Replication of "*Time versus State in Insurance: Experimental Evidence from Contract Farming in Kenya*" (Casaburi and Willis, AER, 2018)

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1 Introduction

The paper "Time versus State in Insurance: Experimental Evidence from Contract Farming in Kenya" by Casaburi and Willis (2018) explores the reasons behind the low demand for crop insurance among farmers, focusing specifically on the timing of premium payments. Traditional insurance models often require upfront premium payments, which can be a significant barrier for farmers who face liquidity constraints and receive cyclical incomes. This de facto required transfer of income across time is particularly challenging for these farmers, potentially explaining their low demand for insurance.

In light of this observation, this paper explores whether allowing farmers to pay for insurance at harvest time when they receive their income, can boost demand for insurance. Through a randomized controlled trial (RCT) involving 605 farmers across three treatment groups, the research examines how the timing of insurance premium payments affects take-up rates. This research also seeks to identify underlying mechanisms influencing demand for insurance such as liquidity constraints, present biasedness, and beliefs about contract risk (mostly default risk of the contract farming company).

In the main experiment, farmers were randomly assigned to one of three treatment groups: the first group (U1) was offered insurance with the requirement to pay the premium upfront at full price; the second group (U2) received a 30% discount on the upfront premium to test whether the cost of insurance was a significant barrier; and the third group (H) could subscribe to the insurance and have the premium deducted from their revenues later, at harvest time, by the contract farming company. The 30% discount in the U2 group served as a benchmark to assess whether the cost of insurance was the primary deterrent to take-up, as opposed to the timing of the payment.

The findings reveal that delaying premium payments until harvest significantly increases insurance demand, with a take-up rate of 72% for pay-at-harvest insurance compared to just 5% for standard pay-up-front insurance and 6% for the up-font payment with a 30% discount. The minimal impact of the 30% discount suggests that the timing of the premium payment, rather than the cost, is a critical factor in farmers' decisions to adopt insurance. Additionally, the study investigates the impact of liquidity constraints and present bias through heterogeneous treatment effects and explores how trust in the company and historical contract default rates influence farmers' decisions to adopt insurance.

2 Comments on the replication process

The empirical analysis in this paper was originally computed in STATA. For the purposes of this replication, the selected exhibits were replicated using R, together with renv to ensure full reproducibility. The original data files, STATA code, and the replication R code are all available in the following GitHub repo. The repository includes a Readme file which describes the content of the package and provides detailed guidance to reproduce the results. The figures displayed in this file are available in the output/Figures file on GitHub in jpg format and were produced by running each R script. Similarly, the R scripts output LaTeX code to knit the regression tables. The LaTeX code produced by our R code -and saved in the output/Tables file on GitHub- was subsequently slightly modified manually for aesthetic purposes.

All replication results in R directly match the results published by the authors. It is worth noting however that when replicating regressions 4 and 5 in Table 6, the heterogeneity variable, which STATA omits automatically due to multicollinearity concerns, was manually dropped in R. This step was necessary as the software preserved these variables despite multicollinearity issues, which were obvious given the very large standard errors outputted by R. While we considered using the feols() function in the fixest package which automatically drops the variables like in STATA, the resulting standard errors outputted were larger than the ones obtained with STATA due to computational differences between the statistical softwares. Therefore, the decision was made to manually drop the variable in R and use the lm() function to preserve the exactitude of the Standard Errors computed using *areg* in STATA. This step allowed us to replicate all results exactly.

Please note that some exhibits include in small characters the original notes written by the authors of the paper to provide additional context to our replication work and interpretation.

3 Exhibits 1, 2 & 3 - Main experiment

3.1 Exhibit 1 - Treatment Effects on Take-Up (Table 2 and Figure 3)

Table 2 summarizes the key result from the main experiment: namely that farmers' decision to adopt insurance is heavily influenced by the timing of insurance premium payments, suggesting that the transfer of income across time implied by an insurance contract heavily hinders crop insurance demand. Table 2 presents a comprehensive regression analysis of the effect of the two different treatment designs of the RCT on insurance take-up. The baseline estimating equation compares the effect of up-front payment with a 30% discount and payment at harvest on insurance take-up with the level of demand under the standard up-front payment design taken as baseline.

3.1.1 Table 2 - Methodology and Key Insights

Column 1 displays the results of the basic regression specification.

$$T_{if} = \alpha + \beta Discount_i + \gamma Harvest_i + \eta_f + \epsilon_{if} \tag{1}$$

The regression takes T_{if}, a binary indicator for insurance take-up for farmer i in field f, as the dependent variable. T_{if} is then regressed on two dummy variables: $Discount_i$ for the treatment groups U2 (up-front with 30% discount) and $Harvest_i$ for the treatment groups H (pay at harvest). η_f represents the field fixed effects, controlling for unobserved heterogeneity at the field level, and ϵ_{if} is the error term. It is also important to comment on α, the intercept of the regression model.

It represents the baseline take-up rate of insurance for the pay-up-front group U1, taken as the reference group. α is then the expected take-up rate when both $Discount_i$ and $Harvest_i$ are zero.

Column 1 summarizes two key messages. On the one hand, the coefficient associated with $Discount_i$ is statistically insignificant and small: only 0.4 percentage points higher take-up than the standard up-front product, meaning that the cost of the insurance on its own is not a major factor in take-up for farmers. On the other hand, the coefficient for $Harvest_i$ shows a 67.5 percentage points higher take-up than the standard pay-up-front design, statistically significant at the 1% level. This shows that allowing farmers to pay the premium at harvest substantially increases take-up rates.

Table 2 - Main Experiment: Treatment Effects on Take-Up

	(1)	(2)	(3)	(4)	(5)
Pay-up-front with 30 percent discount	0.004		0.013	0.003	0.015
	(0.033)		(0.033)	(0.032)	(0.033)
Pay-at-harvest	0.675***	0.673***	0.680***	0.686***	0.694***
	(0.033)	(0.028)	(0.033)	(0.032)	(0.032)
Plot Controls	No	No	Yes	No	Yes
Farmer Controls	No	No	No	Yes	Yes
Mean dep. var.	0.046	0.052	0.046	0.046	0.046
Observations	605	605	605	605	605

Notes: *p<0.1; **p<0.05; ***p<0.01

Column 2 shows a slightly different specification, in which both types of up-front treatments (U1 and U2) are bundled together into a single baseline group.

$$T_{if} = \alpha + \gamma' Harvest_i + \eta_f + \epsilon_{if} \tag{2}$$

As such, the coefficient on $Harvest_i$, significant at the 1% level, suggests that payment at harvest boosts take-up compared to both up-front payment designs, with and without discount, by 67.3 percentage points.

Finally, columns 3, 4 and 5, add a wide range of controls to the basic specification, respectively plot-level controls, farmer characteristics controls, and both types together. Plot-level controls include plot size and previous plot yield, while farmer's attributes consider variables describing the demographic and socioeconomic characteristics as well as relationship with the contracting company. Overall, the three specifications confirm the results of the baseline regression, namely that paying at harvest boosts take-up of insurance by 68 to 69.4 percentage points, all significant results at the 1% level, while a simple 30% discount on up-front payment does not significantly change take-up results.

Column 3 model specification:

$$T_{if} = \alpha + \beta Discount_i + \gamma Harvest_i + \eta_f + \delta PlotControls_i + \epsilon_{if} \tag{3}$$

Column 4 model specification:

$$T_{if} = \alpha + \beta Discount_i + \gamma Harvest_i + \eta_f + \phi FarmerControls_i + \epsilon_{if} \tag{4}$$

Column 5 model specification:

$$T_{if} = \alpha + \beta Discount_i + \gamma Harvest_i + \eta_f + \delta PlotControls_i + \phi FarmerControls_i + \epsilon_{if} \tag{5}$$

3.1.2 Table 2 - Interpretation of the results and Underlying Assumptions

Overall, Table 2 demonstrates that under all specifications, with or without controls, allowing farmers to pay at harvest significantly increases insurance take-up compared to paying upfront. This main result suggests that the low demand for insurance is largely due to farmers' inability to commit part of their income in advance, especially at times when they receive no income. This highlights the importance of timing in insurance premium payments for farmers with highly cyclical incomes and confirms that the transfer of income across time imposed by the up-front payment design is a major impediment to the demand for crop insurance among farmers.

The interpretation of these results assumes that the random assignment of farmers to treatment groups effectively isolates the effects of premium payment timing, and more importantly, that farmers understood the implications of the different premium payment options.

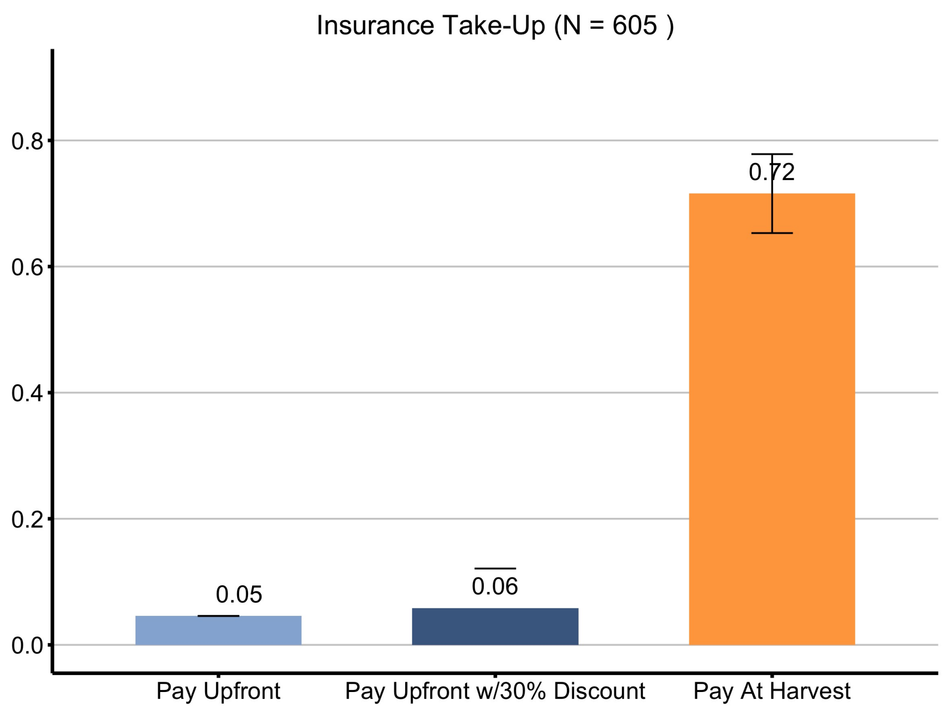

Figure 3. Main Experiment: Insurance Take-Up by treatment Group

3.1.3 Figure 3 - Comments

Figure 3 is a bar plot that allows to visually represents the key results from the first column of Table 2. It summarizes the key results to remember, namely that the pay-at-harvest option has a 67 percentage points higher take-up rate than the full-price up-front option (72% vs 5%), while the 30% discount on the up-front premium does not result in a statistically significant increase in take-up (of less than a percentage point). Visually, this figure emphasizes the significant impact of premium payment timing on, insurance adoption.

3.2 Exhibit 2 - Heterogenous Treatment Effect by Proxies for Wealth and Liquidity Constraints (Table 3)

Table 3 - Heterogenous Treatment Effect by Wealth and Liquidity Constraints Proxies

Variables	(1) Land cultivated	(2) Own cow(s)	(3) Previous yield	(4) Plot size	(5) Portion of income from cane	(6) Savings for Sh 1,000	(7) Savings for Sh 5,000
X × pay at harvest	−0.065**	−0.139*	−0.079**	−0.001	0.053*	−0.174**	−0.131
	(0.033)	(0.078)	(0.031)	(0.031)	(0.028)	(0.069)	(0.097)
X	−0.0001	0.066	0.015	−0.022	−0.004	0.006	−0.016
	(0.017)	(0.044)	(0.020)	(0.019)	(0.016)	(0.043)	(0.059)
Pay At Harvest	0.706***	0.822***	0.673***	0.672***	0.540***	0.764***	0.725***
	(0.029)	(0.068)	(0.028)	(0.028)	(0.096)	(0.035)	(0.031)
Mean dep. var. (pay-upfront group)	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Mean X	0.000	0.791	0.000	0.000	3.311	0.300	0.120
SD X	1.000	0.407	1.000	1.000	1.126	0.459	0.326
Observations	562	569	605	605	569	566	565

Notes: *p<0.1; **p<0.05; ***p<0.01.

In Table 3, the authors investigate the role of liquidity constraints in influencing insurance take-up, particularly given the requirement for up-front premium payments that necessitate an income transfer across time. The central hypothesis is that the disparity in take-up rates between pay-up-front and pay-at-harvest insurance will be more pronounced among poorer farmers, who are more likely to face liquidity constraints compared to their wealthier farmers. To test this hypothesis, the authors introduce multiple proxies for wealth and liquidity constraints, including the size of cultivated land, the number of cows owned, previous yield, plot size, the portion of income derived from cane cultivation, and access to savings. By examining how these factors interact with the timing of premium payments, the analysis aims to shed light on the influence of liquidity constraints on insurance adoption among farmers and explore.

3.2.1 Table 3 - Methodology

Table 3 examines heterogeneous treatment effects on take-up by including interaction terms between the pay-at-harvest treatment design and various proxies for wealth and liquidity constraints. The two pay-up-front designs were bundled together as the baseline, akin to the specification in Table 2- Column 2. The general specification for the regressions displayed in table 3 is the following:

$$T_{if} = \alpha + \beta Harvest_i + \gamma X_i + \delta(Harvest_i \times X_i) + \eta_f + \epsilon_{if} \tag{6}$$

where:

- T_{if} is the binary indicator for insurance take-up for farmer i in field f.
- $Harvest_i$ is the dummy variable indicating whether the farmer is in the treatment groups H (pay at harvest)
- X_i represents different proxies for wealth and liquidity constraints
- $Harvest_i \times X_i$ is the interaction term capturing the heterogenous effect of the pay-at-harvest treatment with each
- α is then the expected take-up rate when $Harvest_i$ is zero (so take-up rate for U1 and U2 groups bundled together).
- η_f represents the field fixed effects
- ϵ_{if} is the error term

3.2.2 Table 3 - Key Insights and Underlying Assumptions

The results show that all coefficients associated with Pay-At-Harvest are statistically significant and vary between 54 to 82 percentage points. More importantly, it demonstrates that the treatment effect does vary by most proxies for liquidity constraints and wealth. More specifically, the coefficients on interaction terms are statistically significant for the following proxies: land cultivated, cow ownership, previous yield, portion of income from cane and savings covering a Sh 1,000 emergency. All, but the income from cane proxies, have negative coefficients, which confirms that treatment effect of paying at harvest is lower among the wealthy, and thus larger among the more liquidity-constrained households. The findings are consistent with the hypothesis that poorer farmers, who are more likely to face liquidity constraints, benefit more from the option to pay premiums at harvest. This suggests that liquidity constraints are a significant barrier to insurance take-up, particularly for farmers who struggle to commit part of their income in advance.

As stated by the authors in the paper, one should keep in mind that given that interaction terms represent heterogenous treatment effects, they may not be interpreted casually due to potential confounds.

3.3 Exhibit 3 - Heterogenous Treatment Effect by Proxies for Expectations of Default (Table 6)

Table 6 - Heterogeneous Treatment Effects by Proxies for Expectations of Default

Variables	(1) Good relationship with company	(2) Trust company field assistants	(3) Trust company managers	(4) Past share of plots harvested in field	(5) Past share of plots harvested in sublocation
X × Pay At Harvest	−0.062	0.022	0.029	−0.228	0.681
	(0.070)	(0.029)	(0.028)	(0.297)	(0.425)
X	0.087**	0.034*	0.027		
	(0.040)	(0.018)	(0.017)		
Pay At Harvest	0.726***	0.654***	0.640***	0.852***	0.101
	(0.035)	(0.087)	(0.073)	(0.261)	(0.358)
Mean dep. var. (pay-upfront group)	0.052	0.052	0.052	0.052	0.052
Mean heterogeneity variable (X)	0.335	2.889	2.423	0.873	0.839
SD heterogeneity variable (X)	0.472	1.045	1.101	0.099	0.068
Observations	570	569	567	556	605

Notes: *p<0.1; **p<0.05; ***p<0.01.

In Table 6, the authors explore the influence of expectations of default on insurance take-up, particularly focusing on how trust in the company and historical rates of contract default affect farmers' decisions. The central hypothesis is that expectations of default, and thus contract risk more generally, might affect take-up rate. Therefore, this regression specification seeks to explore the heterogenous treatment effects of delaying premium payment by proxies of farmers' ex ante beliefs/insights about the risk of contract default by the contracting firm. These priors represent either varying levels of trust in the company (columns 1 to 3) or historical rates of contract default at the field and sublocation levels (columns 4 and 5). By examining how these factors interact with the timing of premium payments, the analysis seeks to understand how perceptions of contract enforcement and default risk shape insurance adoption among farmers.

3.3.1 Table 6 - Methodology, Key Insights, and Underlying Assumption

Similarly to Table 3, Table 6 also seeks to explore heterogenous treatment effects by different proxies. As such, the basic regression specification is identical to the one used for Table 3, with different proxies adapted for the purposes of the analysis.

While the coefficients of two proxies related to trust in the company (Good relationship with the company and Trust in company field assistants) are positive and statistically significant, none of the interaction terms hold statistically significant coefficients. This suggests that while trust factors may influence overall take-up of insurance, specific concerns about contract enforcement and firm default risk do not play a major role in the observed difference in take-up between the pay-up front and pay-at-harvest designs. Therefore, anticipation of default does not affect insurance take-up differentially, as opposed to other factors such as liquidity constraints and present biasedness explored in other exhibits.

These results assume that the proxies used accurately reflect farmers' expectation of a company's risk of default and overall contract risk.

4 Exhibit 4 - Cash Experiment (Table and Figure 4)

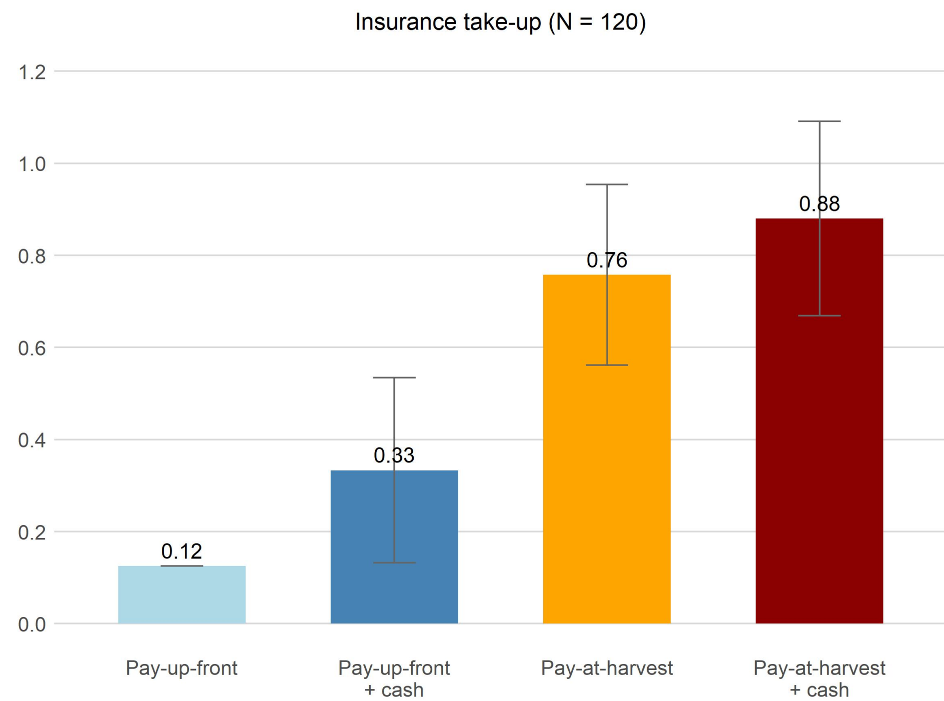

Figure 4. Cash Drop Experiment: Insurance Take-Up by Treatment Group

Notes: The figure shows insurance take-up rates across the four treatment groups in the cash drop experiment. In the *pay-up-front* group, farmers had to pay the premium when signing up for the insurance. In the *pay-up-front + cash* group, farmers were given a cash drop slightly larger than the cost of the premium and had to pay the premium at sign-up. In the *pay-at-harvest* group, if farmers signed up for the insurance, the premium (including accrued interest at 1 percent per month) would be deducted from their revenues at (future) harvest time. In the *pay-at-harvest + cash* group, farmers were given a cash drop equal to the cost of the premium, and premium payment was again through deduction from harvest revenues. The bars report 95 percent confidence intervals from a regression of take-up on dummies for the treatment groups.

Table 4 - Cash Drop Experiment: Treatment Effects on Take-Up

	(1)	(2)	(3)	(4)
Pay-at-harvest	0.603***	0.589***	0.635***	0.635***
	(0.077)	(0.078)	(0.105)	(0.107)
Cash	0.132*	0.128	0.167	0.177
	(0.079)	(0.079)	(0.110)	(0.111)
Pay-at-harvest × Cash			-0.071	-0.100
			(0.156)	(0.159)
Plot controls	No	Yes	No	Yes
Mean dependent variable (pay-up-front group)	0.125	0.125	0.125	0.125
p-value: Pay-at-harvest = Cash	0.000	0.000	0.000	0.000
Observations	120	120	120	120

Notes: The table presents the results of the cash drop experiment. The dependent variable is a binary indicator equal to 1 if the farmer took up the insurance. The baseline (omitted) group is the pay-up-front group, where farmers had to pay the premium upfront and did not receive a cash drop. *Mean dependent variable (pay-up-front group)* reports the mean of the dependent variable in the pay-up-front group. *Plot controls* are plot size and previous yield. All columns include field fixed effects. *p<0.1; **p<0.05; ***p<0.01.

Figure 4 and Table 4 report the results of the cash drop experiment, i.e., a mechanism experiment, complementary to the first one, in which the authors provide a treatment group with enough cash to pay a *pay-up-front* insurance premium. In detail, Figure 4 reports take-up rates across the 4 different treatment arms, together with their confidence intervals obtained regressing the take-up rate on treatment group dummies, with pay-up-front as reference level. Table 4, instead, reports the results of four variants of a regression of the take-up rate T_{if} on two indicators for the farmer receiving a pay-at-harvest offer or cash and their interaction, together with a vector of plot controls η_f, according to the following specification:

$$T_{if} = \alpha + \beta Harvest_i + \gamma Cash_i + \delta(Harvest_i \times Cash_i) + \eta_f + \epsilon_{if} \tag{7}$$

The key takeaway is that even when when provided with the liquidity, farmers' take-up of the pay-up-front insurance increases only by 20% and is largely below the take-up rate achieved with the pay-at-harvest offer. This is also reflected in the lower magnitude and significance of positive coefficients associated to cash, with respect to those associated to the pay-at-harvest dummy, in the regression reported in Table 4.
Under the assumption of comparability across groups, which is ensured by random allocation and balance checks, these results are interpreted by the authors as evidence that liquidity constraints, which had emerged in the literature and in the survey performed by the authors as one of the main reasons for no take-up of the insurance, do play a limited role in this context, suggesting that other channels, such as present bias, might be more relevant.

5 Exhibit 5 - Time Experiment (Table and Figure 5)

To test for intertemporal preferences and present bias, the authors conduct a ”time” experiment, with results reported in Figure 5 and Table 5. In this experiment, both groups chose between free enrollment in the insurance or an equivalent cash payment, differing only in the timing of the payment — one group received it immediately, while the other received it in one month.
The results show that delaying the choice by one month significantly increased insurance take-up: 71% opted for insurance in the delayed group, compared to only 51% in the immediate-payment group. This is also reflected in the positive and significant coefficient obtained when regressing insurance take-up on a dummy controlling for the delayed payment offer.
Assuming comparability across groups — ensured by random allocation and balance checks — and given the experiment's design, which rules out liquidity constraints and standard time preferences, the authors interpret these findings as strong evidence of present bias influencing insurance demand. This conclusion aligns with insights from the cash experiment, further suggesting that intertemporal distortions, rather than liquidity constraints alone, play a major role in explaining the low take-up of pay-up-front insurance.

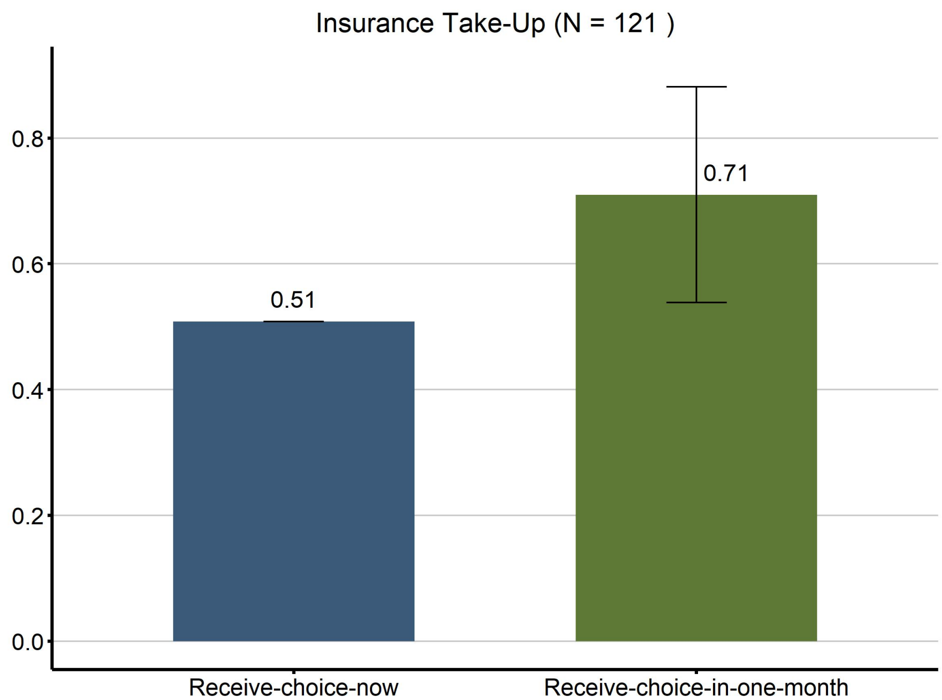

Figure 5. Intertemporal Preferences Experiment: Insurance Take-Up by Treatment Group

Notes: The figure shows insurance take-up rates across the two treatment groups in the intertemporal preferences experiment. In the receive-choice-now group, farmers chose between an amount of money equal to the premium and free subscription to the insurance, knowing that they would receive their choice straight away. In the receive-choice-in-one-month group, farmers made the same choice, but knowing that they would receive whatever they chose one month later. The bars report 95 percent confidence intervals from a regression of take-up on dummies for the treatment groups.

Table 5 - Intertemporal Preferences Experiment: Treatment Effect on Take-Up

	(1)	(2)	(3)	(4)
Receive-choice-in-one-month	0.233**	0.237**	0.286***	0.293***
	(0.089)	(0.092)	(0.107)	(0.109)
Plot Controls	No	Yes	No	Yes
Farmer Controls	No	No	Yes	Yes
Mean dependent variable (receive now group)	0.508	0.508	0.508	0.508
Observations	121	121	121	121

Notes: The table presents the results of the intertemporal preferences experiment. The dependent variable is a binary indicator equal to 1 if the farmer took up the insurance. The baseline (omitted) group is the receive-choice-now group, where farmers chose between an amount of money equal to the premium and free subscription to the insurance. In the receive-choice-in-one-month group, farmers made the same choice, but were told that what chose would be delivered one month later (plus one month's interest if they chose cash). Mean dependent variable (receive-choice-now group) reports the mean of the dependent variable in the receive-choice-now group. Plot controls are plot size and previous yield. Farmer controls are all the other controls reported in the main balance table, Table 1. For each of the plot controls, we also include a dummy equal to 1 if there is a missing value (and recode missing values to an arbitrary value), so to keep the number of observations unchanged. All columns include field fixed effects.
*p<0.1; **p<0.05; ***p<0.01.