Summing the parts: How does "bundling" affect willingness-to-pay for seeds and insurance in a sample of Kenyan farmers?

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1 Introduction

Agricultural households, particularly those operating in rainfed systems in low income countries, are vulnerable to a variety of climate and market risks that pose serious threats to their well-being. While more resourced households are able to pass much of this risk off to financial markets, less resourced households often have few options to do the same. Instead, they are forced to rely on precautionary savings (Lee and Sawada, 2010), drawing down assets (Carter and Lybbert, 2012), or informal risk sharing, all of which have limited ability to deal with shocks (Carter and Maluccio, 2003).

Despite the demonstrated impact of tools like agricultural insurance (Cai, 2016; Bertram-Huemmer and Kraehnert, 2015; Hill et al., 2019), such products are often not available in remote, resource poor areas or, when they are, face low demand due to inaccessibility, lack of information, or concerns about contract quality (Karlan et al., 2014; Clarke, 2016). A fuller understanding of household willingness-to-pay (WTP) for risk-reducing technologies, as well as how this valuation depends on both characteristics of the technology and of the adopting household, is an important step toward designing tools that are attractive and accessible to their target populations.

In this paper, we study WTP for two risk-reducing technologies — agricultural insurance and stress-tolerant seeds — as stand-alone products and as components of a bundle. Bundling a productivity enhancing technology with a risk reducing technology has been proposed as a way to mitigate the risk of agricultural investment to farmers, input suppliers, and financial institutions (Carter, Galarza and Boucher, 2007). Bundling of multiple risk reducing technologies has also been proposed as a way to increase coverage and reduce cost, thereby releasing precautionary savings for productive investment (Lybbert and Carter, 2015).

Using experimental auction data from a sample of over 1,300 farmers from seven counties in Kenya, we elicit WTP for a variety of stand-alone and bundled products. This offers a unique opportunity to study how farmers value access to technology bundles relative to their individual components. Rarely are both the bundle and its components available simultaneously and in comparable forms. In fact, if the bundle is intentionally designed — such that the pieces fit together strategically — it may not make sense to offer a single component independent of the others.

We find that bundling slightly increases WTP for seeds and has a larger positive effect on WTP for insurance. The estimated effects are larger when the seeds studied are not stress tolerant varieties. We use this final result to motivate a discussion of how farmers view the relationship between seeds and insurance, as well as how farmers value marginal reductions in risk.

The rest of this paper proceeds as follows. Sections 2 and Section 3 provide background on the issue of bundling agricultural technologies and describe the data used in this paper. Section 4 lays out our empirical approach to estimating the effect of bundling on WTP, the results of which are reported and discussed in Section 5. Section 6 discusses the implications of these results and concludes.

2 Background

As researchers and agricultural development practitioners continue to search for effective, accessible ways to improve productivity and mitigate risk, there is increasing activity around the idea of tying multiple technologies together into bundles (Boucher et al., 2021; Lybbert and Carter, 2015). In a well-designed bundle, the technologies complement one another in the sense that the value of the bundle is greater than the value of its constituent parts. For example, improved seeds, especially hybrid seeds, and fertilizer are complementary technologies. Planting improved seeds without fertilizer offers a return over planting recycled seeds. Similarly, using fertilizer with recycled seeds can improve yields relative to planting recycled seeds without fertilizer. The benefits, however, increase when the two technologies are used together.[1] Put another way, neither technology reaches its full potential in the absence of the other.

A variety of technologies exist that can reduce risk for smallholder farmers, though whether they offer value that is complementary or additional is not always clear. This has important implications for the question of bundling. As an illustration, consider two technologies that protect against different shock events. One could argue that a bundle of these two technologies would offer benefits that were additional rather than complementary. Benefits would be additional in the sense that there is no direct interaction between the protection of the two technologies and each would "do its job" in the absence of the other. At the same time, from the farmer perspective, whether the effects of the two technologies are complementary depends on the marginal value of increased risk coverage. Lybbert and Carter (2015), for example, argue that the an intentional bundle of drought tolerant maize and index-based agricultural insurance exploits complementarities between the two components because the benefits of the bundle to farmers increase monotonically in drought pressure, whereas this is not true for the components individually.

Exploiting complementarity in generating returns is not the only conceivable justification for bundling. Another goal of bundling two risk-reducing technologies together might be to lower the cost of covering a given set of shock events. While an insurance contract could be designed to cover the full spectrum of hazards facing a farmer, the cost of doing so would likely be prohibitive. A similar point could be made for supplemental irrigation as a solution to water stress or pesticide as a solution to insect pressure. What we often call risk in agriculture is actually a complicated combination of hazard events. This is true even

[1] See Suri (2011) and Duflo, Kremer and Robinson (2008) for discussion and review of the returns to hybrid seeds and fertilizer.

when we focus in more explicitly on a single hazard such as drought. Early season drought poses a different challenge than drought in the middle of the season. Prolonged, severe drought affects a farmer differently than moderate drought. To borrow from the welfare economics literature, though it might appear at first glance that there is one problem to be solved, there are in fact multiple. As such, multiple products might be required to arrive at an efficient solution.

Bundling stress-tolerant seeds and agricultural insurance is conceptually attractive with an eye to both of the goals discussed above. The range of risk events covered by the bundle is more comprehensive than either technology can provide alone. The seed automatically protects against moderate shocks, while the insurance contract picks up severe events that cause even stress-tolerant seeds to fail. The cost of protection is reduced by allowing the stress-tolerant seeds to cover mild and moderate shocks, while severe shocks are covered by the insurance contract. The quality of protection is also improved, as stress-tolerant seeds have proven effective at dealing with moderate shocks, which insurance products, especially remotely-sensed index insurance products, may struggle to differentiate from "normal" years.

Conceptual difficulties of separating complemenarity and additionality aside, farmer perception and valuation of technology bundles is an empirical question. The remainder of this paper focuses on answering that question for a sample of farm households in Kenya.

3 Data

The data used in this section come from two separate experimental auction activities carried out with a sample of 1,361 farm households across seven counties in Kenya, shown in Figure 1.[2] The data were collected by the International Food Policy Research Institute (IFPRI) and Wageningen University in collaboration with Agriculture and Climate Risk Enterprise (ACRE) Africa and the Kenya Agricultural and Livestock Research Organization (KALRO).

The experimental auction was embedded in larger project that used a network of "champion farmers" to improve small farmer access to agro-inputs. The larger project included two elements of randomization, one of which is relevant to the current paper. Relevant to this paper, champion farmers were randomly assigned to promote stress tolerant varieties (STVs) or non-stress tolerant varieties (non-STVs). Table 2 provides summary statistics for the full sample, as well as the two sub-samples. The average farmer plants just over 1.5 acres of land and plans to grow maize.

Additional randomization determined whether the insurance product offered through champion farmers

[2]Bungoma and Busia counties in the western region, Meru, Embu and Tharaka Nithi counties in the upper eastern region, and Machakos and Makueni counties in the lower eastern region

was a weather-based contract or a picture-based contract.[3] While, we do not make use of this randomization here Appendix Table A.1 summarizes the two sub-samples.[4]

Both experimental auction activities use a Becker-Degroot-Marschak (BDM) mechanism to elicit WTP for a variety of products and bundles of products. The experimental auction was implemented via the cards presented in Figure 2.[5] Following an explanation of the exercise and series of practice rounds using common farm implements, respondents provided a WTP for the product or bundle of products in each frame of the card. After completion, a scratch-off field is used to reveal a round of the auction and an offer price. The respondent's WTP in the revealed round is compared to the relevant offer price. If the respondent's WTP exceeds the offer price, the respondent can purchase the good or bundle at the offer price.

In auction rounds containing seeds, participants are told that the product is four (4) two kilogram seed packs (8 kg total). Farmers are first asked which crop they would prefer and can choose among maize, sorghum, green grams, and beans. Most (89%) choose maize. As noted above, the insurance offered is one of two products, either a weather-based insurance or a picture-based insurance. Both products are explained to farmers as covering damage to crops coming from excess rainfall or lack of rainfall, with possible payouts of up to 2,000 KES, which corresponds to the value of the seeds.

Figure 3 shows demand functions for each product (A-D) as recovered from empirical cumulative density functions of the WTPs elicited using both BDM cards. WTP is necessarily censored at zero and long upper tales are observable for all bundles. Both of these features of the data are discussed in the Methodology section below.

Using the information from the cards in Figure 2, we construct five WTP estimates for each respondent: two for seeds and three for insurance. Table 1 shows how each estimate is obtained. In the case of WTP for seeds, one estimate is obtained from the auction round in which respondents submitted a bid for seeds as a stand-alone product. The other estimate is obtained by subtracting WTP for insurance as a stand alone product from the respondent's bid for a bundle containing both seeds and insurance. We will refer to WTP in the latter case as WTP for seeds as part of a bundle and the former case as WTP for seeds when they are not part of a bundle.

Three estimates of WTP are recoverable for insurance, using a similar logic. The first estimate is WTP for insurance when it is not bundled and comes from auction round A, in which insurance is offered as a stand-alone product. The other two WTP estimates are for insurance as part of a bundle: first when bundled

[3]Ceballos, Kramer and Kivuva (2023) provides additional information on the pictured-based insurance contract.

[4]Our empirical approach estimates the effects of bundling using within-respondent variation in WTP. As such, any level differences across the sub-samples, either STV/non-STV or picture/weather-based insurance will not affect our estimates.

[5]The auction rounds without a capital letter, the two right-hand rounds in the top card are not used in this paper. The insurance component of all rounds in the bottom card corresponds round A in the top card, in which payments were made to the respondent's mobile money account.

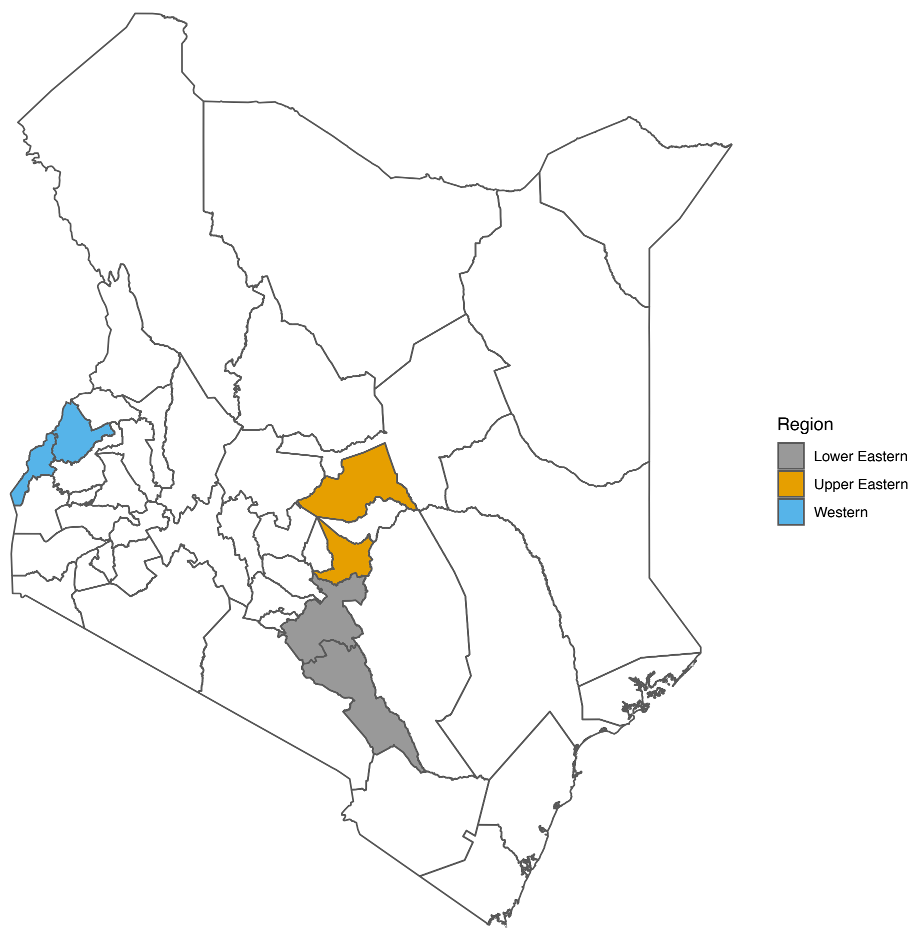

Figure 1: Study Area

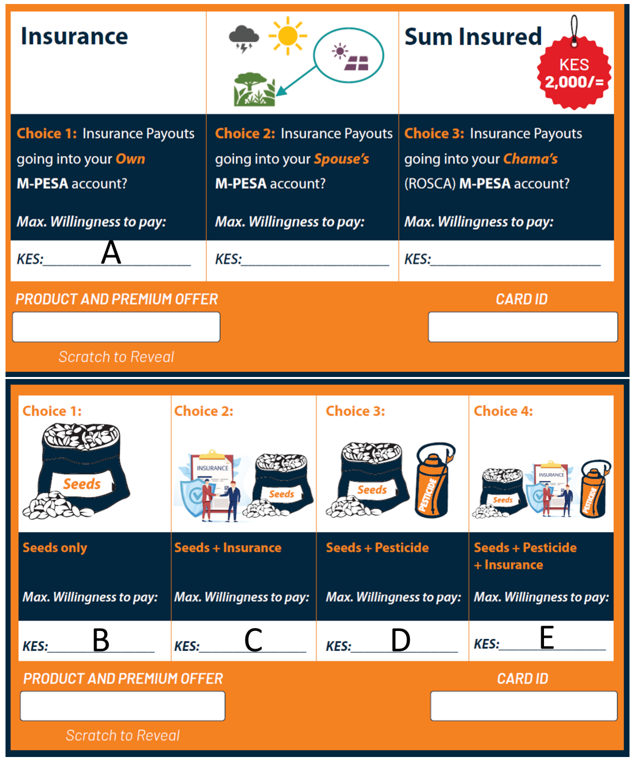

Figure 2: Experimental Auction Cards

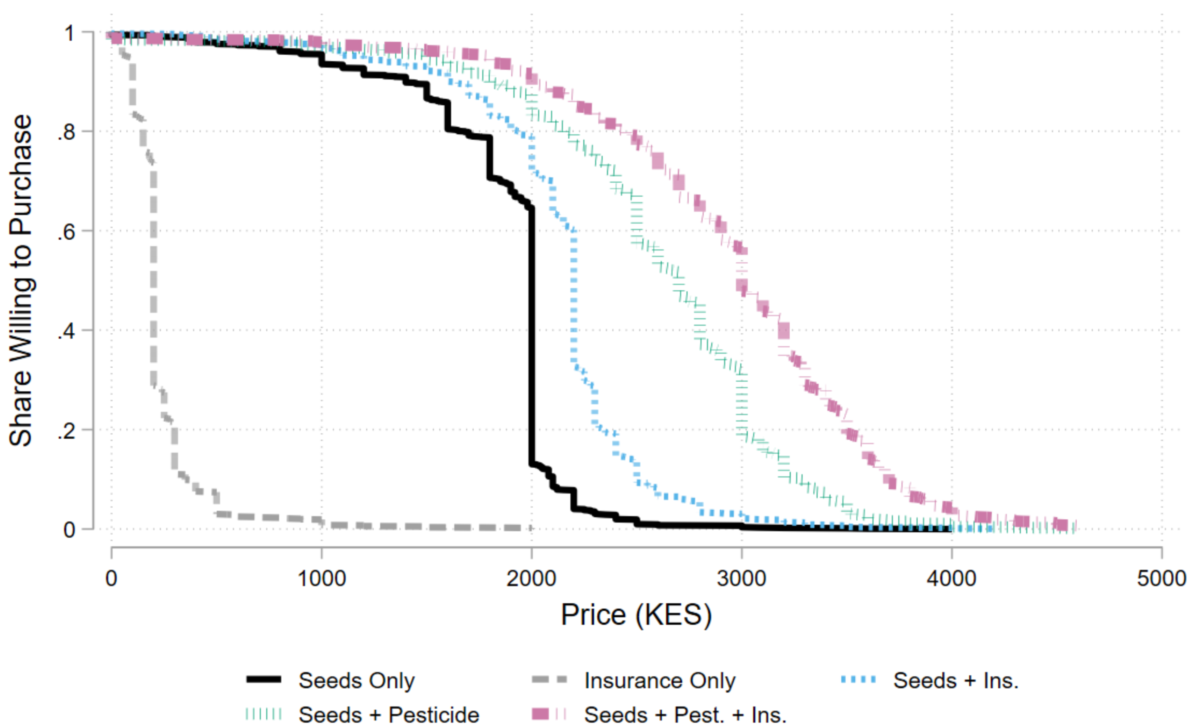

Figure 3: Demand for seed, insurance, and pesticide bundles

Table 1: Recovering WTP Estimates

Seed Estimate	**Calculation**	**Bundled?**
WTP^S_{1i}	B	No
WTP^S_{2i}	C-A	Yes (Insurance)

Insurance Estimate	**Calculation**	**Bundled?**
WTP^I_{1i}	A	No
WTP^I_{2i}	C-B	Yes (Seed)
WTP^I_{3i}	E-D	Yes (Seed & Pesticide)

with seeds and second when bundled with seeds and pesticide. In the first stage of analysis below, we treat both of these as estimates of WTP for insurance as part of a bundle. We then separately estimate whether including pesticides in that bundle, rather than seeds alone, changes respondents' WTP for insurance.

Finally, we repeat our analysis on the sub-samples offered STVs and non-STVS to better understanding farmer perceptions of the relationship between the risk reducing potential embedded in biological technologies and financial technologies. Namely, do farmers see the technologies as complements or substitutes?

Table 2: Summary Statistics

Variable	(1) Full	(2) Non-STV	(3) STV	(4) STV - Non-STV
WTP (KES)				
Insurance Only	236.301	240.791	231.432	-9.359
	(188.267)	(161.150)	(213.840)	(10.215)
Seed Only	1,853.098	1,866.113	1,838.250	-27.863
	(408.505)	(352.824)	(463.793)	(22.635)
Seed + Insurance	2,126.729	2,158.508	2,090.476	-68.032***
	(464.030)	(413.748)	(513.385)	(25.657)
Seed + Pesticide	2,595.950	2,589.340	2,603.491	14.151
	(664.753)	(596.395)	(735.444)	(36.853)
Seed + Pest. + Ins.	2,947.524	2,958.307	2,935.223	-23.084
	(766.290)	(702.228)	(833.797)	(42.479)
Summary Statistics				
Total acres planned	1.559	1.525	1.596	0.071
	(1.379)	(1.416)	(1.338)	(0.075)
Intercropping (%)	0.442	0.444	0.440	-0.003
	(0.497)	(0.497)	(0.497)	(0.027)
Plan to grow maize	0.875	0.901	0.847	-0.054***
	(0.331)	(0.299)	(0.360)	(0.018)
Maize acres planned	1.031	1.016	1.048	0.032
	(0.595)	(0.627)	(0.557)	(0.035)
Won practice round bid (%)	0.303	0.299	0.308	0.008
	(0.460)	(0.458)	(0.462)	(0.025)
Crop insurance training (%)	0.438	0.549	0.321	-0.228***
	(0.496)	(0.498)	(0.467)	(0.027)
Have had crop insurance (%)	0.185	0.218	0.150	-0.068***
	(0.388)	(0.413)	(0.357)	(0.022)
Observations	1,361	708	653	1,361

Columns 1-3 report mean values with standard deviation in parentheses. Column 4 reports the difference between the STV and non-STV sample with standard errors in parentheses.

4 Methodology

Given that it is possible to obtain multiple WTP estimates for each product from each respondent, we take a fixed effect approach to estimating the influence of bundling on WTP. The average effect of bundling on WTP for product p (either seeds or insurance) is estimated via Equation 1:

$$WTP_{ij}^{p} = \alpha_i + \beta_1 B_{ij} + \epsilon_{ij} \tag{1}$$

Where B_{ij} is equal to one if the WTP estimate j for respondent i comes from a bundle, α_i is an respondent fixed effect, and ϵ_{ij} is a mean zero error term. Because we have multiple observations for each respondent, we cluster standard errors at the respondent level in all of the specificaitons discussed below.

We begin by estimating average effects using the full sample. We then split the sample into farmers who were offered STVs and farmers for which the offered seeds were not stress tolerant. In each case, we first estimate Equation 1 via ordinary least squares. We then estimate the same specification as a Tobit model to acknowledge the censoring at zero.[6] Finally, we estimate a version of Equation 1 in which WTP has been subjected to an inverse hyperbolic sine transformation to reduce the influence of the rightward skew. In all cases, we report both the raw coefficient estimate of β_1 as well as the proportional change in WTP associated with B_{ij} changing from zero to one.[7]

As noted in the previous section, we also study the effect on WTP for insurance of expanding the bundle of seeds and insurance to include pesticide.

$$WTP_{ij}^{I} = \alpha_i + \gamma_1 S_{ij} + \gamma_2 P_{ij} + \epsilon_{ij} \tag{2}$$

Equation 2 summarizes our approach, where S_{ij} is equal to one if the WTP estimate comes from a product bundled with seeds (all bundled products) and P_{ij} is equal to one if that bundle also included pesticides. Because all bundles including pesticides also include seeds, conditional on S_{ij}, γ_2 indicates the change in WTP for insurance associated with a bundle including pesticide in addition to seed.

[6]Some papers also account for possible censoring at the market value of the good. That poses challenges here as market values only exist for unbundled products. If bundling changes the value of the component technologies, the relevant censoring point is unclear.

[7]Given that B_{ij} is a binary indicator variable, the proportional change for OLS (with WTP in its natural levels) and Tobit regressions is obtained as:

$$\%\Delta = \beta / W\bar{T}P$$

While percentage changes for OLS with the inverse hyperbolic sine-transformed outcome are obtained as:

$$\%\Delta = exp(\beta) - 1$$

5 Results

As seeds are at the center of the farmer's technological investment decision, we begin by looking at the effect of bundling on WTP for seeds. In auction rounds containing seeds, participants are told that the product is four (4) two kilogram seed packs (8 kg total). Farmers were also offered a choice among crops: maize, sorghum, green grams, or beans. Most (89%) choose maize, followed distantly by sorghum (4.0%), green grams (3.9%), and beans (2.8%). Regardless of the crop chosen, the respondent fixed effect in Equation 1 means that all differences are estimated off of variation around an respondent's own mean WTP.

Table 3 contains the primary results for seeds. Bundling is associated with small positive increases in WTP, just below two percent, when estimated via OLS and Tobit. Using the IHS-transformed WTP returns a negative point estimate that is not statistically significantly different from zero.

We next repeat the estimation separately for the samples offered STVs and non-STVs. The results, visualized in Figure 4, show that the positive average effect is primarily driven by an increase in WTP for bundling non-STVs with insurance. The second and third columns of Table 3 contain the analogous regression results. In the OLS and Tobit specifications, the estimated effects of bundling increase to just under three percent in the non-STV sample and are near zero and statistically insignificant for the STV sample. In Panel 3, which contains the results of using the IHS-transformed WTP, the estimated effect of bundling on WTP for STVs becomes more negative, though still statistically insignificant. The estimated effect of bundling on WTP for non-STVs moves closer to zero.

Table 3: The Effect of Bundling on WTP for Seeds

	(1)	(2)	(3)
Panel 1: WTP (OLS)	All	STV	Non-STV
Bundled	34.81***	13.77	53.26***
	(9.651)	(14.35)	(12.96)
Percent Change	0.0186***	0.00746	0.0281***
	(0.00516)	(0.00778)	(0.00685)
N	2616	1222	1394
Panel 2: WTP (Tobit)	All	STV	Non-STV
Bundled	35.87***	14.83	54.26***
	(6.726)	(10.02)	(9.025)
Percent Change	0.0192***	0.00804	0.0287***
	(0.00360)	(0.00543)	(0.00477)
N	2616	1222	1394
Panel 3: IHS-transformed WTP (OLS)	All	STV	Non-STV
Bundled	-0.0500	-0.103	-0.00344
	(0.0379)	(0.0648)	(0.0427)
Percent Change	-0.0488	-0.0981	-0.00343
	(0.0360)	(0.0584)	(0.0426)
N	2616	1222	1394

Notes: Outcome is WTP in KES. Reference category is the unbundled/stand-alone seed product. All specifications include respondent fixed effects. Standard errors (in parentheses) are clustered at the respondent level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

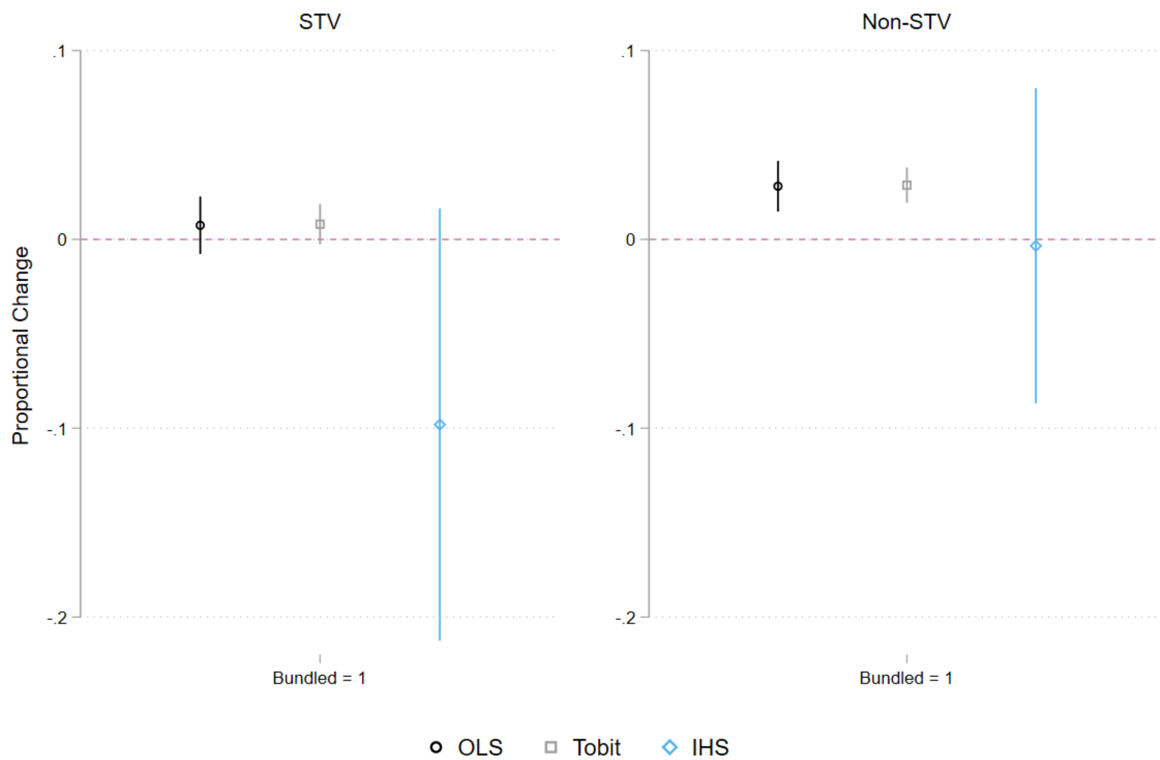

Figure 4: Proportional change in WTP for seeds associated with bundling. Results from Tobit model. Error bars represent respondent-level clustered standard errors

We move now to the question of how bundling affects WTP for insurance. As shown in Table 1, we are able to obtain WTP estimates for insurance in three different scenarios. The first comes from an unbundled insurance product. The second comes a bundle containing insurance and seeds. The final product adds pesticides to the bundle of seeds and insurance.

The "champion farmers" participating in the project ACRE/KALRO project were randomly assigned to promote one of two possible insurance products. The insurance product used in the auction activity was the one being promoted by a respondent's corresponding "champion farmer", either 1) a weather-based index insurance product or 2) a picture-based insurance product.[8] WTP for the two stand-alone insurance products is broadly similar and they are pooled for this exercise. Any difference in levels of WTP for the stand-alone insurance products would be absorbed into the respondent fixed effect. Both products were explained to farmers as covering damage to crops coming from excess rainfall or lack of rainfall, with possible payouts of up to 2,000 KES.[9]

The estimated effect of bundling on WTP for insurance is substantially larger than for seed. Table 4 reports the results, once again estimated using Equation 1. The estimated effects for the full sample range from a twenty-six percent increase, using OLS on WTP measured in its original units, to an eleven percent increase, using the IHS-transformed WTP. Figure 5 illustrates the difference in estimated effects for the STV and non-STV samples. Estimated effects are still larger for the non-STV sample but remain economically meaningfully and statistically significant for the STV sample, as well.

Finally, we consider whether adding pesticides to the bundle affects WTP for insurance by estimating Equation 2, as discussed in Section 4. For ease of comparison with the results in Table 4, we focus on the percentage change in WTP for insurance associated with bundling with seeds and pesticide versus with seeds alone. The two percentage changes in WTP are recovered as (using the OLS specification to illustrate):

$$\text{Including Pesticide:} \quad \%\Delta = \frac{\gamma_1 + \gamma_2}{W\bar{T}P}$$

$$\text{Not Including Pesticide:} \quad \%\Delta = \frac{\gamma_1}{W\bar{T}P}$$

The results are presented in Table 5.[10] In the full sample, also illustrated in Figure 6, the estimated effect of bundling on WTP for insurance triples when the bundle contains pesticide in addition to seed.[11] Large

[8]For more information on picture-based insurance, see Ceballos, Kramer and Kivuva (2023).

[9]Insurance demand curves for PBI and WBI are plotted in Figure A.1. Balance across the sample offered PBI and WBI is tested in Table A.1.

[10]Full regression results can be found in Appendix Table A.2.

[11]Note that the two panels in Figure 6 are differentiated by the presence of pesticide in the bundle, not by STV vs non-STV

Table 4: The Effect of Bundling on WTP for Insurance

Panel 1: WTP (OLS)	(1) All	(2) STV	(3) Non-STV
Bundled	73.78***	53.53***	91.54***
	(8.636)	(12.71)	(11.71)
Percent Change	0.258***	0.198***	0.305***
	(0.0301)	(0.0469)	(0.0390)
N	3977	1875	2102
Panel 2: WTP (Tobit)	All	STV	Non-STV
Bundled	72.81***	53.12***	89.83***
	(7.071)	(10.48)	(9.526)
Percent Change	0.254***	0.196***	0.299***
	(0.0247)	(0.0387)	(0.0317)
N	3977	1875	2102
Panel 3: IHS-transformed WTP (OLS)	All	STV	Non-STV
Bundled	0.105***	0.0960*	0.114**
	(0.0296)	(0.0478)	(0.0365)
Percent Change	0.111***	0.101	0.120**
	(0.0329)	(0.0526)	(0.0409)
N	3977	1875	2102

Notes: Outcome is WTP in KES. Reference category is the unbundled/stand-alone insurance product. All specifications include respondent fixed effects. Standard errors (in parentheses) are clustered at the respondent level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

positive effects are estimated for both the STV and the non-STV samples. At the same time, the estimated effect on WTP for insurance of bundling without pesticide drops to near zero for the STV sample.

as in previous figures.

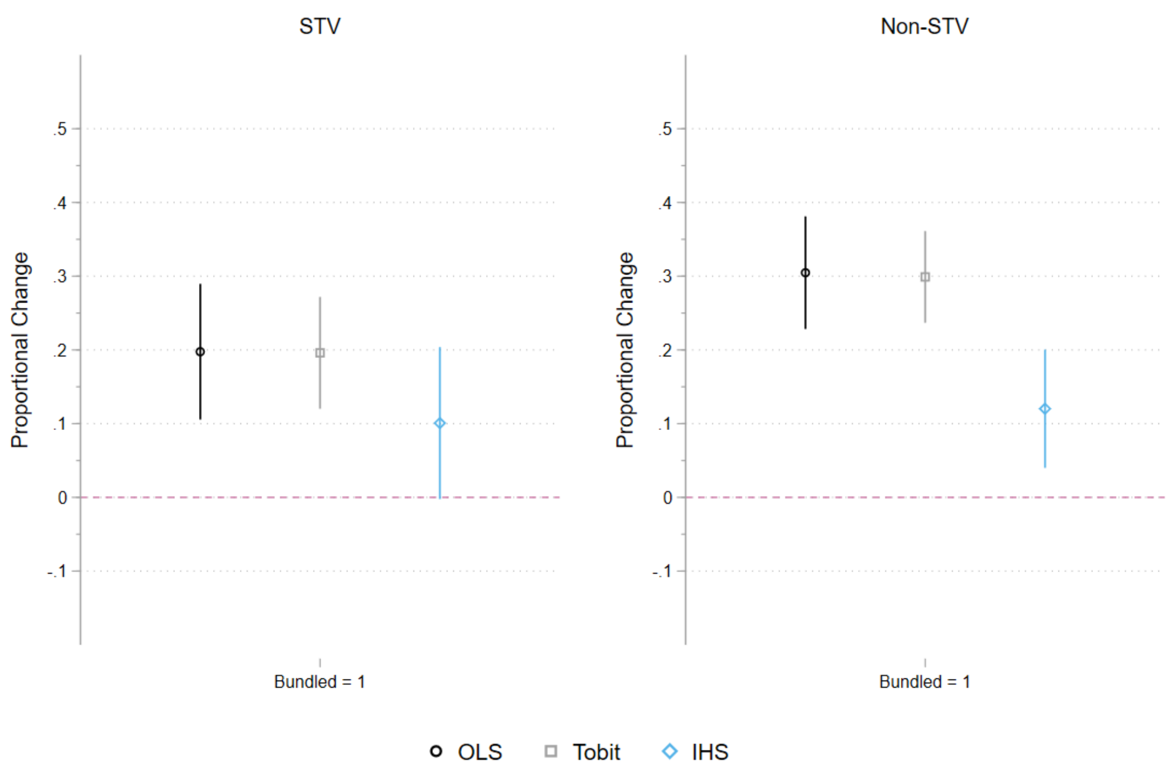

Figure 5: Proportional change in WTP for insurance associated with bundling. Results from Tobit model. Error bars represent respondent-level clustered standard errors.

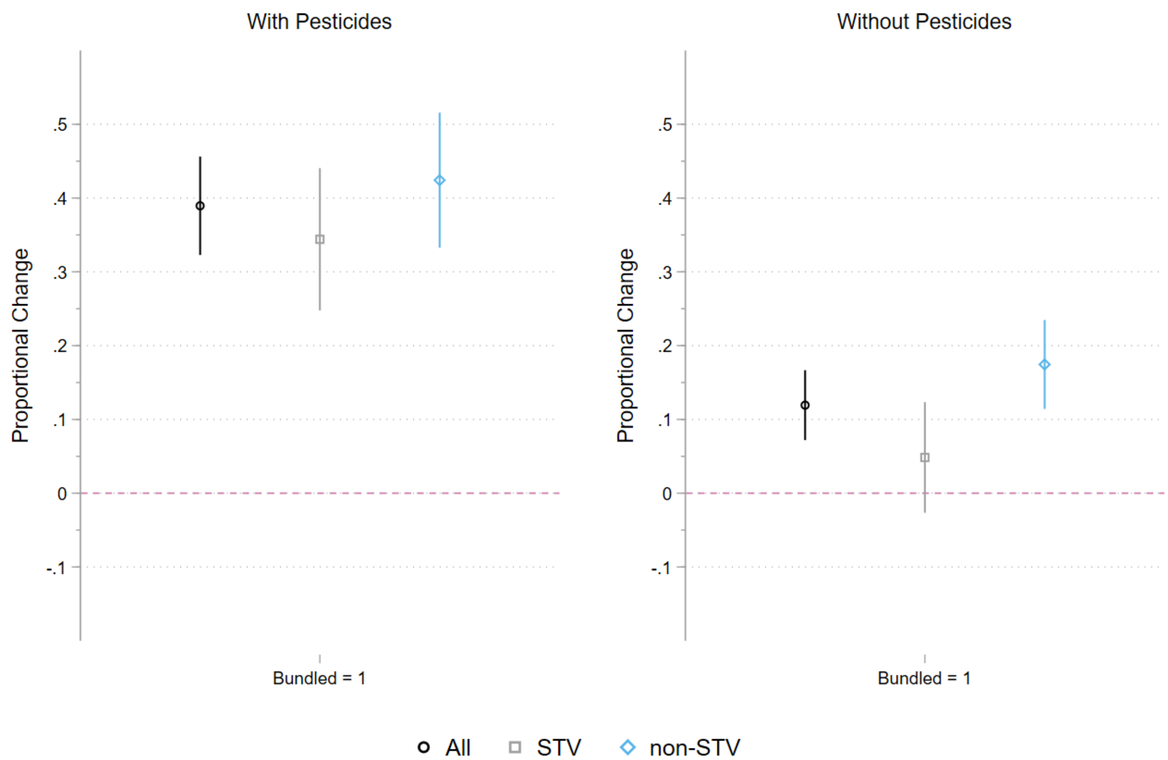

Figure 6: Effect of bundling with and without pesticide. Results from Tobit model. Error bars represent respondent-level clustered standard errors.

Table 5: Proportional Change in WTP for Insurance for Bundles with/without Pesticide

	(1)	(2)	(3)
Panel 1: WTP (OLS)	All	STV	Non-STV
Bundles Including Pesticide			
Percent Change	0.394***	0.344***	0.432***
	(0.0416)	(0.0597)	(0.0574)
Bundles Not Including Pesticide			
Percent Change	0.122***	0.0508	0.177***
	(0.0294)	(0.0464)	(0.0375)
Panel 2: WTP (Tobit)	All	STV	Non-STV
Bundles Including Pesticide			
Percent Change	0.390***	0.344***	0.424***
	(0.0340)	(0.0492)	(0.0467)
Bundles Not Including Pesticide			
Percent Change	0.119***	0.0485	0.175***
	(0.0241)	(0.0383)	(0.0307)
Panel 3: IHS-transformed WTP (OLS)	All	STV	Non-STV
Bundles Including Pesticide			
Percent Change	0.172***	0.185*	0.160*
	(0.0482)	(0.0726)	(0.0645)
Bundles Not Including Pesticide			
Percent Change	0.0538	0.0223	0.0822*
	(0.0303)	(0.0486)	(0.0373)
N	3977	1875	2102

Notes: Outcome is WTP for insurance in KES. All specifications include respondent fixed effects. Standard errors (in parentheses) are clustered at the respondent level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6 Discussion and Conclusions

In this paper, we study the effect of bundling on WTP for seeds and insurance. While Figure 3 shows strong demand for seed as a stand-alone product, even at their full market value, bundling with insurance is not associated with large changes in WTP for seed. Bundling is, on the other hand, associated with large changes in WTP for insurance. The estimated effects on WTP for insurance are especially large when the seeds in the bundle are non-STV and the bundle includes pesticides.

In light of these results, we take a final look at the relationship between the components of our bundle. The positive effect of bundling on WTP for insurance is suggestive of complementarity. Farmers appear to value the insurance more when it is bundled with seeds or, especially, with seeds and pesticides. This is consistent with broader experience in agricultural insurance. While agricultural insurance products have been sold in many countries, including Kenya, uptake has been limited outside of value chains that pair it with agricultural inputs such as seeds and fertilizer (Casaburi and Willis, 2018; Elabed et al., 2013). It seems plausible that the additional risk taken on by a farmer investing in inputs might increase the attractiveness of insurance, even if, like the product studied here and in Boucher et al. (2021), the insurance primarily covers the value of the inputs themselves. The results we present are not a direct test of this hypothesis, however.

The positive effects of bundling on WTP for insurance are uniformly larger for the sample of farmers offered non-STVs than for the sample offered STVs. Given our respondent fixed effect approach to estimation, this result is not attributable to differences in baseline WTP across the two groups. It is tempting to interpret the result as suggesting that farmers view STVs and insurance as at least partial substitutes. At the same time, farmers did not reduce their WTP for seeds or insurance when offered a bundled product, as would be expected if they were truly viewed as substitutes. Further, when asked directly, farmers reject the idea that insurance negates the need to buy inputs and use stress tolerant seeds (Appendix Table A.3). Rather than substitutes, we see results more consistent with the idea that STVs and insurance are viewed as having an additional rather than complementary relationship.

An alternative explanation, however, would be to note that the marginal value of risk reduction when using non-STVs may be higher than the marginal value of risk reduction when using STVs. In both cases, the insurance expands the set of shock outcomes from which the farmer is protected. In the STV case, however, the farmer is relatively more insulated from shocks even without the insurance. So while STVs and insurance may seem like a natural pairing from the practitioner perspective — together the two components provide better coverage at a lower cost than either could alone — there are a variety of farmer perspectives from which the benefits are less clear. The large effects on WTP for insurance associated with adding pesticides to the bundle are also worth discussing through the lens of complementarity. Increasing the value of the investment, as noted above, might increase the appeal of insurance. It is also possible, however, that the increase reflects the fact that farmers place a high value on access to the seeds and/or pesticides and that censoring is reduced as the bundle becomes more complex because it is less obvious what the market price of the bundled product would be.

Bundling may also hold appeals outside of directly increasing farmers' valuation of the individual components. For example, bundling inputs together in the proportions recommended by agricultural advisors may promote learning and simplify the decision-making process. The potential learning effects may be particularly large for newer products such as insurance, which are unfamiliar to many farmers and agro-input dealers alike. As innovative financial products continue to be developed and agro-input dealers are brought more fully into distribution plans for these technologies, considering strategies to streamline learning and simplify decision-making will only increase in importance.

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Appendix

Table A.1: Balance in the Sample offered Picture-based Insurance (PBI) and Weather-based Insurance (WBI)

Variable	(1) Mean WBI	(2) Mean PBI	(3) Diff
WTP (KES)			
Insurance Only	239.624	234.340	-5.284
	(217.905)	(168.462)	(10.567)
Seed Only	1,868.460	1,844.192	-24.268
	(435.221)	(392.181)	(23.434)
Seed + Insurance	2,163.063	2,105.666	-57.397**
	(514.700)	(430.871)	(26.583)
Seed + Pesticide	2,492.833	2,655.728	162.895***
	(729.946)	(616.456)	(37.883)
Seed + Pest. + Ins.	2,872.354	2,991.100	118.746***
	(830.743)	(723.264)	(43.854)
Summary Statistics			
Total acres planned	1.717	1.466	-0.251***
	(1.757)	(1.087)	(0.077)
Intercropping (%)	0.475	0.423	-0.052*
	(0.500)	(0.494)	(0.028)
Plan to grow maize	0.842	0.895	0.053***
	(0.365)	(0.307)	(0.019)
Maize acres planned	1.033	1.029	-0.004
	(0.525)	(0.631)	(0.036)
Won practice round bid (%)	0.315	0.297	-0.018
	(0.465)	(0.457)	(0.026)
Crop insurance training (%)	0.408	0.453	0.045
	(0.492)	(0.498)	(0.029)
Have had crop insurance (%)	0.154	0.201	0.047**
	(0.361)	(0.401)	(0.023)
Observations	505	856	1,361

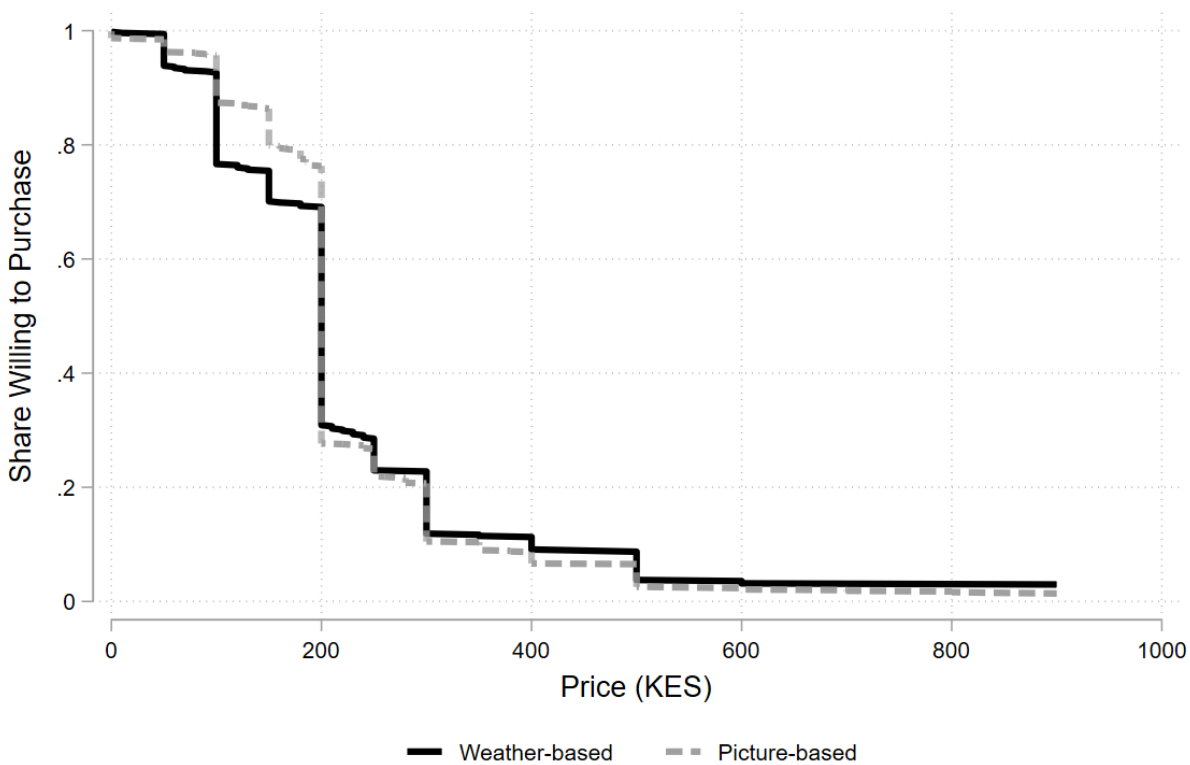

Figure A.1: Demand for Picture-based Insurance (PBI) versus Weather-based Insurance (WBI)

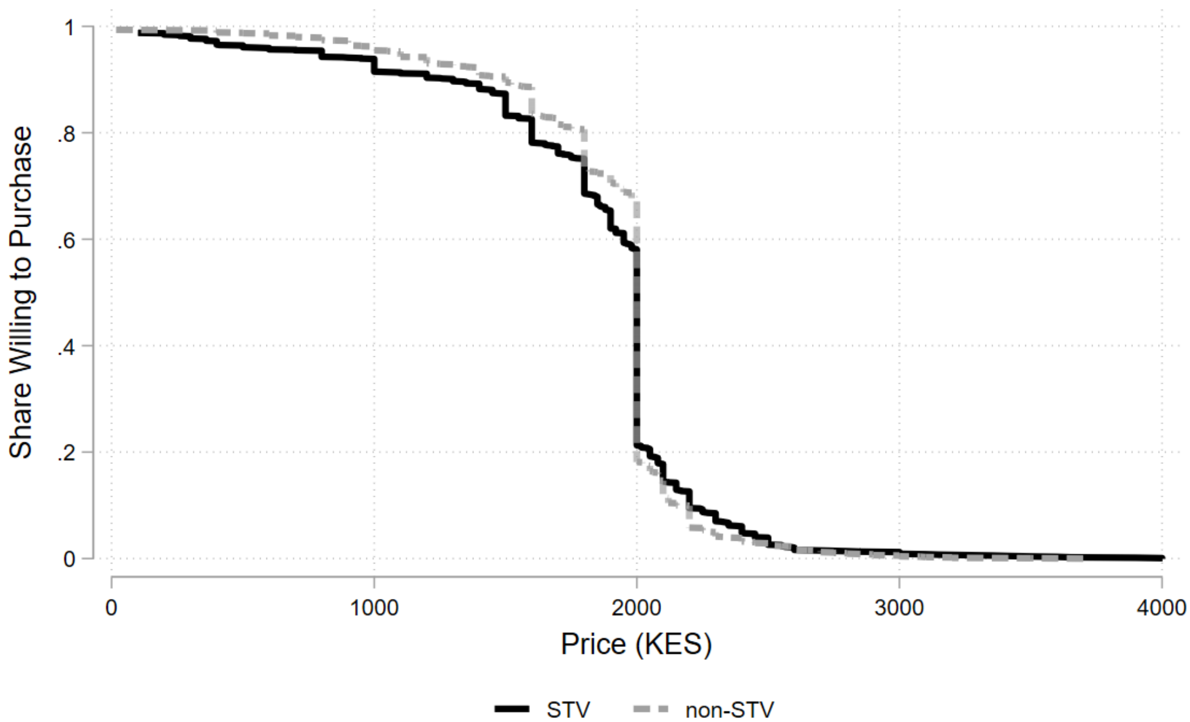

Figure A.2: Demand for STV versus non-STV Seeds

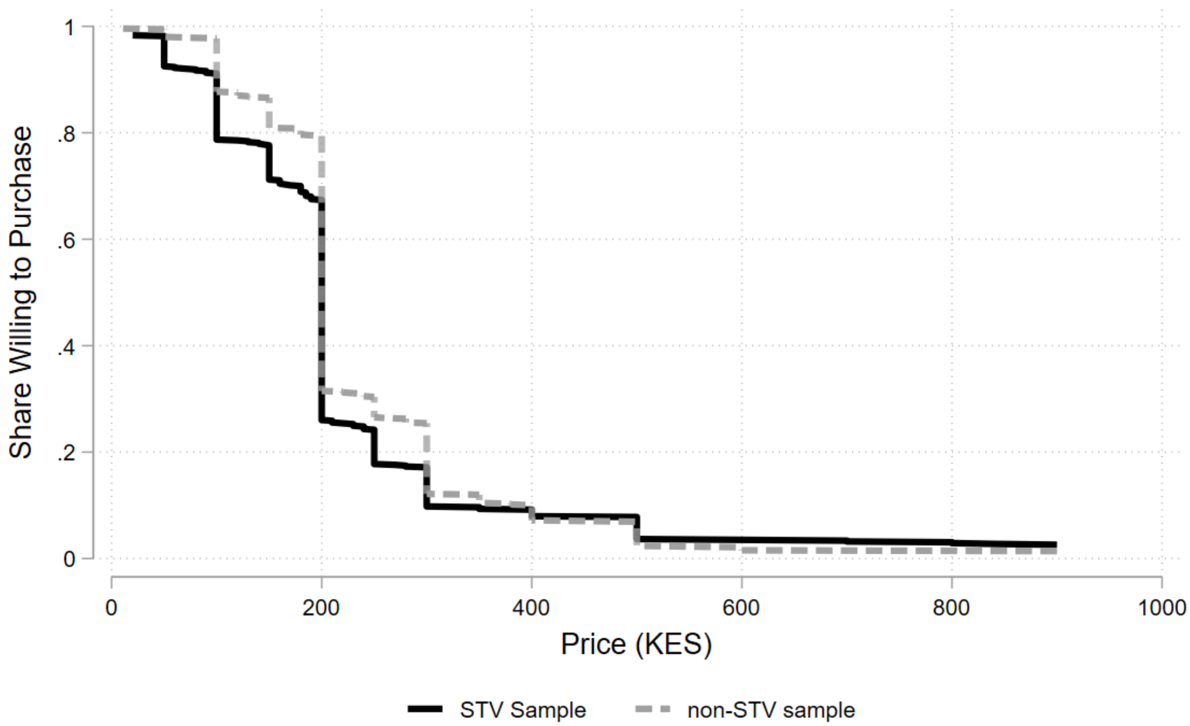

Figure A.3: Stand-alone Insurance Demand in STV versus Non-STV Samples

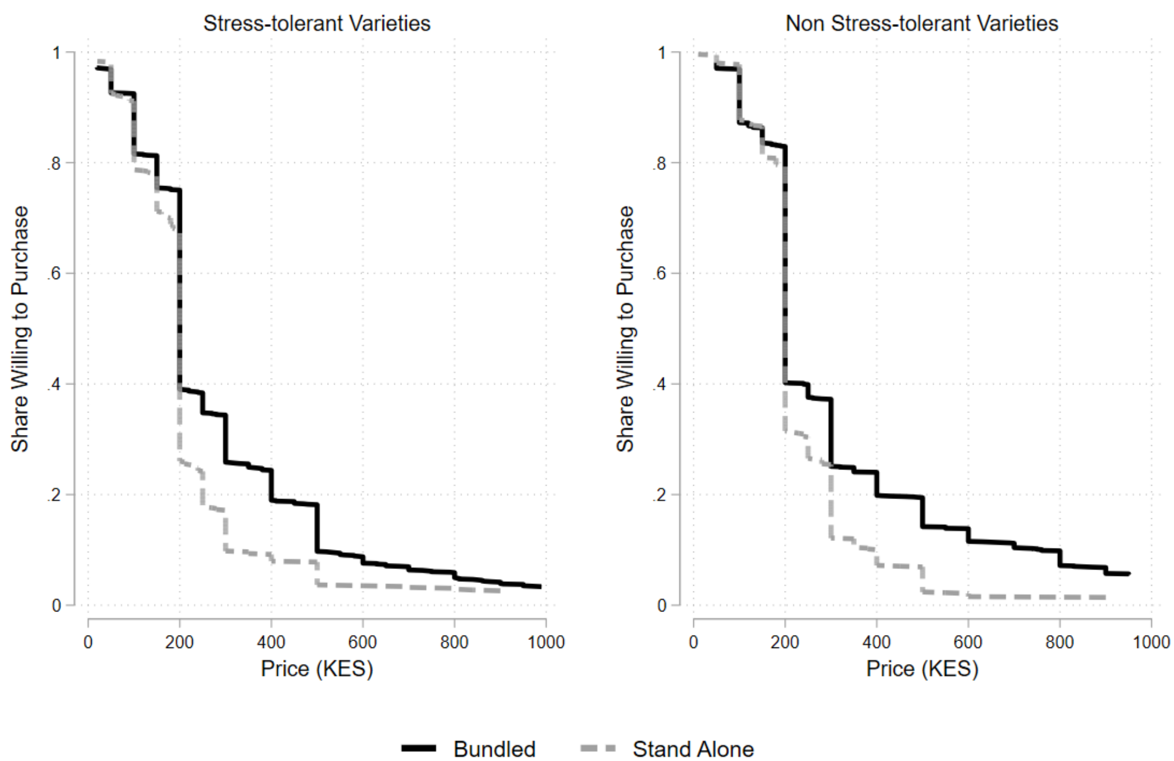

Figure A.4: Demand for Insurance (Bundled/Stand-Alone)

Table A.2: Bundling with/without Pesticide - Regression Results

	(1)	(2)	(3)
Panel 1: WTP (OLS)	All	STV	Non-STV
Bundled (S)	34.81***	13.77	53.26***
	(8.414)	(12.57)	(11.25)
Includes Pesticide (P)	77.94***	79.51***	76.57***
	(11.27)	(13.85)	(17.30)
N	3977	1875	2102
Panel 2: WTP (Tobit)	All	STV	Non-STV
Bundled (S)	34.19***	13.14	52.43***
	(6.919)	(10.36)	(9.231)
Includes Pesticide (P)	77.41***	80.08***	75.02***
	(9.264)	(11.44)	(14.16)
N	3977	1875	2102
Panel 3: IHS-transformed WTP (OLS)	All	STV	Non-STV
Bundled (S)	0.0524	0.0221	0.0790*
	(0.0288)	(0.0475)	(0.0345)
Includes Pesticide (P)	0.106**	0.148**	0.0691
	(0.0394)	(0.0537)	(0.0569)
N	3977	1875	2102

Notes: Outcome is WTP in KES. Reference category is the unbundled/stand-alone insurance product. All specifications include respondent fixed effects. Standard errors (in parentheses) are clustered at the respondent level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.3: Perceptions of the relationship been insurance and inputs

I do not need to buy stress tolerant seeds when I have crop insurance	I do not need to buy inputs (like fertilizer) when I have crop insurance							
	Strongly Agree	Agree	Undecided	Disagree Strongly	Disagree	Do not know	Total	Percent
Strongly Agree	21	1	0	1	6	0	29	1.1
Agree	2	25	0	5	29	0	61	2.34
Undecided	0	1	7	1	3	0	12	0.46
Disagree	0	2	0	499	41	0	542	20.77
Strongly Disagree	4	6	3	25	1818	1	1857	71.18
Do not know	0	0	0	2	0	106	108	4.14
Total	27	35	10	533	1897	107	2609	
Percent	1.03	1.34	0.38	20.43	72.71	4.1		100