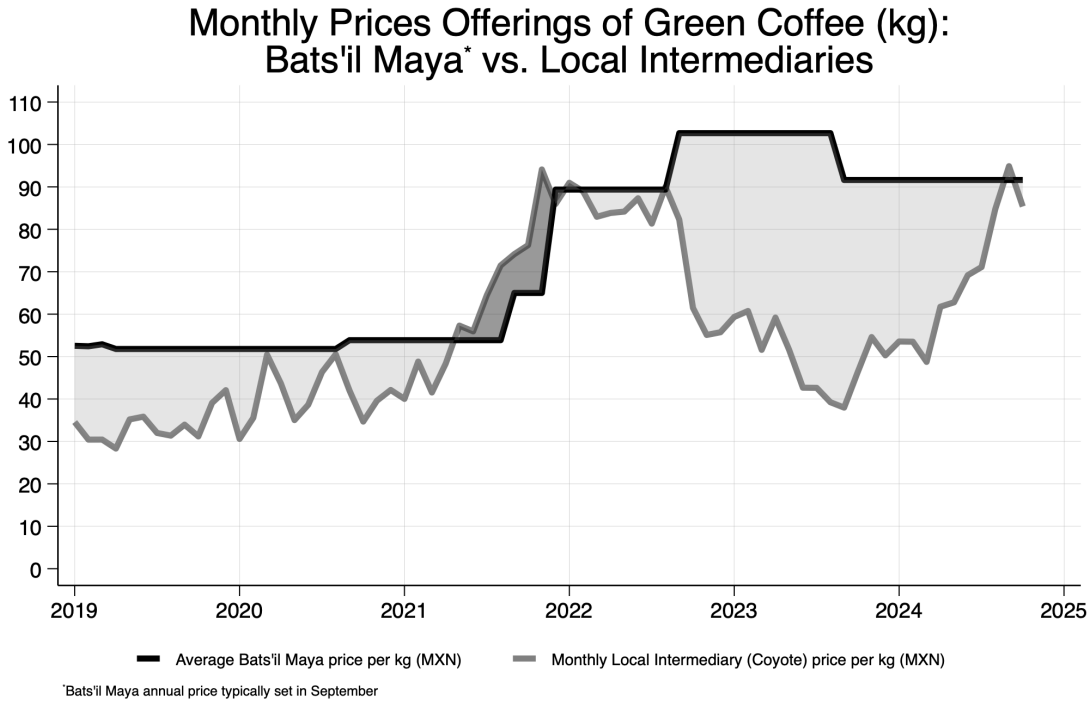


Figure 3: Coffee Cooperative vs Local Trader Price (2019-2024). Source: Administrative Data from Batsil Maya Coffee Cooperative.

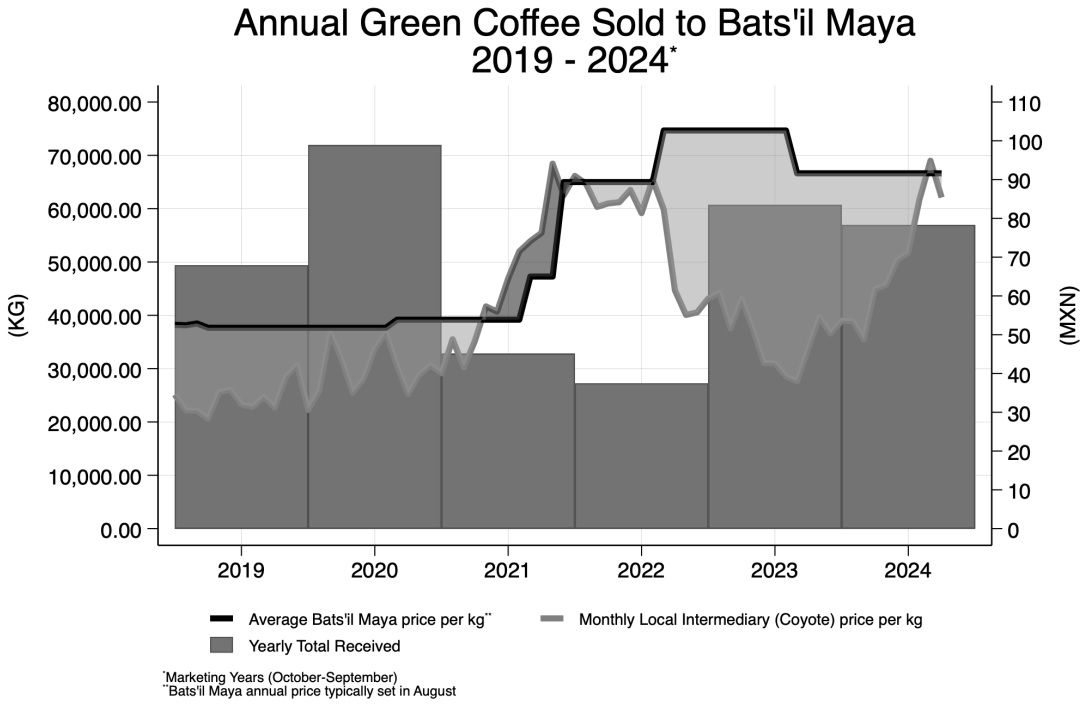


Figure 4: Coffee Deliveries and Market Prices (2019-2024). Source: Administrative Data from Batsil Maya Coffee Cooperative.

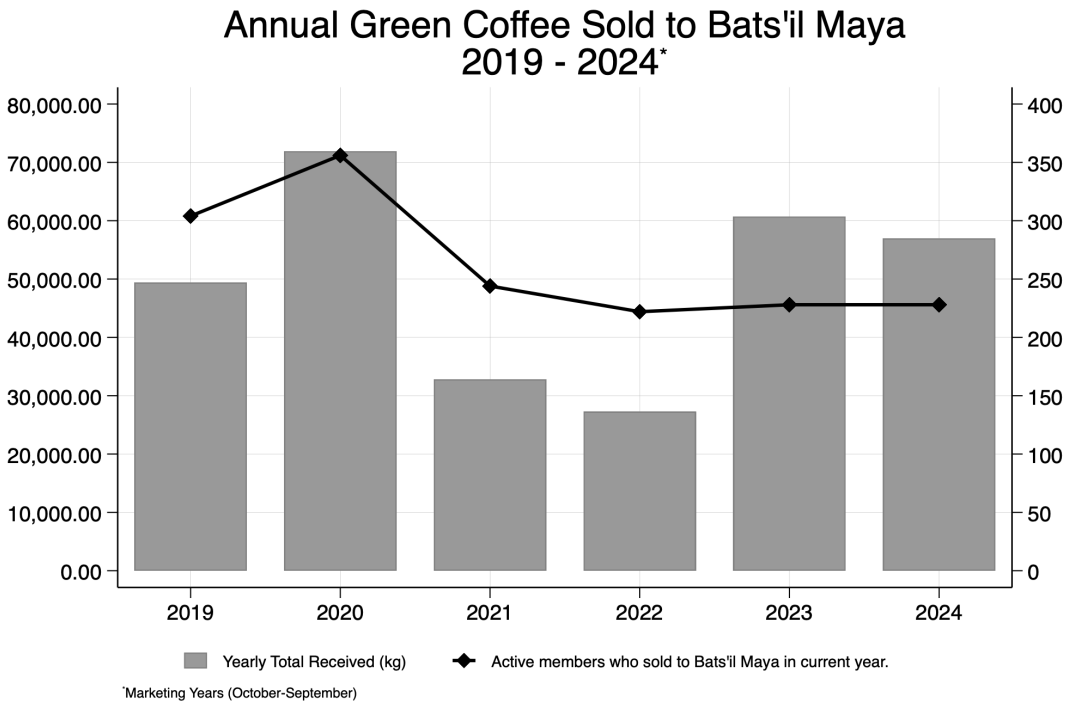


Figure 5: Coffee Deliveries and Members (2019-2024). Source: Administrative Data from Batsil Maya Coffee Cooperative.

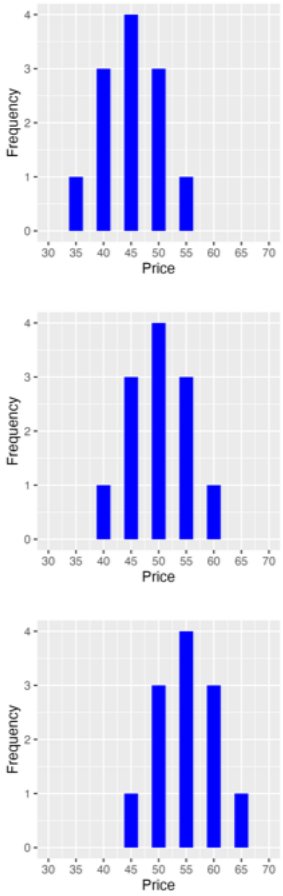


Figure 6: Outside Buyer Price Distributions
The three distributions are centered on 45 MXN, 50 MXN, and 55 MXN.

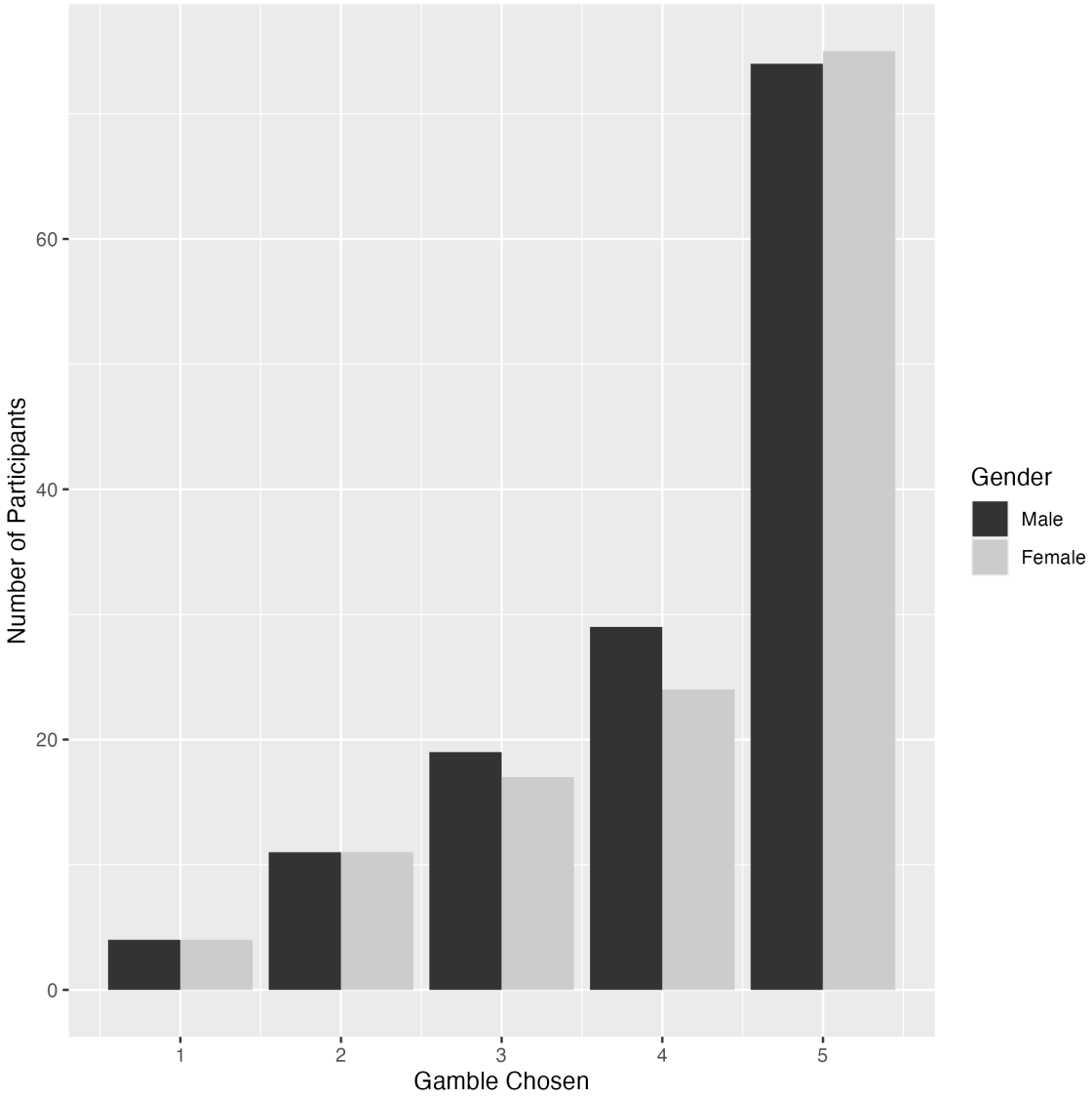
Quintals Sold to Certain Price Buyer (60kg)								
0	1	2	3	4	5	6	7	8
Quintals Sold to Uncertain Price Buyer (60kg)								
8	7	6	5	4	3	2	1	0

Total Revenue from Sales to Both Buyers

	Revenue from Sale to Certain Buyer: (Quantity sold to Certain Buyer x $50 MXN)								
	0	3,000	6,000	9,000	12,000	15,000	18,000	21,000	24,000
Price per kg. (MXN)	Revenue from Sale to Uncertain Buyer: (Quantity sold to Uncertain Buyer x Dice Result)								
40	19,200	16,800	14,400	12,000	9,600	7,200	4,800	2,400	0
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

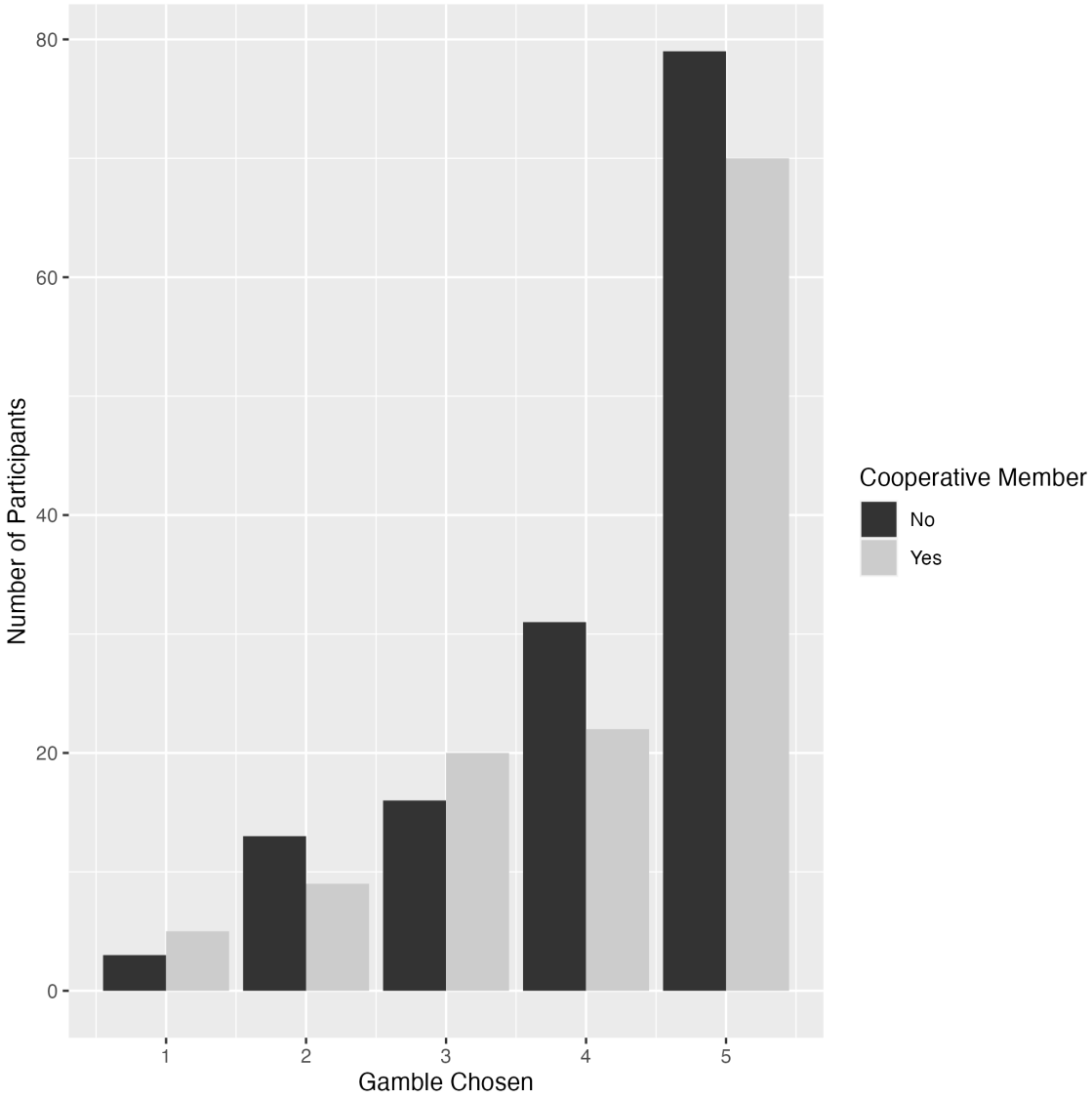
Figure 7: Representative Payoff Table
Participants are shown a version of this table each round that differs according to harvest size and uncertain price buyer distribution.

Figure 8: Lottery Gamble Choices by Gender



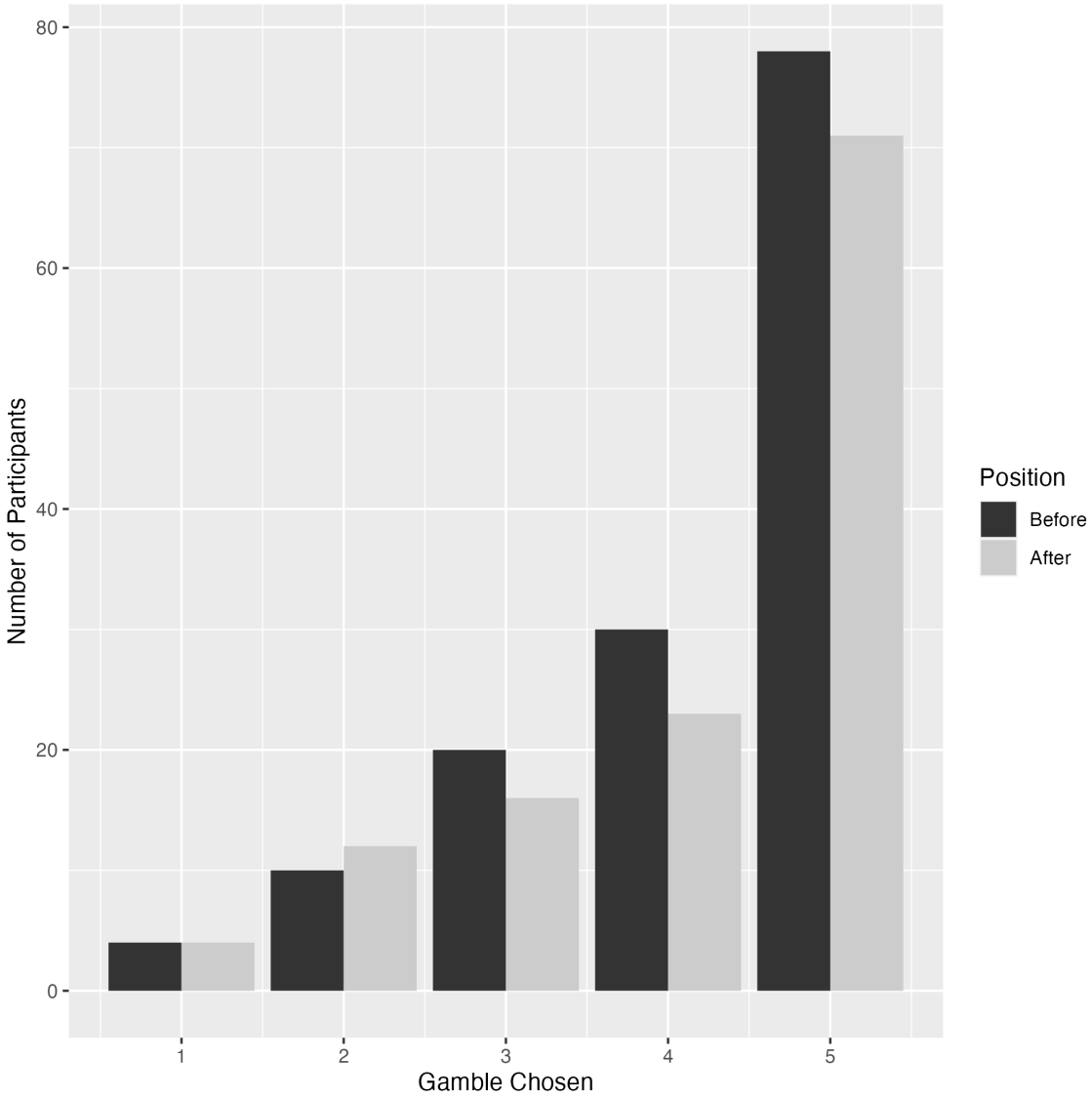
This figure displays a histogram of gamble choices from a no-loss lottery based on Eckel and Grossman (2008). Table 2 describes the choices. It is comparable to Figure 1 in that paper. Here we do not see differences between the gamble choices of men and women.

Figure 9: Lottery Gamble Choices by Cooperative Membership Status



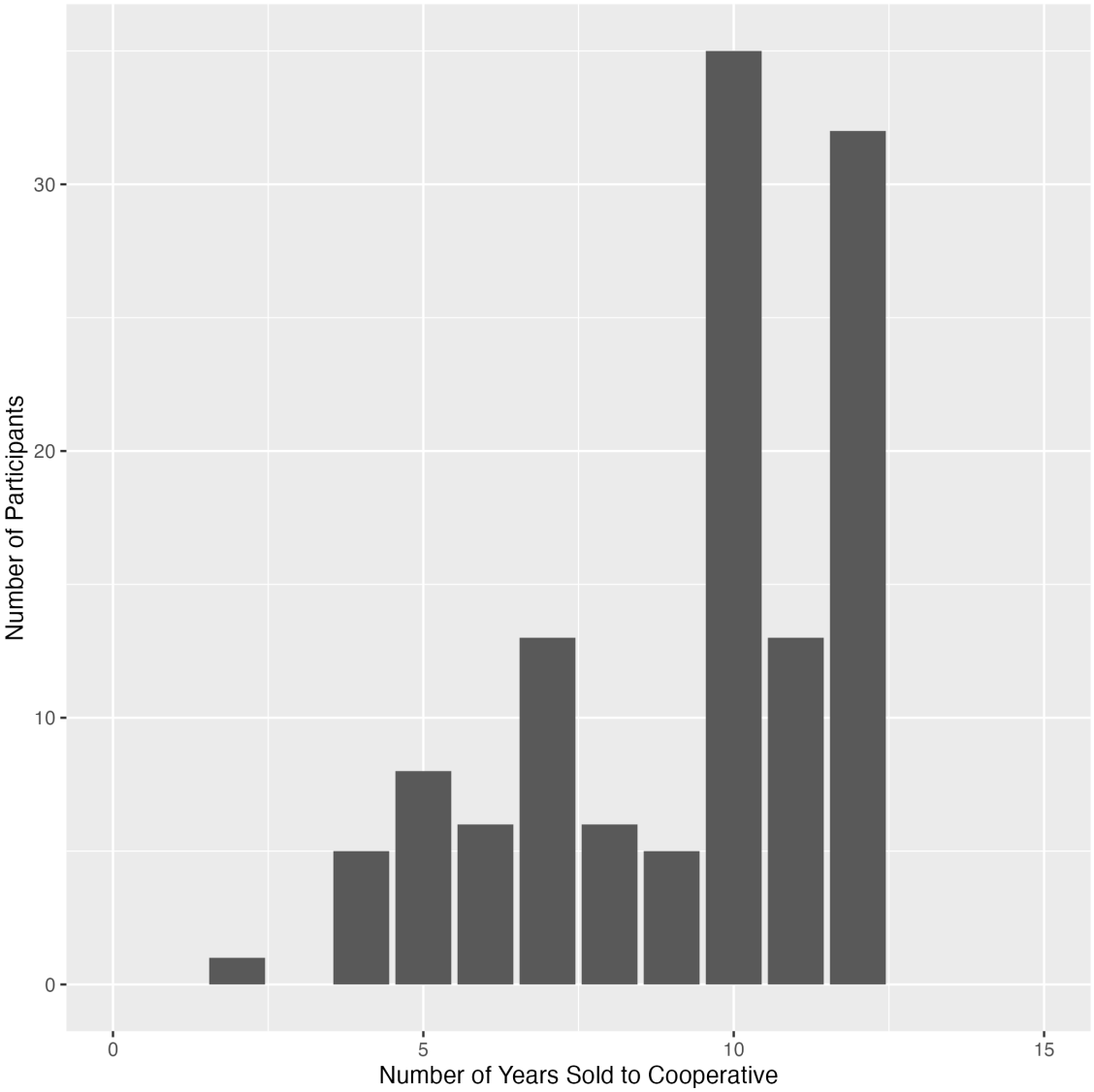
This figure displays a histogram of gamble choices from a no-loss lottery based on Eckel and Grossman (2008). Table 2 describes the choices. It is broken down by cooperative membership status of the participants.

Figure 10: Lottery Gamble Choices by Position



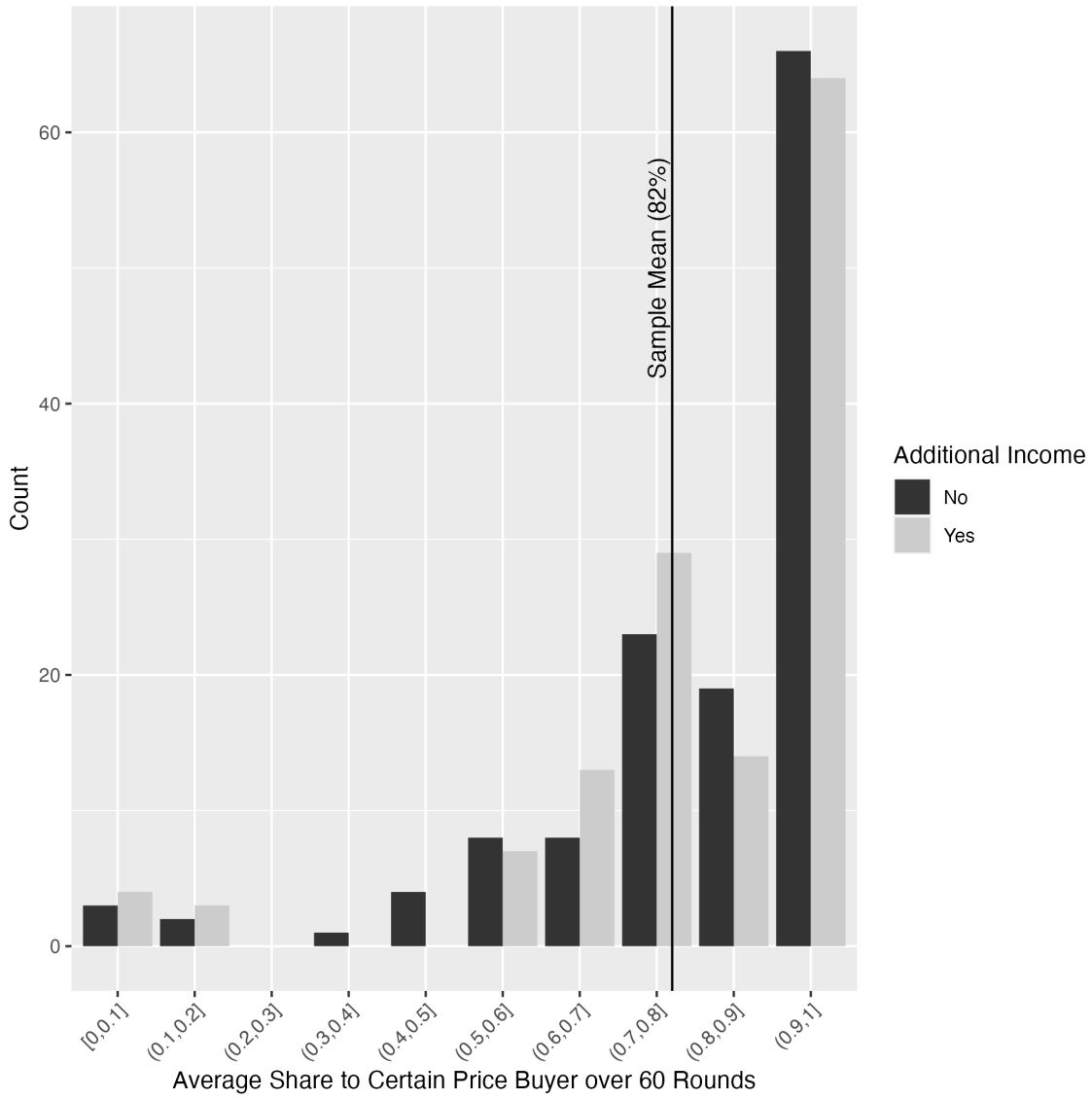
This figure displays a histogram of gamble choices from a no-loss lottery based on Eckel and Grossman (2008). Table 2 describes the choices. It is broken down by whether participants completed the lottery before or after the game.

Figure 11: Cooperative Member Loyalty



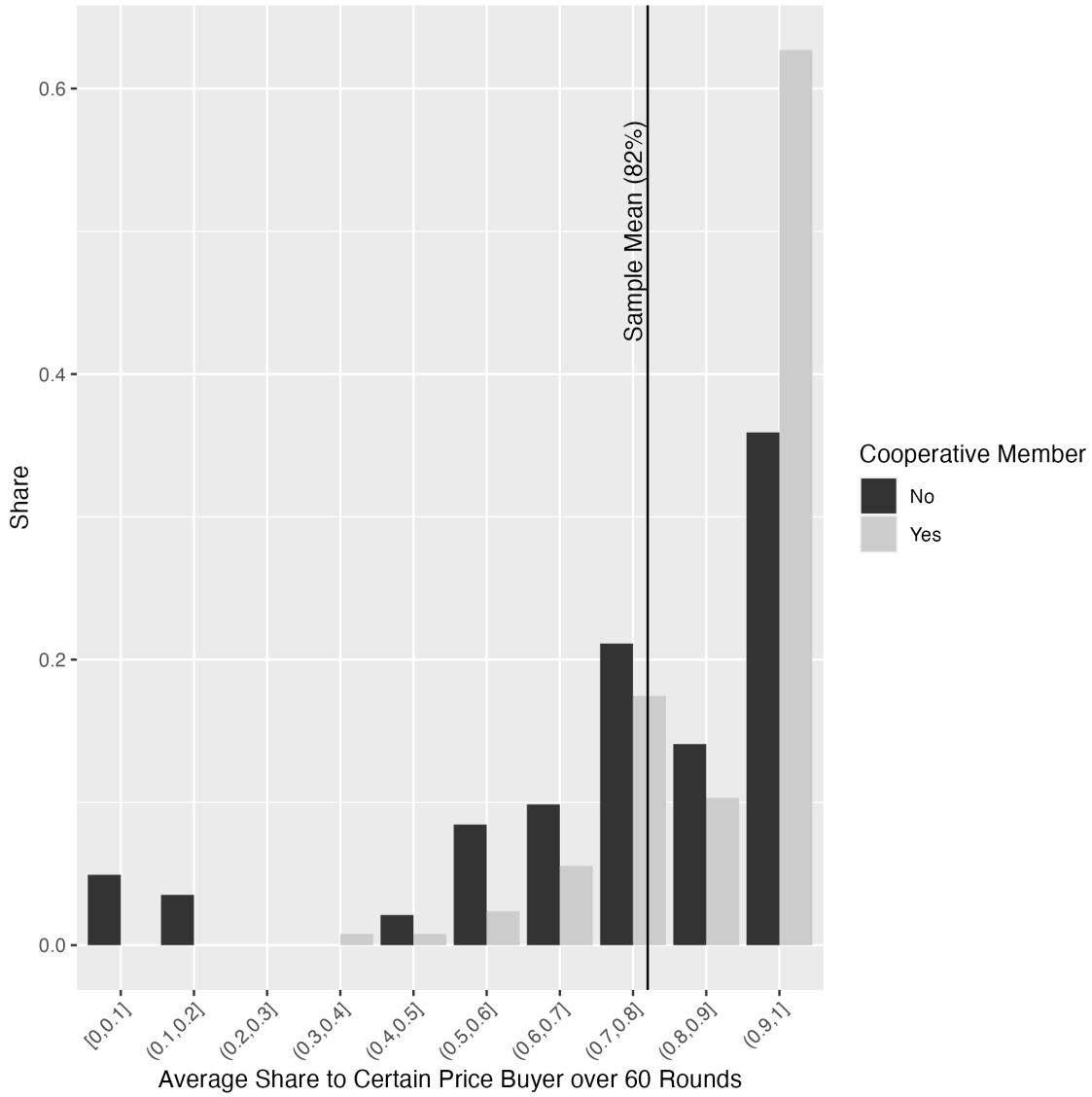
This figure displays a histogram of the number of years in the past 12 years that cooperative members delivered coffee to the cooperative. It is based on administrative data from the Batsil Maya coffee cooperative.

Figure 12: Total Margin by Treatment Status



This figure displays a histogram of average share of allocated to certain-price buyer over all 60 rounds by participants, broken down by treatment status. Treated participants receive 3000 MXN of additional income in every round.

Figure 13: Total Margin by Cooperative Membership Status



This figure displays a histogram of average share allocated to certain-price buyer over all 60 rounds by participants, broken down by cooperative membership status.

Table 1: Field visits to regional centers served by Batsil Maya.

		Participants		
	Dates	Non-Members	Members	Total
Agua Dulce Tehuacan	15 July	9	12	21
Chilón	N/A	—	—	—
Coquilte'el	20 July	13	12	25
Nuevo Progreso	3 Aug; 22 Aug	45	10	55
Paraiso Chic'otanil	14 July	4	21	25
San Jose Veracruz	29 June; 2 Aug	18	29	47
Tzubute'el	19 July	6	20	26
Yaxwinic	30 June; 1 July	45	16	61
Ye'tal Ts'ahc	N/A	—	—	—
Yochibha	28 June	2	6	8
Total	—	142	126	268

Field visits were conducted in summer 2022.
For logistical reasons, we could not visit two of the ten regional centers.
After all of the field visits were completed, we used the Batsil Maya cooperative membership roster to determine whether experiment participants were in cooperative member families.

Table 2: Gamble choices, expected payoff, and risk[1]

Choice	Event	Probability (%)	Payment (MXN)	Expected Payoff	Risk[2]	CRRA[3]
1	A	50%	10000	10000	0	$r > 2$
	B	50%	10000			
2	A	50%	15000	11250	3750	$0.67 < r < 2$
	B	50%	7500			
3	A	50%	20000	12500	7500	$0.38 < r < 0.67$
	B	50%	5000			
4	A	50%	25000	13750	11250	$0.20 < r < 0.38$
	B	50%	2500			
5	A	50%	30000	15000	15000	$r < 0.20$
	B	50%	0			

[1] Adapted from Table 1 in Eckel and Grossman (2008)
[2] Measured as standard deviation of expected payoff.
[3] Calculated as the range of r in the function $U(x) = x^{1-r}/(1-r)$ for which the subject chooses each gamble assuming constant relative risk aversion utility.

Table 3: Subject-level variables

	N	Yes	No	Mean	SD
Exit Survey					
Can read/write (1 = Yes)	268	199	69	0.743	0.438
Gender (1 = Female)	268	131	137	0.489	0.501
Age	268	—	—	43.593	15.587
Completed Only Middle School (1 = Yes)	268	37	231	0.138	0.346
Completed High School (1 = Yes)	268	29	239	0.108	0.311
Administrative Data					
Cooperative Member (1 = Yes)	268	126	142	0.470	0.500
Years Sold to Cooperative	124	—	—	9.347	2.509
Preliminary Activities					
Understands arithmetic (1 = Yes)	268	268	0	1.000	0.000
Understands percentages (1 = Yes)	268	266	2	0.993	0.086
Understands probability (1 = Yes)	268	200	68	0.746	0.436
Additional income treatment (1 = Yes)	268	134	134	0.500	0.501
CRRA (from Eckel-Grossman Lottery)	268	—	—	0.530	0.655
Practice game (1 = Yes)	268	228	40	0.851	0.357
Outcome of Interest					
Overall Margin	268	—	—	0.821	0.221
Extensive Margin	268	58	210	0.216	0.413
Intensive Margin	210	—	—	0.772	0.225

40 participants did not complete the practice game because of surveyor error.
Overall Margin is average allocation to certain price buyer across 60 rounds.
Extensive Margin is 1 if a participant always allocates entire harvest to certain price buyer across 60 rounds, 0 otherwise.
Intensive Margin is the average allocation for the subset of participants for whom Extensive Margin is not 1.

Table 4: Game Order

	Order	Count
Lottery Before		
	Lottery, Game 1, Game 2, Game 3	26
	Lottery, Game 1, Game 3, Game 2	26
	Lottery, Game 2, Game 1, Game 3	22
	Lottery, Game 2, Game 3, Game 1	24
	Lottery, Game 3, Game 1, Game 2	24
	Lottery, Game 3, Game 2, Game 1	20
Subtotal	—	142
Lottery After		
	Game 1, Game 2, Game 3, Lottery	19
	Game 1, Game 3, Game 2, Lottery	25
	Game 2, Game 1, Game 3, Lottery	15
	Game 2, Game 3, Game 1, Lottery	23
	Game 3, Game 1, Game 2, Lottery	23
	Game 3, Game 2, Game 1, Lottery	21
Subtotal	—	126
Total	—	268

All participants completed three games and an Eckel-Grossman risk preference lottery before or after the three games.
The order of the lottery and the games was determined with a roll of a 12-sided die.

Table 5: Descriptive statistics at the subject-round level

	Game 1		Game 2		Game 3		Pooled	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Experimental Variables								
Harvest 2 quintals (1 = Yes)	0.156	(0.363)	0.154	(0.361)	0.152	(0.359)	0.154	(0.361)
Harvest 4 quintals (1 = Yes)	0.198	(0.398)	0.208	(0.406)	0.193	(0.394)	0.199	(0.399)
Harvest 6 quintals (1 = Yes)	0.305	(0.460)	0.319	(0.466)	0.327	(0.469)	0.317	(0.465)
Harvest 8 quintals (1 = Yes)	0.341	(0.474)	0.320	(0.466)	0.329	(0.470)	0.330	(0.470)
Mean of Uncertain Price Buyer 45 MXN (1 = Yes)	0.204	(0.403)	0.211	(0.408)	0.203	(0.402)	0.206	(0.405)
Mean of Uncertain Price Buyer 50 MXN (1 = Yes)	0.431	(0.495)	0.431	(0.495)	0.418	(0.493)	0.426	(0.495)
Mean of Uncertain Price Buyer 55 MXN (1 = Yes)	0.365	(0.481)	0.358	(0.480)	0.379	(0.485)	0.368	(0.482)
Outcome of Interest								
Allocation to Certain Price Buyer	0.820	(0.275)	0.826	(0.268)	0.818	(0.277)	0.821	(0.273)
Observations								
Subjects	268	—	268	—	268	—	268	—
Rounds	5360	—	5360	—	5360	—	16080	—

Table 6: Impact on Share to Certain Price Buyer by Game (Fixed Effects)

	Dependent variable:		
	Share Sold to Certain-Price Buyer		
	Game 1	Game 2	Game 3
	(1)	(2)	(3)
Harvest 2 quintals (1 = Yes)	-0.035^{***} (0.009)	-0.036^{***} (0.009)	-0.015 (0.010)
Harvest 6 quintals (1 = Yes)	0.003 (0.006)	0.001 (0.006)	0.018^{***} (0.006)
Harvest 8 quintals (1 = Yes)	-0.021^{**} (0.008)	-0.021^{***} (0.006)	-0.014^{*} (0.007)
Mean of Uncertain Price Buyer 45 MXN (1 = Yes)	-0.025^{***} (0.007)	-0.024^{***} (0.007)	-0.022^{***} (0.007)
Mean of Uncertain Price Buyer 55 MXN (1 = Yes)	-0.005 (0.006)	0.002 (0.005)	-0.003 (0.006)
Linear Time Trend	0.0001 (0.001)	-0.00001 (0.0004)	0.001 (0.0004)
Subject Fixed Effects	Y	Y	Y
Subjects	268	268	268
Rounds	60	60	60
Baseline Allocation	0.820	0.826	0.818
Observations	5,360	5,360	5,360

*p<0.1; **p<0.05; ***p<0.01
Standard errors are clustered at the subject level.
Reference harvest is 4 quintals. Reference mean of uncertain price buyer is 50 MXN.
In columns (1), (2), and (3), certain price buyer offers 50 MXN.
In column (2), certain price buyer also offered microcredit to subject last year.
In column (3), certain price buyer is a cooperative that offered microcredit and technical assistance last year.

Table 7: Impact on Share to Certain Price Buyer (Fixed Effects)

	Dependent variable:
	Share Sold to Certain-Price Buyer
Harvest 2 quintals (1 = Yes)	-0.030^{***} (0.007)
Harvest 6 quintals (1 = Yes)	0.007^{*} (0.004)
Harvest 8 quintals (1 = Yes)	-0.017^{***} (0.006)
Mean of Uncertain Price Buyer 45 MXN (1 = Yes)	-0.024^{***} (0.005)
Mean of Uncertain Price Buyer 55 MXN (1 = Yes)	−0.003 (0.004)
Game 2 (Microcredit)	0.001 (0.007)
Game 3 (Coop with Microcredit and Technical Assistance)	−0.011 (0.011)
Linear Time Trend	0.0002 (0.0003)
Subject Fixed Effects	Y
Subjects	268
Rounds	60
Baseline Allocation	0.821
Observations	16,080

*p<0.1; **p<0.05; ***p<0.01
Standard errors are clustered at the subject level.
Reference harvest is 4 quintals. Reference mean of uncertain price buyer is 50 MXN.

Table 8: Subject-level Outcomes

	Average Allocation to Certain-Price Buyer Over 60 Rounds		
	Overall Margin	Extensive Margin	Intensive Margin
	(1)	(2)	(3)
3000 MXN Additional Income	0.005 (0.025)	0.108** (0.052)	−0.018 (0.030)
Female (1=Yes)	0.004 (0.028)	0.030 (0.055)	−0.010 (0.034)
Age	−0.0003 (0.001)	−0.0002 (0.002)	−0.0003 (0.001)
Completed Only Middle School (1=Yes)	−0.101* (0.053)	−0.150** (0.069)	−0.083 (0.058)
Completed High School (1=Yes)	−0.046 (0.053)	0.023 (0.092)	−0.053 (0.070)
Played Practice Game (1=Yes)	−0.148*** (0.033)	−0.295*** (0.087)	−0.127*** (0.049)
Understands Probability (1=Yes)	−0.089*** (0.031)	−0.154** (0.065)	−0.051 (0.037)
Can Read/Write (1=Yes)	0.022 (0.037)	0.039 (0.062)	0.011 (0.044)
Constant	1.023*** (0.089)	0.533*** (0.168)	0.962*** (0.107)
Game Order, Lottery Position, Lottery Outcome Controls	Y	Y	Y
Observations	268	268	210
R^2	0.130	0.125	0.114

*p<0.1; **p<0.05; ***p<0.01
In column (2), the dependent variable is a dummy which equals 1 if the subject allocates the entire harvest to the certain price buyer in all rounds; 0 otherwise. Column (3) presents the same regression as column (1) on the subset of subjects for whom the dummy variable is 0.
All three columns present heteroskedasticity-robust standard errors.

Table 9: Impact on Share by Cooperative Membership Status (Fixed Effects)

	Dependent variable:	
	Share Sold to Certain-Price Buyer	
	Members	Non-Members
	(1)	(2)
Harvest 2 quintals (1 = Yes)	-0.025^{***} (0.009)	-0.036^{***} (0.010)
Harvest 6 quintals (1 = Yes)	0.008^{**} (0.003)	0.005 (0.006)
Harvest 8 quintals (1 = Yes)	-0.001 (0.006)	-0.032^{***} (0.009)
Mean of Uncertain Price Buyer 45 MXN (1 = Yes)	-0.007^{*} (0.004)	-0.041^{***} (0.009)
Mean of Uncertain Price Buyer 55 MXN (1 = Yes)	-0.0003 (0.004)	-0.005 (0.006)
Game 2 (Microcredit)	0.013^{*} (0.008)	-0.009 (0.011)
Game 3 (Coop with Microcredit and Technical Assistance)	0.011 (0.011)	-0.032^{*} (0.019)
Linear Time Trend	0.00002 (0.0002)	0.0004 (0.0004)
Subject Fixed Effects	Y	Y
Subjects	126	142
Rounds	60	60
Observations	7,560	8,520

*p<0.1; **p<0.05; ***p<0.01
Standard errors are clustered at the subject level.
Reference harvest is 4 quintals. Reference mean of uncertain price buyer is 50 MXN.
In columns (1), (2), and (3), certain price buyer offers 50 MXN.
In column (2), certain price buyer also offered microcredit to subject last year.
In column (3), certain price buyer is a cooperative that offered microcredit and technical assistance last year.

Table 10: Subject-level Outcomes (Cooperative Members)

	Average Allocation to Certain-Price Buyer Over 60 Rounds		
	Overall Margin	Extensive Margin	Intensive Margin
	(1)	(2)	(3)
3000 MXN Additional Income	0.016 (0.024)	0.163** (0.082)	−0.009 (0.033)
Female (1=Yes)	0.017 (0.033)	−0.011 (0.113)	0.009 (0.046)
Age	−0.001 (0.001)	−0.001 (0.003)	−0.0005 (0.002)
Completed Only Middle School (1=Yes)	−0.039 (0.053)	−0.237* (0.122)	−0.006 (0.066)
Completed High School (1=Yes)	0.053 (0.050)	0.140 (0.190)	0.055 (0.088)
Played Practice Game (1=Yes)	−0.090** (0.038)	−0.308** (0.122)	−0.067 (0.064)
Understands Probability (1=Yes)	−0.082*** (0.027)	−0.206** (0.099)	−0.057 (0.041)
Can Read/Write (1=Yes)	−0.045 (0.032)	−0.042 (0.103)	−0.056 (0.042)
Constant	1.151*** (0.081)	0.872*** (0.323)	1.079*** (0.119)
Game Order, Lottery Position, Lottery Outcome Controls	Y	Y	Y
Observations	126	126	89
R^2	0.216	0.231	0.157

*p<0.1; **p<0.05; ***p<0.01
In column (2), the dependent variable is a dummy which equals 1 if the subject allocates the entire harvest to the certain price buyer in all rounds; 0 otherwise. Column (3) presents the same regression as column (1) on the subset of subjects for whom the dummy variable is 0.
All three columns present heteroskedasticity-robust standard errors.

Table 11: Subject-level Outcomes (Cooperative Non-Members)

	Average Allocation to Certain-Price Buyer Over 60 Rounds		
	Overall Margin	Extensive Margin	Intensive Margin
	(1)	(2)	(3)
3000 MXN Additional Income	−0.036 (0.043)	0.025 (0.060)	−0.037 (0.046)
Female (1=Yes)	0.068 (0.049)	0.115* (0.064)	0.046 (0.054)
Age	−0.001 (0.002)	−0.001 (0.002)	−0.0003 (0.002)
Completed Only Middle School (1=Yes)	−0.105 (0.070)	−0.094 (0.086)	−0.107 (0.076)
Completed High School (1=Yes)	−0.053 (0.071)	0.004 (0.111)	−0.054 (0.087)
Played Practice Game (1=Yes)	−0.210*** (0.062)	−0.166 (0.132)	−0.247*** (0.080)
Understands Probability (1=Yes)	−0.105** (0.052)	−0.143* (0.082)	−0.045 (0.057)
Can Read/Write (1=Yes)	0.120* (0.062)	0.178*** (0.064)	0.090 (0.067)
Constant	0.942*** (0.148)	0.171 (0.196)	0.948*** (0.165)
Game Order, Lottery Position, Lottery Outcome Controls	Y	Y	Y
Observations	142	142	121
R^2	0.204	0.153	0.200

*p<0.1; **p<0.05; ***p<0.01
In column (2), the dependent variable is a dummy which equals 1 if the subject allocates the entire harvest to the certain price buyer in all rounds; 0 otherwise. Column (3) presents the same regression as column (1) on the subset of subjects for whom the dummy variable is 0.
All three columns present heteroskedasticity-robust standard errors.

Table 12: Subject-level Outcomes (CRRA)

	Average Allocation to Certain-Price Buyer Over 60 Rounds		
	Overall Margin	Extensive Margin	Intensive Margin
	(1)	(2)	(3)
3000 MXN Additional Income	0.006 (0.033)	0.067 (0.066)	−0.009 (0.038)
CRRA	0.016 (0.020)	−0.041 (0.044)	0.030 (0.023)
Additional Income * CRRA	−0.001 (0.028)	0.075 (0.085)	−0.013 (0.031)
Female (1=Yes)	0.003 (0.028)	0.038 (0.055)	−0.014 (0.034)
Age	−0.0003 (0.001)	−0.0001 (0.002)	−0.0004 (0.001)
Completed Only Middle School (1=Yes)	−0.099* (0.052)	−0.148** (0.069)	−0.080 (0.058)
Completed High School (1=Yes)	−0.050 (0.053)	0.035 (0.093)	−0.059 (0.070)
Played Practice Game (1=Yes)	−0.145*** (0.034)	−0.296*** (0.087)	−0.124** (0.049)
Understands Probability (1=Yes)	−0.089*** (0.031)	−0.155** (0.065)	−0.052 (0.037)
Can Read/Write (1=Yes)	0.019 (0.037)	0.041 (0.062)	0.006 (0.045)
Constant	1.010*** (0.092)	0.551*** (0.168)	0.943*** (0.110)
Game Order, Lottery Position, Lottery Outcome Controls	Y	Y	Y
Observations	268	268	210
R^2	0.132	0.129	0.119

*p<0.1; **p<0.05; ***p<0.01
In column (2), the dependent variable is a dummy which equals 1 if the subject allocates the entire harvest to the certain price buyer in all rounds; 0 otherwise. Column (3) presents the same regression as column (1) on the subset of subjects for whom the dummy variable is 0.
All three columns present heteroskedasticity-robust standard errors.

Table 13: Subject-level Outcomes CRRA (Cooperative Members)

	Average Allocation to Certain-Price Buyer Over 60 Rounds		
	Overall Margin	Extensive Margin	Intensive Margin
	(1)	(2)	(3)
3000 MXN Additional Income	0.007 (0.031)	0.066 (0.112)	−0.003 (0.042)
CRRA	−0.021 (0.018)	−0.061 (0.080)	−0.022 (0.020)
Additional Income * CRRA	0.018 (0.031)	0.182 (0.133)	−0.017 (0.036)
Female (1=Yes)	0.018 (0.034)	0.016 (0.112)	0.007 (0.046)
Age	−0.0004 (0.001)	−0.0004 (0.003)	−0.0004 (0.002)
Completed Only Middle School (1=Yes)	−0.037 (0.053)	−0.233* (0.127)	−0.001 (0.066)
Completed High School (1=Yes)	0.060 (0.052)	0.196 (0.204)	0.044 (0.093)
Played Practice Game (1=Yes)	−0.093** (0.039)	−0.299** (0.119)	−0.070 (0.066)
Understands Probability (1=Yes)	−0.082*** (0.027)	−0.216** (0.097)	−0.054 (0.042)
Can Read/Write (1=Yes)	−0.043 (0.033)	−0.039 (0.101)	−0.052 (0.042)
sorteo	−0.002* (0.001)	−0.006 (0.005)	−0.002 (0.002)
Constant	1.160*** (0.084)	0.831** (0.330)	1.101*** (0.122)
Game Order, Lottery Position, Lottery Outcome Controls	Y	Y	Y
Observations	126	126	89
R^2	0.221	0.246	0.169

*p<0.1; **p<0.05; ***p<0.01
In column (2), the dependent variable is a dummy which equals 1 if the subject allocates the entire harvest to the certain price buyer in all rounds; 0 otherwise. Column (3) presents the same regression as column (1) on the subset of subjects for whom the dummy variable is 0.
All three columns present heteroskedasticity-robust standard errors.

Table 14: Subject-level Outcomes CRRA (Cooperative Non-Members)

	Average Allocation to Certain-Price Buyer Over 60 Rounds		
	Overall Margin	Extensive Margin	Intensive Margin
	(1)	(2)	(3)
3000 MXN Additional Income	−0.008 (0.057)	0.058 (0.074)	−0.013 (0.059)
CRRA	0.045 (0.037)	−0.064 (0.057)	0.062 (0.039)
Additional Income * CRRA	−0.043 (0.048)	−0.112 (0.075)	−0.029 (0.054)
Female (1=Yes)	0.060 (0.050)	0.130** (0.064)	0.033 (0.056)
Age	−0.001 (0.002)	−0.0003 (0.002)	−0.0003 (0.002)
Completed Only Middle School (1=Yes)	−0.100 (0.070)	−0.121 (0.088)	−0.093 (0.077)
Completed High School (1=Yes)	−0.064 (0.072)	0.028 (0.107)	−0.071 (0.086)
Played Practice Game (1=Yes)	−0.210*** (0.062)	−0.183 (0.126)	−0.241*** (0.079)
Understands Probability (1=Yes)	−0.105** (0.052)	−0.143* (0.083)	−0.047 (0.055)
Can Read/Write (1=Yes)	0.116* (0.064)	0.203*** (0.070)	0.074 (0.070)
sorteo	0.001 (0.002)	−0.001 (0.003)	0.002 (0.003)
Constant	0.913*** (0.154)	0.228 (0.189)	0.903*** (0.172)
Game Order, Lottery Position, Lottery Outcome Controls	Y	Y	Y
Observations	142	142	121
R^2	0.211	0.182	0.216

*p<0.1; **p<0.05; ***p<0.01
In column (2), the dependent variable is a dummy which equals 1 if the subject allocates the entire harvest to the certain price buyer in all rounds; 0 otherwise. Column (3) presents the same regression as column (1) on the subset of subjects for whom the dummy variable is 0.
All three columns present heteroskedasticity-robust standard errors.

Table 15: Subject-level Outcomes (Cooperative Members) - Loyalty

	Average Allocation to Certain-Price Buyer Over 60 Rounds		
	Overall Margin	Extensive Margin	Intensive Margin
	(1)	(2)	(3)
3000 MXN Additional Income	−0.0005 (0.111)	0.416 (0.347)	−0.043 (0.154)
Female (1=Yes)	0.019 (0.035)	−0.004 (0.108)	0.012 (0.049)
Age	−0.001 (0.001)	−0.001 (0.003)	−0.001 (0.002)
Completed Only Middle School (1=Yes)	−0.046 (0.049)	−0.235 (0.153)	−0.012 (0.061)
Completed High School (1=Yes)	0.049 (0.062)	0.164 (0.194)	0.045 (0.105)
Played Practice Game (1=Yes)	−0.094** (0.038)	−0.325*** (0.119)	−0.073 (0.059)
Understands Probability (1=Yes)	−0.087*** (0.031)	−0.239** (0.097)	−0.056 (0.047)
Can Read/Write (1=Yes)	−0.053 (0.033)	−0.092 (0.104)	−0.061 (0.049)
Years Sold to Cooperative	−0.005 (0.009)	−0.0004 (0.029)	−0.004 (0.012)
Years Sold * Additional Income	0.001 (0.011)	−0.029 (0.036)	0.003 (0.016)
Constant	1.221*** (0.140)	0.952** (0.437)	1.143*** (0.186)
Game Order, Lottery Position, Lottery Outcome Controls	Y	Y	Y
Observations	124	124	88
R^2	0.222	0.266	0.153

*p<0.1; **p<0.05; ***p<0.01
In column (2), the dependent variable is a dummy which equals 1 if the subject allocates the entire harvest to the certain price buyer in all rounds; 0 otherwise. Column (3) presents the same regression as column (1) on the subset of subjects for whom the dummy variable is 0.
All three columns present heteroskedasticity-robust standard errors.