

Does cost-sharing increase learning? Experimental evidence from seed trail packs in Uganda

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Abstract

A popular way to increase use of a product or technology is providing it for free (or at greatly reduced price) for a limited period of time such that potential users can gain experience with it and share this experience with others. However, it is sometimes argued that something that is provided for free is less likely to be used for its intended purpose. There are three main reasons why a positive price may increase use. First, a pecuniary cost may serve as a screening mechanism, putting the product only in the hands of those that value it. Second, a mechanism known as the sunk cost effect may be at play where a price induces a psychological cost of failing to use the product for its intended purpose. Third, a price tag may be interpreted as a signal about the quality of the product. Using a recently released seed variety as a case, we offer smallholder farmers the opportunity to buy a trial pack of seed from us, and compare use of the seed and subsequent adoption of the technology to farmers that were provided the seed trial pack for free. We further design a field experiment that enables us to assess the importance of screening, sunk cost, and signaling effects of prices.

Keywords: technology adoption, screening effect, sunk cost effect, signaling.

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1 Introduction

Prices are ubiquitous in economic transactions. Prices are central to the efficient allocation of scarce resources within a society and provide an important incentive to producers. But charging the (full) price may not always be optimal. For instance, if a product or technology is new, providing it for free or at a discount for a short period of time may be necessary to encourage potential consumers to try and learn from it (Bawa and Shoemaker, 2004). From a social welfare point of view, subsidies may be justified to ensure access to essential goods and services for low-income individuals or disadvantaged communities that may benefit most. Positive externalities is another strong argument against charging the full price (Miguel and Kremer, 2004).

At the same time, some argue that when goods or services are provided for free, recipients often do not value them and lead to waste. Goods obtained for free often remain unused, are resold, or are otherwise used in unintended ways. High profile examples include the use of free bed-nets for fishing or the use of subsidized chlorine for cleaning instead of treating drinking water (Cohen and Dupas, 2010; Ashraf, Berry, and Shapiro, 2010).

There are at least three ways in which charging a positive price may lead to increased use. The first is a *screening effect*, whereby only people who really appreciate the intrinsic value the product will acquire it. A second is more psychological in nature and conjectures that people are prone to *sunk cost effects*, and as a result, paying a positive price for something leads one to appreciate it more (regardless of whether they really want it or not). Finally, prices may also provide a *signaling effect* especially in cases where there is uncertainty about the intrinsic value of the product (Milgrom and Roberts, 1986).

The basic problem is that these effects are conflated in observational data, as each of these effects imply that if prices rise, so does use. Building on the work of Ashraf, Berry, and Shapiro (2010), this paper uses a field experiment designed to disentangle these three effects. To do so, we extend the randomized two-stage pricing design introduced by Arkes and Blumer (1985) by adding a third stage that allows us to, in addition to the screening and sunk cost effects, identify the signaling effect as well.

For the empirical application, we use seed trial packs to promote a recently introduced improved maize seed variety among smallholder farmers in eastern Uganda. There are various reasons why improved seed varieties provide an interesting and policy relevant case. First, as this is a new and relatively unknown seed type, providing free samples may be necessary to encourage risk averse farmers to learn by experimentation.

Second, it is well established that one of the most effective ways to increase agricultural technology adoption is through peer learning (Conley and Udry, 2010; Bandiera and Rasul, 2006). Furthermore, informal seed systems used by farmers often suffer from decades of seed degeneration due to recycling of seed introduced during colonial times (McGuire and Sperling, 2016). Injecting new seed varieties can be one strategy to improve the overall seed stock.

Seed is an important investment requiring non-negligable monetary outlays

up front. As such, there may be important sunk cost effects associated to seed purchases. Finally, improved seed varieties suffer from substantial information asymmetries with respect to quality. [Bulte et al. \(2023\)](#) find that uncertainty about the quality of the seed leads to reduced labour allocation and conclude that the presence of lemon inputs on the market for modern inputs impedes learning about the profitability of these inputs. This suggests a signaling role for prices.

The rest of this paper is organized as follows.

2 Methods and experimental design

At the heart of the study is randomized trial that comprises of three different groups of farmers that receive a seed trial pack of 1 kg of seed of an improved variety in some way. The seed we use is a recently introduced hybrid seed popularly known as Bazooka, produced by Naseco Seed Ltd. The seed is high yielding promising between 3.5 and 4 metric tons per acre. The seed was partly chosen because it is widely available in the market.

A first group of randomly selected farmers was provided a seed trial pack for free. The enumerator then explains what kind of seed it is and what the advantages are.

A second group of farmers farmers paid a positive price for the seed trial pack. In particular this group of randomly selected farmers were offered the opportunity to buy a bag of seed from the enumerator in a way that is as close as possible as how this happens in a real life setting where bargaining is the norm.¹ The enumerator follows a standard script that was implemented in Open Data Kit (ODK) on Android tablet computers. An initial ask price is randomly drawn, ranging from 12,000 to 9,000, and this price is then presented to the farmer as the price of the bag of seed. The enumerator explains what kind of seed it is and what the advantages are. The farmer has the option to accept this price or not.

If the farmer does not accept the initial offer price, the farmer enters into a bargaining stage where he or she is encouraged to name his/her first bid price. A computer algorithm then determines a counter-offer that the enumerator asks in a second round of negotiation. This new ask price is determined as the farmer's bid price plus 80 percent of the difference between the (initial) ask price and

¹In other studies that use a two-stage pricing design ([Ashraf, Berry, and Shapiro, 2010](#); [Cohen and Dupas, 2010](#)), farmers are simply offered the commodity at different price points. However, this results in a substantial number of farmers that decide not to buy the seed, leading to important reductions in sample size (or requiring significant over-subscription). However, as willingness to pay of a farmer is needed for two-stage pricing experiments, one could use elicitation methods such as a Becker-DeGroot-Marschak (BDM) auction. In its simplest version, the subject formulates a bid and this bid is compared to a price determined by a random number generator. If the subject's bid is greater than the price, they pay the price and receives the item being auctioned. If the subject's bid is lower than the price, they pay nothing and receive nothing. A BDM has the added advantage of also including the second stage surprise discount if farmers bid higher than the trigger price - see appendix E in [Berry, Fischer, and Guiteras \(2020\)](#).

the farmer’s bid price, and this is rounded to the nearest multiple of 500. This updated (lower) ask price is then presented to the farmer and the farmer gets another opportunity to accept or not. If the farmer does not accept, he or she is encouraged to make a second bid and a third ask price is determined as the farmer’s last bid price plus 80 percent of the difference between the last ask price and the farmer’s last bid price. Bargaining continues until the farmer accepts an ask price, or the price difference between the bid and ask price is smaller than 500 ugandan shilling, in which case the computer instructs the enumerator sell at the last price the farmer bids.²

A third group of farmers also plays the bargaining game, but is offered a surprise 100 percent discount. Most pricing designs use a random discount to be included as a continuous variable in the regression, or a set of equally spaced discounts. The aim of this is often to set optimal subsidy level. In our study, we want to maximize power and work with only one discount. The decision to use only a single full discount is also due to the fact that we expect a discontinuity in the relationship (free versus paying, even though it may be only a little) and the fact that we also want to maximize sample size for a comparison between the 100 % discount and the farmers that get the free seed trial pack.

In a first part of the analysis, we simply compare behaviour between the 3 groups of farmers. We ask for instance if seed pack use is indeed lower in the subset of farmers that received the seed for free as opposed to those who paid a positive price. Comparing the three groups may also give us an idea of what effects are most important. For instance, if we see a pattern of higher use in the subgroup that paid a positive price and the subgroup that (and lower use in the group that received the seed for free without) this suggests that signaling may be important. Trial pack use that is higher in the group that paid a positive price only would be consistent with a sunk cost effect. If use is actually lower in the paid group, this may suggest important income effects.

To further investigate the relationship between prices and use we focus on the second and third group and extend the randomized two-stage pricing design to isolate the sunk-cost effect from the screening effect ([Ashraf, Berry, and Shapiro, 2010](#); [Cohen and Dupas, 2010](#)). In the original two-stage design, study participants are given the opportunity to buy a commodity at different price points and in a second stage are given a surprise discount. Running a regression of product use on the price paid while controlling for the discount gives an estimate of the screening effect, while a regression of product use on the discount while controlling for price paid provides an estimate of the sunk cost effect.

As mentioned above, in our design, instead of simply asking farmers to purchase the seed at a given price, we provide farmers with the opportunity to buy seed through a sequential bargaining game starting from a randomized initial offer price that provides the starting point of the negotiations process. This procedure gives us a price that can be used to estimate (or control for) the signaling effect that is different from the price that farmers agree upon,

²To make the bargaining also incentive compatible for the enumerators, we tell them in advance that the money that is collected from farmers during this first stage will be divided and distributed equally among all the enumerators.

the latter which can be used to estimate (or control for) the screening effect. The last stage in our design remains the same with a surprise discount that can be used to estimate (or control for) the sunk cost effect.

Assignment into the groups will be at the village level, as we want to avoid that a farmer that gets a bag of maize seed for free lives right next to a farmer that has to pay a positive price for it. However, we did vary the initial offer price in the bargaining experiment at the individual level. We will work with 10 farmers per village, which is the maximum our field teams can handle.

3 Estimation

In a first part of the analysis, we compare the outcomes between three groups: 1) farmers who paid a positive price for the seed trial pack after the bargaining experiment explained in the previous section; 2) farmers who paid participated in the bargaining experiment but received the seed for free anyway due to a 100 percent surprise discount; and 3) farmers that received the seed trial pack for free and did not participate in the bargaining experiment. We thus estimate the following equation:

$$Y_i = \alpha + \beta_D D_i + \beta_F F_i + \varepsilon_i \quad (1)$$

where Y_i is an outcome of interest for farmer i , D_i is an indicator variable that takes the value of 1 if the farmer was randomly selected to receive a full discount after then bargaining, and F_i is an indicator variable that takes the value of 1 if the farmer was randomly selected to receive the seed trial pack for free without bargaining. The group that paid a positive price for the seed trial pack thus serves as the reference group. We also implement a linear hypothesis test to test if $\beta_D = \beta_F$. As randomization happened at the village level, we use cluster-robust standard errors with a small sample correction following the bias-reduced linearization adjustment proposed by [Bell and McCaffrey \(2002\)](#) - see also [Bell and McCaffrey \(2002\)](#); [Imbens and Kolesar \(2016\)](#).

If signaling is important, we would expect that being enrolled in the bargaining experiment (group 1 and group 2) will result in a positive impact ($\beta_D = 0$, $\beta_F < 0$ and $\beta_D \neq \beta_F$). If the sunk cost effect exists, we would expect a positive impact only in the first group, as these are the only ones that paid a positive price ($\beta_D < 0$, $\beta_D < \beta_F$ and $\beta_D \neq \beta_F$).

To identify screening effects, in a second part of the analysis, we estimate a models that are similar to [Ashraf, Berry, and Shapiro \(2010\)](#) that allows us to isolate the screening effect. To do so, we drop the groups that did not enroll in the bargaining experiment and confine attention to the first two groups (farmers that paid a positive price and farmers that received a 100 percent discount after negotiation). We then regress outcomes on the price that was agreed on during the bargaining experiment (controlling for the actual price paid after the discount and the initial offer price) to estimate the screening effect (see β_P in equation 2). We also regress outcomes on the actual price paid (controlling for the price agreed on during bargaining and the initial offer price) to estimate the

sunk cost effect (which corresponds to β_D in equation 2). Finally, we regress outcomes on the initial offer price (controlling for the price agreed on during bargaining and the price paid after discount) to estimate the signaling effect (corresponding to β_{FD} in equation 2):³

$$Y_i = \alpha + \beta_P P_i + \beta_D D_i + \beta_F F_i + \varepsilon_i \quad (2)$$

where P_i is the price for the seed pack that was agreed upon after bargaining and other variables are as defined above.

In the analysis, we look at different (correlated) outcomes and it is often not immediately clear which are the most appropriate especially when some outcomes are significantly different for different farmer groups and others are not. To deal with this problem, we follow a method proposed by [Anderson \(2008\)](#) and aggregate different outcome measures within broadly defined families (eg seed pack use, subsequent adoption of technology, use of complementary inputs and services,...) into single summary indices. Each index is computed as a weighted mean of the standardized values of the outcome variables, with the weights derived from the inverse variance covariance matrix of the components of the index. Combining outcomes in indices is also a common strategy to guard against over-rejection of the null hypothesis due to multiple inference.

4 Sample and Descriptive Statistics

The total sample consists of a representative sample of about 1150 households, drawn from 4 districts in southeastern Uganda (Mayuge, Kamuli, Iganga, and Bugiri).⁴ These districts were chosen because maize is an important crop for both food and cash. In these 4 districts, 115 villages were randomly selected from a list of all villages, with the likelihood of a village being selected proportional to the number of households that live in the village. Within each village, 10 households were randomly selected.

In February and March 2023, well before the first agricultural season, we visited all sampled households and collected baseline data. At that time, farmers were also provided with the trial seed pack. The groups were equally split across the sample, with about 390 farmers (in 39 villages) that received the seed trial pack for free without bargaining, 380 farmers (in 38 villages) that were enrolled in the bargaining and paid the price agreed upon, and 380 farmers (in 38 villages) that were enrolled in the bargaining and received a 100% discount. Selected farmers were notified that we would visit them a few days before enumerators would visit the villages, and they were told that there may be an opportunity

³In the analysis, instead of simply estimating Equation 2, we estimate 3 separate equations depending on the effect we are interested in and controls are included demeaned and fully interacted ([Lin, 2013](#)). Standard errors are not adjusted as initial offer prices are randomized at the individual level.

⁴According to a series of power simulations, we needed about 360 household per groups, which would have been 1080 households.

to buy something so they should make sure they had a little bit of money by the time we visited them.

Baseline survey and treatment administration was done by trained enumerators. After a short introduction and obtaining consent, enumerators started with the bargaining as explained in detail in Section 2 (if farmers were in the treatment groups that involved the bargaining experiment). After the experiment ended and seed and money changed hands, the baseline survey was implemented asking questions about general household characteristics and more specific questions about maize farming and the use of seed of an improved variety. We also collected some data on consumption expenditure and more subjective questions on food security and welfare. After the survey, farmers that were in the 100 discount groups were told that they were lucky winners and got a 100 percent cash-back. Farmers who were in the group that would receive seed for free got their bag of seed at this point.

Table 1 shows farmer characteristics at baseline and also doubles as a balance test for the three groups we will compare in the first part of the study. For instance, we see that the average household head in the sample that paid a positive price for the seed is 48 years (column 1). Household heads in the group that participated in the bargaining but was provided a cash-back are almost 1.5 years older, but the difference with the first group is not statistically significant. Also in the group that got the seed for free, the average age of the head does not differ from the group that paid a positive price.

About 53 percent of farmers at least finished primary education. In 82 percent of households, the head is a man. However, in the group that received a discount, this is only about 75 percent. The average household in our sample comprises of 8.5 individuals. Also on this characteristic we find a slight imbalance for the group that received a discount.

Of relevance to the current study is that the average household in our sample lives about 3.7 kilometers from the nearest agro-input shop. About 43 percent of farmers report that they used maize of an improved variety (as opposed to local seed) on at least one plot in the season preceding the baseline (which was the second season of 2022). For a more precise measure of technology adoption, we asked farmers to list all plots on which maize was grown. The data capturing program (ODK) then randomly selected a plot for which a series of detailed questions are asked.⁵ About 7 percent of farmers indicated that they adopted the seed variety that we promoted (Bazooka). This low adoption rate confirms that the new technology was not yet widely adopted before our study.

About 35 percent of farmers in the group that paid a positive price used seed from a formal seed source (for instance from an agro-input dealer or from

⁵The decision to only ask detailed questions on one (randomly selected) plot was guided by the fact that outcomes at plot level (such as adoption of improved inputs and technologies, management practices and production) are likely to be correlated such gains in power from surveying all plots likely do not outweigh costs of longer and more tedious questionnaires. As the plot to survey was selected randomly, outcomes should be unbiased and consistent. The validity of this approach was confirmed during the endline questionnaire where we asked detailed questions on seed use on all plots: average use of the promoted variety calculated using all maize plots was the same as only using the randomly selected plot.

the government extension system). This is somewhat lower in the group that received the seed for free without bargaining. While this difference is not significant when compared to the group that paid a positive price, it is significantly lower than in the group that got 100 percent discount. To maintain sufficient vigor, seed should not be recycled too much. Only about 22 percent of households used seed that was recycled less than 4 times (which is considered the limit for open pollinating varieties). Finally, maize yields on the randomly selected plot in the second season of 2022 was about 400 kilograms per acre. This was slightly higher in the group that got the 100 percent discount after negotiation than in the group that got the seed for free.

In total, Table 1 makes 30 comparisons. This means that we should expect about three false positives at the 10 percent level and one or two false positives at the 5 percent significance level. Even though we find somewhat more significant differences at the 5 percent level, we would still argue that our sample is reasonably balanced across treatment groups.

5 Results

We now present results. In a first part of this section, we compare outcomes across the three groups (see Equation 1). We do this for four categories of outcomes measured at different points along the causal impact chain. We first look if, and how, the trial pack was used. We then look adoption in the subsequent season and potential impact on production. We then explore impact pathways and explore differences in attention and effort when using the seed trial pack.

5.1 Analysis of different treatment groups

5.1.1 Trial pack use

A first set of outcomes we consider is related to the use of the seed trial pack. Not only did we check if the seed was planted, but we also consider if the trial pack was used in a way that facilitates learning. For instance, if the seed from the trial pack was mixed with other seed, it will be more difficult for farmers to observe differences in for instance germination rates or yield of the promoted seed variety compared to other seed. Furthermore, a plot layout whereby the seed from the trial pack is planted next to a plot that was planted with another (local) seed variety will facilitate comparison throughout the growing and harvesting cycle. Similarly, if the maize obtained from the trial pack is kept separate after harvest, differences in for example susceptibility to aflatoxin or market value of the grain may become more salient.

Table 2 shows that more than 95 percent of farmers that paid a positive price for the trial pack planted the seed in the first season of 2023. This is very high. In [Mahmoud \(2024\)](#) less than 50 percent of farmers actually planted the trial pack of an improved wheat variety in Bangladesh. There is no difference in seed use with the group that received a 100 percent cash-back. In the group that did not negotiate over the seed but was simply given it for free, the likelihood that

Table 1: Baseline Balance

	paid	100 % discount	free	discount = free	nobs
Age of household head - years	48.024 (0.799)	1.47 (1.102)	0.152 (1.206)	1.252	1131
Household head has finished primary education - 1 is yes	0.534 (0.03)	-0.03 (0.042)	-0.024 (0.044)	0.021	1149
Gender of household head - 1 is male	0.818 (0.023)	-0.069* (0.034)	-0.011 (0.031)	3.134+	1149
Household size	8.537 (0.236)	-0.74* (0.346)	-0.465 (0.332)	0.636	1149
Distance of homestead to nearest agro-input shop	3.734 (0.472)	0.158 (0.593)	0.429 (0.584)	0.298	1104
Has used quality maize seed on any plot in last season	0.432 (0.023)	-0.033 (0.037)	-0.037 (0.041)	0.006	1149
Has used the promoted seed (bazooka) on a randomly chosen plot in the last season	0.068 (0.016)	-0.01 (0.02)	0.019 (0.025)	1.593	1149
Formal seed source	0.347 (0.035)	0.006 (0.046)	-0.07 (0.048)	2.931+	1149
Seed on random plot was recycled less than 4 times?	0.216 (0.022)	-0.042 (0.03)	-0.008 (0.033)	1.059	1149
Maize yields on a randomly chosen plot in last season	407.313 (20.583)	29.036 (30.27)	-35.26 (27.004)	5.18*	1139

Note:

the seed from that trial pack was planted is 2.5 percentage points higher than in the group that paid a positive price for the trial pack, and the difference is significant at the 10 percent level. However, results need to be interpreted with caution given the limited variation in the outcome variable.⁶

About 90 percent of households that paid a positive price for the trial pack did not mix the seed with other seed. This share increases to 95 percent in the group that got the seed for free without bargaining, and the difference with the first group is significant at the 5 percent level. The likelihood of not mixing the seed in this group is also significantly higher than in the second group where farmers also received the trial pack for free, but after going through the negotiation process.

About a third of the households that paid for the trial pack planted the seed in close proximity to a plot with local seed. This share is again significantly higher for the group of farmers that just received the seed trial pack without being taken through the bargaining process. Similar to the likelihood of not mixing the seed above, there is no difference between the groups that got a surprise discount after negotiating and those that did not get the discount.

Finally, we test if there are differences between groups with respect to the likelihood that maize derived from the seed trial pack is kept separate during and post harvest. Maize derived from the seed trial pack is kept separate post harvest by almost 60 percent of households that paid the agreed price. This share increases if the seed was provided for free; in the group that was taken through the negotiation and then received the discount, this share increases to almost 70 percent.

Overall, we do not find that farmers that paid a positive price for the seed used it more or in ways that facilitate learning more than farmers that did not pay a price for it. In fact, results point towards the opposite, where farmers that paid a positive price are actually less likely to have used the seed trial pack in ways that would optimize learning. This seems to be particularly the case when the group that paid a positive price is compared to farmers that were simply given the seed for free, and this is confirmed by the significant positive effect for this group on the index.

5.1.2 Adoption and outcomes in subsequent season

We now look at differences in behavior between the three farmer groups that may result from differential use and learning from the seed trial pack. The primary objective of a seed trial pack is to increase adoption of the promoted seed (or of seed of an improved variety in general) in subsequent seasons. The ultimate aim of promoting improved seed varieties is increase maize yields.

Table 3 shows that about 22 percent of farmers that paid the price arrived at after bargaining have used seed of an improved variety in the season following

⁶Our pre-analysis plan specifies that questions for which 95 percent of observations have the same value within the relevant sample will be omitted from the analysis.

Table 2: Use of trial seed

	paid	100 % discount	free	discount = free	nobs
used trail pack as seed	0.957 (0.012)	0.006 (0.015)	0.025 ⁺ (0.013)	2.708	1150
did not mix seed with other seed	0.899 (0.022)	0.004 (0.028)	0.05* (0.025)	4.626*	1150
field layout improved next to local seed	0.322 (0.03)	0.02 (0.04)	0.103* (0.043)	4.197*	1150
kept produce from improved separate from local during and post harvest	0.585 (0.034)	0.115* (0.049)	0.059 (0.05)	1.199	1150
Index	-0.086 (0.051)	0.092 (0.066)	0.164* (0.063)	1.651	1150

Note:

the season that they used the trial pack.⁷⁸ This share reduces to about 14 percent for farmers that got the seed trial pack for free without participating in the bargaining experiment and this difference is significant at the 5 percent level. In the group that received a full discount after negotiation, the share of adopters is similar to the group that did not receive the discount. If we define adoption more narrowly as the use of fresh seed of the promoted variety in the season following the try-out, we see that only about 11 percent of farmers that paid a positive price adopts. Also here, adoption in the group that did not negotiate is lower, but the difference is significant at 10 percent only.

In addition to adoption as a binary variable, we consider quantity of improved seed used on a randomly selected maize plot within the household. We see that this is about 1 kilograms in households that paid a positive price for the seed trial pack. Difference are again largest with farmers that were not enrolled in the bargaining treatment but just received the seed trial pack for free. These farmers only used on average about 0.7 kg of seed. To look at the intensive margin, we also compare seed use per acre. Seed use per acre in the reference group is about 1.2 kilo per acre. Seed use per acre is somewhat lower in the group that did not negotiate and was given the seed for free.

Finally, we look at production (expressed in kilograms of maize) on the randomly selected plot and also scale by area of the selected plot. Farmers that received the seed trial pack at a positive cost after negotiation reported harvesting about 360 kilograms on the randomly selected plot, corresponding to about 440 kg per acre. Production is significantly lower among farmers that did not bargain and received the seed for free. Interestingly, in the group that negotiated and received full discount, productivity is highest.

Overall, we find lower adoption of improved seed varieties and as a result lower production among farmers that did not engage in bargaining. This suggests that for actual behavior change, it is important that farmers learn about the value of seed (eg through a signaling effect emanating from the initial offer price or some other psychological process whereby the bargaining made valuation more salient to the farmer).

5.1.3 Attention

One of the main reasons why farmers that get the trial seed pack for free have lower adoption and yield is that they may be paying less attention. To test this hypothesis, we look at the proportion of farmers that correctly remembered the type of seed that was used for the trial pack (reported in Table 4). We find that in the group that paid a positive price, almost 77 percent of farmers

⁷We define seed of an improved variety as a fresh hybrid or an OPV that has not been recycled more than four times.

⁸The seed usage measure referenced here applies to a plot chosen randomly from within the farm household. During endline, we asked farmers to enumerate all maize plots they cultivated and one plot was randomly selected on which detailed information was collected. However, for key outcomes such as seed use, we collected information on all plots. As most farmers cultivated only one or two plots, defining the outcome in terms of seed use on at least one plots leads results that are very similar.

Table 3: Effects in subsequent season

	paid	100 % discount	free	discount = free	nobs
used improved seed on random plot	0.217 (0.031)	-0.024 (0.041)	-0.08* (0.037)	2.83 ⁺	1141
used bazooka seed on random plot	0.11 (0.024)	-0.007 (0.029)	-0.043 (0.027)	3.423 ⁺	1141
Quantity of seed	0.988 (0.133)	0.07 (0.221)	-0.309 ⁺ (0.184)	3.035 ⁺	1037
Quantity of seed/acre	1.172 (0.176)	0.279 (0.347)	-0.421 ⁺ (0.231)	4.414*	1037
Production	357.499 (25.237)	8.297 (35.033)	-74.782* (31.889)	7.113**	1044
Productivity	437.287 (22.839)	63.424 ⁺ (32.576)	-90.299** (30.206)	25.402**	1035
Index	0.046 (0.057)	0.053 (0.08)	-0.197** (0.066)	14.974**	1020

Note:

correctly recalled that we used a seed variety called “Bazooka”. This is about 6.5 percentage points lower in the group that got the seed for free without negotiation, but the reduction is not significant. The discount did not affect the proportion.

Interestingly, despite the fact that the company name “Naseco Seeds” was clearly indicated on the seed pack, only about 5 percent of farmers that paid for the seed correctly recalled the name. This is again lower in the group that got the seed for free without bargaining, and this time the difference is significant at the 5 percent level.

For farmers that were enrolled in the bargaining experiment, we also test if they remember the price at which agreement was reached. During midline, about 95 percent of farmers that actually paid the price indicated that they did, while at endline this share reduced to about 91 percent. We find that this share was lower among farmers were offered a 100 percent discount, especially at endline where the share is about 9 percentage points lower.

When farmers indicated that they remembered the price, we asked them what the price they thought it was and compared it the the price recorded during baseline. We find that in the group that paid the full price, the absolute value of the difference between the real price and the price farmers remember is on average 722 UGX. Recall error goes up to about 900 UGX at endline. We find that farmers that received the discount are less accurate in recalling the price they arrived at during negotiation.

5.1.4 Complementary input use

Performance of improved seed varieties also depends on the use of good agronomic practices such as row planting and complementary inputs such as fertilizer. Differential use of complementary inputs across the three groups may be expected for several reasons. For example, as some inputs such as fertilizer or pesticides are costly, an income effect related to whether a price was paid or not may affect complementary input use. In such case, one would expect that input use is lower in the group that was charged a positive price. It may also be that farmers who paid a positive price value the seed higher because of a sunk cost effect and this may crowd-in complementary inputs and practices. Farmers who participated in the bargaining experiment may likewise value the seed higher due to signaling with similar crowding in of complementary inputs and services (Bulte et al., 2023). At the same time, paying a positive price for improved seed may lead to overly optimistic expectations, leading farmers to cut back on other inputs or practices (for example since the seed is of a higher yielding variety farmers expect that the seed would grow even without fertilizer or weeding) (Miehe et al., 2023).

In Table 5, we see that only about 25 percent of farmers in the first group used the latest recommendations with respect to seed spacing and seed rate when planting the seed from the trial pack. We do not find differences in this probability across the groups.

About 35 percent of farmers that paid a positive price have used organic

Table 4: Attention

	paid	100 % discount	free	discount = free	nobs
Remember seed type correctly at midline	0.766 (0.03)	-0.006 (0.038)	-0.065 (0.042)	2.339	1150
Remembers seed producer correctly at midline	0.053 (0.013)	0.002 (0.02)	-0.038* (0.014)	5.82*	1150
Remembers price of trail pack at midline	0.949 (0.014)	-0.021 (0.019)	—	—	749
difference between actually paid and what farmer remembers at midline	721.751 (84.884)	598.651** (155.931)	—	—	702
Remembers price of trial pack at endline	0.91 (0.016)	-0.091** (0.026)	—	—	731
difference between actually paid and what farmer remembers at endline	900.901 (116.397)	420.169** (152.566)	—	—	632

Note:

fertilizer on the field where the seed from the trial pack was planted. This is higher among farmers that received a discount after negotiations, albeit not significantly so. It is lower among farmers that received the seed for free without bargaining, but also here the difference is not significant. When comparing the last two groups, we do find a significant difference, suggesting the importance of prices to signal quality.

About 20 percent of farmers in the reference group used inorganic fertilizer on the trial plot. While inorganic fertilizer use seems somewhat higher in the group that received the seed for free, results do not point towards an important income effect. The same can be said for the use of chemicals, which is also a complementary input that comes at a significant cost.

Gap filling, whereby farmers replant seed that did not germinate after about one week, requires both labour time and seed. About 13 percent of farmers that paid a positive price for seed engaged in gap filling. This is higher in the groups where seed was provided for free, which suggests an important income effect.

Weeding is labour intensive. We do not find that farmers allocate more or less labour to the trial plot depending on what group they fall in. Timely planting requires that labour is available at the right time. If seed is valued less because it was provided for free, we would expect to find that farmers in this group are less likely to prioritize the trial seed plot. This does not seem to be the case.

Overall, looking at the index, we find increased use of complementary inputs and good agronomic practices in the group that was exposed to the bargaining experiment but then received a surprise discount. This is consistent with prices acting as a signal for quality and may also indicate a potential income effect.

5.2 Three-stage pricing analysis

5.2.1 Trial pack use

We start again by looking at if, and how, farmers used the seed trial pack. Table 6 shows that on average, almost 97 percent of farmers that obtained the seed pack after negotiation used it as seed on a plot in the first season of 2023. The second column shows that there is no impact on the propensity to use the seed as the price at which the transaction was concluded changes. In other words, we do not find evidence of screening effects on seed trial pack use. In a similar vein, we do not find evidence of a sunk cost effect on seed trial pack use: in the third column, we estimate the relationship between actual price paid (after discount) and trial pack use, but the coefficient is zero. Finally, the fourth column shows that the price at which the seed was initially offered at the start of the bargaining does also not impact seed use, suggesting there is not signaling effect.

The table similarly does not find screening, sunk cost, nor signaling effects for the likelihood that farmers did not mix the seed from the seed trial pack with other seed. There are also no effects for the proportion of farmers that use a plot layout that enables for direct comparison between seed performance of the trial seed and local seed. We do find that farmers who paid a higher price after

Table 5: Inputs and Agronomic practices

	paid	100 % discount	free	discount = free	nobs
Followed recommended seed spacing and seed rate	0.25 (0.025)	0.027 (0.033)	-0.017 (0.038)	1.514	1150
Used organic fertilizer	0.346 (0.035)	0.067 (0.051)	-0.036 (0.05)	3.903*	1150
Used inorganic fertilizer (dap or urea)	0.202 (0.024)	0.004 (0.039)	0.054 (0.036)	1.51	1150
Used chemicals	0.258 (0.03)	0.032 (0.045)	0.034 (0.042)	0.002	1150
Gap filling	0.133 (0.022)	0.042 (0.029)	0.064 ⁺ (0.035)	0.448	1150
Number of times weeding	2.45 (0.045)	0.083 (0.063)	-0.015 (0.066)	2.249	1112
Timely planting	0.602 (0.037)	0.086 (0.053)	0.064 (0.052)	0.169	1088
Index	-0.035 (0.028)	0.098* (0.039)	0.053 (0.041)	1.223	1087

Note:

the discount were less likely to keep grain obtained from the trial plot separate during and after harvest. This points to a negative sunk cost effect.

Overall, we do not find convincing effects that screening, sunk cost or signaling are important early in the causal impact chain.

5.2.2 Adoption and outcomes in subsequent season

Also here, no real effects.

Finally, we do find evidence of screening effects on production. For each 1000 UGX increase in the valuation of the seed trial pack, production in the subsequent year increased by almost 20 kilograms.

5.2.3 Attention

5.2.4 Complementary input use

Finally, we look at screening, sunk cost and signaling effects with respect to complementary inputs and practices. We find evidence of important screening effects for some of the inputs. For example, an increase in the farmer’s willingness to pay by 1000 UGX as proxied by the outcome of the negotiation leads to an increase in the likelihood that the farmer uses organic fertilizer of almost 2 percentage points. Similarly, for inorganic fertilizer use, an 1000 UGX higher valuation leads to an increase of 1.3 percentage points in use rate. A similar effect is found for

Overall, and as illustrated by the index, we find evidence of screening effects

6 Conclusion

A farmer’s willingness to pay as approximated by the price on which agreement was reached during does not predict use of the seed trial pack.

7 Ethical clearance

This research received clearance form Makerere’s School of Social Sciences Research Ethics Committee (MAKSSREC 01.23.627/PR1) as well as from IFPRI IRB (DSGD-23-0108). The research was also registered at the Ugandan National Commission for Science and Technology (SS1657ES).

8 Transparency and replicability

To maximize transparency and allow for replicability, we use the following strategies:

- pre-analysis plan: in the past, a document was prepared that provides an ex-ante step-by-step plan setting out the hypothesis we will test, the

Table 6: Effects on Use of trial seed

	mean	screening	sunk cost	signaling	nobs
used trail pack as seed	0.96 (0.195)	0.004 (0.003)	-0.006 (0.014)	-0.003 (0.006)	758
did not mix seed with other seed	0.901 (0.299)	0 (0.005)	-0.006 (0.022)	-0.008 (0.009)	758
field layout improved next to local seed	0.332 (0.471)	-0.015+ (0.008)	-0.021 (0.034)	-0.008 (0.014)	758
kept produce from improved separate from local during and post harvest	0.643 (0.479)	0.004 (0.008)	-0.114** (0.035)	0.002 (0.015)	758
Index	0 (0.69)	-0.003 (0.012)	-0.088+ (0.051)	-0.012 (0.021)	758

Note:

Table 7: Effects in subsequent season

	mean	screening	sunk cost	signaling	nobs
used improved seed on any plot?	0.22 (0.415)	0.01 (0.007)	0.028 (0.031)	0.014 (0.013)	751
used fresh bazooka on any plot?	0.116 (0.32)	0.004 (0.006)	0.008 (0.024)	0.004 (0.01)	751
used improved seed on random plot	0.205 (0.404)	0.007 (0.007)	0.022 (0.03)	0.01 (0.012)	751
used bazooka seed on random plot	0.106 (0.308)	0.005 (0.005)	0.011 (0.023)	0.002 (0.009)	751
Quantity of seed	1.024 (2.597)	0.077 (0.048)	-0.105 (0.2)	0.015 (0.084)	684
Quantity of seed/acre	1.315 (3.498)	0.027 (0.065)	-0.313 (0.271)	0.067 (0.114)	684
Production	361.707 (345.765)	17.376** (6.342)	-7.943 (26.603)	-15.482 (11.177)	686
Productivity	469.279 (356.843)	8.868 (6.575)	-61.506* (27.64)	-13.389 (11.604)	678
Index	-0.004 (0.697)	0.023+ (0.013)	-0.043 (0.055)	-0.012 (0.023)	668

Note:

Table 8: Pathways

	mean	screening	sunk cost	signaling	nobs
Remembers seed at midline	0.763 (0.426)	0.009 (0.007)	0.014 (0.031)	-0.022+ (0.013)	758
Remembers seed producer correctly at midline	0.054 (0.226)	-0.003 (0.004)	0.001 (0.017)	0.007 (0.007)	758
Remembers price of trail pack at midline	0.939 (0.24)	-0.004 (0.004)	0.024 (0.018)	0.005 (0.007)	748
difference between actually paid and what farmer remembers at midline	1018.519 (1577.191)	-17.465 (28.097)	-572.685** (118.267)	-15.865 (49.585)	702
Remembers price of trail pack at endline	0.865 (0.342)	0 (0.006)	0.091** (0.025)	-0.007 (0.011)	729
difference between actually paid and what farmer remembers at endline	1099.684 (1537.291)	-28.61 (29.846)	-416.906** (122.955)	13.916 (51.454)	632

Note: price bought only on subset of farmers that paid positive price - not included in index.

Table 9: Effects on Inputs and Agronomic practices

	mean	screening	sunk cost	signaling	nobs
Followed recommended seed spacing and seed rate	0.264 (0.441)	0 (0.008)	-0.026 (0.032)	0.036** (0.013)	758
Used organic fertilizer	0.379 (0.486)	0.015+ (0.008)	-0.064+ (0.035)	0.02 (0.015)	758
Used inorganic fertilizer (dap or urea)	0.204 (0.403)	0.012+ (0.007)	-0.002 (0.03)	-0.019 (0.012)	758
Used chemicals	0.274 (0.446)	0.011 (0.008)	-0.032 (0.033)	-0.01 (0.014)	758
Gap filling	0.154 (0.361)	0.007 (0.006)	-0.039 (0.026)	0.002 (0.011)	758
Number of times weeding	2.492 (0.702)	-0.008 (0.013)	-0.074 (0.052)	-0.033 (0.022)	727
Timely planting	0.646 (0.479)	0.001 (0.009)	-0.083* (0.036)	0.013 (0.015)	713
Index	0.017 (0.402)	0.014+ (0.007)	-0.092** (0.03)	0.007 (0.013)	712

Note:

intervention we will implement to test these hypotheses, the data that will be collected and specifications we will run to bring the hypotheses to the data. This pre-analysis plan was pre-registered at the AEA RCT registry.

- revision control: the entire project will be under revision control (that is time stamped track changes) and committed regularly to a public repository (github).
- mock report: This document provides a pre-registered report that was added to the AEA RCT registry and GitHub. This report differs from the pre-analysis plan in that it already has the tables filled with simulated data. The idea is that after the endline, only minimal changes are necessary (basically connecting a different dataset) to obtain the final result, further reducing the opportunity of specification search. In the near future as data comes in, this report will be updated on github.

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10 Appendix

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Table 10: Baseline Balance

	mean	screening	sunk cost	signaling	no bs
Age of household head - years	48.759 (13.53)	0.357 (0.239)	-1.48 (0.993)	0.658 (0.414)	743
Household head has finished primary education - 1 is yes	0.519 (0.5)	0.026** (0.009)	0.025 (0.036)	0 (0.015)	758
Gender of household head - 1 is male	0.784 (0.412)	-0.004 (0.007)	0.076* (0.03)	-0.023+ (0.013)	758
Household size	8.167 (3.818)	-0.084 (0.067)	0.719* (0.279)	-0.022 (0.116)	758
Distance of homestead to nearest agro-input shop	3.812 (4.014)	-0.144* (0.071)	-0.059 (0.297)	-0.112 (0.124)	728
Has used quality maize seed on any plot in last season	0.415 (0.493)	0.018* (0.009)	0.033 (0.036)	-0.014 (0.015)	758
Has used the promoted seed (bazooka) on a randomly chosen plot in the last season	0.063 (0.244)	-0.002 (0.004)	0.011 (0.018)	-0.011 (0.007)	758
Formal seed source	0.35 (0.477)	0.01 (0.008)	-0.01 (0.035)	0.002 (0.015)	758
Seed on random plot was recycled less than 4 times?	0.195 (0.396)	0.009 (0.007)	0.044 (0.029)	-0.006 (0.012)	758
Maize yields on a randomly chosen plot in last season	421.851 (359.59)	8.802 (6.363)	-31.098 (26.466)	-2.444 (11.047)	748

Note:

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