

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

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## Abstract

A popular way to increase adoption of a new technology is by providing the technology for free (or greatly reduced price) for a limited period of time such that potential users can gain experience with it and share this experience with their others. However, it is sometimes argued that something that is provided for free is less likely to be used for its intended purpose, leading to waste. There are three 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 price tag may be interpreted as a signal about the quality of the product. Third, 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. We design a field experiment that enables us to separate these three effects for the case of improved seed varieties and implement it among smallholder maize farmers in eastern Uganda. We find evidence of economically important screening and sunk-cost effects but no consistent evidence of signaling effects.

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

JEL: Q16, H24, O33, D91

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# 1 Motivation

Prices are ubiquitous in economic transactions. In general, prices are key to the efficient allocation of scarce resources within a society and provide an important incentive for producers. But charging a (full) price may not always be optimal for society. If a commodity is new, providing it for free or at a discount for a short period of time may be necessary to encourage to try out a new product (Bawa and Shoemaker, 2004). Public sector actors may think commercial seed is out of reach of poor households and want to kick-start large scale adoption by providing the initial investment (Blackie and Mann, 2005). The case for free (or subsidized) inputs also stems from positive externalities: it is well established that one of the most effective ways to increase technology adoption is through peer learning, and both private and public partners may attempt to leverage social 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. For instance, public research organizations often invest in open pollinating varieties (OPVs) that can be recycled to some extent without losing vigor. Income effects, and the fact that the poorest are likely to gain most of it.

At the same time, some argue that providing goods or services for free (or with a significant subsidy) may lead to wastage. 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 standard observational data, as each of these effects assume 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. 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. In the original two-stage design, study participants are given the opportunity to buy a commodity at different prices 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.

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, 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.

There are various reasons why improved seed varieties provide an interesting case. First, improved seed is an important investment requiring non-negligible monetary outlays up front with a noisy return in the future. As such, a positive price may act as an important filter. Second [Kremer, Rao, and Schilbach \(2019\)](#) note that learning about new technologies requires costly experimentation and costly attention, and so individuals would benefit from decreasing the costs of learning. The fact that learning is also costly means the same mechanisms (a screening effect and/or a sunk cost effect) may also affect the extent to which farmers learn. That is, if a seed is valued less because it is provided for free, it may also be that farmers put in less effort and complementary investment when experimenting, and pay less attention to outcomes. Examples include planting subsidized seed on sub-optimal plots or mixing subsidized seed with farmer-saved seed, which would make learning harder. 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.

Our paper extends the literature in various ways. special psychological properties to zero financial price and that demand may drop precipitously when the price is raised slightly above zero ([Ariely and Shampan'er 2007](#); [Kremer and Miguel 2007](#)).

The above also suggests that the size of the subsidy and the relative magnitude of screening and sunk cost effects are important unknowns when evaluating supply interventions to promote seed varietal turnover. In this study, we use an intervention that has three treatment arms. In one treatment arm, a seed trial pack is provided for free. In a second treatment arm, we offer farmers the opportunity to buy seed through a sequential bargaining game. In a third treatment arm a two stage pricing design is used, where we again play the sequential bargaining game to identify the screening effect, and then provide a discount to isolate the sunk cost effect.

This document was started as a dynamic report prior to data endline data collection. It combines latex with R code using the Knitr engine and is tracked under revision control on github. As such, this “mock report” will provide a useful reference in evaluating the final results of the study ([Humphreys, Sanchez de la Sierra, and van der Windt, 2013](#); [Duflo et al., Working Paper](#)).

## 2 Methods and experimental design

To test whether farmers learn differently from seed that was obtained for free than if they had to pay a (small) price for it, we use a 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 designs, subjects are offered a service or good for a particular price in a first stage. In a second stage, a discount is applied to that price. Regressing outcomes (such as whether the product is used for the intended purpose) on the price while controlling for the discount gives an estimate of the screening effect of the price; regressing outcomes on the discount while controlling for the price gives an estimate of the sunk cost effect. We will use a slightly different design with three treatment arms, where one group gets seed for free, a second group gets to pay for the seed pack, and a third group gets to pay but gets a 100 percent surprise discount.

The two stage pricing design consist of a first stage where farmers are 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. The enumerator follows a standard script. 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 then 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 ask price, then the farmer 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 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. To 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.<sup>1</sup>

The second stage of the design involves providing an unexpected discount

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<sup>1</sup>A popular alternative way to measure willingness to pay is 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 receive the item being auctioned. If the subject's bid is lower than the price, they pay nothing and receive nothing. However, after testing in the field, we found that too many farmers had problems comprehending the procedure, struggling especially with the fact that they could not bargain over the price.

on the price. 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. In particular, half of the farmers that bought seed will get all their money back (100 percent 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.

Treatment assignment will be at the village level, as we want to avoid that a control farmer (that gets a bar of soap as a token of gratitude) lives right next to a treatment farmer that gets a bag of maize seed for free. We will work with 10 farmers per village, which is the maximum our field teams can handle.

### 3 Estimation and inference

We will estimate the following equation

$$Y_{ij} = \alpha + \beta_D T_{ij}^D + \varepsilon_{ij} \quad (1)$$

$$Y_{ij} = \alpha + \beta_P P_{ij} + \beta_D T_{ij}^D + \varepsilon_{ij} \quad (2)$$

$$Y_{ij} = \alpha + \beta_P P_{ij} + \beta_D P_{ij} * T_{ij}^D + \varepsilon_{ij} \quad (3)$$

where  $Y_i$  is an outcome of interest for farmer  $i$ ,  $T_i^P$  is an indicator that takes the value of one if the farmer paid a price for the seed (through the bargaining) and  $T_i^D$  indicator that takes the value of one if the farmer paid a price for the seed (through the bargaining) and also received a 100 percent discount.

Because we will test for treatment effects on a range of outcome measures, we will deal with multiple outcomes and multiple hypotheses testing by means of two approaches. Firstly, we follow a method proposed by [Anderson \(2008\)](#) and aggregate different outcome measures within each domain into single summary indices. Each index is computed as a weighted mean of the standardized values of the outcome variables. The weights of this efficient generalized least squares estimator are calculated to maximize the amount of information captured in the index by giving less weight to outcomes that are highly correlated with each other. Combining outcomes in indices is a common strategy to guard against over-rejection of the null hypothesis due to multiple inference. However, it may also be interesting to see the effect of the intervention on individual outcomes. An alternative strategy to deal with the multiple comparisons problem is to adjust the significance levels to control the Family Wise Error Rates (FWER). The simplest such method is the Bonferroni method. However, the Bonferroni adjustment assumes outcomes are independent, and so can be too conservative

when outcomes are correlated. We therefore use a Bonferroni adjustment which adjusts for correlation (Sankoh, Huque, and Dubey, 1997; Aker et al., 2016)

## 4 Results

### 4.1 Baseline balance

Standard orthogonality tables will be included in the final paper. We pre-register 10 variables. Half of these are characteristics that are unlikely to be affected by the intervention, while the other 5 are picked from the primary and secondary endline outcomes listed in the next subsection. The following variables will be compared at baseline:

### 4.2 Binary analysis

In this part, we simply compare the outcomes between three groups: 1) farmers who paid a positive price for the seed trial pack; 2) farmers who paid a positive price for the seed trial pack 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. The first group will serve as the reference group.

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. 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. If there is an income effect, we expect to have positive effects in the groups that received the trial pack for free, either after bargaining (group 2) or without bargaining (group 3).

The binary analysis is not appropriate for identifying screening effects as virtually all farmers that participated in the bargaining experiment ended up buying. To identify the screening effect, we need to control for the actual price that was paid, which we do in the next section.

#### 4.2.1 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 eg 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 eg post harvest losses or market value may become more salient.

Table 3 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. There is no

Table 1: Baseline Balance

|   | paid              | 100 % discount     | free              | discount = free | nobs |
|---|-------------------|--------------------|-------------------|-----------------|------|
| Age of household head - years   | 48.024<br>(0.799) | 1.47<br>(1.102)    | 0.152<br>(1.206)  | 1.252           | 1131 |
| Household head has finished primary education - 1 is yes                          | 0.534<br>(0.03)   | -0.03<br>(0.042)   | -0.024<br>(0.044) | 0.021           | 1149 |
| Gender of household head - 1 is male  | 0.818<br>(0.023)  | -0.069*<br>(0.034) | -0.011<br>(0.031) | 3.134+          | 1149 |
| Household size  | 8.537<br>(0.236)  | -0.74*<br>(0.346)  | -0.465<br>(0.332) | 0.636           | 1149 |
| Distance of homestead to nearest agro-input shop                                  | 3.734<br>(0.472)  | 0.158<br>(0.593)   | 0.429<br>(0.584)  | 0.298           | 1104 |
| Has used quality maize seed on any plot in last season                            | 0.432<br>(0.023)  | -0.033<br>(0.037)  | -0.037<br>(0.041) | 0.006           | 1149 |
| Has used the promoted seed (bazooka) on a randomly chosen plot in the last season | 0.068<br>(0.016)  | -0.01<br>(0.02)    | 0.019<br>(0.025)  | 1.593           | 1149 |
| Formal seed source  | 0.347<br>(0.035)  | 0.006<br>(0.046)   | -0.07<br>(0.048)  | 2.931+          | 1149 |
| How often was the seed that was used on the randomly selected plot recycled?      | 0.216<br>(0.022)  | -0.042<br>(0.03)   | -0.008<br>(0.033) | 1.059           | 1149 |
| Maize yields on a randomly chosen plot in last season                             | 6.249<br>(0.082)  | 0.161<br>(0.104)   | 0.02<br>(0.1)     | 2.722+          | 1139 |

Note:

Table 2: Baseline Balance

|   | mean              | screening                      | sunk cost                     | signaling         | no bs |
|---|-------------------|--------------------------------|-------------------------------|-------------------|-------|
| Age of household head - years   | 48.56<br>(13.627) | 0.467 <sup>+</sup><br>(0.251)  | -0.338*<br>(0.159)            | 0.514<br>(0.432)  | 743   |
| Household head has finished primary education - 1 is yes                          | 0.516<br>(0.5)    | 0.025**<br>(0.009)             | 0.006<br>(0.006)              | 0.002<br>(0.016)  | 758   |
| Gender of household head - 1 is male  | 0.792<br>(0.406)  | -0.009<br>(0.008)              | 0.014**<br>(0.005)            | -0.013<br>(0.013) | 758   |
| Household size  | 8.135<br>(3.814)  | -0.143*<br>(0.07)              | 0.115*<br>(0.045)             | -0.052<br>(0.122) | 758   |
| Distance of homestead to nearest agro-input shop                                  | 3.931<br>(3.975)  | -0.137 <sup>+</sup><br>(0.075) | -0.004<br>(0.048)             | -0.075<br>(0.129) | 728   |
| Has used quality maize seed on any plot in last season                            | 0.408<br>(0.492)  | 0.016 <sup>+</sup><br>(0.009)  | 0.005<br>(0.006)              | -0.011<br>(0.016) | 758   |
| Has used the promoted seed (bazooka) on a randomly chosen plot in the last season | 0.071<br>(0.258)  | -0.003<br>(0.005)              | 0.002<br>(0.003)              | -0.013<br>(0.008) | 758   |
| Formal seed source  | 0.326<br>(0.469)  | 0.01<br>(0.009)                | 0<br>(0.006)                  | 0.001<br>(0.015)  | 758   |
| How often was the seed that was used on the randomly selected plot recycled?      | 0.199<br>(0.4)    | 0.006<br>(0.007)               | 0.008 <sup>+</sup><br>(0.005) | -0.002<br>(0.013) | 758   |
| Maize yields on a randomly chosen plot in last season                             | 6.309<br>(1.058)  | 0.059**<br>(0.02)              | -0.031*<br>(0.013)            | -0.025<br>(0.035) | 748   |

Note:



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 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.<sup>2</sup>

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.

#### **4.2.2 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 to increase maize yields.

Table 4 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

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<sup>2</sup>Our 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 3: Use of trial seed

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

Note:

the season that they used the trial pack.<sup>34</sup> 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).

### 4.2.3 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 5). We find that in the group that paid a positive price, almost 77 percent of farmers

<sup>3</sup>We define seed of an improved variety as a fresh hybrid or an OPV that has not been recycled more than four times.

<sup>4</sup>The 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 4: Effects in subsequent season

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

#### 4.2.4 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 6, 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 5: Attention

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

### 4.3 Continuous analysis

In this part, 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 first 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. 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. 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.<sup>5</sup>

#### 4.3.1 Trial pack use

We start again by looking at if, and how, farmers used the seed trial pack. Table 7 shows that on average, almost 97 percent of farmers that obtained the seed

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<sup>5</sup>Controls are demeaned and enter the regression fully interacted ([Lin, 2013](#)). Standard errors are not adjusted as initial offer prices are randomized at the individual level.

Table 6: Inputs and Agronomic practices

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

Note:



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 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.

#### **4.3.2 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.

#### **4.3.3 Attention**

#### **4.3.4 Complementary input use**

## **5 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.

## **6 Ethical clearance**

This research received clearance from 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).

Table 7: Effects on Use of trial seed

|  | mean             | screening         | sunk cost           | signaling         | nobs |
|--|------------------|-------------------|---------------------|-------------------|------|
| used trail pack as seed  | 0.968<br>(0.177) | 0.004<br>(0.004)  | 0<br>(0.002)        | -0.002<br>(0.006) | 758  |
| did not mix seed with other seed                                       | 0.917<br>(0.275) | 0<br>(0.006)      | 0.001<br>(0.003)    | -0.007<br>(0.01)  | 758  |
| field layout improved next to local seed                               | 0.363<br>(0.481) | -0.013<br>(0.009) | -0.005<br>(0.005)   | -0.01<br>(0.015)  | 758  |
| kept produce from improved separate from local during and post harvest | 0.643<br>(0.479) | 0.012<br>(0.009)  | -0.016**<br>(0.006) | 0.002<br>(0.015)  | 758  |
| Index  | 0<br>(0.679)     | 0.004<br>(0.013)  | -0.013<br>(0.008)   | -0.012<br>(0.023) | 758  |

Note:

Table 8: Effects in subsequent season

|                                   | mean                 | screening           | sunk cost          | signaling           | nobs |
|-----------------------------------|----------------------|---------------------|--------------------|---------------------|------|
| used improved seed on any plot?   | 0.195<br>(0.397)     | 0.008<br>(0.008)    | 0.005<br>(0.005)   | 0.014<br>(0.013)    | 751  |
| used fresh bazooka on any plot?   | 0.102<br>(0.302)     | 0.004<br>(0.006)    | 0.001<br>(0.004)   | 0.008<br>(0.01)     | 751  |
| used improved seed on random plot | 0.181<br>(0.386)     | 0.005<br>(0.008)    | 0.004<br>(0.005)   | 0.009<br>(0.013)    | 751  |
| used bazooka seed on random plot  | 0.093<br>(0.29)      | 0.005<br>(0.006)    | 0.002<br>(0.004)   | 0.006<br>(0.01)     | 751  |
| Quantity of seed                  | 0.907<br>(2.474)     | 0.079<br>(0.05)     | -0.015<br>(0.032)  | -0.026<br>(0.088)   | 684  |
| Quantity of seed/acre             | 1.124<br>(3.119)     | 0.043<br>(0.068)    | -0.041<br>(0.043)  | 0.024<br>(0.119)    | 684  |
| Production                        | 334.772<br>(327.458) | 18.197**<br>(6.683) | -0.585<br>(4.24)   | -13.707<br>(11.704) | 686  |
| Productivity                      | 427.333<br>(330.801) | 13.598+<br>(6.927)  | -8.408+<br>(4.405) | -11.94<br>(12.13)   | 678  |
| Index                             | -0.004<br>(0.692)    | 0.028+<br>(0.015)   | -0.006<br>(0.009)  | -0.013<br>(0.026)   | 668  |

Note:

Table 9: Pathways

|   | mean                   | screening          | sunk cost             | signaling         | nobs |
|---|------------------------|--------------------|-----------------------|-------------------|------|
| Remembers seed at midline   | 0.742<br>(0.438)       | 0.009<br>(0.008)   | 0.005<br>(0.005)      | -0.011<br>(0.013) | 759  |
| Remembers seed producer correctly at midline                          | 0.041<br>(0.198)       | -0.002<br>(0.004)  | 0.001<br>(0.003)      | 0.011<br>(0.007)  | 759  |
| Remembers price of trail pack at midline                              | 0.939<br>(0.24)        | -0.006<br>(0.004)  | 0.003<br>(0.003)      | 0.006<br>(0.008)  | 748  |
| difference between actually paid and what farmer remembers at midline | 1018.519<br>(1577.191) | 28.007<br>(29.685) | -98.956**<br>(18.754) | -9.865<br>(51.71) | 702  |
| Remembers price of trail pack at endline                              | 0.865<br>(0.342)       | -0.006<br>(0.006)  | 0.016**<br>(0.004)    | -0.006<br>(0.011) | 729  |
| difference between actually paid and what farmer remembers at endline | 1099.684<br>(1537.291) | -1.433<br>(31.313) | -76.849**<br>(19.361) | 7.699<br>(53.086) | 632  |

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

Table 10: Effects on Inputs and Agronomic practices

|   | mean             | screening         | sunk cost          | signaling          | nobs |
|---|------------------|-------------------|--------------------|--------------------|------|
| Followed recommended seed spacing and seed rate | 0.253<br>(0.435) | 0.001<br>(0.008)  | 0<br>(0.005)       | 0.037**<br>(0.014) | 759  |
| Used organic fertilizer                         | 0.356<br>(0.479) | 0.019*<br>(0.009) | -0.004<br>(0.006)  | 0.023<br>(0.015)   | 759  |
| Used inorganic fertilizer (dap or urea)         | 0.222<br>(0.416) | 0.013+<br>(0.007) | 0.002<br>(0.005)   | -0.012<br>(0.013)  | 759  |
| Used chemicals                                  | 0.28<br>(0.449)  | 0.014+<br>(0.008) | -0.002<br>(0.005)  | -0.005<br>(0.014)  | 759  |
| Gap filling                                     | 0.169<br>(0.375) | 0.011<br>(0.007)  | -0.008+<br>(0.004) | 0.003<br>(0.011)   | 759  |
| Number of times weeding                         | 2.472<br>(0.698) | -0.002<br>(0.013) | -0.01<br>(0.008)   | -0.031<br>(0.023)  | 728  |
| Timely planting                                 | 0.653<br>(0.476) | 0.007<br>(0.009)  | -0.012*<br>(0.006) | 0.013<br>(0.016)   | 714  |
| Index   | 0.016<br>(0.402) | 0.02**<br>(0.007) | -0.011*<br>(0.005) | 0.012<br>(0.013)   | 713  |

Note:

Table 11: Effects on assessment of characteristics

|  | mean             | screening           | sunk cost         | signaling         | nobs |
|--|------------------|---------------------|-------------------|-------------------|------|
| Seed had higher yields than expected           | 0.648<br>(0.478) | 0<br>(0.009)        | -0.01+<br>(0.006) | -0.001<br>(0.015) | 759  |
| Seed was more drought tolerant than expected   | 0.503<br>(0.5)   | -0.025**<br>(0.009) | 0.011+<br>(0.006) | 0.027+<br>(0.016) | 759  |
| Seed more pest/disease resistant than expected | 0.419<br>(0.494) | -0.016+<br>(0.009)  | 0.009<br>(0.006)  | 0.035*<br>(0.016) | 759  |
| Seed germinated better than expected           | 0.803<br>(0.398) | -0.011<br>(0.007)   | 0<br>(0.005)      | -0.004<br>(0.013) | 759  |
| In general, was happy with the seed            | 0.802<br>(0.399) | 0<br>(0.007)        | 0<br>(0.005)      | -0.002<br>(0.013) | 759  |
| Index  | 0<br>(0.685)     | -0.023+<br>(0.013)  | 0.004<br>(0.008)  | 0.022<br>(0.022)  | 759  |

Note:

Table 12: Effects on yield

|                       | mean              | screening         | sunk cost           | signaling         | nobs |
|-----------------------|-------------------|-------------------|---------------------|-------------------|------|
| overall area          | 6.474<br>(72.235) | 1.441<br>(1.504)  | -0.997<br>(0.953)   | -0.941<br>(2.605) | 751  |
| overall production    | 6.469<br>(1.186)  | 0.054*<br>(0.022) | 0.006<br>(0.014)    | 0.03<br>(0.038)   | 751  |
| overall yield         | 6.524<br>(0.753)  | 0.023<br>(0.014)  | -0.014<br>(0.009)   | 0.01<br>(0.025)   | 740  |
| trial plot area       | 4.084<br>(61.408) | 1.774<br>(1.482)  | -1.744+<br>(0.932)  | -2.798<br>(2.571) | 684  |
| trial plot production | 5.428<br>(0.885)  | 0.001<br>(0.016)  | 0.022*<br>(0.01)    | 0.022<br>(0.028)  | 680  |
| trial plot yield      | 6.761<br>(1.084)  | 0.004<br>(0.021)  | 0.006<br>(0.013)    | 0.065+<br>(0.037) | 680  |
| index                 | 0<br>(0.455)      | 0.021*<br>(0.009) | -0.018**<br>(0.006) | 0.001<br>(0.016)  | 674  |

Note:

Table 13: Effects on plans

|   | mean             | screening         | sunk cost          | signaling          | nobs |
|---|------------------|-------------------|--------------------|--------------------|------|
| planning to use improved seed?                | 0.615<br>(0.487) | 0.023*<br>(0.009) | 0.007<br>(0.006)   | 0.009<br>(0.015)   | 759  |
| planning to use bazooka?                      | 0.564<br>(0.496) | 0.021*<br>(0.009) | 0.005<br>(0.006)   | 0.009<br>(0.016)   | 759  |
| acre planned under new seed (acre)?           | 1.499<br>(1.318) | 0.006<br>(0.034)  | 0.031<br>(0.021)   | -0.076<br>(0.056)  | 473  |
| already bought improved seed for next season? | 0.08<br>(0.271)  | 0.007<br>(0.005)  | -0.006+<br>(0.003) | -0.011<br>(0.008)  | 759  |
| index   | 0.293<br>(0.542) | 0.01<br>(0.013)   | -0.004<br>(0.008)  | -0.043+<br>(0.022) | 473  |

Note:



## 7 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 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.

## 8 Acknowledgments

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