Why Not Insure Prices? Experimental Evidence from Peru*

Chris M. Boyd† Marc F. Bellemare‡

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Abstract

In a competitive market, a profit-maximizing producer's total revenue is determined both by the quantity of output she chooses to produce and by the price at which she can sell that output. Of these two variables, only output is in part or wholly within the producer's control, price being entirely determined by market forces. Given that, it is puzzling that the literature studying the effects of providing insurance to producers in low- and middle-income countries has ignored price risk entirely, focusing instead on insuring output. We run an artefactual lab-in-the-field experiment in Peru to look at the effects of insurance against output price risk on production. We randomize the order of three games: (i) a baseline game in which price risk is introduced at random, (ii) the baseline game to which we add mandatory insurance against price risk sold at an actuarially fair premium, and (iii) the baseline game to which we add voluntary insurance against price risk sold at the actuarially fair premium, but for which we offer a random 0-, 50- or 100-percent discount to exogenize take-up. Our results show that, on average, (i) price risk does not significantly change production relative to price certainty and (ii) neither does the provision of compulsory insurance against price risk, but the introduction of voluntary price risk (iii) causes the average producer on the market to produce more in situations of price risk than in situations of price certainty, and (iv) causes the average producer on the market to produce more in situations of price certainty than in cases where there is no insurance or where insurance is mandatory. When looking only at situations where there is price risk, (v) this is due almost entirely to the insurance rather than to selection into purchasing the insurance. Our findings further suggest that (vi) even in the absence of the discount, the insurance against price risk would have a large (i.e., 70-percent) take-up rate.

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† PhD Candidate, Department of Applied Economics, University of Minnesota.

‡ Corresponding Author and Distinguished McKnight University Professor, Distinguished, University Teaching Professor, and Northrop Professor, Department of Applied Economics, University of Minnesota.

1. Introduction

A profit-maximizing producer's total revenue is determined both by the quantity of output the producer chooses to produce as well as by the price at which she can sell that output on the market. In a competitive market, the producer is a price taker, meaning that only the former variable—how much she chooses to produce—is at least in part, if not wholly, within the producer's control, with the latter variable—the price at which she can sell her output—being determined by market forces.

Given that, it is puzzling that the literature studying the effects of insurance on producers in low- and middle-income countries—also known as micro-insurance, or "index insurance" because an index such as rainfall or average yield in a given area is used to determine whether the insurance will pay out[1]—has focused on insuring producers' revenues by insuring output risk, ignoring price risk altogether.[2,3,4]

We do not compare the impacts of insuring output versus the impacts of insuring prices, but we ask: What happens to output when producers are insured against price risk? To answer this question, we report the results of an artefactual lab-in-the-field experiment with producers in rural Peru. In our experiment, subjects are administered three treatments whose order is randomized. The first (i.e., baseline) treatment consists of introducing price risk at random relative to price certainty, which provides a benchmark estimate of the effect of price risk on production. The second (i.e., mandatory insurance) treatment consists of the baseline treatment, but with the addition of compulsory full insurance against

[1] In some cases (e.g., Elabed et al. 2013), more than one index is used.
[2] In two recent reviews of the literature on index insurance (Carter et al. 2017; Platteau et al. 2017), the word "price" only shows up to refer to the price of the insurance itself, and not to refer to price as a source of risk. Another review by Cole and Xiong (2017) discusses output price as a source of risk, but it does not discuss any micro-insurance intervention against price risk.
[3] In some cases, such as in the case of the Index Based Livestock Insurance (Chantarat et al. 2013), the insurance aims to insure assets instead of insuring income (i.e., revenue) via output.
[4] This is not to say that policies aimed at reducing price risk or allowing people to hedge against price risk have never been implemented in low- and middle-income countries. The Ethiopian Commodity Exchange, for instance, has been shown to reduce price dispersion (Andersson et al. 2017). More generally, commodity exchanges have typically failed in developing countries. Sitko and Jayne (2012) document this pattern with a case study of the former Zambian commodity exchange.

price risk at an actuarially fair premium in uncertain price rounds.[5,6] The third (i.e., voluntary insurance) treatment consists of the baseline treatment, but with the addition of voluntary full insurance against price risk at an actuarially fair premium, but whose take-up in two thirds of the (uncertain price) rounds is encouraged by a random 0-, 50-, or 100-percent discount on the premium, or subsidy.[7]

This article contributes to three distinct strands of the applied microeconomics literature. The first strand is that on micro-insurance, which we have already discussed. Here, the landmark study is by Cole et al. (2013), who find that the demand for rainfall insurance is low in rural India. Cole et al. (2017) look specifically at the impact of rainfall insurance on production decisions and find that the insurance causes producers to invest more ex ante in crops whose yields depend more heavily on rainfall. Karlan et al. (2014) run experiments aimed at removing insurance market failures, credit market failures, or both, and find that the binding constraint on investment decisions is uninsured risk instead of unmet credit demand.[8]

The second strand is the literature on price risk. Building on theoretical contributions by Baron (1970), Sandmo (1971), Turnovsky et al. (1980), and Finkelshtain and Chalfant (1991), Barrett (1996) shows that the inverse farm size--productivity relationship arises as a result of price risk. Bellemare et al. (2013) develop and estimate a measure of price risk defined over several commodities and find that price risk

[5] To avoid confusion, we will use "premium" throughout this article to refer to the price of the insurance, and we will use "price" to refer to the output price.
[6] By "full insurance," we mean that the entirety of the risk is covered by the insurance.
[7] A reviewer noted that since price and quantity produced combine into total revenue, insuring either price or quantity in a way that ends up affecting revenue in exactly the same way should have the exact same effect on producer behavior. In practice, however, a few things may lead to discrepancies between insuring quantity and insurance price. We believe that the difference between insuring a variable one has (some) control over (i.e., quantity) and insuring a variable one has no control over (i.e., price, assuming producers are price takers) can lead to considerable differences in uptake, if not behavior, via some locus of control or self-efficacy effects. Similarly, insurance schemes that aim at insuring quantities via some nebulous, hard-to-verify index (e.g., area-yield or rainfall) may be perceived very differently from insurance schemes that aim at insuring prices, which can be directly verified by talking to other producers, traders, and so on.
[8] In practice, some contract farming arrangements implicitly insure price risk by ensuring a guaranteed price at which agents can sell their crops to the principal; see, for instance, Arouna et al. (2021) and Bellemare et al. (2021).

aversion appears to be increasing in wealth in their rural Ethiopian data. Bellemare et al. (2020) take the predictions in Baron (1970) and Sandmo (1971) to the lab to look at the effect of output price risk, finding that producers do not significantly change their production behavior in situations of price risk relative to situations of price certainty.[9] More recently, Lee (2021) has found empirical support for the hypothesis that rural households send out migrants to work outside of agriculture in response to price risk.

The third and last strand of literature this article contributes to is that on agricultural insurance broadly defined. Moschini and Hennessy (2001) offer an in-depth discussion of the literature on agricultural insurance focusing on the information asymmetries—adverse selection and moral hazard—involved. Smith and Glauber (2012) provide a historical overview of agricultural insurance, noting how most agricultural insurance products in high-income countries tend to be heavily subsidized by the state. More recently, Tack and Yu (2021) provide a comprehensive overview of the literature on risk management in agriculture, discussing among other things both on-farm production and price risk as well as the design and effects of agricultural insurance contracts on producers.

Our results show that, on average, (i) price risk does not significantly change production relative to price certainty and (ii) neither does the provision of compulsory insurance against price risk, but the introduction of voluntary price risk (iii) causes the average producer on the market to produce more in situations of price risk than in situations of price certainty, and (iv) causes the average producer on the market to produce more in situations of price certainty than in cases where there is no insurance or where insurance is mandatory. When looking only at situations where there is price risk, (v) this is due almost entirely to the insurance rather than to selection into purchasing the insurance. Our findings also suggest that (vi) even in the absence of any discount or subsidy, insurance against price risk would have a large (i.e., 70-percent) take-up rate. In keeping with the previous literature, we further explore the effects on

[9] See Boyd and Bellemare (2020) for a review of the literature on the microeconomics of price risk.

output of price risk at the intensive margin (i.e., the effect of increasing the degree of price risk, conditional on there being price risk) in addition to price risk at the extensive margin (i.e., the effect of price risk, no matter how much of it there is).

The remainder of this article is organized as follows. In section 2, we present an extension of the basic Sandmo (1971) theoretical framework that incorporates insurance against output price risk. Section 3 presents the experimental protocol we develop and deploy to test the predictions of our theoretical framework. In section 4, we lay out our empirical framework, discussing both our estimation and identification strategies. Section 5 presents the data and some descriptive statistics. In section 6, we present and discuss our empirical results. Section 7 summarizes and concludes with some implications for policy and future research.

2. Theoretical Framework

To show that price risk leads to underproduction relative to situations of price certainty, we first borrow the theoretical framework in Sandmo (1971), which is grounded in expected utility (EU) theory. Though EU theory has come under fire for not always corresponding to how people behave and Tack and Yu (2021) discuss a number of potential alternative decision theories to study the kind of insurance we are interested in, we start from Sandmo's framework, first because (i) EU theory remains the theory that underlies most agricultural policy instruments in low- and middle-income countries as well as in high-income countries, and (ii) even though EU theory clearly has its shortcomings (see for example Bellemare et al. 2020), there is no widespread agreement about which alternative decision theory one should use in its stead.

Sandmo's theoretical framework corresponds to Game B ("baseline"), i.e., our baseline treatment. Then, we extend Sandmo's framework to show that, with price risk and mandatory insurance, production

should be the same as in situations of price certainty. This corresponds to Game MI ("mandatory insurance"), i.e., baseline treatment plus compulsory insurance. Finally, we generalize the framework for Game MI to derive the results in the case of non-compulsory insurance. This corresponds to Game VI ("voluntary insurance"), i.e., baseline treatment plus voluntary insurance, with discounts on the premium offered at random.

The intuition behind our theoretical framework is as follows. Relative to situations of price certainty, the introduction of price risk (i.e., an uncertain price whose expectation is equal to the certain price) causes a risk-averse producer to produce less under price risk than under price certainty to hedge against price risk (Game B). When introducing full-insurance at an actuarially fair premium, the risk-averse producer is "made whole" by the insurance (i.e., the market failure introduced by price risk is effectively removed), and so she produces the same under price risk with compulsory insurance as she does under price certainty because the price of the insurance is a fixed cost which does not affect her profit-maximization decision at the margin (Game MI). The same occurs when the producer chooses to purchase voluntary insurance at an actuarially fair premium, with or without a discount (Game VI), because a rational risk-averse producer will always choose to purchase the insurance.[10]

The primitives are as follows. We assume that a producer has a utility function $u(\cdot)$ that is well-behaved (i.e., $u' > 0$ and $u'' < 0$) and defined over the producer's profit $\pi = px - c(x) - F$, where $x > 0$ is how much the producer chooses to produce, $p > 0$ is the price at which she can sell her output, and $c(x)$ is the variable cost of producing output x such that $c' > 0$ and $c > 0$, and $F > 0$ is the fixed cost of producing output x. Moreover, we assume that (i) the producer cannot store output to sell at a future time, and (ii) the producer cannot purchase insurance or otherwise hedge against price risk. These latter two assumptions mimic the situation of many rural producers in low- and middle-income countries.

[10] In this latter case, we introduce the discount in the experiment to induce the producer to buy the insurance. The discount does not change the producer's profit-maximization decision at the margin.

Price can be certain, in which case it is equal to p, or it can be uncertain with expectation $E(p) = \mu$. In what follows, when we talk of changes in price risk, we will be considering mean preserving spreads of the price distribution.

Given the foregoing, we now state our core results.

PROPOSITION 1 (Sandmo 1971). Under output price risk, a risk-averse agent produces less output than under output price certainty.

Proof. See Appendix A.

The foregoing obviously hinges on risk-aversion, i.e., on the assumption that $u'' < 0$. What if we did not assume risk aversion? Given the foregoing, it is relatively straightforward to show that a risk-neutral producer would not change her behavior under price risk relative to a situation of price certainty, and that a risk-loving producer would benefit from price risk, and thus produce more under price risk than under price certainty.

From the foregoing theoretical framework, we can also state the following.

PROPOSITION 2. Under output price risk and a compulsory and actuarially fair output price insurance, a risk-averse agent produces the same output as she does under output price certainty.

Proof. See Appendix A.

PROPOSITION 3. Under output price risk and a voluntary and actuarially fair output price insurance, a risk-averse agent produces the same output than under output price certainty.

Proof. See Appendix A.

Before proceeding with the work of testing the propositions just laid out, we briefly discuss those propositions. Indeed, since price and quantity produced combine into making total revenue, insuring either price or quantity in a way that ends up affecting revenue in exactly the same way should have the exact same effect on producer behavior. In practice, however, a few things may lead to discrepancies between insuring quantity and insuring price. We believe that the difference between insuring a variable one has some control over (here, quantity produced) and insuring a variable one has no control over (here, price, given the assumption that producers are price takers) can lead to considerable differences in uptake, if not behavior, via some locus of control or self-efficacy effects (Ajzen 2002). Similarly, from a trust perspective, insurance schemes that aim at insuring quantities via some nebulous, hard-to-verify-by-farmers index (e.g., rainfall or area-yield) may be perceived very differently relative to insurance schemes that aim at insuring prices, which can be more accurately assessed and verified by talking to other producers, traders, and so on (Jensen and Barrett 2017).

Although the foregoing looks at production in the face of price risk with or without insurance through the lens of EU theory, agents in this setting may perceive buying insurance in every round as a loss (Kahneman and Tversky 1979). As a consequence, they might end up underproducing instead of increasing their production as predicted in this section. Whether they do so is an empirical question which we address in our empirical work below.

3. Experimental Protocol

Our experiment aims to study the production behavior (i.e., output choices) of our subjects in the face of output price risk with and without insurance (either mandatory or voluntary) in a controlled setting mimicking the theoretical framework in Section 2. Each subject-specific experimental session consists of five sections; the first three are games where the subject has to choose output levels and, in some cases,

whether to purchase insurance; the fourth is a standard Eckel-Grossman (2002) risk elicitation lottery; the last one is a survey questionnaire aimed at collecting some socio-economic information about the subject. We randomized the order of (i) the first three game sets and (ii) the risk elicitation lottery to eliminate potential bias arising from the order in which games are played.

Before participating in the experiment, enumerators made sure potential subjects were potato farmers and sold at least part of their potato harvest at market. Potential subjects had to correctly answer two out of three basic math screening questions to make sure they could understand the experimental games.[11] After passing this screening, participants read and signed the consent form, which stated that they would receive a minimum (fixed) amount of 40 PEN (i.e., about $10) for their participation if they completed the experiment, as well as the maximum amount they could gain from their participation in the experiment. Then, for each subject, an additional random compensation was added which ranged from 1 to 10 PEN (i.e., about $0.25 to $2.50). This allows testing whether there is a "house money" effect, i.e., whether a different fixed payoff changes behavior because subjects are playing with the experimenter's money instead of theirs.[12] Thus, a subject's minimal compensation ranged from 41 to 50 PEN (i.e., from $10.25 to $12.50). Subsequently, enumerators randomized the order of Games B, MI, and VI, and then the order of the Eckel-Grossman risk-elicitation game, which was played either before or after the other three games. Though subjects played Games B, MI, and VI and the lottery in a random order, the survey questionnaire was always at the end, after the experimental games were played. In the remainder of this section, we describe the five sections of the experiment; our entire experimental protocol can be found in Appendix C.

[11] The three questions were: "What is 40% of 100 PEN?," "If there is 25% probability of rain, what is the probability that it does not rain?," and "Imagine a bag with three blue balls and seven red balls; what is the probability of choosing a blue ball?"

[12] Moreover, adding a non-stochastic compensation might have helped getting a more realistic (i.e., less risk-averse) sample (Harrison, Lau, and Rutström 2009).

3.1. Game B: Production with Price Risk

For the purposes of comparison and establishing a baseline, Game B ("baseline") replicates the output price risk game in Bellemare, Lee and Just (2020), with only a few changes. In this game, subjects have only one task: choosing a discrete production level (units of a single commodity) ranging from 0 to 20 under two scenarios: (i) when the price per unit produced is certain and equal to 7 PEN, and (ii) when the price per unit produced is uncertain, but subjects know its distribution among values of 5, 6, 7, 8, or 9 PEN. The price can be drawn from four different price distributions differing only along their standard deviations (0.8, 1.17, 1.45, and 1.58). In other words, all in-game price distribution are mean-preserving spreads of one another.

In each round with uncertain price, one of the four uncertain-price distributions was selected at random and shown to the subject ex ante of her choosing a production level. Price (un)certainty rounds occurred at random; price certainty occurred with 1/3 probability, and price uncertainty occurred with 2/3 probability. Conditional on there being price uncertainty, each of the four distributions with uncertain price had even odds (i.e., 1/4 probability) of being selected at random. This design allows studying the effect of price risk at the extensive margin (i.e., the effect of price risk relative to price certainty) as well as at the intensive margin (i.e., the effect of more relative to less price risk).

Our design differs from the one in Bellemare, Lee and Just (2020) as follows. First, we did not frame the experiment commodity as they did, but as a notional "commodity"; our experiment is thus artefactual rather than framed. Second, instead of using a 10 kg bag as the unit of production, we use *arrobas* ($\approx$ 11.5 kg), which is the local measure used when selling crops in the study area. Third, instead of offering only a fixed base compensation, we offered participants a fixed base compensation plus a random additional amount, as described above. Fourth, and finally, we use the Eckel and Grossman (2002, 2008)

approach to elicit risk aversion instead of the Holt and Laury (2002) approach used in Bellemare, Lee, and Just (2020).[13]

Profits in each round are calculated such that

$$\pi = px - c(x) - F = px - 2x^{1.4} - 15, \quad (1)$$

where p is the realized price.[14] Profits from each round under uncertain price were realized after the round price was realized. Subjects were given tables and figures that showed what their profits would be under every output level—price pair to help guide their production decisions. To make sure everyone understood the game, participants played 10 rounds of practice at first, and then 20 real rounds on which their final payoff was based.[15]

To focus on the effect of output price risk, our game abstracts away from other types of uncertainty (e.g., uncertainty over production or costs). Moreover, and as in Section 2, our setup did not allow storage, there were no survival constraints, rounds were independent from one another (i.e., one round's payoff did not affect other rounds' payoffs), subject decisions were independent from one another since each subject ran through the experiment individually with an enumerator, and there were no general equilibrium effects. Finally, participants started every round with an endowment of 25 PEN to eliminate liquidity constraints.

[13] The Eckel and Grossman method—a direct descendant of the method developed by Binswanger (1980) to elicit risk preferences in low-income countries—has been proved to work better among individuals with low math abilities, which we can expect from the subjects in our experiment, but it has the issue that it cannot differentiate among higher levels of risk-seeking (Charness, Gneezy, and Imas 2013). Similarly, Crosetto and Filippin (2016) suggest that the Holt-Laury method of risk elicitation might be troublesome when subjects' numeracy is an issue.

[14] This profit function has the same functional form as the function maximized the theoretical framework in section 2.

[15] At the end of the experiment, one round of the 60 real rounds (20 per game) was selected at random as the round on which payoff was going to be based. Beyond minimizing the administrative costs associated with computing payoffs for 60 rounds, this avoids path dependency in and cumulative earnings having an effect on decision making while setting up proper incentives in each round (Charness, Gneezy, and Halladay 2016).

3.2. Game MI: Production with Price Risk and Mandatory Insurance

Game MI ("mandatory insurance") has exactly the same structure as the previous one, except for the presence of mandatory insurance, which changes the profit function to

$$\pi = px - c(x) - F + (d - k)x. \tag{2}$$

This is a full-insurance scheme, i.e., all of output x is insured. The insurance premium per unit (k) for the experiment was actuarially fair, and was thus equal to 0.30 PEN per unit of output x. The insurance indemnity per unit (d) takes the value of \$2 if the realized price is equal to \$5, or \$1 if the realized price is \$6.[16] In other words, the compulsory full-insurance insures the output price only when it falls below the average price, in which case it sets the price back to the average price (\$7). If the realized prices are \$7, \$8 or \$9, the insurance premium (k) is paid for all units produced, but the indemnity (d) is equal to zero. As such, the presence of compulsory insurance makes the variance of profits smaller by eliminating downside risk. As in Game B, to ensure subjects understood the instructions of this game, they first played 10 rounds of practice, and then 20 rounds of real games.

We wish to highlight two important features relating to the micro-insurance literature. First, our controlled setting allows avoiding the presence of informal insurance schemes that could also cover covariate risks, like the one our price-risk insurance covers (Mobarak and Rosenzweig 2013). Second, as in Game B, all participants have a base payoff of 25 PEN to start every round of Game MI. This also allows eliminating liquidity constraints, which are seen in the micro-insurance literature as one of the reasons why micro-insurance uptake tends to be low.[17]

[16] Note that the indemnity (d) depends on the realized price (p). For simplicity, in section 2, we considered a unique value of d. However, this simplification does not lead to changes in the results presented in section 2.

[17] Although the base payoff (25 PEN) is the same for everyone, the compensation for participating in the experiment is randomized between 41 and 50 PEN to measure the house money effect. We thus assume that the liquidity constraint is related to the base payoff and that the participants do not mentally account the compensation as part of their liquidity (Thaler 1985).

3.3. Game VI: Production with Price Risk and Voluntary Insurance

When faced with price risk in Game VI ("voluntary insurance"), subjects choose whether to purchase the insurance and the quantity produced. After participants were told whether the price would be certain or uncertain, and subsequently the price distribution from which the price will be drawn (both chosen randomly, like in the two previous games), they were randomly offered discounts on the insurance premium of 0, 50, or 100%, each with probability 1/3 (within uncertain price rounds). With this information, participants choose whether to purchase the insurance, and thereafter farmers choose how much to produce. The output price, and thus within-round profits, were realized after participants chose whether to purchase insurance and their production level. Note that participants who purchased the insurance had to purchase it for all produced units, as partial insurance was not an option.

The profit from this game is thus equal to the profit of Game B if the subject chooses not to purchase insurance, such that

$$\pi = px - c(x) - F. \tag{3}$$

The profit is equal to the profit of Game MI if the subject chooses to buy insurance and she is assigned a 0% discount on the premium per unit:

$$\pi = px - c(x) - F + (d - k)x \tag{4}$$

The subject's profit when buying insurance at a 50% discount is

$$\pi = (p - 0.5k + d)x - c(x) - F. \tag{5}$$

Finally, the subject's profit when buying insurance at a 100% discount is

$$\pi = (p + d)x - c(x) - F. \tag{6}$$

Again, subjects played 10 rounds of practice and then 20 rounds of real games, and payoffs were based on one randomly selected round among the three games.

The insurance offered in Game VI is not a pooled micro-insurance scheme, but it shares an important characteristic with those schemes: A firm offering the output price risk insurance would not need to check

every farmer's losses—only the price level, which is usually publicly available, easy to access, is easily understood, and reliable. That said, our experiment also assumes that there are no transaction costs, that every farmer is a price taker, and that the realized (i.e., announced) price received by every farmer will be the same. Lastly, as in Game MI, no one can buy the insurance in Game VI in rounds where the price is certain; in those rounds, the insurance is simply not offered.

4. Empirical Framework

We now describe our empirical framework. To do so, we first discuss our estimation strategy. We then discuss our identification strategy, because even though we are dealing with experimental data, there are enough moving parts to our lab-in-the-field experiment that such a discussion is warranted.

4.1. Estimation Strategy

Our estimation strategy consists of three approaches, viz. one common to Games B, MI, and VI, and two additional ones unique to Game VI.

In the approach common to Games B, MI, and VI, we estimate the effect of price risk on production by estimating three different specifications, which are such that

$$y_{it} = \alpha_1 + \beta_1 x_{it} + \gamma_1 D_{1it} + \delta_{1i} + \epsilon_{1it}, \tag{7}$$

$$y_{it} = \alpha_2 + \beta_2 x_{it} + \gamma_2 D_{2it} + \lambda_2 \sigma_{it} + \delta_{2i} + \epsilon_{2it}, \tag{8}$$

and

$$y_{it} = \alpha_3 + \beta_3 x_{it} + \gamma_3 \Sigma_{3it} + \delta_{3i} + \epsilon_{3it}. \tag{9}$$

Among the things common to Equations (7) to (9), the subscripts i and t respectively denote the individual subject and the within-game round, subscripts 1 to 3 denote different specifications of price risk (as we explain below, this is distinct from whether we estimate these equations for each of Games B, MI, and VI), y denotes the output level in $\{1, \ldots, 20\}$, x is a vector of control variables (i.e., here, this consists only of a linear trend included to capture possible changes over time within the game), δ is a subject-specific fixed effect, and ϵ is an error term with mean zero.[18]

One thing that should be noted for emphasis is the fact that the treatment variable varies both within subjects over time as well as between subjects for a given round number. This is because every subject goes through the experiment one-on-one with an enumerator, and each subject sees his or her own unique sequence of random treatment realizations within each game (and the order of games is also randomized).

What does vary across Equations (7) to (9) are the way price risk enters each equation, namely:

(i) In Equation (7), price risk enters as a dummy variable for whether price is uncertain. This allows testing the core prediction of Baron (1970) and Sandmo (1971), which is that price risk at the extensive margin decreases output for risk-averse producers.

(ii) In Equation (8), price risk enters at both the extensive margin (i.e., D, which captures whether there is any price risk) and linearly at the intensive margin (i.e., σ, which captures how much price risk there is conditional on there being price risk). This allows partially testing the core prediction of Batra and

[18] An earlier version of this paper presented random effects specifications in addition to fixed effects specifications. Results were qualitatively the same across fixed and random effects specifications, and so we no longer present random effects specifications for the sake of brevity. Even though random effects specifications are efficient relative to fixed effects specifications and the assumptions required for random effects hold given our experimental setup, the former impose an undesirable structure on the error term, and so we prefer the latter. We nevertheless show random effects results in the appendix for completeness. It stands to reason that when we include subject-specific fixed effects instead of subject-specific random effects, a number of time-invariant control variables are dropped.

Ullah (1974), which is that price risk at the intensive margin decreases output for producers whose preferences exhibit decreasing absolute risk aversion.

(iii) In Equation (9), price risk enters nonlinearly, by including a vector of dummy variables to capture various levels of price risk (i.e., standard deviations of the price distribution) relative to price certainty. Specifically, this equation includes one dummy for each level of price risk, such that $\Sigma = \{\sigma_1, \sigma_2, \sigma_3, \sigma_4\}$, where $\sigma_1 = I(\sigma = 0.795)$, $\sigma_2 = I(\sigma = 1.17)$, $\sigma_3 = I(\sigma = 1.451)$, $\sigma_4 = I(\sigma = 1.458)$. This allows testing whether individuals respond to increases in price risk in a consistent (i.e., monotonic) fashion.

Taking the specification in Equation (7) as representative, when it comes to Game VI, γ_1 is an intent-to-treat (ITT) estimate. We also pool observations from Games B and VI to estimate

$$y_{it} = \alpha_4 + \beta_4 x_{it} + \gamma_4 D_{4it} + \gamma_I I_{it} + \gamma_{DI} D_{4it} \times I_{it} + \delta_{4i} + \epsilon_{4it}, \tag{10}$$

where γ_4 captures the effect of price risk on production in the absence of insurance, γ_I captures the effect of Game VI relative to Game B, and γ_{DI} captures the effect of price risk in Game VI. While γ_4 is an ATE, γ_{DI} is an ITT, with the latter capturing the effect of price risk in a game where insurance is available in rounds where price is uncertain.

Finally, we also estimate the following two-stage least squares specification (2SLS), such that

$$B_{it} = \alpha_5 + \beta_5 x_{it} + \pi_5 R_{it} + \delta_{5i} + \epsilon_{5it}, \text{ and} \tag{11}$$

$$y_{it} = \alpha_6 + \beta_6 x_{it} + \gamma_6 \hat{B}_{6it} + \delta_{6i} + \epsilon_{6it}, \tag{12}$$

where Equation (11) is the first stage, wherein random discount R is used as an instrumental variable for B in the second stage in Equation (12). This allows estimating the local average treatment effect (LATE) of D on y, or the effect of the insurance availability on production for those subject-rounds where the random discount induced the subject to purchase the insurance.

Although y is a non-negative integer, Equations (7) to (12) are estimated by least squares for ease of interpretation of the coefficients as well as for computational simplicity, given our 101 subjects playing each game for 20 periods. Because we will need an instrumental-variable setup when studying Game VI, we shy away from nonlinear (e.g., Poisson, negative binomial) models to prefer instead linear models throughout even though our dependent variable is a count variable.

We cluster standard errors at the subject level, but because Abadie et al. (2022) note that traditional approaches to clustering tend to be conservative (in the sense that they tend to err on the side of clustering when it is not necessary), we also show results for which standard errors are not clustered in Appendix B.

4.2. Identification Strategy

Given our experimental research design, identification is straightforward in Equations (7) to (10), but somewhat more involved in equations (11) and (12). In what follows, we discuss each estimand in turn, and explain where identification comes from for that estimand.

For Equations (7) to (10), the foregoing yields the following estimates of various treatment effects. Taking the specification in Equation (7) as representative, then:

(i) γ_1 is the ATE of price risk on production without insurance in Game B, the (unbiased) estimate of the ATE of price risk on production with compulsory insurance in Game MI, and the ITT estimate of the effect of insurance availability on production in Game VI (i.e., the effect on production of making insurance available for purchase).

(ii) γ_4 and γ_{DI} are estimates of the ATE of price risk on production in Game VI (i.e., respectively, the effect of price risk on production in cases where no insurance is available and in cases where insurance is available on a voluntary basis).

(iii) γ_6 is the estimate of the LATE of insurance on production in Game VI (i.e., the effect of the insurance on production for those subject-rounds wherein the random discount induced uptake of the insurance).

Equations (11) and (12) should provide a better estimate of the effect of purchasing the insurance on output in that they can estimate the effect of purchasing the insurance on output for those subject-rounds that were induced to do so by the random discount of on the price of the insurance.

In other words, under assumptions that are easily satisfied in this context, γ_6 is a LATE. For γ_6 to be a LATE, it has to be the case that the instrumental variable R (i) be independent, (ii) that it meets the exclusion restriction, (iii) that it be relevant, and that (iv) it has a monotonic effect on the treatment variable D. By virtue of being a random discount, assumptions (i) and (ii) are satisfied. Assumption (iii) is directly testable. And assumption (iv) holds under the assumption that the demand for insurance decreases as the insurance premium (i.e., the price of the insurance) increases. This is estimated on the subsample of subject-rounds for which price has been randomly assigned to be uncertain. The external validity of this result is thus limited by the fact that it is a LATE, which necessarily applies to fewer subject-rounds than either the ITT or the ATE, as well as to the fact that it is estimated on the subsample of cases where a subject-round has been assigned an uncertain price, which necessarily applies to fewer subject-rounds than the ITT.

5. Data and Descriptive Statistics

Our data come from lab-in-the-field experiments conducted individually with 101 potato farmers in Peru in August 2019. Each farmer played 10 practice rounds and 20 real rounds for each one of the three games described in Section 3. We focus on the real rounds only, and so thus for each one of the three game sets, we use a sample of 2,020 observations, with the exception of the 2SLS results, where we focus on subject-rounds with price uncertainty, and our sample size drops to 1,345. See Appendix D for minimum detectable effects and statistical power considerations.

The experiments were conducted in the districts of Cajamarca that had the most potato farmers according to the most recent data of the Ministry of Agriculture. Subjects were personally invited to participate in the experiment, held in the villages where they lived or worked.

Tables 1a and 1b respectively present summary statistics at the subject-round and subject levels. Table 1a shows that price and price risk were strictly randomized in the three game sets: price was on average 7 PEN, two thirds of the rounds had uncertain prices, and in those rounds the four different price distributions (scenarios 1, 2, 3 and 4) occurred similar number of times (around 16.7% each one). Similarly, for the third game set, insurance premium discounts (of 0%, 50%, and 100%) were offered randomly, a third of the time each in uncertain price rounds (around 22.2% each one), as designed. On average, participants chose to produce around 10.3 units in certain rounds of each game, when the optimal level was 10, showing that the game was in general well understood.

Subject-level descriptive statistics in Table 1b show that the risk-elicitation lottery was played at the end of the three game sets for half of our subjects, which we would expect from randomization. The risk-aversion derived from this lottery was on average 0.738 (on a scale from 0.2 to 2, where 2 is the CRRA value for most risk-averse individual). The randomized additional compensation (from 1 to 10 PEN), aimed

to measure the house-money effect, was on average 5.82 PEN; again, this is what we would expect from randomization.

From the final questionnaire, we also know potato farmers in our sample live in remote rural areas, are not well-connected to the markets, depend heavily on agriculture, and have little access to financial services that can help them cope with risks associated with agricultural activities. Nonetheless, these farmers face large price variation: on average, the worst potato price they received was 5.02 PEN—same as the minimum price in our experiment—and the best was 15.96 PEN—while our maximum price was 9 PEN.

6. Results and Discussion

Table 2 shows estimation results for Game B, i.e., the case where there is no price risk insurance. Without any control variables, we find that price risk overall has no statistically significant effect on production (column 1). When breaking down price risk into its extensive margin and intensive margin components (column 2), we find that price risk at the extensive margin has a negative impact on output, but price risk at the intensive margin has a positive impact on output; the former is consistent with Baron (1970) and Sandmo (1971), whose theoretical results showed that the effect of price risk on output is negative for risk-averse individuals, but the latter is only consistent with increasing absolute risk aversion, going by the theoretical results in Batra and Ullah (1974). When breaking down price risk into various levels of price risk and omitting price certainty as a reference category (column 3), we see that the results in columns 1 and 2 mask a certain amount of heterogeneity in that they are driven solely by the lowest price risk category, viz. when the standard deviation of the price distribution is equal to 0.795, output decreases in response, but this is not the case for other values of the standard deviation of price risk. For all other values of price risk, subjects do not change their level of production relative to situations of price certainty. These results are similar to those in Bellemare, Lee, and Just (2020), save for those in column 2: Whereas

we find that price risk at the extensive margin decreases production and price risk at the intensive margin increases production, Bellemare, Lee, and Just (2020) find results of similar sign for their subsample of Peruvian farmers, but without any statistical significance. Appendix Tables A2a to A2c shows the same specification, but without clustering (A2a), without a linear time trend but with clustering (A2b), and without either a linear time trend or clustering (A2c). All specifications have findings that are qualitatively identical to those in Table 2.

Overall, the results in Table 2 (and its corresponding Appendix Tables) offer mixed support for our theoretical framework. On the one hand, and contra Baron (1970) and Sandmo (1971), we find that that price risk overall does not cause decreases in output. On the other hand, we find that price risk at the extensive margin, when controlling for price risk at the intensive margin, does cause a decrease in output, consistent with Baron (1970) and Sandmo (1971). But in that case, the result at the intensive margin is only consistent with the theory if preferences exhibit increasing absolute risk aversion, which seems unlikely. The results in column 3 of Tables 2, however, suggest that there is a discontinuity in preferences somewhere between price certainty and the smallest amount of price risk. Such a discontinuity is inconsistent with the axioms of expected utility theory, but it has been found in other contexts.

Table 3 shows similar results for Game MI, i.e., the case where subjects are offered compulsory insurance against price risk at an actuarially fair premium. In this case, we find practically no statistical significance anywhere, and it looks as though compulsory full insurance all but mutes the effects of price risk, as (i) price risk overall appears not to have any effect on production, (ii) the same goes when breaking price risk into its extensive margin and intensive margin components, and (iii) the same goes when breaking down price risk into various levels of price risk and omitting price certainty as a reference category (column 3). Appendix Tables A3a to A3c shows the same specification, but without clustering (A3a), without a linear time trend but with clustering (A3b), and without either a linear time trend or clustering (A3c). All specifications have findings that are nearly identical to those in Table 3.

Overall, the results in Table 3 show that the introduction of compulsory price risk insurance at an actuarially fair premium causes people to behave as though there is no price risk at all. In other words, people do not produce at levels that significantly differ from 10 (i.e., the optimal level of production under price certainty) when faced with price risk that is fully insured at an actuarially fair premium. Thus, while the results in Table 2 showed that people do respond to price risk in sometimes unexpected ways, the results in Table 3 show that once the insurance market failure is removed, people behave the way producer theory says they should in the absence of price risk, viz. by choosing the profit-maximizing level of output.

Table 4 pools observations from Games B and MI to estimate the ATE of price risk on output with and without compulsory price risk insurance at an actuarially fair premium (i.e., the results from column 1 in Tables 2 and 3) in order to test whether behavior is the same across those two treatments. Both without and with controlling for the game round, we fail to reject the null hypothesis that behavior is the same in both scenarios. Appendix Table A4 shows a version of the results in Table 4 without clustering. Here, too, we cannot reject the null hypothesis that behavior is the same in both scenarios, even though the coefficient on price risk in Game B is statistically significant at less than the 10 percent level.

Table 5 shows estimation results for Game VI, looking at the effect of price risk on output when there is voluntary insurance against price risk for the whole sample, but ignoring the random discount. In other words, Table 5 shows the ITT of price risk on output with such voluntary insurance. Column 1 of Table 5 shows that in such cases, price risk causes subjects to produce more than under price certainty. When breaking price risk down into its extensive margin and intensive margin component (column 2), neither of these margins is statistically significant. But when breaking down price risk into various levels of price risk and omitting price certainty as a reference category (column 3), we find that the three higher out of four levels of price risk cause an increase in output relative to price certainty, but we find no monotonicity in how output responds to various levels of price risk. This non-monotonicity also runs counter to expected

utility theory. Appendix Tables A5a to A5c shows the same specification, but without clustering (A5a), without a linear time trend but with clustering (A5b), and without either a linear time trend or clustering (A5c). All specifications have findings that are nearly identical to those in Table 5.

Table 6 pools observations from Games B and VI to look at the effect of price risk on production in cases where voluntary insurance is made available on the market, i.e., the interacted effect of price risk and Game VI. Here, we see that subjects who do not change their behavior in response to price risk in the absence of insurance do increase their output when voluntary insurance is available, and a similar result obtains in the absence of clustering (Appendix Table A6).

Table 7 shows estimation results for Game VI, but looks instead at the effect of purchasing insurance on output only when there is voluntary insurance against price risk, taking into account the random discount offered to our subject to stimulate purchase of insurance. In columns 1 and 2, that discount enters as a continuous variable; in columns 3 and 4, it is broken down into two dummy variables—one for a 50-percent discount, and one for a 100-percent discount. In other words, the random discount (either continuous or broken down into two dummies) is used as an instrumental variable to exogenize the purchase of insurance, thereby allowing to estimate the causal effect of purchasing the insurance on output. In both cases, without and with controlling for round, the instrumental variable(s) is (are) relevant, and we find that purchasing the insurance causes an increase in output of 1.26 units, or roughly a 12.5-percent increase in production relative to the baseline price certainty case (i.e., comparing with the results of Game B). While this seems economically significant, it is not statistically significant in Table 7, but it is statistically significant in Appendix Table 7, which shows results without clustering.

In Tables 8 and 9, we explore treatment heterogeneity for the effect of price risk on production both without any insurance (Game B, in Table 8), and with compulsory insurance against price risk at an actuarially fair premium (Game MI, in Table 9). In Table 8, we find that being a recipient of the Juntos

national conditional cash transfer program is associated with decreases in production in response to price risk (Perova and Vakis 2012). Appendix Table A8 shows similar results for the case where standard errors are not clustered.

In Table 9, when there is compulsory insurance against price risk at an actuarially fair premium, we also see some treatment heterogeneity. Here, subjects who only cultivate potatoes respond more strongly to price risk than subjects who cultivate potatoes and other crops. When it comes to the best and worst prices ever received for the potatoes, farmers respond by increasing how much they produce in response to price risk as the best price ever received increases, but they respond by decreasing how much they produce in response to price risk as the worst price ever received increases. Finally, subjects who live further away from a market respond to price risk by increasing how much they produce in the presence of compulsory insurance. This is perhaps because they are insulated from price risk. Appendix Table A9 shows similar results for the case where standard errors are not clustered.

More interestingly, we find no systematic treatment heterogeneity when we look at the interaction of price risk and our subjects' coefficient of relative risk aversion as estimated from the Eckel and Grossman (2002, 2008) list experiment in either Table 8 or Table 9 or their Appendix versions. This, combined with our results at the intensive margin for Game B (which support Sandmo's prediction but seem to contradict Batra and Ullah's theoretical prediction), our results when breaking down price risk into the various values of the standard deviation of the price risk distribution in Game B (which suggests a discontinuity in risk preferences between price certainty and small amounts of price risk) as well as earlier results in Bellemare, Lee, and Just (2020) suggest that expected utility theory is not the right framework to study behavior in the face of price risk and insurance. More importantly, these results suggest that any ex ante analysis of policies aimed at insuring price risk based on expected utility theory will lead to mistaken policy recommendations.

7. Summary and Concluding Remarks

Most micro-insurance schemes for producers in low- and middle-income countries seek to insure the quantity of output produced (which lies partly within the producer's control) instead of the price at which that output is sold (which is beyond the producer's control in almost all cases). Against that context, we have looked at the impacts of insurance against output price risk on production using lab-in-the-field experiments conducted with potato growers in Peru. Extending the experimental protocol in Bellemare, Lee, and Just (2020), we have tested two forms of insurance against price risk: full compulsory insurance at an actuarially fair premium, and full voluntary insurance at an actuarially fair premium, but with a random discount to induce uptake.

Counter to the predictions of microeconomic theory, we have found that relative to situations of price certainty, the mere presence of price risk does not cause our subjects to significantly change how much they chose to produce. Consistent with that, we have also found that the introduction of a compulsory full insurance scheme sold at an actuarially fair premium also does not cause our subjects to significantly change how much they chose to produce relative to situations of price certainty. In other words, perfectly solving the market failure, production under price certainty is similar to production under price risk. When the insurance is purchased on a voluntary basis, however, output increases for the average subject-round in response to price risk—that is, the intent to treat effect of making the insurance available for purchase in situations of price uncertainty is positive. Accounting for that selection by using the random discount on the premium as an instrumental variable for insurance take-up, we find that purchasing the insurance causes subjects to increase their production above the optimal production level—that is, the local average treatment effect of the insurance on output is positive.

Our work is limited in two important ways. First, as with any lab-in-the-field experiment, the external validity of our results is limited, as our results only apply to potato producers in the Cajamarca region of

Peru at the time the data were collected. Running the same lab-in-the-field experiments with producers who grow a different crop, or who grow the same crop in a different region, or at another time might lead to different results. Second, our experimental protocol was meant to mimic Sandmo (1971), and so to test the predictions of expected utility theory when applied to production decisions in the face of output price risk. Though this would not be an issue had we found support for expected utility theory, the fact that we fail to find support for the predictions of the theory begs the question of which alternative decision-making model applies here. Future research should focus on testing alternative models of decision models. Given that Bellemare et al. (2020) find some support for prospect theory as an explanation for the behavior of their subjects in experiments aimed at testing Sandmo (1971), the Tanaka et al. (2010) list experiments used by Liu (2013) to study the adoption of *Bt* cotton in China, for instance, could lend themselves to testing whether prospect theory does a better job of explaining behavior than does expected utility theory. We also encourage future researchers interested in index insurance to consider conducting randomized controlled trials aimed at studying the effect of the provision of insurance against price risk, both mandatory and voluntary, on output.

Taken at face value, our findings have important implications for policy. Specifically, these findings suggest that any formal, government-led agricultural insurance scheme aiming at insuring producers against price risk whose design is based on expected utility theory necessarily adopts what Pritchett (2009) called a "normative as positive" (NAP) approach, wherein ex ante policy analysis substitutes the way people should behave for the way people actually behave. What this means is that when the NAP approach makes correct predictions, it has made those predictions by chance because they were based on the wrong objective function. This in turn leads to our findings' main implication for research, which is that instead of testing specific micro-insurance schemes (or worse, minor tweaks on existing micro-insurance schemes) to see whether they "work" (that is, whether they cause producers to purchase more inputs, adopt better technologies, or to simply produce more), future research should aim to test

interventions that will allow determining what is the right decision model used by the producers we seek to insure.

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Table 1a. Descriptive Statistics at the Subject-Round Level

Panel A. Round-level variables	*Game B*	*Game MI*	*Game VI*
Uncertain price rounds (1=Yes)	0.657	0.674	0.666
	(0.475)	(0.469)	(0.472)
Price distribution 1 (1=Yes)	0.168	0.167	0.167
	(0.374)	(0.373)	(0.373)
Price distribution 2 (1=Yes)	0.159	0.151	0.159
	(0.366)	(0.359)	(0.366)
Price distribution 3 (1=Yes)	0.174	0.161	0.177
	(0.379)	(0.368)	(0.382)
Price distribution 4 (1=Yes)	0.156	0.194	0.163
	(0.363)	(0.396)	(0.369)
Insurance offered at 0% discount (1=Yes)	--	--	0.215
			(0.411)
Insurance offered at 50% discount (1=Yes)	--	--	0.215
			(0.411)
Insurance offered at 100% discount (1=Yes)	--	--	0.236
			(0.425)
Output choice in certain rounds	10.266	10.307	10.253
	(2.660)	(2.379)	(2.286)
Output choice in uncertain rounds	10.170	10.392	10.802
	(3.721)	(3.197)	(3.229)
Output choice if purchased insurance	--	--	10.929
			(3.125)
Purchased insurance at 0% discount (1=Yes)	--	--	0.708
			(0.455)
Purchased insurance at 50% discount (1=Yes)	--	--	0.809
			(0.394)
Purchased insurance at 100% discount (1=Yes)	--	--	0.941
			(0.236)
Observations (rounds)	2,020	2,020	2,020
Subjects	101	101	101

Table 1b. Descriptive Statistics at the Subject Level

Panel B. Subject-level variables	***Mean***	***SD***
Risk-aversion (CRRA)	0.738	0.633
Eckel-Grossman lottery played after the 3 games (1=Yes)	0.535	0.501
Additional random compensation for participation (1-10 PEN)	5.792	2.546
Feel hungry (1=Yes)	0.168	0.376
Weather preference (min 1- max 10)	7.614	2.222
Age	38.505	13.057
Gender (1=male)	0.624	0.487
Years of education	6.812	3.236
Indigenous, mestizo or non-white (1=Yes)	0.812	0.393
Altitude (m.a.s.l.)	3381.366	217.575
Distance to the closest market (hours)	1.181	0.948
Household income from agriculture (%)	48.663	25.168
Number of crops planted by the household	3.822	2.151
Potato monocropping (1=Yes)	0.149	0.357
Number of potato varieties planted	2.455	1.229
Potato area (ha)	0.475	0.593
Potato harvest for self-consumption (%)	38.853	19.941
Years cultivating potato	16.733	12.671
Best price of potato ever received, per arroba	15.960	6.025
Worst price of potato ever received, per arroba	5.025	2.728
Price of potato received last season, per arroba	11.188	5.061
Number of small animals	16.495	17.379
Number of big animals	4.762	3.858
Currently has a credit (1=Yes)	0.109	0.313
Has had non-health insurance (1=Yes)	0.030	0.171
Observations (subjects)	101	

Table 2. Game B: Baseline Test of Sandmo's Hypothesis. ATE of Price Risk on Output without Insurance. Fixed Effects with Clustering and a Linear Time Trend.

Variables	(1)	(2)	(3)
	Dependent Variable: Units of Output (1 to 20)		
Uncertain Price round (1=Yes)	-0.176	-1.228***	
	(0.202)	(0.435)	
Standard deviation of Price Distribution		0.846***	
		(0.306)	
Standard deviation = 0.795			-0.600**
			(0.244)
Standard deviation = 1.170			-0.163
			(0.298)
Standard deviation = 1.451			0.037
			(0.245)
Standard deviation = 1.580			0.034
			(0.271)
Linear Trend (Round)	0.025	0.024	0.025
	(0.016)	(0.016)	(0.016)
Constant	10.058***	10.061***	10.060***
	(0.229)	(0.230)	(0.230)
Observations	2,020	2,020	2,020
R-squared	0.003	0.008	0.008
Number of Subjects	101	101	101

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3. Game MI. ATE of Price Risk on Output with Mandatory Insurance. Fixed Effects with Clustering and a Linear Time Trend.

Variables	(1)	(2)	(3)
	Dependent Variable: Units of Output (1 to 20)		
Uncertain Price round (1=Yes)	-0.039	-0.409	
	(0.162)	(0.355)	
Standard deviation of Price Distribution		0.292	
		(0.241)	
Standard deviation = 0.795			-0.160
			(0.203)
Standard deviation = 1.170			-0.197
			(0.235)
Standard deviation = 1.451			0.320
			(0.214)
Standard deviation = 1.580			-0.107
			(0.213)
Linear Trend (Round)	0.007	0.007	0.007
	(0.011)	(0.011)	(0.011)
Constant	10.188***	10.175***	10.161***
	(0.363)	(0.363)	(0.361)
Observations	2,020	2,020	2,020
R-squared	0.000	0.001	0.004
Number of Subjects	101	101	101

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Games B and MI. Are ATEs of Price Risk on Output without Insurance and with Mandatory Insurance the Same? Fixed Effects with Clustering.

Variables	(1)	(2)
Dependent Variable: Units of Output (1 to 20)		
Uncertain Price Round in Game B (1=Yes)	-0.125	-0.126
	(0.108)	(0.108)
Uncertain Price Round in Game MI (1=Yes)	0.043	0.045
	(0.100)	(0.100)
Linear Trend (Round)		0.016
		(0.010)
Constant	10.375***	10.051***
	(0.088)	(0.229)
Observations	4,040	4,040
R-squared	0.001	0.002
Number of Subjects	101	101
Test of Uncertain Price Round in Game B =		
Uncertain Price Round in Game MI F-Statistic	0.74	0.77
Prob > F	0.39	0.38

Standard errors clustered at the subject-level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Game VI: ITT of Price Risk on Output with Voluntary Insurance. Fixed Effects with Clustering and a Linear Trend.

Variables	(1)	(2)	(3)
Dependent Variable: Units of Output (1 to 20)			
Uncertain Price Round (1=Yes)	0.516***	0.209	
	(0.191)	(0.325)	
Standard deviation of Price Distribution		0.245	
		(0.219)	
Standard deviation = 0.795			0.338
			(0.223)
Standard deviation = 1.170			0.664***
			(0.225)
Standard deviation = 1.451			0.475*
			(0.241)
Standard deviation = 1.580			0.600**
			(0.252)
Linear Trend (Round)	0.015	0.015	0.015
	(0.012)	(0.012)	(0.012)
Constant	9.498***	9.498***	9.515***
	(0.636)	(0.636)	(0.637)
Observations	2,020	2,020	2,020
R-squared	0.010	0.010	0.011
Number of Subjects	101	101	101

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Games B and VI: Test of Sandmo's Hypothesis. ATE of Price Risk on Output without Insurance and with Voluntary Insurance. Fixed Effects with Clustering.

Variables	(1)	(2)
Dependent Variable: Units of Output (1 to 20)		
Uncertain Price round (1=Yes)	-0.180	-0.182
	(0.202)	(0.202)
Game VI	-0.067	-0.072
	(0.170)	(0.170)
Uncertain Price Round x Game VI	0.728***	0.735***
	(0.221)	(0.222)
Linear Trend (Round)	0.020**	
	(0.010)	
Constant	10.111***	10.322***
	(0.186)	(0.135)
Observations	4,040	4,040
R-squared	0.011	0.009
Number of Subjects	101	101

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7. Game VI. LATE of Insurance on Output for Subjects Who Buy the Insurance Because of the Discount. Fixed Effects with Clustering.

Variables	(1)	(2)	(3)	(4)
	Dependent Variable: Units of Output (1 to 20)			
Purchased insurance (1=Yes)	1.261	1.264	1.265	1.272
	(0.999)	(0.999)	(0.998)	(0.997)
Linear Trend (Round)		0.014		0.014
		(0.016)		(0.016)
Constant	9.765***	9.053***	9.761***	9.048***
	(0.822)	(0.859)	(0.821)	(0.858)
Observations	1,345	1,345	1,345	1,345
Number of Subjects	101	101	101	101
Instruments:	Discount	Discount	Dummy for each discount	Dummy for each discount
First-stage F-stat Discount	41.088	41.216		
First-stage F-stat 50% Discount			17.057	16.322
First-stage F-stat 100% Discount			41.216	41.345

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8. Game B. Heterogeneous Effects (ATE) of Price Risk on Output without Insurance. Fixed Effects with Clustering.

Variables	(1)	(2)
Dependent Variable: Units of Output (1 to 20)		
Uncertain price round (1=Yes)	-0.605	-0.525
	(1.458)	(1.458)
Uncertain price * Potato monocropping (1=Yes)	-0.175	-0.147
	(0.598)	(0.596)
Uncertain price * Family receives the Juntos CCT (1=Yes)	-0.722*	-0.727*
	(0.422)	(0.421)
Uncertain price * Risk-aversion (CRRA)	-0.292	-0.298
	(0.295)	(0.294)
Uncertain price * Years cultivating potato	0.016	0.015
	(0.015)	(0.014)
Uncertain price * Best price of potato ever received, per arroba	0.079	0.078
	(0.050)	(0.050)
Uncertain price * Worst price of potato ever received, per arroba	-0.008	-0.006
	(0.058)	(0.057)
Uncertain price * Potato area (ha)	0.068	0.053
	(0.346)	(0.346)
Uncertain price * Distance to the closest market (hours)	-0.243	-0.254
	(0.188)	(0.186)
Uncertain price * Years of education	0.002	-0.000
	(0.069)	(0.069)
Uncertain price * Indigenous, mestizo or non-white (1=Yes)	-0.206	-0.186
	(0.528)	(0.523)
Uncertain price * Number of potato varieties planted	-0.155	-0.154
	(0.206)	(0.205)
Uncertain price * Potato harvest for self-consumption (%)	0.019	0.018
	(0.012)	(0.012)
Uncertain price * When price is low, holds potato for some time (1=Yes)	-0.369	-0.365
	(0.583)	(0.582)
Uncertain price * When price is low, sells potato at the market price (1=Yes)	-0.997	-1.026
	(0.635)	(0.633)
Linear Trend Round)		0.025
		(0.016)
Constant	10.341***	10.080***
	(0.119)	(0.221)
Observations	2,020	2,020
R-squared	0.015	0.017
Number of Subjects	101	101

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9. Game MI. Heterogeneous Effects (ATE) of Price Risk on Output without Insurance. Fixed Effects with Clustering.

Variables	(1)	(2)
Dependent Variable: Units of Output (1 to 20)		
Uncertain price round (1=Yes)	-1.180	-1.196
	(0.761)	(0.760)
Uncertain price * Potato monocropping (1=Yes)	-0.924**	-0.930**
	(0.419)	(0.419)
Uncertain price * Family receives the Juntos CCT (1=Yes)	-0.108	-0.102
	(0.322)	(0.322)
Uncertain price * Risk-aversion (CRRA)	0.104	0.103
	(0.255)	(0.255)
Uncertain price * Years cultivating potato	-0.009	-0.008
	(0.013)	(0.013)
Uncertain price * Best price of potato ever received, per arroba	0.100**	0.100**
	(0.038)	(0.038)
Uncertain price * Worst price of potato ever received, per arroba	-0.078**	-0.078**
	(0.037)	(0.037)
Uncertain price * Potato area (ha)	0.154	0.155
	(0.191)	(0.192)
Uncertain price * Distance to the closest market (hours)	0.413**	0.412**
	(0.184)	(0.185)
Uncertain price * Years of education	-0.036	-0.035
	(0.044)	(0.044)
Uncertain price * Indigenous, mestizo or non-white (1=Yes)	0.544	0.545
	(0.386)	(0.388)
Uncertain price * Number of potato varieties planted	-0.136	-0.137
	(0.128)	(0.128)
Uncertain price * Potato harvest for self-consumption (%)	0.009	0.009
	(0.009)	(0.009)
Uncertain price * When price is low, holds potato for some time (1=Yes)	-0.291	-0.278
	(0.366)	(0.363)
Uncertain price * When price is low, sells potato at the market price (1=Yes)	-0.066	-0.057
	(0.429)	(0.429)
Linear Trend (Round)		0.005
		(0.011)
Constant	10.402***	10.236***
	(0.099)	(0.352)
Observations	2,020	2,020
R-squared	0.016	0.016
Number of Subjects	101	101

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix A

Proof of Proposition 1.[19] Under expected utility theory, the agent's maximization problem is such that

$$\max_{x} E[u(px - c(x) - F)]. \tag{A1}$$

The first-order condition is such that

$$E\big[u'(\pi)\big(p - c'(x)\big)\big] = 0. \tag{A2}$$

Rearranging, we get that

$$E[u'(\pi)(p)] = E[u'(\pi)c'(x)]. \tag{A2'}$$

In other words, the agent maximizes when the expected output price is equal to the marginal cost.

Since $E(p) = \mu$, we can express the expected profit as

$$E(\pi) = E[px - c(x) - F] = \mu x - c(x) - F \tag{A3}$$

Adding and subtracting px on both sides, we get

$$E(\pi) = \mu x - c(x) - F + px - px. \tag{A4}$$

Noting that $\pi = px - c(x) - F$, we can rewrite this as

$$E(\pi) = (\mu - p)x + \pi, \tag{A5}$$

and thus

$$\pi = E(\pi) + (p - \mu)x. \tag{A6}$$

From Equation (A6), it is clear that when $p = \mu$, $\pi = E(\pi)$, so x^* will be the same under certainty or uncertainty. However, when $p \neq \mu$, specifically if $p > \mu$, Equation (A6) can be rewritten as

$$u'(\pi) = u'(E(\pi) + (p - \mu)x), \tag{A7}$$

which implies that

$$u'(\pi) \leq u'(E(\pi)). \tag{A8}$$

Multiplying both sides by $(p - \mu)$ and taking expectations, we get

$$E[u'(\pi)(p - \mu)] \leq u'(E(\pi))E(p - \mu), \tag{A9}$$

[19] This proof follows Sandmo (1971).

but since $E(p) = \mu = E(\mu)$, the right-hand side of Equation (A9) is equal to zero. Knowing this, and recalling the equality in (A2'), we get that

$$E[u'(\pi)(c'(x) - \mu)] \leq 0, \tag{A10}$$

which means that the marginal cost is smaller than the marginal benefit ($c'(x) < \mu$) of producing x, since marginal utility is always positive. Thus, under output price uncertainty, a risk-averse agent will produce less x than under output price certainty. ■

Proof of Proposition 2. Assume an insurance scheme that covers producers against low output prices. In this scheme, k is the actuarially fair premium (i.e., the price of the insurance) per unit of x, and d is the realized indemnity per insured unit of x. Thus, the expected indemnity per insured unit of x, δ, is equal to the actuarially fair premium k. Insured producers would receive d per unit of x produced only if the realized output price p falls below a given threshold; in this case, the threshold is the expected output price μ. Specifically, the indemnity received d is equal to the difference between the expected output price and the realized output price $\mu - p$ when the realized price is above or equal to the threshold (i.e., $p \geq \mu$), and equal to zero when the realized price is below the threshold (i.e., $p < \mu$).

Building on the previous scenario with price uncertainty, under this compulsory full-insurance scheme, the risk-averse producer will maximize:

$$\max_{x^I} E[u(px^I - c(x^I) - F + (d - k)x^I] \tag{A11}$$

From the first order condition, for the quantity of x produced under insurance (x^I), we have that

$$E[u'(\pi)(p + d)] = E[u'(\pi)(c'(x^I) + k)]. \tag{A12}$$

Now, recalling $E(p) = \mu$ and $E(d) = \delta$, the expected profit can be expressed as

$$E(\pi) = E[px^I - c(x^I) - F + (d - k)x^I] = \mu x^I - c(x^I) - F + \delta x^I - kx^I\ . \tag{A13}$$

Rearranging as in Equations (A4) to (A6) yields

$$\pi = E(\pi) + (p - \mu + d - \delta)x^I, \tag{A14}$$

and Equation (A14) can be rewritten as:

$$u'(\pi) = u'(E(\pi) + (p - \mu + d - \delta)x^I) \tag{A14'}$$

which implies that

$$u'(\pi) \gtreqless u'(E(\pi)). \tag{A15}$$

Multiplying both sides by $(p - \mu + d - \delta)$ and taking expectations, we get

$$E[u'(\pi)(p - \mu + d - \delta)] \gtreqless u'(E(\pi))E(p - \mu + d - \delta). \tag{A16}$$

Since $E(p) = \mu$ and $E(d) = \delta$,

$$E[u'(\pi)(p - \mu + d - \delta)] \gtreqless 0. \tag{A17}$$

Defining $\alpha = Prob(p \geq \mu)$, and recalling that $d = 0$ when $p \geq \mu$ and $d = \mu - p$ when $p < \mu$, which implies $\delta = (1 - \alpha)(\mu - p)$, we can rearrange equation (17) as:

$$E[u'(\pi)(\alpha)(p - \mu - \delta)] + E[u'(\pi)(1 - \alpha)(-\delta)] \gtreqless 0, \tag{A18}$$

$$E[u'(\pi)((\alpha)(p - \mu) - \delta)] \gtreqless 0, \text{ and} \tag{A18'}$$

$$E[u'(\pi)(p - \mu)] \gtreqless 0. \tag{A18''}$$

By definition, the output price insurance makes on average any output price equal to the expected output price. Specifically, once the premium is paid, the realized output price plus the expected indemnity would be equal to the expected output price, such that

$$E[p] = p - k + E[d], \tag{A19}$$

$$\mu = p - k + \delta, \text{ and} \tag{A19'}$$

$$k - \delta = p - \mu. \tag{A19''}$$

Moreover, by definition $k - \delta = 0$, so $p - \mu = 0$, and equation (A18'') is such that

$$E[u'(\pi)(p - \mu + d - \delta)] = 0. \tag{A20}$$

Using equation (A12), equation (A20) can also be rewritten as

$$E[u'(\pi)(c'(x^I) + k - \mu - \delta)] = 0 \tag{A21}$$

Thus, $c'(x^I) + k = \mu + \delta$, which means that the marginal cost of producing x under an actuarially fair output price insurance is equal to the marginal benefit. ■

Proof of Proposition 3. Risk-averse producers will buy the insurance if the expected utility from profits with insurance exceeds the expected utility of profits without insurance. In other words, with or without insurance, the risk-averse producer will maximize

$$\max_{x,x^I} \{E[u(px - c(x) - F]; E[u(px^I - c(x^I) - F + (d - k)x^I]\} \tag{A22}$$

From Propositions 1 and 2, we know that more will be produced under insurance ($x^* < x^{*I}$), and that since the insurance is actuarially fair ($k = \delta$), Equation (A22) can be expressed as

$$\max_{x,x^I} \{E[u(px^* - c(x^*) - F]; E[u(px^{*I} - c(x^{*I}) - F]\} \tag{A23}$$

Given that expected utility is an increasing function of x, the expected utility with insurance will be larger than the expected utility without insurance. Thus, the risk-averse producer will choose to maximize production under insurance, insuring all her produced units. In other words, she will always prefer to purchase insurance when it is available, and she will produce more x (i.e., the same x as under price certainty) than without insurance. ■

Appendix B. Appendix Tables.

Table A2a. Game B: Baseline Test of Sandmo's Hypothesis. ATE of Price Risk on Output without Insurance. Fixed Effects with a Linear Time Trend.

Variables	(1)	(2)	(3)
	Dependent Variable: Units of Output (1 to 20)		
Uncertain price round (1=Yes)	-0.176	-1.228***	
	(0.147)	(0.385)	
Standard deviation of Price Distribution		0.846***	
		(0.286)	
Standard deviation = 0.795			-0.600***
			(0.208)
Standard deviation = 1.170			-0.163
			(0.211)
Standard deviation = 1.451			0.037
			(0.205)
Standard deviation = 1.580			0.034
			(0.214)
Linear Trend (Round)	0.025**	0.024**	0.025**
	(0.012)	(0.012)	(0.012)
Constant	10.058***	10.061***	10.060***
	(0.171)	(0.171)	(0.171)
Observations	2,020	2,020	2,020
R-squared	0.003	0.008	0.008
Number of Subjects	101	101	101

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2b. Game B: Baseline Test of Sandmo's Hypothesis. ATE of Price Risk on Output without Insurance. Fixed Effects with Clustering.

Variables	(1)	(2)	(3)
Dependent Variable: Units of Output (1 to 20)			
Uncertain price round (1=Yes)	-0.178	-1.236***	
	(0.202)	(0.438)	
Standard deviation of Price Distribution		0.850***	
		(0.309)	
Standard deviation = 0.795			-0.601**
			(0.245)
Standard deviation = 1.170			-0.174
			(0.296)
Standard deviation = 1.451			0.042
			(0.247)
Standard deviation = 1.580			0.031
			(0.272)
Constant	10.320***	10.319***	10.320***
	(0.133)	(0.132)	(0.132)
Observations	2,020	2,020	2,020
R-squared	0.001	0.005	0.006
Number of Subjects	101	101	101

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2c. Game B: Baseline Test of Sandmo's Hypothesis. ATE of Price Risk on Output without Insurance. Fixed Effects.

Variables	(1)	(2)	(3)
	Dependent Variable: Units of Output (1 to 20)		
Uncertain price round (1=Yes)	-0.178	-1.236***	
	(0.147)	(0.385)	
Standard deviation of Price Distribution		0.850***	
		(0.286)	
Standard deviation = 0.795			-0.601***
			(0.208)
Standard deviation = 1.170			-0.174
			(0.211)
Standard deviation = 1.451			0.042
			(0.205)
Standard deviation = 1.580			0.031
			(0.214)
Constant	10.320***	10.319***	10.320***
	(0.118)	(0.118)	(0.118)
Observations	2,020	2,020	2,020
R-squared	0.001	0.005	0.006
Number of Subjects	101	101	101

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3a. Game MI: Baseline Test of Sandmo's Hypothesis. ATE of Price Risk on Output with Mandatory Insurance. Fixed Effects with a Linear Time Trend.

Variables	(1)	(2)	(3)
	Dependent Variable: Units of Output (1 to 20)		
Uncertain price round (1=Yes)	-0.039	-0.409	
	(0.130)	(0.334)	
Standard deviation of Price Distribution		0.292	
		(0.243)	
Standard deviation = 0.795			-0.160
			(0.183)
Standard deviation = 1.170			-0.197
			(0.190)
Standard deviation = 1.451			0.320*
			(0.186)
Standard deviation = 1.580			-0.107
			(0.174)
Linear Trend (Round)	0.007	0.007	0.007
	(0.010)	(0.010)	(0.010)
Constant	10.188***	10.175***	10.161***
	(0.333)	(0.333)	(0.333)
Observations	2,020	2,020	2,020
R-squared	0.000	0.001	0.004
Number of Subjects	101	101	101

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3b. Game MI: Baseline Test of Sandmo's Hypothesis. ATE of Price Risk on Output with Mandatory Insurance. Fixed Effects with Clustering.

Variables	(1)	(2)	(3)
	Dependent Variable: Units of Output (1 to 20)		
Uncertain price round (1=Yes)	-0.041	-0.403	
	(0.162)	(0.356)	
Standard deviation of Price Distribution		0.286	
		(0.242)	
Standard deviation = 0.795			-0.159
			(0.203)
Standard deviation = 1.170			-0.200
			(0.235)
Standard deviation = 1.451			0.315
			(0.215)
Standard deviation = 1.580			-0.110
			(0.213)
Constant	10.391***	10.392***	10.391***
	(0.109)	(0.109)	(0.110)
Observations	2,020	2,020	2,020
R-squared	0.000	0.001	0.004
Number of Subjects	101	101	101

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3c. Game MI: Baseline Test of Sandmo's Hypothesis. ATE of Price Risk on Output with Mandatory Insurance. Fixed Effects.

Variables	(1)	(2)	(3)
	Dependent Variable: Units of Output (1 to 20)		
Uncertain price round (1=Yes)	-0.041	-0.403	
	(0.130)	(0.334)	
Standard deviation of Price Distribution		0.286	
		(0.243)	
Standard deviation = 0.795			-0.159
			(0.183)
Standard deviation = 1.170			-0.200
			(0.190)
Standard deviation = 1.451			0.315*
			(0.186)
Standard deviation = 1.580			-0.110
			(0.174)
Constant	10.391***	10.392***	10.391***
	(0.106)	(0.106)	(0.106)
Observations	2,020	2,020	2,020
R-squared	0.000	0.001	0.004
Number of Subjects	101	101	101

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A4. Games B and MI. Are ATEs of Price Risk on Output without Insurance and with Mandatory Insurance the Same? Fixed Effects.

Variables	(1)	(2)
Dependent Variable: Units of Output (1 to 20)		
Uncertain price round in Game B (1=Yes)	-0.125	-0.126*
	(0.077)	(0.077)
Uncertain price round in Game MI (1=Yes)	0.043	0.045
	(0.069)	(0.069)
Linear Trend (Round)		0.016**
		(0.008)
Constant	10.375***	10.051***
	(0.078)	(0.179)
Observations	4,040	4,040
R-squared	0.001	0.002
Number of Subjects	101	101
Test of Uncertain Price Round in Game B =		
Uncertain Price Round in Game MI F-Statistic	1.52	1.57
Prob > F	0.22	0.21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5a. Game VI: ITT of Price Risk on Output with Voluntary Insurance. Fixed Effects with a Linear Trend.

Variables	(1)	(2)	(3)
Dependent Variable: Units of Output (1 to 20)			
Uncertain price round (1=Yes)	0.516***	0.209	
	(0.129)	(0.339)	
Standard deviation of Price Distribution		0.245	
		(0.251)	
Standard deviation = 0.795			0.338*
			(0.183)
Standard deviation = 1.170			0.664***
			(0.186)
Standard deviation = 1.451			0.475***
			(0.179)
Standard deviation = 1.580			0.600***
			(0.185)
Linear Trend (Round)	0.015	0.015	0.015
	(0.010)	(0.010)	(0.010)
Constant	9.498***	9.498***	9.515***
	(0.529)	(0.529)	(0.530)
Observations	2,020	2,020	2,020
R-squared	0.010	0.010	0.011
Number of Subjects	101	101	101

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5b. Game VI: ITT of Price Risk on Output with Voluntary Insurance. Fixed Effects with Clustering.

Variables	(1)	(2)	(3)
Dependent Variable: Units of Output (1 to 20)			
Uncertain price round (1=Yes)	0.520***	0.214	
	(0.192)	(0.324)	
Standard deviation of Price Distribution		0.245	
		(0.219)	
Standard deviation = 0.795			0.341
			(0.223)
Standard deviation = 1.170			0.673***
			(0.225)
Standard deviation = 1.451			0.476*
			(0.243)
Standard deviation = 1.580			0.605**
			(0.252)
Constant	10.273***	10.273***	10.272***
	(0.128)	(0.127)	(0.127)
Observations	2,020	2,020	2,020
R-squared	0.008	0.009	0.010
Number of Subjects	101	101	101

Standard errors clustered at the subject level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5c. Game VI: ITT of Price Risk on Output with Voluntary Insurance. Fixed Effects.

Variables	(1)	(2)	(3)
Dependent Variable: Units of Output (1 to 20)			
Uncertain price round (1=Yes)	0.520***	0.214	
	(0.129)	(0.339)	
Standard deviation of Price Distribution		0.245	
		(0.251)	
Standard deviation = 0.795			0.341*
			(0.183)
Standard deviation = 1.170			0.673***
			(0.186)
Standard deviation = 1.451			0.476***
			(0.179)
Standard deviation = 1.580			0.605***
			(0.185)
Constant	10.273***	10.273***	10.272***
	(0.104)	(0.104)	(0.104)
Observations	2,020	2,020	2,020
R-squared	0.008	0.009	0.010
Number of Subjects	101	101	101

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A6. Games B and VI: Test of Sandmo's Hypothesis. ATE of Price Risk on Output without Insurance and with Voluntary Insurance. Fixed Effects.

Variables	(1)	(2)
Dependent Variable: Units of Output (1 to 20)		
Uncertain Price Round	-0.180	-0.182
	(0.140)	(0.140)
Game VI	-0.067	-0.072
	(0.160)	(0.160)
Uncertain Price Round x Game VI	0.728***	0.735***
	(0.198)	(0.198)
Round order number, per game	0.020**	
	(0.008)	
Constant	10.111***	10.322***
	(0.141)	(0.113)
Observations	4,040	4,040
R-squared	0.011	0.009
Number of Subjects	101	101

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A7. Game VI. LATE of Insurance Output for Subjects Who Buy the Insurance Because of the Discount. Fixed Effects.

Variables	(1)	(2)	(3)	(4)
Dependent Variable: Units of Output (1 to 20)				
Purchased insurance (1=Yes)	1.261*	1.264*	1.265*	1.272*
	(0.716)	(0.715)	(0.716)	(0.715)
Linear Trend (Round)		0.014		0.014
		(0.013)		(0.013)
Constant	9.765***	9.053***	9.761***	9.048***
	(0.594)	(0.828)	(0.594)	(0.828)
Observations	1,345	1,345	1,345	1,345
Number of Subjects	101	101	101	101
Instruments:	Discount	Discount	Dummy for each discount	Dummy for each discount
Fist-stage F-stat Discount	179.83	180.63		
Fist-stage F-stat 50% Discount			40.45	39.31
Fist-stage F-stat 100% Discount			179.29	180.1

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A8. Game B. Heterogeneous Effects (ATE) of Price Risk on Output without Insurance. Fixed Effects.

Variables	(1)	(2)
Dependent Variable: Units of Output (1 to 20)		
Uncertain price round (1=Yes)	-0.605	-0.525
	(0.894)	(0.894)
Uncertain price * Potato monocropping (1=Yes)	-0.175	-0.147
	(0.492)	(0.492)
Uncertain price * Family receives the Juntos CCT (1=Yes)	-0.722**	-0.727**
	(0.342)	(0.341)
Uncertain price * Risk-aversion (CRRA)	-0.292	-0.298
	(0.264)	(0.264)
Uncertain price * Years cultivating potato	0.016	0.015
	(0.013)	(0.013)
Uncertain price * Best price of potato ever received, per arroba	0.079**	0.078**
	(0.036)	(0.036)
Uncertain price * Worst price of potato ever received, per arroba	-0.008	-0.006
	(0.040)	(0.040)
Uncertain price * Potato area (ha)	0.068	0.053
	(0.271)	(0.271)
Uncertain price * Distance to the closest market (hours)	-0.243	-0.254
	(0.173)	(0.173)
Uncertain price * Years of education	0.002	-0.000
	(0.051)	(0.051)
Uncertain price * Indigenous, mestizo or non-white (1=Yes)	-0.206	-0.186
	(0.414)	(0.414)
Uncertain price * Number of potato varieties planted	-0.155	-0.154
	(0.131)	(0.131)
Uncertain price * Potato harvest for self-consumption (%)	0.019**	0.018**
	(0.009)	(0.009)
Uncertain price * When price is low, holds potato for some time (1=Yes)	-0.369	-0.365
	(0.387)	(0.387)
Uncertain price * When price is low, sells potato at the market price (1=Yes)	-0.997**	-1.026***
	(0.397)	(0.397)
Linear Trend Round)		0.025**
		(0.012)
Constant	10.341***	10.080***
	(0.119)	(0.171)
Observations	2,020	2,020
R-squared	0.015	0.017
Number of Subjects	101	101

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A9. Game MI. Heterogeneous Effects (ATE) of Price Risk on Output without Insurance. Fixed Effects.

Variables	(1)	(2)
Dependent Variable: Units of Output (1 to 20)		
Uncertain price round (1=Yes)	-1.180	-1.196
	(0.807)	(0.807)
Uncertain price * Potato monocropping (1=Yes)	-0.924**	-0.930**
	(0.429)	(0.429)
Uncertain price * Family receives the Juntos CCT (1=Yes)	-0.108	-0.102
	(0.303)	(0.304)
Uncertain price * Risk-aversion (CRRA)	0.104	0.103
	(0.218)	(0.218)
Uncertain price * Years cultivating potato	-0.009	-0.008
	(0.012)	(0.012)
Uncertain price * Best price of potato ever received, per arroba	0.100***	0.100***
	(0.031)	(0.031)
Uncertain price * Worst price of potato ever received, per arroba	-0.078**	-0.078**
	(0.036)	(0.036)
Uncertain price * Potato area (ha)	0.154	0.155
	(0.234)	(0.234)
Uncertain price * Distance to the closest market (hours)	0.413***	0.412***
	(0.142)	(0.142)
Uncertain price * Years of education	-0.036	-0.035
	(0.045)	(0.045)
Uncertain price * Indigenous, mestizo or non-white (1=Yes)	0.544	0.545
	(0.365)	(0.365)
Uncertain price * Number of potato varieties planted	-0.136	-0.137
	(0.115)	(0.116)
Uncertain price * Potato harvest for self-consumption (%)	0.009	0.009
	(0.008)	(0.008)
Uncertain price * When price is low, holds potato for some time (1=Yes)	-0.291	-0.278
	(0.345)	(0.346)
Uncertain price * When price is low, sells potato at the market price (1=Yes)	-0.066	-0.057
	(0.352)	(0.353)
Round order number, per game		0.005
		(0.010)
Constant	10.402***	10.236***
	(0.106)	(0.333)
Observations	2,020	2,020
R-squared	0.016	0.016
Number of Subjects	101	101

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix C. Experimental Protocol

General Instructions for Participants

- This is an experiment about individual decision making under uncertainty. We are trying to understand how people make production decisions when they are unsure of the price. We have designed simple decision-making games in which we will ask you to make choices in a series of situations. In this experiment you have to imagine you are producing a commodity, and that only the price is uncertain.
- You will spend about two hours in this study playing games, for which you will be compensated with at least 40 soles (PEN), and the chance to earn more (up to 10 PEN), for your sole participation. In addition, you may earn between 1.21 and 41.31 PEN depending on chance and your performance on the games. Finally, you may receive an additional compensation of up to 14.28 PEN in a lottery game. The amount will be paid to you in cash at the end of the experiment.
- You will play three sets of games and a lottery. Each one has its own instructions.
- You should make your own decisions. Do not discuss your decisions with other participants or other members of the family.
- Please turn off your cell phone, radio or television.
- You need to have a good understanding of how your decisions affect your game payoff. Please raise your hand at any time during the session if you have any question.

Instructions for Enumerators

1. Ask the following filter questions:
   - Are you cultivating potatoes now? Yes/No (If "No", finish and thank him/her)

   - What is the 40% of 100 PEN? _____
   - If there is 25% of probability of rain, what is the probability that it does not rain? _____
   - Imagine there is bag with 3 blue balls and 7 red balls. Which is the probability if choosing a blue ball? _____

   If more than one answer (i.e. two or three answers) is wrong, finish and thank him/her.

2. Give the farmer the Consent Form, explain the experiment, and answer any questions he/she would have. Remind the farmer that he/she must complete the whole experiment to receive compensation. Make sure all the fields are filled and that the form is signed. Give a copy of the consent to the farmer.

3. Use a ten-sided dice to determine the farmer's base compensation. Remind the farmer he/she has already got 40 PEN for his/her participation. Using the dice, he/she got additional _____ PEN.

4. Use a six-sided dice to determine which game (A, B, or C) will be played first. Write down the selected order: _____ _____ _____. Start playing the games in this order. Read the corresponding game instructions to the farmer. Once you finish with the three games (A, B, and C), play the lottery and do the questionnaire before determining the farmer's total compensation.

Instructions for Participants

Game A: Producing a commodity with known and unknown prices

Tasks

- In this game you have to imagine that you are producing and selling a single commodity. This commodity has a sales price in soles per unit that can be one of the five possible values: 5, 6, 7, 8, and 9 PEN.

- You will have to play two types of games. (1) In the first one, you will know that your selling price will be exactly 7 PEN (see Figure 1); (2) In the second one, you do not know the price, but you know that the price will be one of these five values: 5, 6, 7, 8, and 9. Each price has a different chance to be drawn in each round, which will follow any of the four distributions in Figures 2 to 5. Both types of games will occur randomly, one third (1/3) of the games will be of the first type (certain price) and two thirds (2/3) will be of the second type (uncertain price).

Figure 1. Price distribution of certain price

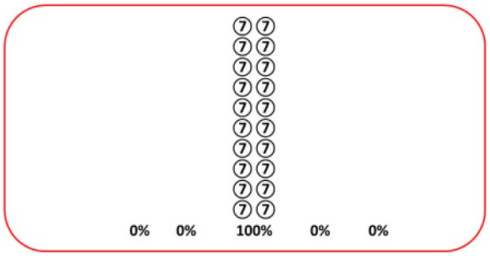


Figure 2. Price distribution of uncertain price – setting 1

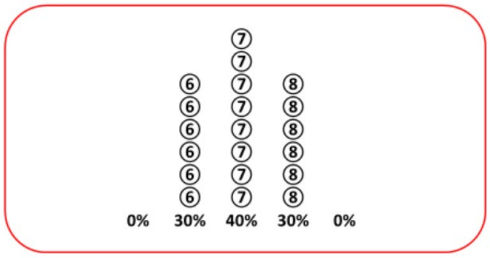
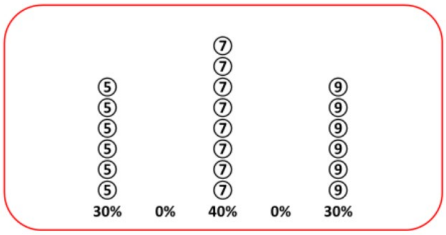


Figure 3. Price distribution of uncertain price – setting 2

Figure 4. Price distribution of uncertain price – setting 3

Figure 5. Price distribution of uncertain price – setting 4



- **In each round you have to decide how much to produce**, when the price is 7 PEN, or without knowing the price. The price will be realized *after* you make your production decision, so you could know your round profit.

- In each round, you will be asked to determine how much of the commodity to produce by **choosing between 0 and 20 units** as your production level. Your goal is to choose a production level (between 0 and 20) to **maximize your profit** (price times quantity produced minus cost of production), since maximizing profit is equivalent to maximizing your payoff.

- You may **refer to the tables A1-A6** to facilitate your decision. These tables have all the information you will need to make a decision about how much to produce. These tables show the amount of cost to be incurred according to production levels 0 through 20 (in 100 units), and the corresponding profit (in 100 PEN) that will occur *under the five different price scenarios*. These tables show how your production decision, cost of production, and your profit relate to one another.

- In these games, you start with 25 PEN to invest in producing the commodity. In any given round, your **profit will be between -47.58 and 32.61 PEN**. You will get a minimum profit of -47.58 PEN if you choose to produce 20 units and you sell them at a price of 5 PEN each. You will get a maximum profit of 32.61 PEN if you choose to produce 19 units and you sell them at a price of 9 PEN (See Profit Tables A1-A6).

- You will first play ten rounds of practice games. After the practice games, you will play twenty rounds of the real games. In the real games, **your profits will affect your game payoff**, but not your compensation for participating in the experiment.

Keep in mind

- You **cannot store** the commodity produced or profits between rounds. Each round of the game has its own profit.

- You do **not need to produce a minimum** amount of this commodity to survive. Your survival from one round to the next one does not depend on your chosen production.

- It is not required to make a positive profit to survive to the next round. Negative profits simply mean that you lose some of the money that you started the round of the game with.

- There is no uncertainty in production levels. You are certain of the production level of the commodity.

Payoffs

- Your payoff from the game will be based on your performance on the real (not the practice) rounds of the game.

- At the end of the experiment, **we will randomly select one round** from the real (non-practice) rounds of **the three set of games (Game A, Game B and Game C)**. Your game payoff will be determined in the following way:

  the base payoff (25 PEN) + a half of your profit in the randomly selected round.

  Example 1: if you have made a loss of 30 PEN in the selected round, your final payoff will be 25 PEN + (-30 PEN X 0.5) = 10 PEN.

  Example 2: If you have made a profit of 30 PEN, your final payoff will be 25 PEN + (30 PEN X 0.5) = 40 PEN.

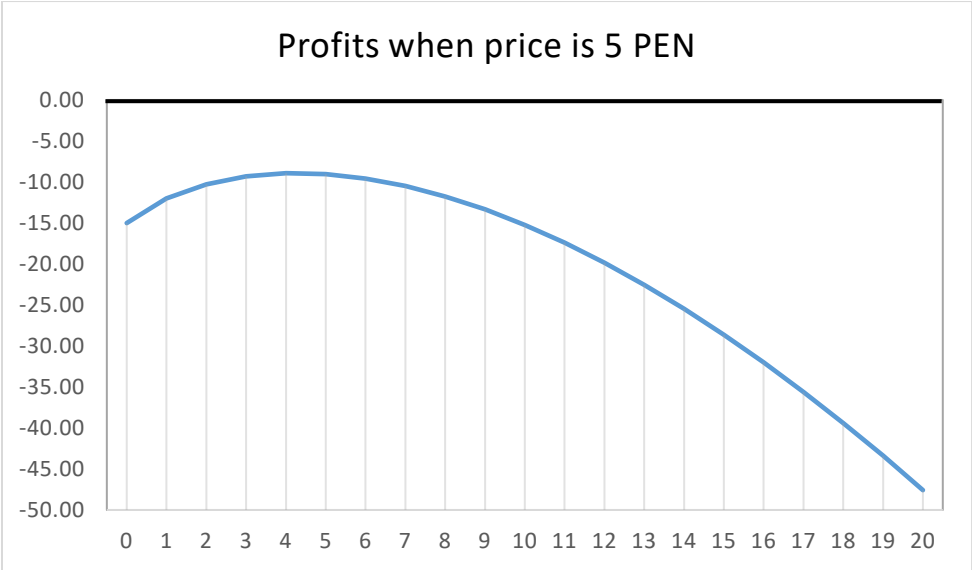
- If the selected round is from **Game A**, your **payoff** will range between **1.21** and **41.31 PEN**.

- If the selected round is from **Game A**, you will walk out of this experiment with a final compensation that will range between 41.21 and 91.31 PEN (40 to 50 PEN as compensation for your participation plus 1.21 to 41.31 PEN from the game payoff), besides the lottery payoff.

Tables

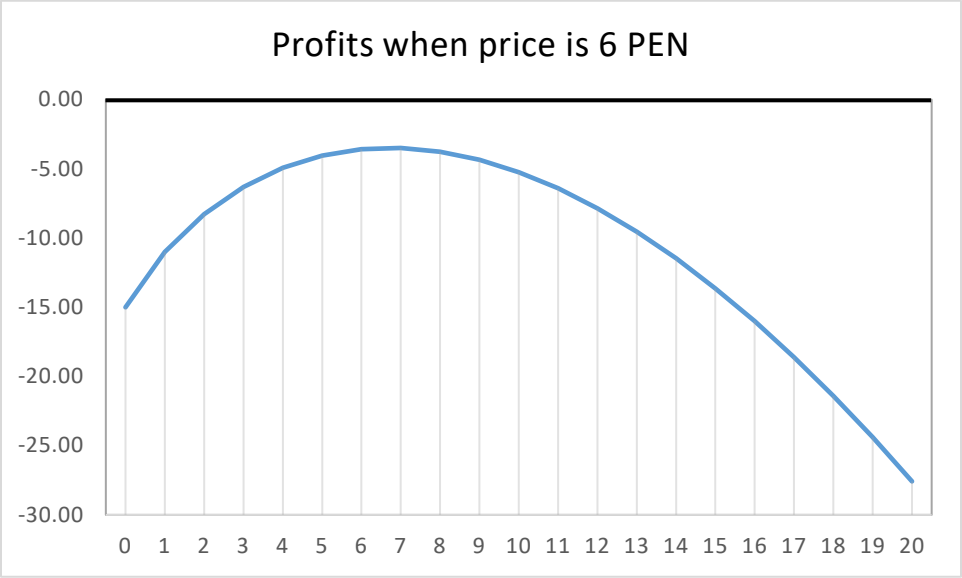
A.1. When price is 5 PEN

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = (1) x (2) - (3)
0	5	15.00	-15.00
1	5	17.00	-12.00
2	5	20.28	-10.28
3	5	24.31	-9.31
4	5	28.93	-8.93
5	5	34.04	-9.04
6	5	39.57	-9.57
7	5	45.49	-10.49
8	5	51.76	-11.76
9	5	58.35	-13.35
10	5	65.24	-15.24
11	5	72.41	-17.41
12	5	79.85	-19.85
13	5	87.54	-22.54
14	5	95.47	-25.47
15	5	103.63	-28.63
16	5	112.01	-32.01
17	5	120.60	-35.60
18	5	129.40	-39.40
19	5	138.39	-43.39
20	5	147.58	-47.58



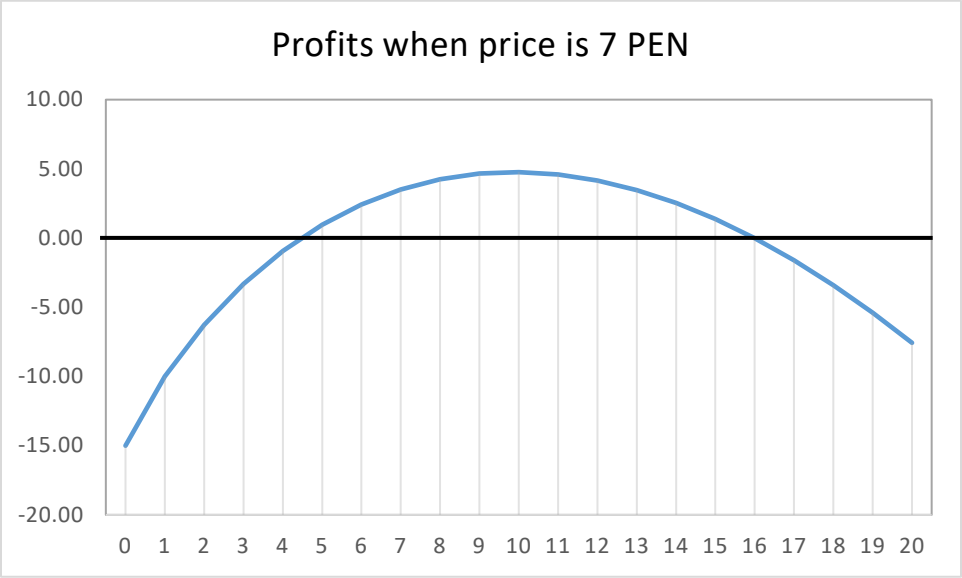
A.2. When price is 6 PEN

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = (1) x (2) - (3)
0	6	15.00	-15.00
1	6	17.00	-11.00
2	6	20.28	-8.28
3	6	24.31	-6.31
4	6	28.93	-4.93
5	6	34.04	-4.04
6	6	39.57	-3.57
7	6	45.49	-3.49
8	6	51.76	-3.76
9	6	58.35	-4.35
10	6	65.24	-5.24
11	6	72.41	-6.41
12	6	79.85	-7.85
13	6	87.54	-9.54
14	6	95.47	-11.47
15	6	103.63	-13.63
16	6	112.01	-16.01
17	6	120.60	-18.60
18	6	129.40	-21.40
19	6	138.39	-24.39
20	6	147.58	-27.58



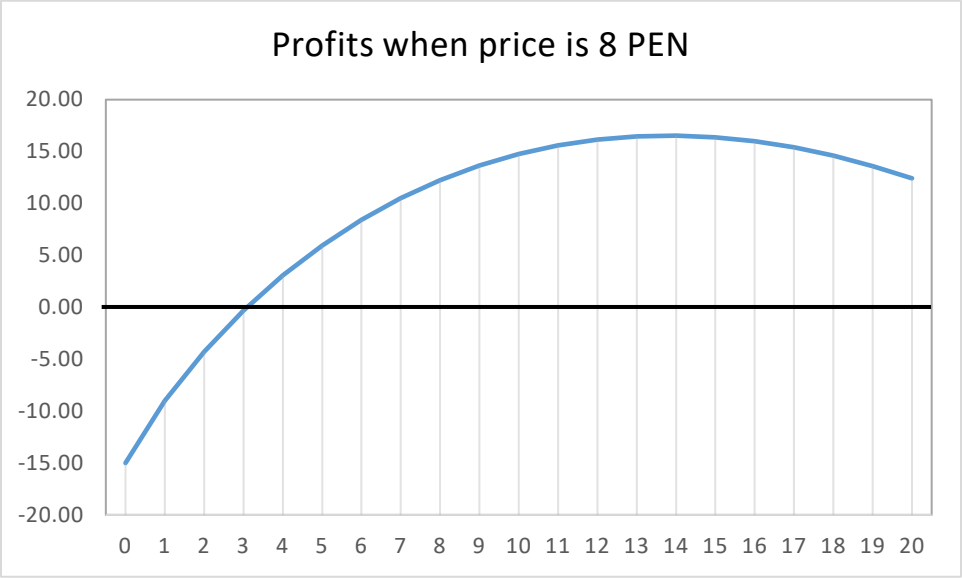
A.3. When price is 7 PEN

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = (1) x (2) - (3)
0	7	15.00	-15.00
1	7	17.00	-10.00
2	7	20.28	-6.28
3	7	24.31	-3.31
4	7	28.93	-0.93
5	7	34.04	0.96
6	7	39.57	2.43
7	7	45.49	3.51
8	7	51.76	4.24
9	7	58.35	4.65
10	7	65.24	4.76
11	7	72.41	4.59
12	7	79.85	4.15
13	7	87.54	3.46
14	7	95.47	2.53
15	7	103.63	1.37
16	7	112.01	-0.01
17	7	120.60	-1.60
18	7	129.40	-3.40
19	7	138.39	-5.39
20	7	147.58	-7.58



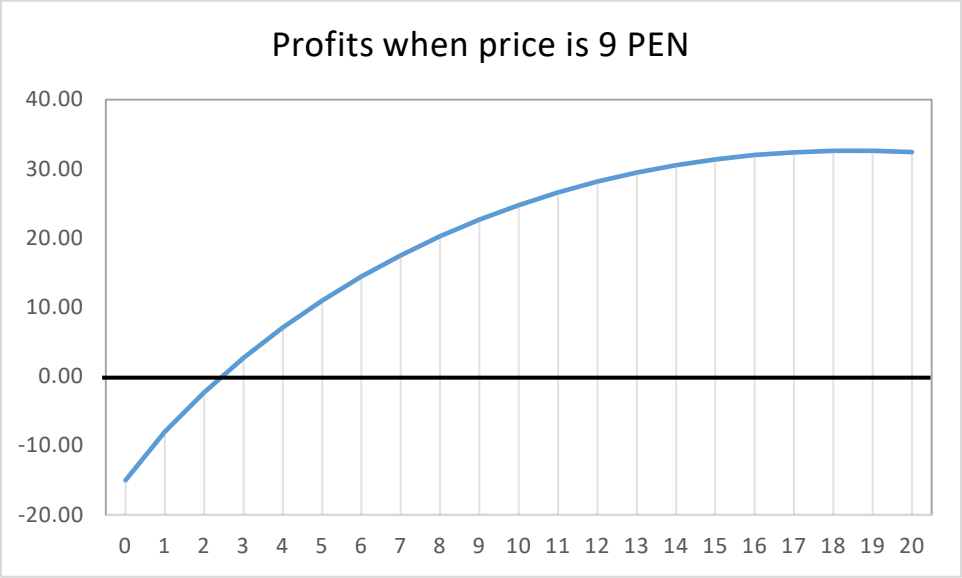
A.4. When price is 8 PEN

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = (1) x (2) - (3)
0	8	15.00	-15.00
1	8	17.00	-9.00
2	8	20.28	-4.28
3	8	24.31	-0.31
4	8	28.93	3.07
5	8	34.04	5.96
6	8	39.57	8.43
7	8	45.49	10.51
8	8	51.76	12.24
9	8	58.35	13.65
10	8	65.24	14.76
11	8	72.41	15.59
12	8	79.85	16.15
13	8	87.54	16.46
14	8	95.47	16.53
15	8	103.63	16.37
16	8	112.01	15.99
17	8	120.60	15.40
18	8	129.40	14.60
19	8	138.39	13.61
20	8	147.58	12.42



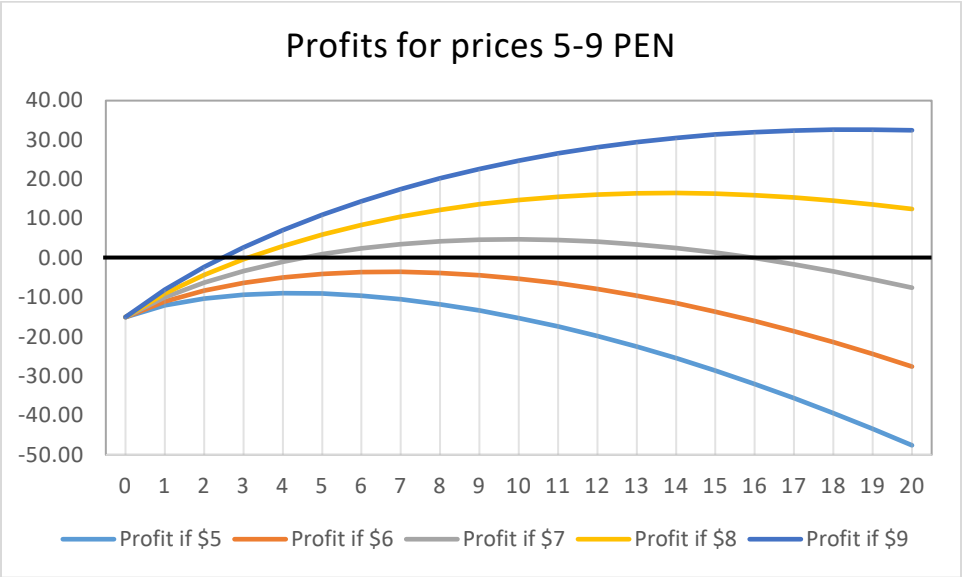
A.5. When price is 9 PEN

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = (1) x (2) - (3)
0	9	15.00	-15.00
1	9	17.00	-8.00
2	9	20.28	-2.28
3	9	24.31	2.69
4	9	28.93	7.07
5	9	34.04	10.96
6	9	39.57	14.43
7	9	45.49	17.51
8	9	51.76	20.24
9	9	58.35	22.65
10	9	65.24	24.76
11	9	72.41	26.59
12	9	79.85	28.15
13	9	87.54	29.46
14	9	95.47	30.53
15	9	103.63	31.37
16	9	112.01	31.99
17	9	120.60	32.40
18	9	129.40	32.60
19	9	138.39	32.61
20	9	147.58	32.42



A.6. Summary of Profits for prices 5-9 PEN

Production (100 arrobas)	Profit if 5 PEN	Profit if 6 PEN	Profit if 7 PEN	Profit if 8 PEN	Profit if 9 PEN
0	-15.00	-15.00	-15.00	-15.00	-15.00
1	-12.00	-11.00	-10.00	-9.00	-8.00
2	-10.28	-8.28	-6.28	-4.28	-2.28
3	-9.31	-6.31	-3.31	-0.31	2.69
4	-8.93	-4.93	-0.93	3.07	7.07
5	-9.04	-4.04	0.96	5.96	10.96
6	-9.57	-3.57	2.43	8.43	14.43
7	-10.49	-3.49	3.51	10.51	17.51
8	-11.76	-3.76	4.24	12.24	20.24
9	-13.35	-4.35	4.65	13.65	22.65
10	-15.24	-5.24	4.76	14.76	24.76
11	-17.41	-6.41	4.59	15.59	26.59
12	-19.85	-7.85	4.15	16.15	28.15
13	-22.54	-9.54	3.46	16.46	29.46
14	-25.47	-11.47	2.53	16.53	30.53
15	-28.63	-13.63	1.37	16.37	31.37
16	-32.01	-16.01	-0.01	15.99	31.99
17	-35.60	-18.60	-1.60	15.40	32.40
18	-39.40	-21.40	-3.40	14.60	32.60
19	-43.39	-24.39	-5.39	13.61	32.61
20	-47.58	-27.58	-7.58	12.42	32.42



Game B: Producing a commodity with unknown prices and mandatory insurance

Tasks

- In this game you have to imagine that you are producing and selling a single commodity. This commodity has a sales price in soles per unit that can be one of the five possible values: 5, 6, 7, 8, and 9 PEN.

- You will have to play two types of games. (1) In the first one, you will know that your selling price will be exactly 7 PEN (see Figure 1); (2) In the second one, you do not know the price, but you know that the price will be one of these five values: 5, 6, 7, 8, and 9. Each price has a different chance to be drawn in each round, which will follow any of the four distributions in Figures 2 to 5. Both types of games will occur randomly, one third (1/3) of the games will be of the first type (certain price) and two thirds (2/3) will be of the second type (uncertain price).

Figure 1. Price distribution of certain price

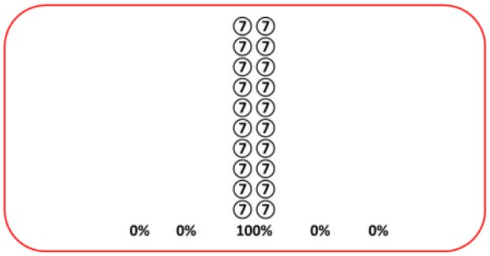


Figure 2. Price distribution of uncertain price – setting 1

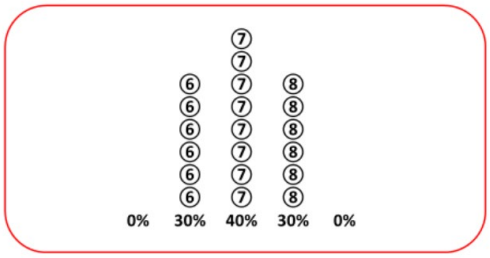


Figure 3. Price distribution of uncertain price – setting 2

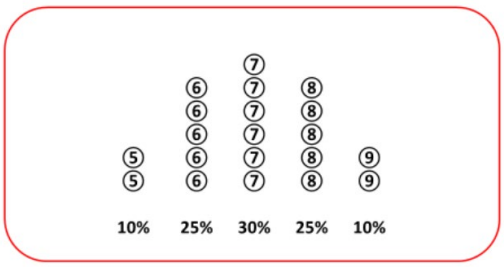
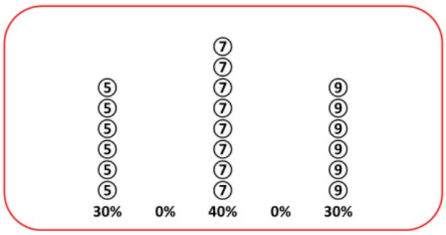


Figure 4. Price distribution of uncertain price – setting 3

Figure 5. Price distribution of uncertain price – setting 4



- **In each round you have to decide how much to produce**, when the price is certain and equal to 7 PEN, or without knowing the price. In uncertain price rounds, the price will be realized *after* you make your production decision, so you could know your round profit.

- In each round you have to **decide how much to produce** of the commodity by **choosing between 0 and 20 units** as your production level. Your goal is to choose a production level (between 0 and 20) to **maximize your profit**, since maximizing profit is equivalent to maximizing your payoff.

- Only **in uncertain rounds**, your cost of production includes the **cost of a mandatory insurance**. Your profit includes the **indemnity paid** by this insurance. The **cost of this insurance is of 0.30 PEN** per unit of commodity produced. Once you decide how much to produce, you have to **buy insurance for all your chosen production**.

- The insurance covers you when the sales price of the commodity is too low: **the insurance will cover fully if the price is below 7 PEN**. For example, imagine you decided to produce 10 units of the commodity -so you insured your 10 units-; then if the realized price is 6 PEN, you will receive 10 PEN ((7 PEN – 6 PEN) x 10 units).

- Your goal is again to maximize profit (price times quantity produced minus cost of production -including the insurance cost-, plus insurance indemnity payment), since maximizing profit is equivalent to maximizing your payoff.

- You may **refer to the tables B.1 to B.7** to facilitate your decision. These tables show the amount of cost to be incurred, including the insurance cost, and the corresponding profit (in 100 PEN) that will occur *under the five different price scenarios*.

- In these rounds of the game, you start with 25 PEN to invest in producing the commodity. In any given round, your **profit will be between -15.00 and 27.30 PEN**. You will get a minimum profit of -15.00 PEN if you choose to produce 0 units and you sell them at any price. You will get a maximum profit of 27.30 PEN if you choose to produce 17 units (all of them are insured) and you sell them at a price of PEN 9 (See Profit Tables B.1 to B.7).

- You will first play 10 rounds of practice games. After the practice games, you will play twenty rounds of the real games. In the real games, **your profits will affect your game payoff**, but not your compensation for participating in the experiment.

Keep in mind

- Remember that **insurance covers you when the sales price of the commodity is too low**.

- There is no uncertainty in production levels. You are certain of the production level of the commodity.

- Remember you have to **insure all your decided production**, you cannot insure just part of it.

- You **cannot store** the commodity produced or profits between rounds. Each round of the game has its own profit.

- You do **not need to produce a minimum** amount of this commodity to survive. Your survival from one round to the next one does not depend on your chosen production.

- It is not required to make a positive profit to survive to the next round. Negative profits simply mean that you lose some of the money that you started the round of the game with.

Payoffs

- Your payoff from the game will be based on your performance on the real (not the practice) rounds of the game.

- At the end of the experiment, **we will randomly select one round** from the real (non-practice) rounds of **the three set of games (Game A, Game B, and Game C)**. Your game payoff will be determined in the following way:

  the base payoff (25 PEN) + a half of your profit in the randomly selected round.

  Example 1: if you have made a loss of 30 PEN in the selected round, your final payoff will be 25 PEN + (-30 PEN X 0.5) = 10 PEN.

  Example 2: If you have made a profit of 30 PEN, your final payoff will be 25 PEN + (30 PEN X 0.5) = 40 PEN.

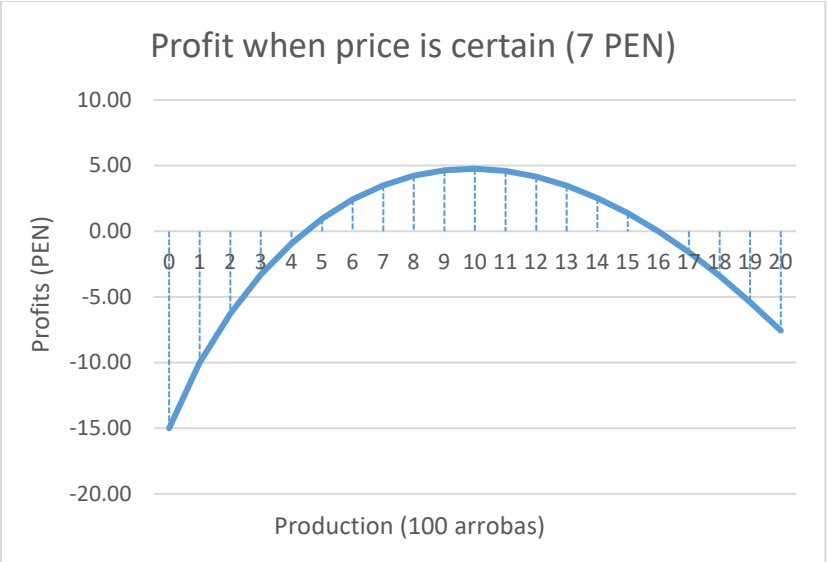
- If the selected round is from **Game B**, your payoff range between **17.50 PEN** and **38.65 PEN**.

- If the selected round is from **Game B**, you will walk out of this experiment with a final compensation that will range between 57.50 PEN and 88.65 PEN (40 to 50 PEN as compensation for your participation plus 17.50 PEN to 38.65 PEN from the game payoff), besides the lottery payoff.

Tables

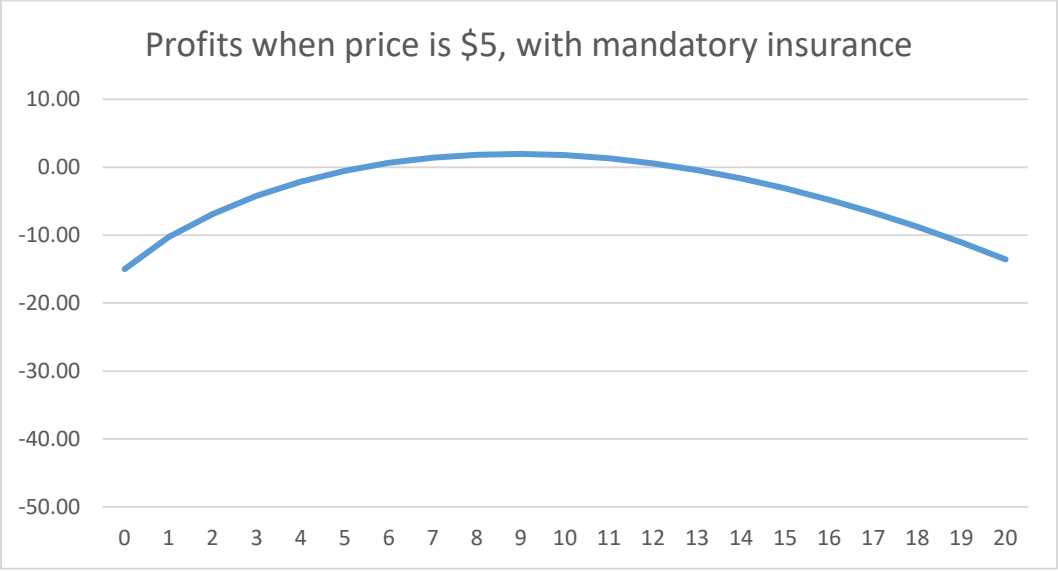
B.1. When price is certain and equal to 7 PEN, without insurance

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = (1) x (2) - (3)
0	7	15.00	-15.00
1	7	17.00	-10.00
2	7	20.28	-6.28
3	7	24.31	-3.31
4	7	28.93	-0.93
5	7	34.04	0.96
6	7	39.57	2.43
7	7	45.49	3.51
8	7	51.76	4.24
9	7	58.35	4.65
10	7	65.24	4.76
11	7	72.41	4.59
12	7	79.85	4.15
13	7	87.54	3.46
14	7	95.47	2.53
15	7	103.63	1.37
16	7	112.01	-0.01
17	7	120.60	-1.60
18	7	129.40	-3.40
19	7	138.39	-5.39
20	7	147.58	-7.58



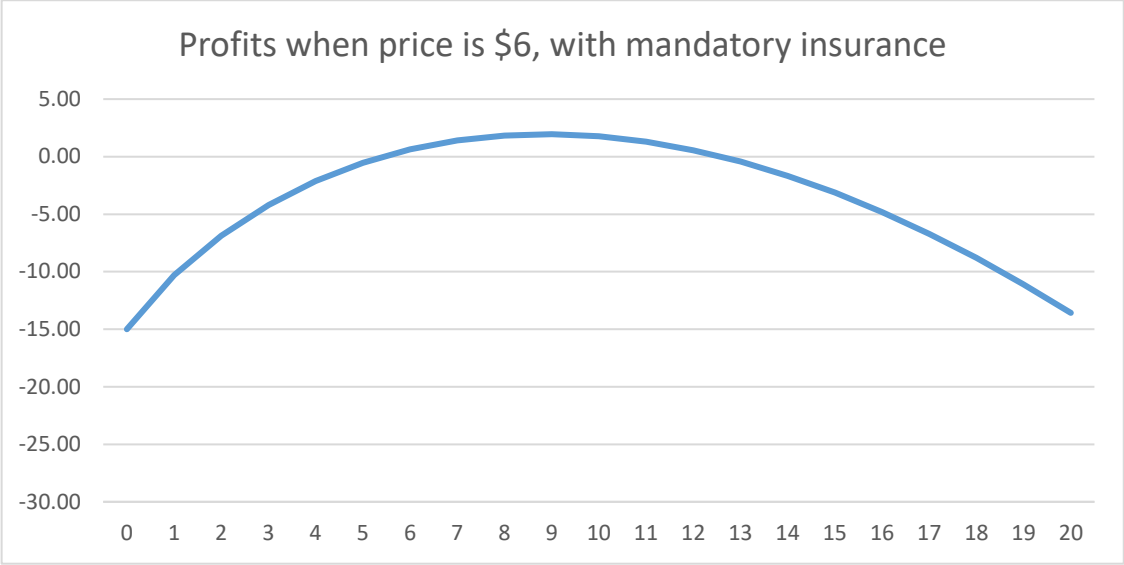
B.2. When price is 5 PEN and there is mandatory insurance

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = ((1) x (2)) - (3) - Premium price x (1) + (7-(2)) x (1)
0	5	15.00	-15.00
1	5	17.00	-10.30
2	5	20.28	-6.88
3	5	24.31	-4.21
4	5	28.93	-2.13
5	5	34.04	-0.54
6	5	39.57	0.63
7	5	45.49	1.41
8	5	51.76	1.84
9	5	58.35	1.95
10	5	65.24	1.76
11	5	72.41	1.29
12	5	79.85	0.55
13	5	87.54	-0.44
14	5	95.47	-1.67
15	5	103.63	-3.13
16	5	112.01	-4.81
17	5	120.60	-6.70
18	5	129.40	-8.80
19	5	138.39	-11.09
20	5	147.58	-13.58



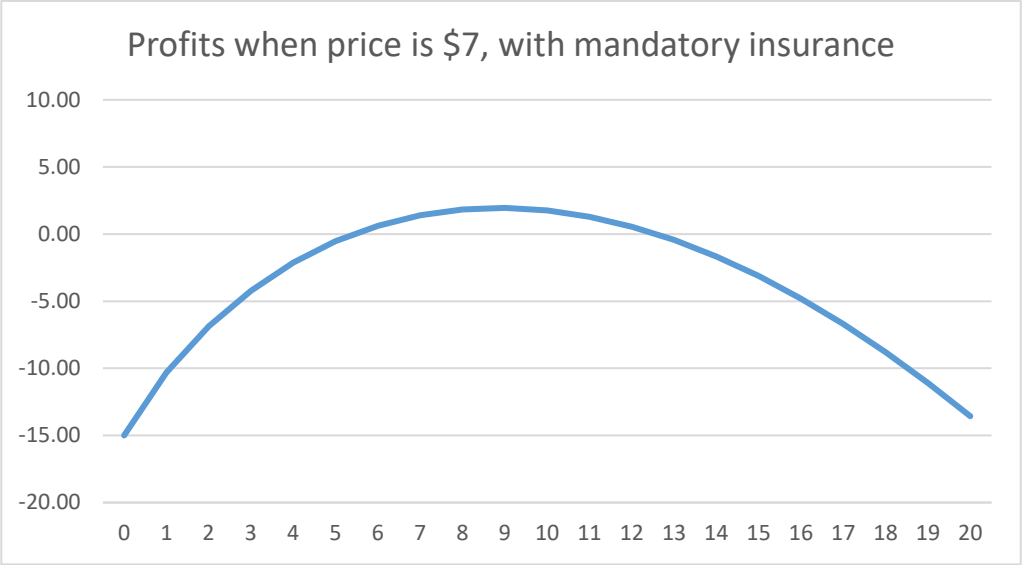
B.3. When price is $6 and there is mandatory insurance

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = ((1) x (2)) - (3) - Premium price x (1) + (7-(2)) x (1)
0	6	15.00	-15.00
1	6	17.00	-10.30
2	6	20.28	-6.88
3	6	24.31	-4.21
4	6	28.93	-2.13
5	6	34.04	-0.54
6	6	39.57	0.63
7	6	45.49	1.41
8	6	51.76	1.84
9	6	58.35	1.95
10	6	65.24	1.76
11	6	72.41	1.29
12	6	79.85	0.55
13	6	87.54	-0.44
14	6	95.47	-1.67
15	6	103.63	-3.13
16	6	112.01	-4.81
17	6	120.60	-6.70
18	6	129.40	-8.80
19	6	138.39	-11.09
20	6	147.58	-13.58



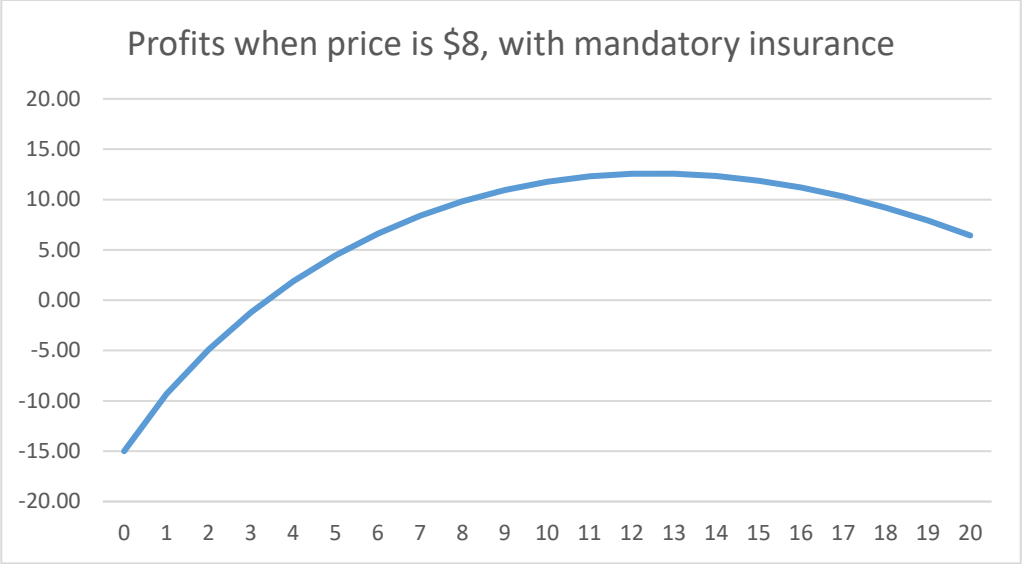
B.4. When price is $7 and there is mandatory insurance

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = ((1) x (2)) - (3) - Premium price x (1) + (7-(2)) x (1)
0	7	15.00	-15.00
1	7	17.00	-10.30
2	7	20.28	-6.88
3	7	24.31	-4.21
4	7	28.93	-2.13
5	7	34.04	-0.54
6	7	39.57	0.63
7	7	45.49	1.41
8	7	51.76	1.84
9	7	58.35	1.95
10	7	65.24	1.76
11	7	72.41	1.29
12	7	79.85	0.55
13	7	87.54	-0.44
14	7	95.47	-1.67
15	7	103.63	-3.13
16	7	112.01	-4.81
17	7	120.60	-6.70
18	7	129.40	-8.80
19	7	138.39	-11.09
20	7	147.58	-13.58



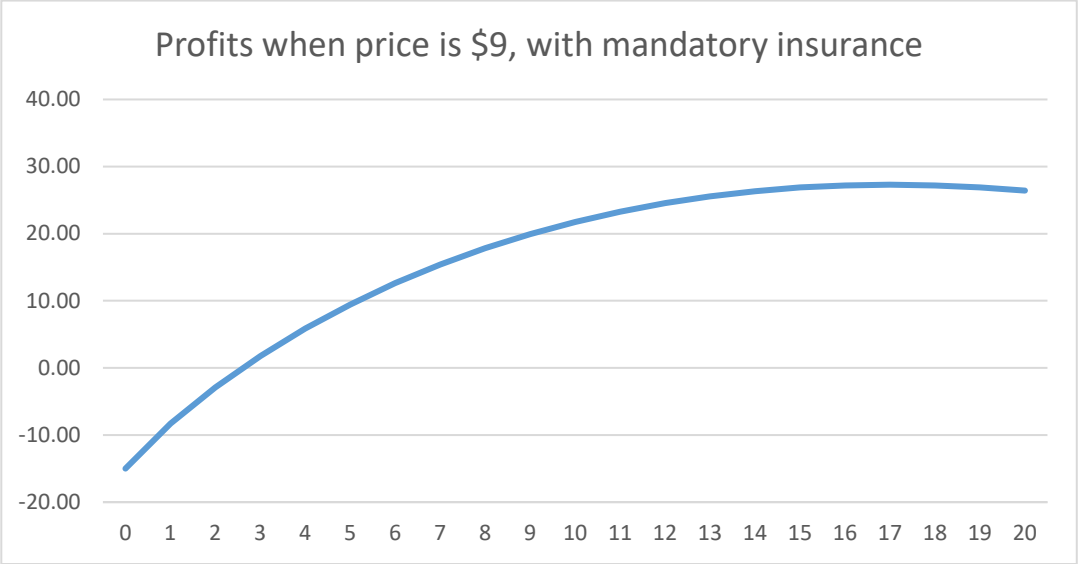
B.5. When price is $8 and there is mandatory insurance

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = ((1) x (2)) - (3) - Premium price x (1) + (7-(2)) x (1)
0	8	15.00	-15.00
1	8	17.00	-9.30
2	8	20.28	-4.88
3	8	24.31	-1.21
4	8	28.93	1.87
5	8	34.04	4.46
6	8	39.57	6.63
7	8	45.49	8.41
8	8	51.76	9.84
9	8	58.35	10.95
10	8	65.24	11.76
11	8	72.41	12.29
12	8	79.85	12.55
13	8	87.54	12.56
14	8	95.47	12.33
15	8	103.63	11.87
16	8	112.01	11.19
17	8	120.60	10.30
18	8	129.40	9.20
19	8	138.39	7.91
20	8	147.58	6.42



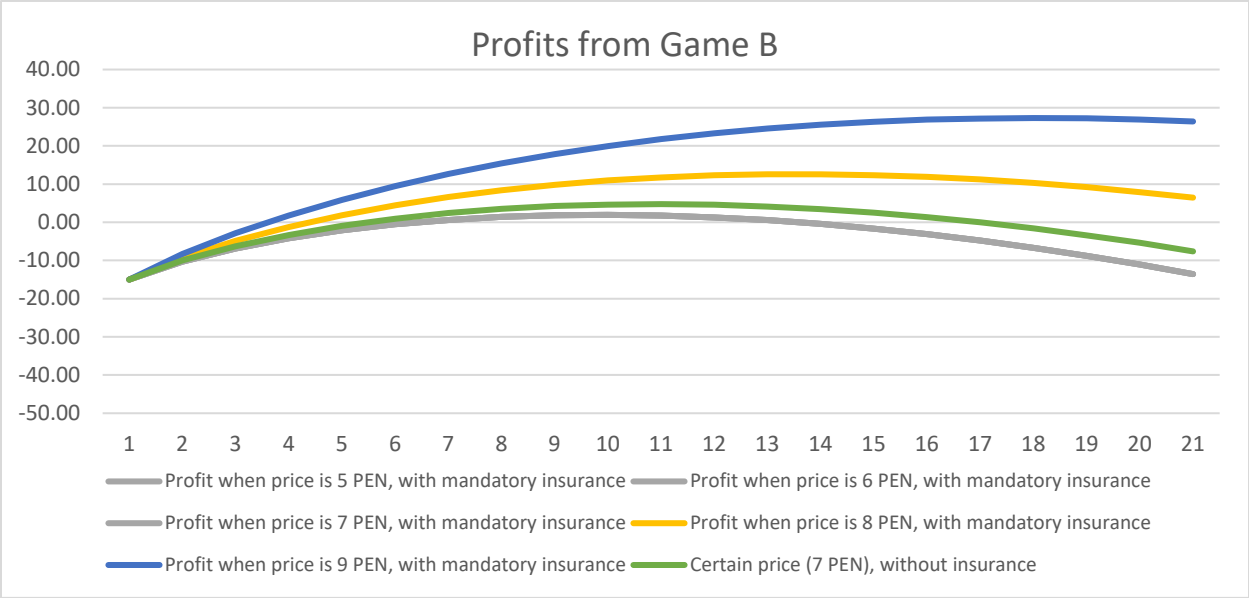
B.6. When price is $9 and there is mandatory insure

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) Profit = ((1) x (2)) - (3) - Premium price x (1) + (7-(2)) x (1)
0	9	15.00	-15.00
1	9	17.00	-8.30
2	9	20.28	-2.88
3	9	24.31	1.79
4	9	28.93	5.87
5	9	34.04	9.46
6	9	39.57	12.63
7	9	45.49	15.41
8	9	51.76	17.84
9	9	58.35	19.95
10	9	65.24	21.76
11	9	72.41	23.29
12	9	79.85	24.55
13	9	87.54	25.56
14	9	95.47	26.33
15	9	103.63	26.87
16	9	112.01	27.19
17	9	120.60	27.30
18	9	129.40	27.20
19	9	138.39	26.91
20	9	147.58	26.42



B.7. Profits for prices 5 PEN to 9 PEN with mandatory insurance

Production (100 arrobas)	Profit if 5 PEN, with mandatory insurance	Profit if 6 PEN, with mandatory insurance	Profit if 7 PEN, with mandatory insurance	Profit if 8 PEN, with mandatory insurance	Profit if 9 PEN, with mandatory insurance	Profit if price is certain (7 PEN)
0	-15.00	-15.00	-15.00	-15.00	-15.00	-15.00
1	-10.30	-10.30	-10.30	-9.30	-8.30	-10.00
2	-6.88	-6.88	-6.88	-4.88	-2.88	-6.28
3	-4.21	-4.21	-4.21	-1.21	1.79	-3.31
4	-2.13	-2.13	-2.13	1.87	5.87	-0.93
5	-0.54	-0.54	-0.54	4.46	9.46	0.96
6	0.63	0.63	0.63	6.63	12.63	2.43
7	1.41	1.41	1.41	8.41	15.41	3.51
8	1.84	1.84	1.84	9.84	17.84	4.24
9	1.95	1.95	1.95	10.95	19.95	4.65
10	1.76	1.76	1.76	11.76	21.76	4.76
11	1.29	1.29	1.29	12.29	23.29	4.59
12	0.55	0.55	0.55	12.55	24.55	4.15
13	-0.44	-0.44	-0.44	12.56	25.56	3.46
14	-1.67	-1.67	-1.67	12.33	26.33	2.53
15	-3.13	-3.13	-3.13	11.87	26.87	1.37
16	-4.81	-4.81	-4.81	11.19	27.19	-0.01
17	-6.70	-6.70	-6.70	10.30	27.30	-1.60
18	-8.80	-8.80	-8.80	9.20	27.20	-3.40
19	-11.09	-11.09	-11.09	7.91	26.91	-5.39
20	-13.58	-13.58	-13.58	6.42	26.42	-7.58



Game C: Producing a commodity with unknown prices and available insurance

Tasks

- In this game you have to imagine that you are producing and selling a single commodity. This commodity has a sales price in soles per unit that can be one of the five possible values: 5, 6, 7, 8, and 9 PEN.

- You will have to play two types of games. (1) In the first one, you will know that your selling price will be exactly 7 PEN (see Figure 1); (2) In the second one, you do not know the price, but you know that the price will be one of these five values: 5, 6, 7, 8, and 9. Each price has a different chance to be drawn in each round, which will follow any of the four distributions in Figures 2 to 5. Both types of games will occur randomly, one third (1/3) of the games will be of the first type (certain price) and two thirds (2/3) will be of the second type (uncertain price).

Figure 1. Price distribution of certain price

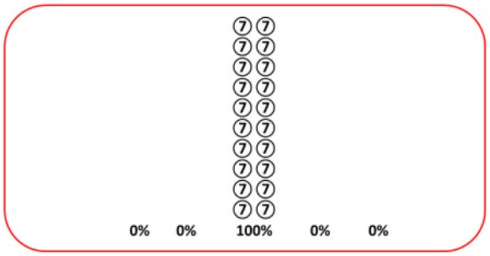


Figure 2. Price distribution of uncertain price – setting 1

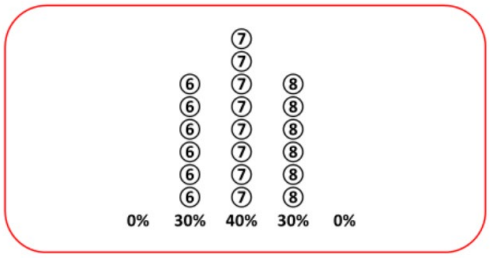


Figure 3. Price distribution of uncertain price – setting 2

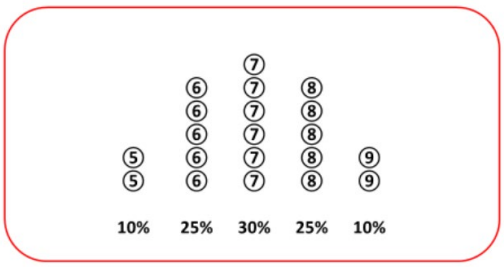
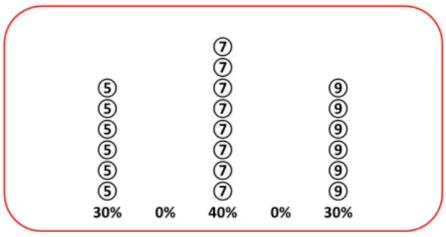


Figure 4. Price distribution of uncertain price – setting 3

Figure 5. Price distribution of uncertain price – setting 4



- **In each round you have to decide how much to produce**, when the price is certain and equal to 7 PEN, or without knowing the price. In uncertain price rounds, the price will be realized *after* you make your production decision, so you could know your round profit.
- In each round you have to **decide how much to produce** of the commodity by **choosing between 0 and 20 units** as your production level. Your goal is to choose a production level (between 0 and 20) to **maximize your profit**, since maximizing profit is equivalent to maximizing your payoff.
- **Only in uncertain rounds**, your will be able to purchase insurance, and you will be offered a discount of 0%, 50% or 100% on the insurance premium price. After knowing the discount, you must decide to buy insurance or not. Then, you will have to decide how much to produce.
- The **cost of this insurance is of 0.30 PEN** per unit of commodity produced (0.15 PEN with 50% discount, and free with 100% discount). If you decided to purchase insurance, you have to **buy insurance for all your chosen production**. Your profit includes the **indemnity paid** by this insurance.
- No matter the discount on price insurance you will receive, the insurance covers you when the sales price of the commodity is too low: **the insurance will cover fully if the price is below 7 PEN**. For example, imagine you decided to produce 10 units of the commodity -so you insured your 10 units-; then if the realized price is 6 PEN, you will receive 10 PEN ((7 PEN – 6 PEN) x 10 units).
- Your goal is again to maximize profit (price times quantity produced minus cost of production -including the insurance cost-, plus insurance indemnity payment), since maximizing profit is equivalent to maximizing your payoff.

- You may **refer to the tables C.1 to C.9** to facilitate your decision. These tables show the amount of cost to be incurred, under the different premium price discounts, including the insurance cost, and the corresponding profit (in 100 PEN) that will occur *under the five different price scenarios*.

- In these rounds of the game, you start with 25 PEN to invest in producing the commodity. In any given round, your **profit will be between -47.58 and 32.61 PEN**. You will get a minimum profit of -47.58 PEN if you choose to produce 20 units and you sell them at a price of 5 PEN each, without purchasing insurance. You will get a maximum profit of 32.61 PEN if you choose to produce 19 units and you sell them at a price of 9 PEN, without buying insurance, or buying insurance at 100% discount (See Profit Tables C.1 to C.9).

- You will first play ten rounds of practice games. After the practice games, you will play twenty rounds of the real games. In the real games, **your profits will affect your game payoff**, but not your compensation for participating in the experiment.

Keep in mind

- Remember that **insurance covers you when the sales price of the commodity is too low**.

- There is no uncertainty in production levels. You are certain of the production level of the commodity.

- Remember if you decide to buy insurance, you have to **insure all your decided production**, you cannot insure just part of it.

- You **cannot store** the commodity produced or profits between rounds. Each round of the game has its own profit.

- You do **not need to produce a minimum** amount of this commodity to survive. Your survival from one round to the next one does not depend on your chosen production.

- It is not required to make a positive profit to survive to the next round. Negative profits simply mean that you lose some of the money that you started the round of the game with.

Payoffs

- Your payoff from the game will be based on your performance on the real (not the practice) rounds of the game.

- At the end of the experiment, **we will randomly select one round** from the real (non-practice) rounds of **the three set of games (Game A, Game B and Game C)**. Your game payoff will be determined in the following way:

  the base payoff (25 PEN) + a half of your profit in the randomly selected round.

  Example 1: if you have made a loss of 30 PEN in the selected round, your final payoff will be 25 PEN + (-30 PEN X 0.5) = 10 PEN.

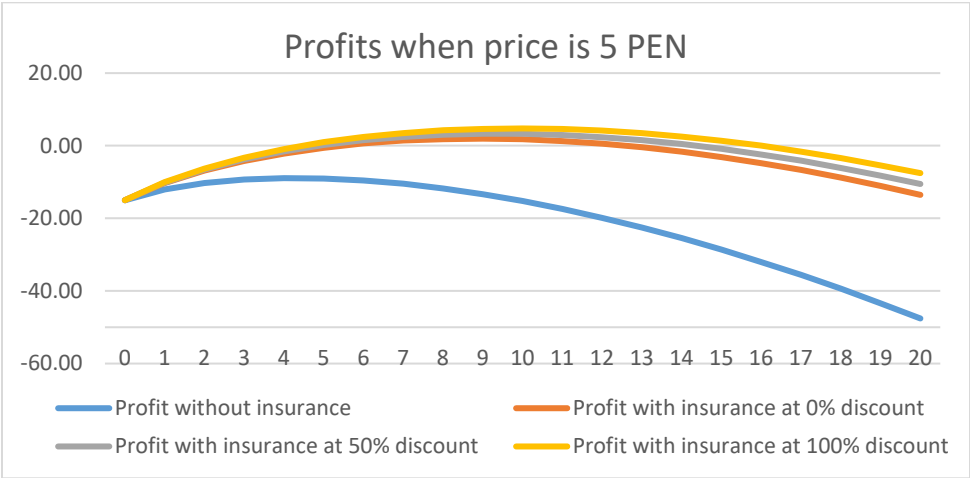
Example 2: If you have made a profit of 30 PEN, your final payoff will be 25 PEN + (30 X 0.5) = 40 PEN.

- If the selected round is from **Game C,** your payoff will range between **1.21** and **41.31 PEN**.
- If the selected round is from **Game C,** you will walk out of this experiment with a final compensation that will range between 41.21 and 91.31 PEN (40 to 50 as compensation for your participation plus 1.21 to 41.31 PEN from the game payoff), besides the lottery payoff.

Tables

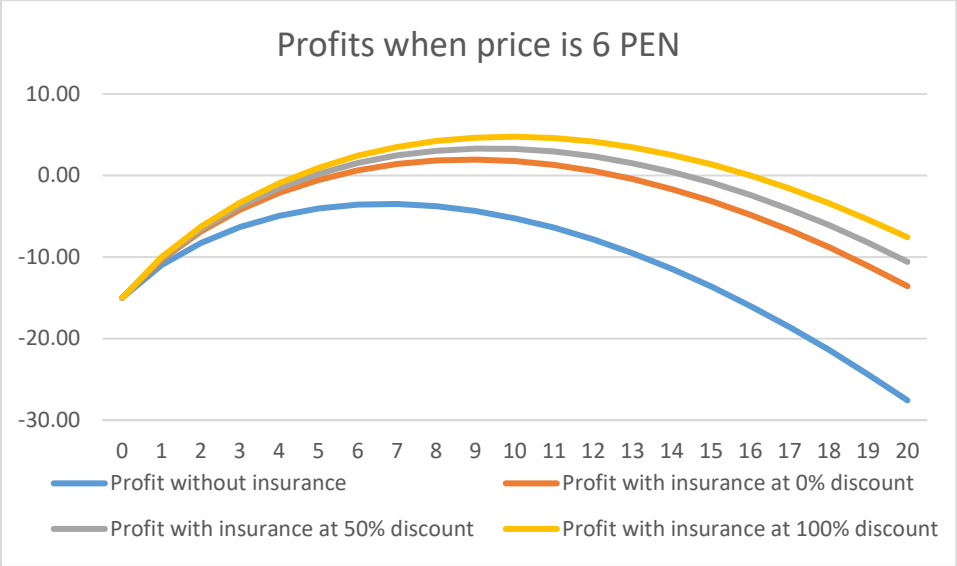
C.1. Profits when price is 5 PEN, without insurance and with insurance at different discounts

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) **Profit without insurance** (1) x (2) - (3)	(5) **Profit when buying insurance at 0% discount** = (4) - 0.3*(1) + (7-(2))*(1)	(6) **Profit when buying insurance at 50% discount** = (4) - 0.15*(1) + (7-(2))*(1)	(7) **Profit when buying insurance at 100% discount** = (4) - 0*(1) + (7-(2))*(1)
0	5	15.00	-15.00	-15.00	-15.00	-15.00
1	5	17.00	-12.00	-10.30	-10.15	-10.00
2	5	20.28	-10.28	-6.88	-6.58	-6.28
3	5	24.31	-9.31	-4.21	-3.76	-3.31
4	5	28.93	-8.93	-2.13	-1.53	-0.93
5	5	34.04	-9.04	-0.54	0.21	0.96
6	5	39.57	-9.57	0.63	1.53	2.43
7	5	45.49	-10.49	1.41	2.46	3.51
8	5	51.76	-11.76	1.84	3.04	4.24
9	5	58.35	-13.35	1.95	3.30	4.65
10	5	65.24	-15.24	1.76	3.26	4.76
11	5	72.41	-17.41	1.29	2.94	4.59
12	5	79.85	-19.85	0.55	2.35	4.15
13	5	87.54	-22.54	-0.44	1.51	3.46
14	5	95.47	-25.47	-1.67	0.43	2.53
15	5	103.63	-28.63	-3.13	-0.88	1.37
16	5	112.01	-32.01	-4.81	-2.41	-0.01
17	5	120.60	-35.60	-6.70	-4.15	-1.60
18	5	129.40	-39.40	-8.80	-6.10	-3.40
19	5	138.39	-43.39	-11.09	-8.24	-5.39
20	5	147.58	-47.58	-13.58	-10.58	-7.58



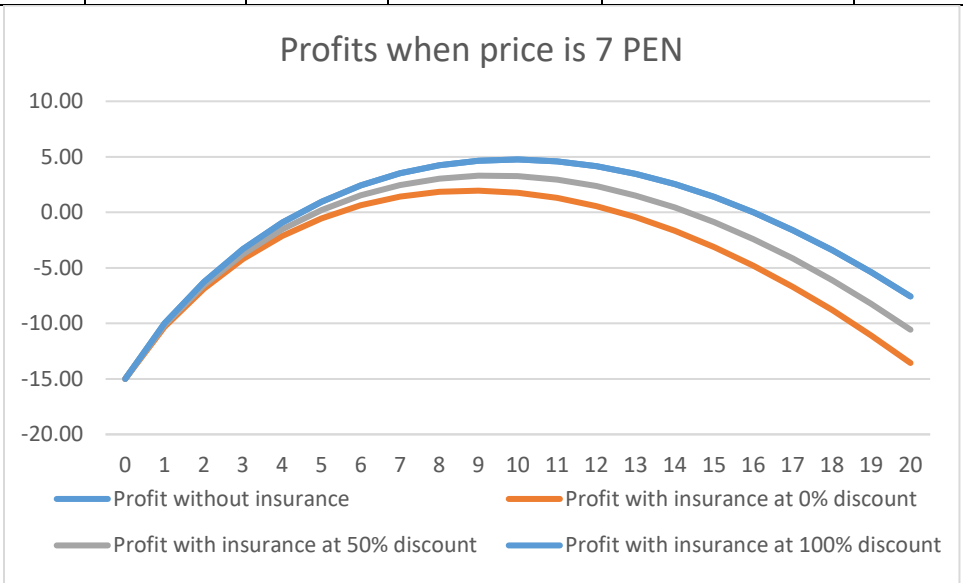
C.2. Profits when price is 6 PEN, without insurance and with insurance at different discounts

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) **Profit without insurance** (1) x (2) - (3)	(5) **Profit when buying insurance at 0% discount** = (4) - 0.3*(1) + (7-(2))*(1)	(6) **Profit when buying insurance at 50% discount** = (4) - 0.15*(1) + (7-(2))*(1)	(7) **Profit when buying insurance at 100% discount** = (4) - 0*(1) + (7-(2))*(1)
0	6	15.00	-15.00	-15.00	-15.00	-15.00
1	6	17.00	-11.00	-10.30	-10.15	-10.00
2	6	20.28	-8.28	-6.88	-6.58	-6.28
3	6	24.31	-6.31	-4.21	-3.76	-3.31
4	6	28.93	-4.93	-2.13	-1.53	-0.93
5	6	34.04	-4.04	-0.54	0.21	0.96
6	6	39.57	-3.57	0.63	1.53	2.43
7	6	45.49	-3.49	1.41	2.46	3.51
8	6	51.76	-3.76	1.84	3.04	4.24
9	6	58.35	-4.35	1.95	3.30	4.65
10	6	65.24	-5.24	1.76	3.26	4.76
11	6	72.41	-6.41	1.29	2.94	4.59
12	6	79.85	-7.85	0.55	2.35	4.15
13	6	87.54	-9.54	-0.44	1.51	3.46
14	6	95.47	-11.47	-1.67	0.43	2.53
15	6	103.63	-13.63	-3.13	-0.88	1.37
16	6	112.01	-16.01	-4.81	-2.41	-0.01
17	6	120.60	-18.60	-6.70	-4.15	-1.60
18	6	129.40	-21.40	-8.80	-6.10	-3.40
19	6	138.39	-24.39	-11.09	-8.24	-5.39
20	6	147.58	-27.58	-13.58	-10.58	-7.58



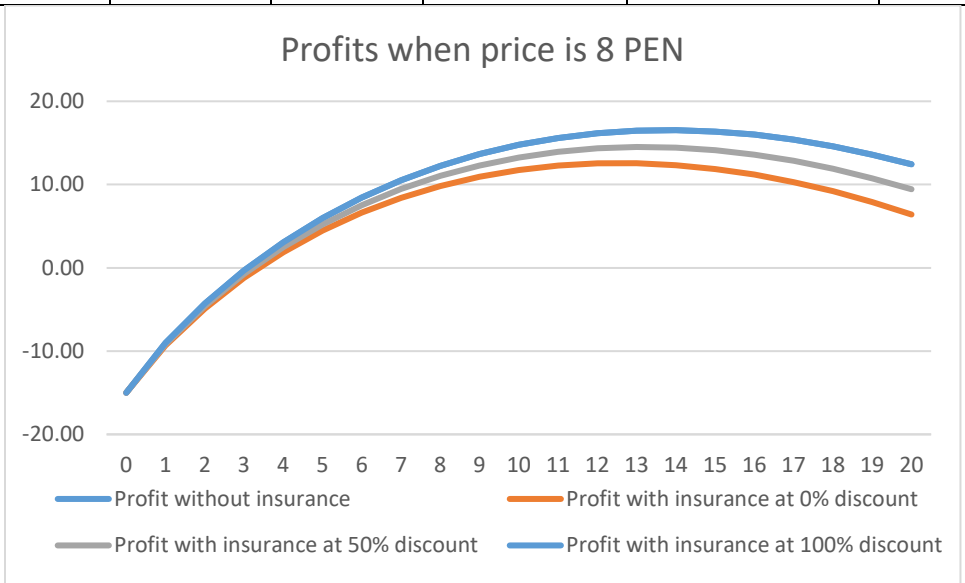
C.3. Profits when price is 7 PEN, without insurance and with insurance at different discounts

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) **Profit without insurance** (1) x (2) - (3)	(5) **Profit when buying insurance at 0% discount** = (4) - 0.3*(1)	(6) **Profit when buying insurance at 50% discount** = (4) - 0.15*(1)	(7) **Profit when buying insurance at 100% discount** = (4) - 0*(1)
0	7	15.00	-15.00	-15.00	-15.00	-15.00
1	7	17.00	-10.00	-10.30	-10.15	-10.00
2	7	20.28	-6.28	-6.88	-6.58	-6.28
3	7	24.31	-3.31	-4.21	-3.76	-3.31
4	7	28.93	-0.93	-2.13	-1.53	-0.93
5	7	34.04	0.96	-0.54	0.21	0.96
6	7	39.57	2.43	0.63	1.53	2.43
7	7	45.49	3.51	1.41	2.46	3.51
8	7	51.76	4.24	1.84	3.04	4.24
9	7	58.35	4.65	1.95	3.30	4.65
10	7	65.24	4.76	1.76	3.26	4.76
11	7	72.41	4.59	1.29	2.94	4.59
12	7	79.85	4.15	0.55	2.35	4.15
13	7	87.54	3.46	-0.44	1.51	3.46
14	7	95.47	2.53	-1.67	0.43	2.53
15	7	103.63	1.37	-3.13	-0.88	1.37
16	7	112.01	-0.01	-4.81	-2.41	-0.01
17	7	120.60	-1.60	-6.70	-4.15	-1.60
18	7	129.40	-3.40	-8.80	-6.10	-3.40
19	7	138.39	-5.39	-11.09	-8.24	-5.39
20	7	147.58	-7.58	-13.58	-10.58	-7.58



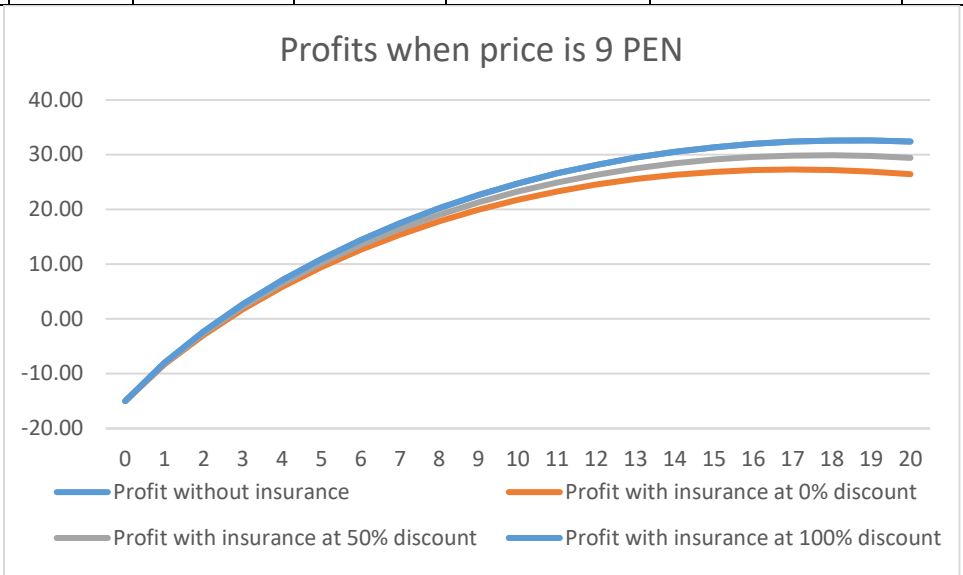
C.4. Profits when price is 8 PEN, without insurance and with insurance at different discounts

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) **Profit without insurance** (1) x (2) - (3)	(5) **Profit when buying insurance at 0% discount** = (4) - 0.3*(1)	(6) **Profit when buying insurance at 50% discount** = (4) - 0.15*(1)	(7) **Profit when buying insurance at 100% discount** = (4) - 0*(1)
0	8	15.00	-15.00	-15.00	-15.00	-15.00
1	8	17.00	-9.00	-9.30	-9.15	-9.00
2	8	20.28	-4.28	-4.88	-4.58	-4.28
3	8	24.31	-0.31	-1.21	-0.76	-0.31
4	8	28.93	3.07	1.87	2.47	3.07
5	8	34.04	5.96	4.46	5.21	5.96
6	8	39.57	8.43	6.63	7.53	8.43
7	8	45.49	10.51	8.41	9.46	10.51
8	8	51.76	12.24	9.84	11.04	12.24
9	8	58.35	13.65	10.95	12.30	13.65
10	8	65.24	14.76	11.76	13.26	14.76
11	8	72.41	15.59	12.29	13.94	15.59
12	8	79.85	16.15	12.55	14.35	16.15
13	8	87.54	16.46	12.56	14.51	16.46
14	8	95.47	16.53	12.33	14.43	16.53
15	8	103.63	16.37	11.87	14.12	16.37
16	8	112.01	15.99	11.19	13.59	15.99
17	8	120.60	15.40	10.30	12.85	15.40
18	8	129.40	14.60	9.20	11.90	14.60
19	8	138.39	13.61	7.91	10.76	13.61
20	8	147.58	12.42	6.42	9.42	12.42



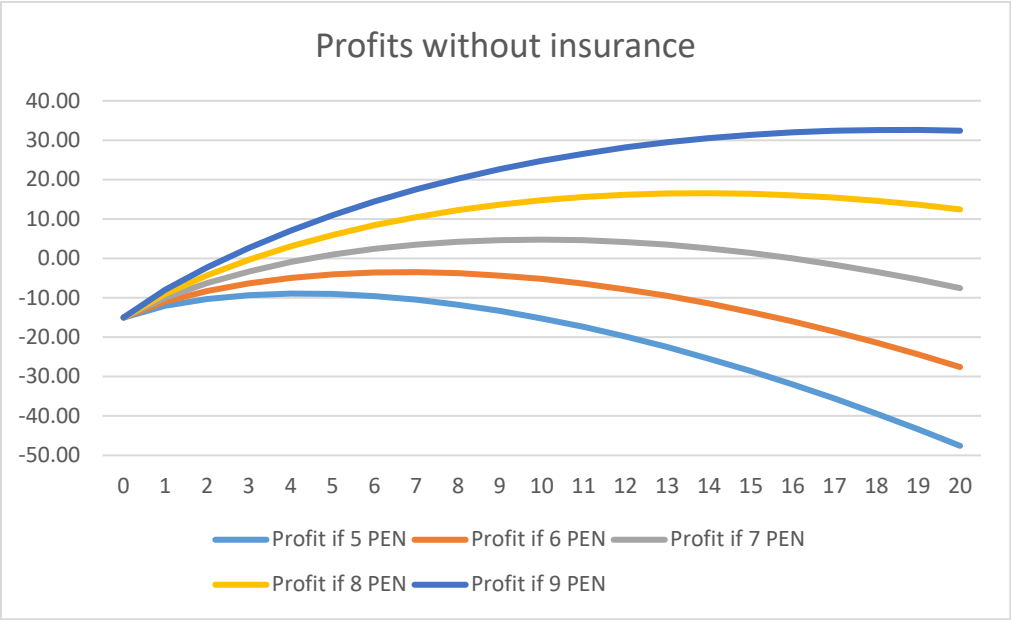
C.5. Profits when price is 9 PEN, without insurance and with insurance at different discounts

(1) Production (100 arrobas)	(2) Price (PEN per arroba)	(3) Cost of production = 2 x (1)^1.4 + 15	(4) **Profit without insurance** (1) x (2) - (3)	(5) **Profit when buying insurance at 0% discount** = (4) - 0.3*(1)	(6) **Profit when buying insurance at 50% discount** = (4) - 0.15*(1)	(7) **Profit when buying insurance at 100% discount** = (4) - 0*(1)
0	9	15.00	-15.00	-15.00	-15.00	-15.00
1	9	17.00	-8.00	-8.30	-8.15	-8.00
2	9	20.28	-2.28	-2.88	-2.58	-2.28
3	9	24.31	2.69	1.79	2.24	2.69
4	9	28.93	7.07	5.87	6.47	7.07
5	9	34.04	10.96	9.46	10.21	10.96
6	9	39.57	14.43	12.63	13.53	14.43
7	9	45.49	17.51	15.41	16.46	17.51
8	9	51.76	20.24	17.84	19.04	20.24
9	9	58.35	22.65	19.95	21.30	22.65
10	9	65.24	24.76	21.76	23.26	24.76
11	9	72.41	26.59	23.29	24.94	26.59
12	9	79.85	28.15	24.55	26.35	28.15
13	9	87.54	29.46	25.56	27.51	29.46
14	9	95.47	30.53	26.33	28.43	30.53
15	9	103.63	31.37	26.87	29.12	31.37
16	9	112.01	31.99	27.19	29.59	31.99
17	9	120.60	32.40	27.30	29.85	32.40
18	9	129.40	32.60	27.20	29.90	32.60
19	9	138.39	32.61	26.91	29.76	32.61
20	9	147.58	32.42	26.42	29.42	32.42



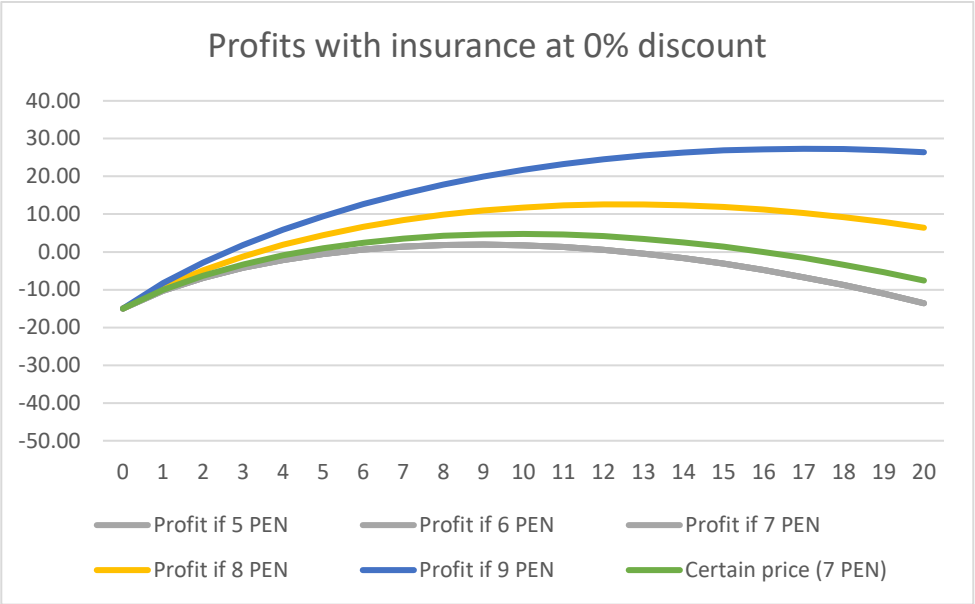
C.6. Profits for prices 5-9 PEN without insurance

Production (100 arrobas)	Profit if 5 PEN	Profit if 6 PEN	Profit if 7 PEN	Profit if 8 PEN	Profit if 9 PEN	Certain price (7 PEN)
0	-15.00	-15.00	-15.00	-15.00	-15.00	-15.00
1	-12.00	-11.00	-10.00	-9.00	-8.00	-10.00
2	-10.28	-8.28	-6.28	-4.28	-2.28	-6.28
3	-9.31	-6.31	-3.31	-0.31	2.69	-3.31
4	-8.93	-4.93	-0.93	3.07	7.07	-0.93
5	-9.04	-4.04	0.96	5.96	10.96	0.96
6	-9.57	-3.57	2.43	8.43	14.43	2.43
7	-10.49	-3.49	3.51	10.51	17.51	3.51
8	-11.76	-3.76	4.24	12.24	20.24	4.24
9	-13.35	-4.35	4.65	13.65	22.65	4.65
10	-15.24	-5.24	4.76	14.76	24.76	4.76
11	-17.41	-6.41	4.59	15.59	26.59	4.59
12	-19.85	-7.85	4.15	16.15	28.15	4.15
13	-22.54	-9.54	3.46	16.46	29.46	3.46
14	-25.47	-11.47	2.53	16.53	30.53	2.53
15	-28.63	-13.63	1.37	16.37	31.37	1.37
16	-32.01	-16.01	-0.01	15.99	31.99	-0.01
17	-35.60	-18.60	-1.60	15.40	32.40	-1.60
18	-39.40	-21.40	-3.40	14.60	32.60	-3.40
19	-43.39	-24.39	-5.39	13.61	32.61	-5.39
20	-47.58	-27.58	-7.58	12.42	32.42	-7.58



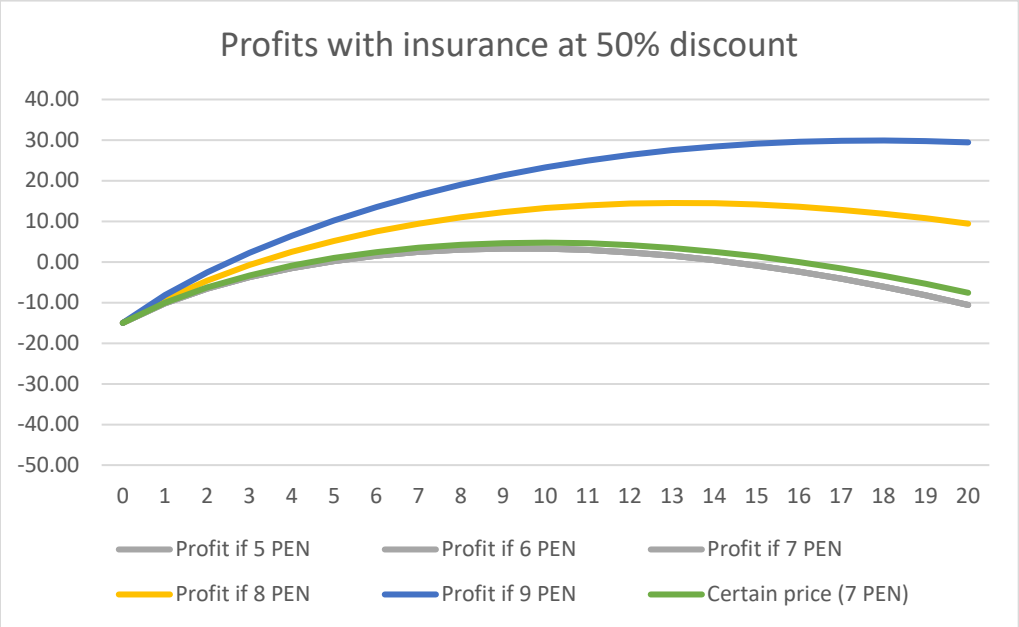
C.7. Profits for prices 5-9 PEN with insurance sold at 0% discount

Production (100 arrobas)	Profit if 5 PEN	Profit if 6 PEN	Profit if 7 PEN	Profit if 8 PEN	Profit if 9 PEN	Certain price (7 PEN)
0	-15.00	-15.00	-15.00	-15.00	-15.00	-15.00
1	-10.30	-10.30	-10.30	-9.30	-8.30	-10.00
2	-6.88	-6.88	-6.88	-4.88	-2.88	-6.28
3	-4.21	-4.21	-4.21	-1.21	1.79	-3.31
4	-2.13	-2.13	-2.13	1.87	5.87	-0.93
5	-0.54	-0.54	-0.54	4.46	9.46	0.96
6	0.63	0.63	0.63	6.63	12.63	2.43
7	1.41	1.41	1.41	8.41	15.41	3.51
8	1.84	1.84	1.84	9.84	17.84	4.24
9	1.95	1.95	1.95	10.95	19.95	4.65
10	1.76	1.76	1.76	11.76	21.76	4.76
11	1.29	1.29	1.29	12.29	23.29	4.59
12	0.55	0.55	0.55	12.55	24.55	4.15
13	-0.44	-0.44	-0.44	12.56	25.56	3.46
14	-1.67	-1.67	-1.67	12.33	26.33	2.53
15	-3.13	-3.13	-3.13	11.87	26.87	1.37
16	-4.81	-4.81	-4.81	11.19	27.19	-0.01
17	-6.70	-6.70	-6.70	10.30	27.30	-1.60
18	-8.80	-8.80	-8.80	9.20	27.20	-3.40
19	-11.09	-11.09	-11.09	7.91	26.91	-5.39
20	-13.58	-13.58	-13.58	6.42	26.42	-7.58



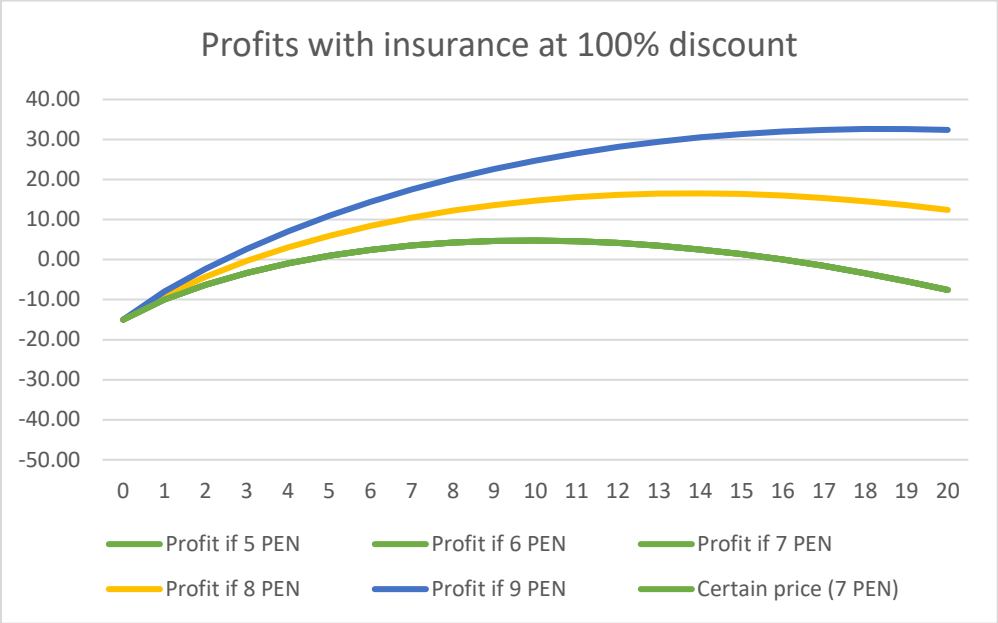
C.8. Profits for prices 5-9 PEN with insurance sold at 50% discount

Production (100 arrobas)	Profit if 5 PEN	Profit if 6 PEN	Profit if 7 PEN	Profit if 8 PEN	Profit if 9 PEN	Certain price (7 PEN)
0	-15.00	-15.00	-15.00	-15.00	-15.00	-15.00
1	-10.15	-10.15	-10.15	-9.15	-8.15	-10.00
2	-6.58	-6.58	-6.58	-4.58	-2.58	-6.28
3	-3.76	-3.76	-3.76	-0.76	2.24	-3.31
4	-1.53	-1.53	-1.53	2.47	6.47	-0.93
5	0.21	0.21	0.21	5.21	10.21	0.96
6	1.53	1.53	1.53	7.53	13.53	2.43
7	2.46	2.46	2.46	9.46	16.46	3.51
8	3.04	3.04	3.04	11.04	19.04	4.24
9	3.30	3.30	3.30	12.30	21.30	4.65
10	3.26	3.26	3.26	13.26	23.26	4.76
11	2.94	2.94	2.94	13.94	24.94	4.59
12	2.35	2.35	2.35	14.35	26.35	4.15
13	1.51	1.51	1.51	14.51	27.51	3.46
14	0.43	0.43	0.43	14.43	28.43	2.53
15	-0.88	-0.88	-0.88	14.12	29.12	1.37
16	-2.41	-2.41	-2.41	13.59	29.59	-0.01
17	-4.15	-4.15	-4.15	12.85	29.85	-1.60
18	-6.10	-6.10	-6.10	11.90	29.90	-3.40
19	-8.24	-8.24	-8.24	10.76	29.76	-5.39
20	-10.58	-10.58	-10.58	9.42	29.42	-7.58



C.9. Profits for prices 5-9 PEN with insurance sold at 100% discount

Production (100 arrobas)	Profit if 5 PEN	Profit if 6 PEN	Profit if 7 PEN	Profit if 8 PEN	Profit if 9 PEN	Certain price (7 PEN)
0	-15.00	-15.00	-15.00	-15.00	-15.00	-15.00
1	-10.00	-10.00	-10.00	-9.00	-8.00	-10.00
2	-6.28	-6.28	-6.28	-4.28	-2.28	-6.28
3	-3.31	-3.31	-3.31	-0.31	2.69	-3.31
4	-0.93	-0.93	-0.93	3.07	7.07	-0.93
5	0.96	0.96	0.96	5.96	10.96	0.96
6	2.43	2.43	2.43	8.43	14.43	2.43
7	3.51	3.51	3.51	10.51	17.51	3.51
8	4.24	4.24	4.24	12.24	20.24	4.24
9	4.65	4.65	4.65	13.65	22.65	4.65
10	4.76	4.76	4.76	14.76	24.76	4.76
11	4.59	4.59	4.59	15.59	26.59	4.59
12	4.15	4.15	4.15	16.15	28.15	4.15
13	3.46	3.46	3.46	16.46	29.46	3.46
14	2.53	2.53	2.53	16.53	30.53	2.53
15	1.37	1.37	1.37	16.37	31.37	1.37
16	-0.01	-0.01	-0.01	15.99	31.99	-0.01
17	-1.60	-1.60	-1.60	15.40	32.40	-1.60
18	-3.40	-3.40	-3.40	14.60	32.60	-3.40
19	-5.39	-5.39	-5.39	13.61	32.61	-5.39
20	-7.58	-7.58	-7.58	12.42	32.42	-7.58



Lottery Game

In the following table you have five different lotteries. Each lottery has two possible outcomes: A and B, each one with half the chance to be your additional payoff.

Gamble choice	Event	Probability (%)	Payoff
1	A	50%	4.76
	B	50%	4.76
2	A	50%	7.14
	B	50%	3.57
3	A	50%	9.52
	B	50%	2.38
4	A	50%	11.90
	B	50%	1.19
5	A	50%	14.28
	B	50%	0.00

Please choose the lottery you prefer (only one).

Instructions for Enumerator: Write down the **preferred lottery**: _____.

Roll a six-sided dice. If the number is 1, 2 or 3, add to the farmer's payment the result of option A for the lottery chosen. If the number is 4, 5 or 6, add to the payment the result of option B.

Result: A / B _____.

Payment from lottery: _____.

End of experiment questionnaire

Farmer and family

1. Place of birth (CCPP, District, Province, Region): _____
2. Before coming here today, did you feel hungry? Yes / No
3. In a scale from 1 (dislike) to 10 (love), how much you like the weather today? _____
4. Highest education level achieved: _____
5. Ethnicity / Race: a. Blanco b. Mestizo c. Quechua d. Aimara e. Nativo amazónico f. Negro, afrodescendiente g. Otro _____
6. Does the family receive the Juntos CCT transfer? Yes / No
7. Do you work as a temporal worker in other farms? Yes/No
8. Besides the farm which other activities the family does to obtain money/wealth? _____
9. Which activity brings the most money/wealth to the household?
10. How much of the wealth of the household is brought by the farm?

11. How many members are in the household (permanent residents)?
12. How many of them are kids under 12 years old?
13. How many of them are elders over 65 years old?
14. How many of them work at the farm?

15. Do you have animals? Yes / No
16. Number of big animals (cows, horses, pigs) _____
17. Number of small animals (chicken, ducks, turkeys) _____

Farm

18. List all the crops the farmer has now _____
19. How much land is cultivated now? _____
20. How much is owned land and how much is rented land?
21. How much land owned by the household is not being used now?
22. From the cultivated land, how much is cultivated with temporary crops and how much is cultivated with perennial crops? _____
23. Do you usually sell at the farm or sell your products in a local market yourself?

24. What kind of potatoes you have in the farm now?
25. Price received for potatoes (per arroba) during last season
26. How many years have you cultivated potatoes?
27. Which is the best price you have received for potatoes? (price at the farm)
28. Which is the worst price you have received for potatoes? (price at the farm)
29. How much of your potatoes production is for self-consumption?
30. Total area of potatoes
31. Which is your yield of potatoes?

32. Which is the yield on average for your neighbors?

33. Distance to the capital or main city where they buy and sell products

Instructions for enumerator: Fill the following without asking the farmer.

Name of enumerator _____

ID of farmer _____

Time and date of start _____

Time of end _____

Did you have any interruptions during the experiment? Yes/No. Mention _____

CCPP, District, Province, Region _____

GPS location ____° ____' ____'' S ____° ____' ____'' W

GPS location of ☐Farm ☐House ☐Both (Farm is next to the house)

Altitude _____ msnm

Instructions for enumerator: Fill all the following:

- Base payment: 40 PEN plus _____ (additional amount determined before Games A, B, C) = _____(*)

- Roll dices and determine the number of round from Games A, B, C selected for payoff: _____.

- Profit from this round: _____.

- Calculate the payoff: 25 PEN + (Profit/2) = _____. (**)

- Payoff from lottery: _____. (***)

Sum (*)+(**)+(***)= _____. ***This is the TOTAL amount you must pay the farmer.***

Now ask the farmer to sign the payment form before leaving and thank him/her.

Appendix D. Minimum Detectable Effects Calculations

Using the standard deviations in Table 1 and calculating the intra-cluster (i.e., intra-subject) correlation of production, we can calculate the minimum detectable effects (i.e., power calculations) using the following formula (Duflo, Glennerster, and Kremer 2007):

$$MDE = \left(t_{(1-k)} + t_{\propto}\right) * \sqrt{\frac{1}{P(1-P)\,J}}\sqrt{\rho + \frac{1-\rho}{n}}\,\sigma\,. \tag{11}$$

In Game B, the standard deviation (σ) of the variable of interest (output chosen) is 3.40, and the intra-cluster correlation ρ (i.e. intra-person correlation of output in each round) is equal to 0.18. The proportion of the treatment (P) is given by the experiment setup: the proportion of uncertain rounds is 2/3. For 101 subjects (J) and twenty rounds of real games (n) per subject, and the usual 80% power and 95% confidence level, we obtain a minimum detectable effect (MDE) of 1.00.[20] This means we are able to correctly assess the results of our regressions if the change in output found is no smaller than 1.00 units. In other words, we will not be incurring in the Type II error (rejecting the hypothesis of the existence of an effect when it actually exists) for effects (changes) of at least 1.00 in output. Similarly, for Game MI, with a standard deviation of 2.93 and intra-cluster (intra-subject correlation between rounds) is 0.17, the MDE is 0.84.[21]

For Game VI, given that not all participants would decide to purchase the available price insurance, we need to multiply equation (11) by the insurance take-up to calculate the MDE. Thus, with a take-up of 0.83, a standard deviation of 2.89, and an intra-person correlation of 0.17, the MDE is 1.01.[22, 23]

[20] Note that this is the MDE for the specifications (1) in Table 2, referring to Game B. For specification (3) in the same table, which includes dummies for each price distribution scenario, we need to assume that the proportion of the treatment (P) is 1/6 (= (2/3)*(1/4)), so the MDE would be 1.27.
[21] For specification (3) in Table 3, referring to Game MI, the MDE corresponding to P=1/6 is 1.07.
[22] For specification (3) in Table 5, the MDE corresponding to P=1/6 is 1.28.
[23] Power calculations show that adding more rounds to the same type of game only contribute minimally to power, due to intra-individual correlation between rounds. Much more power will be brought by adding more participants (Duflo et al. 2007).

Appendix E. Eckel-Grossman Lottery

Since Sandmo's (1971) theoretical predictions hold for a risk-averse agent, it is necessary to measure the level of risk aversion of each participant. Here, we use a modified version of the Eckel and Grossman (2002) game, using the maximum profit at the average price ($7) as a certainty reference point, i.e. $4.76.[24] Participants were shown only the first four columns of Table D1, and they had to choose only one of the five lotteries. Risk (i.e. the risk level) is measured as the standard deviation of the expected payoffs, and the Constant Relative Risk Aversion (CRRA) coefficient R is calculated using the utility function ($U(x) = x^{1-r}/(1-R)$, where x is the payoff) proposed by Eckel and Grossman (2008).[25]

Table D1. Eckel and Grossman Risk Elicitation Game

Gamble choice	Event	Probability (%)	Payoff	Expected Payoff	Risk	CRRA ranges
1	A	50	4.76	4.76	0.00	$R > 2$
	B	50	4.76			
2	A	50	7.14	5.36	1.79	$0.67 < R < 2$
	B	50	3.57			
3	A	50	9.52	5.95	3.57	$0.38 < R < 0.67$
	B	50	2.38			
4	A	50	11.90	6.55	5.36	$0.20 < R < 0.38$
	B	50	1.19			
5	A	50	14.28	7.14	7.14	$r < 0.20$
	B	50	0.00			

[24] Bellemare, Lee and Just (2020) use the Holt-Laury risk elicitation lottery to assess risk aversion, but they do not find it is a relevant measure.

[25] The modified payoffs of our lotteries allow us to obtain the same CRRA coefficients as Eckel and Grossman (2008). The CRRA used in the regressions correspond to 2 for lottery 1, 0.2 for lottery 5, and the mid-value of the CRRA range for the remaining lotteries.