Using Auctions in Agricultural Development Economics




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Why use an auction?

- Measure demand {willingness to pay (WTP)} for a new technology
- Measure how buyers value certain attributes or multiple attributes of a product
- Measure a producer, trader, retailer's willingness to accept (WTA) for a product
- Want to know how much someone would be WTA to implement a policy that costs something (eg: pay farmers to take land out of production)

Why are auctions useful?

- Allows you to experimentally vary attributes that affect demand
- Observations data measuring demand likely suffers from endogeneity.
  - Eg: consumers have unobservable attributes that affect how they value attributes of a product.
    - May bias estimates of how attributes are valued by consumers.
- Observational data may not allow us to observe much variation in certain attributes.
  - Auctions allow us to vary these randomly.

Types of Auctions

- Revealed preference auctions (people bid real money)
  - Incentive compatible (people bid their "true" WTP/WTA)
    - Becker-Degroote-Marshak (BDM)
    - Second price auction
  - Non-incentive compatible (people bid strategically)
    - First-price/English auction *(don't see these in academic literature)*

- Stated preference auctions (people state their WTP/WTA)
  - "incentive compatible"
    - Choice-experiments:
      - Mas and Pallais (2017) find that well designed choice experiments can produce results close to revealed preference experiments.
  - General contingent valuation studies
    - General willingness to pay questions

Outline of methods

1. Revealed preference methods
   - Prieto et al. (2021)
   - Channa et al. (2021)

2. Stated preference methods
   - Mahmud et al. (2020)
   - General example of contingent valuation

Incomplete information and product quality in rural markets: Evidence from an experimental auction for maize in Senegal

Stacy Prieto
Jacob Ricker-Gilbert
Jonathan Bauchet
Moussa Sall

Forthcoming in *Economic Development and Cultural Change*

FEED THE FUTURE FPL FOOD PROCESSING LAB

PURDUE UNIVERSITY

ISRA

USAID FROM THE AMERICAN PEOPLE

Harvesting/Drying/Storing grain quickly is important to ensure quality and safety

Biologists/mycologists recommend reducing aflatoxin risk by drying maize within 3 days of maturity to ≤ 13% moisture content (mc), especially in hot humid climates.

Is there a quality problem in maize markets?

Moisture measurement in formal markets

(56 lbs, at 15.5% moisture)

Volume = Mass/Density

> $200

Is there a quality problem in maize markets?

Moisture measurement in formal markets

(56 lbs, at 15.5% moisture)

Volume = Mass/Density

> $200

Moisture measurement in rural SSA

Weight, 1 kg = 1kg

or Volume

but not both!

Without moisture is there asymmetric information?

- Selling maize based on <u>only</u> weight <u>or</u> volume creates a potential problem….
- Seller has more information about moisture than buyer.
- Drying maize is costly, and reduces weight.
- **Wet maize weights more than dry maize! Has more volume too!**
- If moisture content is <u>unobservable</u> there is potentially an incentive <u>not to dry</u> maize that undermines food safety.
  - In an October 2015 Purdue study in southern Senegal, 30% of 88 maize samples drying post-harvest had aflatoxins, and 20% was above 20 ppb (Ileleji and Woloshuk 2015).
  - 29% above 20 ppb in larger study in same area in 2017 (Prieto, Bauchet and Ricker-Gilbert 2018)

Research Questions

Engineering Question: Can we build a better/cheaper moisture meter?

Economics Question: How observable is moisture content?

1) Do consumers and traders value drier maize?
2) If they value drier maize, does the higher value constitute a "quality premium."
   - defined as willingness to pay more for drier maize than the difference in density between wet and dry maize would dictate?

If there is asymmetric information about maize MC, could create a "lemons market" with no reward for quality following Akerlof (1970).

- Hoffman and Gatobu (2014) find that rural Kenyans willing to pay 20% more for maize grown at home than purchased in market.
  - Attribute this to **adverse selection** due asymmetric information about aflatoxins in maize.
- Bernard et al. (2017) find that provision of information about weight and volume along with labels for onions in Senegal improves quality investments by smallholders.
  - Use less urea (volume increasing), more NPK (weight increasing)
  - Some traders who had information advantage ex ante were not happy with the change.

Contribution of present article

Use experimental incentive-compatible auctions among maize traders and consumers in Southern Senegal to:

(i) empirically document the reliability of local maize moisture detection methods.

(ii) separately identify density and quality premiums for maize.

(iii) directly test for the differences between traders' and consumers' ability to determine maize MC and its effect on their WTP.

“density” and “quality” premiums and dis-incentives to dry maize

- Water less dense than nutritional material in maize kernels (flour, bran, oil, etc.)
- Maize density is directly related to MC.
  - D = M/V, so if know M and V then you know MC.
- In our context, a higher WTP for dryer maize could be because drier maize has more kernels than the same mass of wetter maize.
- Use a simple engineering formula to calculate any change in MC and how it affects density, mass, and volume (Brusewitz 1975).
- Maize density is almost linear in MC in realistic range
- We attribute any difference in WTP for dry vs wet maize above the difference in density as a “quality” premium
  - Due to improved storability of drier maize
  - Not needing to pay to dry before re-selling
  - Awareness of dangers of fungi growth and aflatoxins in wet maize.

Our context: the Kolda region of southern Senegal.

Experimental Auction

- Occurred in October 2015, seven largest urban and rural markets of Kolda region in Southern Senegal.
- Procured fresh maize at harvest from one large-scale farmer in region.
- Dried it ourselves to different MC levels. (controlled for other attributes)
- Rented local shops or stalls in different markets on market days.
- Enumerators started in different corners of the market walking towards center.
    - invited all traders they could find to the stall to participate
    - Enumerators invited every third woman consumer at the market
- Given small show-up/participation fee.

Traders (Resellers)	Consumers
166	182
Vickrey 2nd price sealed bids for 50 kg	Becker-Marchand-Degroot (BDM) mechanism for 1 kg

348 total participants (traders and consumers)

1. Two practice rounds with chocolate and pens! Making sure they understood process.
2. Shown unlabeled maize of three MC grades {High= 17-19% MC, Medium = 14-16% MC, Low<13% MC (safe for storage)} in random order. Asked to bid on each.
3. Shown a Dickey John moisture meter and explained that it tests Moisture content in maize (no other info given).
4. Shown labeled maize of three MC grades {High, Medium, Low} in random order. Asked to bid on each.
5. Each participant bid on 6 maize-grades, thus have panel data set of 2,088 observations

Instructions for participants

1. Strategic behavior was not to their advantage, i.e. they should bid their true value for each grade of maize (Plott and Zeiler, 2005);
2. They would bid for each of the 6 grades of maize, but only one grade would be randomly selected for sale to avoid diminishing marginal returns on subsequent maize bids (Corrigan and Rousu, 2006); and
3. Their bid would be compared to all other bids that day (for traders) or to a randomly determined amount (for consumers) to determine if they had the 'high' offer for the randomly selected maize-grade.

Empirical Model

WTP for each participant i for six maize grades j

$$(1)\ WTP_{ij} = \beta_0 + \beta_1 MEDIUM_{ij} + \beta_2 HIGH_{ij} + \alpha L_{ij} + \gamma_1 L_{ij} * MEDIUM_{ij} + \gamma_2 L_{ij} * HIGH_{ij} + c_i + \varepsilon_{ij}$$

WTP: measured in CFA (CFA 580 = USD 1.00)

MEDIUM: =1 if MC between 14-16% (unsafe to store)

HIGH: =1 if MC between 17-19% (unsafe to store)

LOW: =1 if MC <13% (safe to store)

L: =1 if MC is labeled

$\mathbf{c_i}$ = participant FE

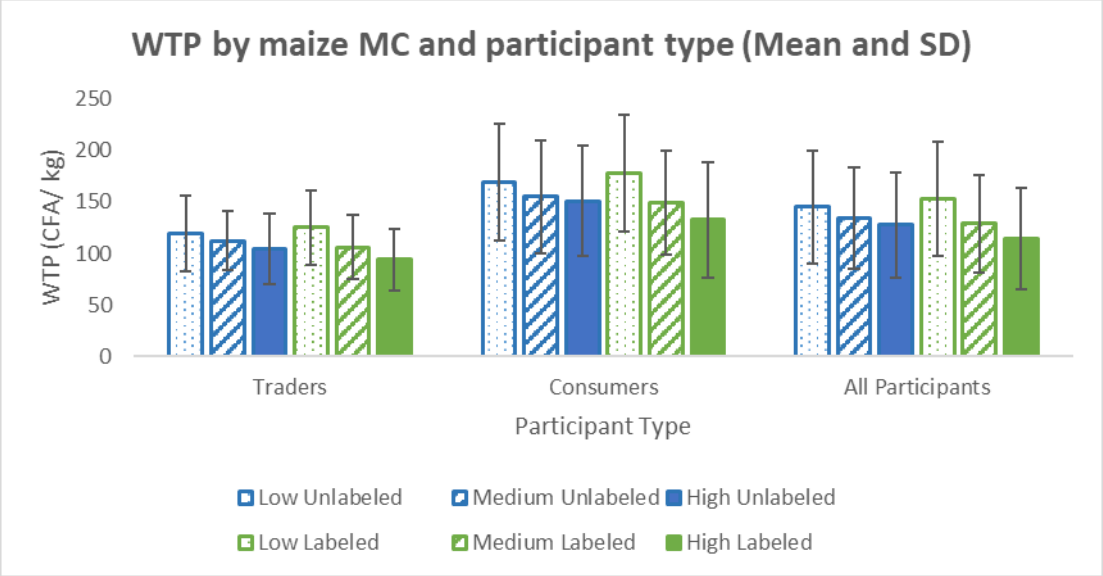
$\boldsymbol{\varepsilon_{ij}}$ = i.i.d. normally distributed error.

Descriptive results (continued)

Table 3. Mean WTP by moisture content and participant type (CFA/kg)

	Low – safe		Medium – unsafe		High – unsafe	
	Unlabeled	Labeled	Unlabeled	Labeled	Unlabeled	Labeled
Traders	119	125	112	106	104	94
Consumers	169	178	155	149	151	133
All Participants	145	153	134	129	128	114

"Safe" denotes maize is safe for long-term storage. USD1≈FCFA580 at the time of the auction (October 2015).



- WTP premium seems to exist for dry maize
  - Both **labeled** and **unlabeled** (to some degree)
- But WTP premium for **labeled** vs **unlabeled** only seems to exist for **low-safe** MC. Care about knowing if it is safe

Table 4. Regression results – WTP with Experimentally varied parameters

Equation:	(1)		(2)			
Coefficients Interacted With:	N/A		$P_{Consumer}$		P_{Trader}	
Panel A. Regression coefficients						
Unlabeled medium ($\widehat{\beta_1}$)	-10	***	-13	***	-7	***
	(2.20)		(3.72)		(2.10)	
Unlabeled high ($\widehat{\beta_2}$)	-17	***	-18	***	-15	***
	(2.52)		(4.38)		(2.20)	
Labeled low ($\hat{\alpha}$)	8	***	10	**	6	***
	(2.22)		(3.99)		(1.60)	
Labeled * Medium ($\widehat{\gamma_1}$)	-14	***	-16	***	-11	***
	(2.82)		(5.03)		(2.10)	
Labeled * High ($\widehat{\gamma_2}$)	-22	***	-28	***	-15	***
	(2.99)		(5.24)		(2.43)	
Number of observations			2,088			
Number of unique bidders			348			
Panel B. Change in WTP between unlabeled low-MC maize and:						
Labeled medium ($\widehat{\beta_1} + \hat{\alpha} + \widehat{\gamma_1}$)	-16	***	-19	***	-13	***
	(2.19)		(3.61)		(2.31)	
Labeled high ($\widehat{\beta_2} + \hat{\alpha} + \widehat{\gamma_2}$)	-31	***	-36	***	-25	***
	(2.69)		(4.53)		(2.60)	

Visualizing the quality vs. density premium

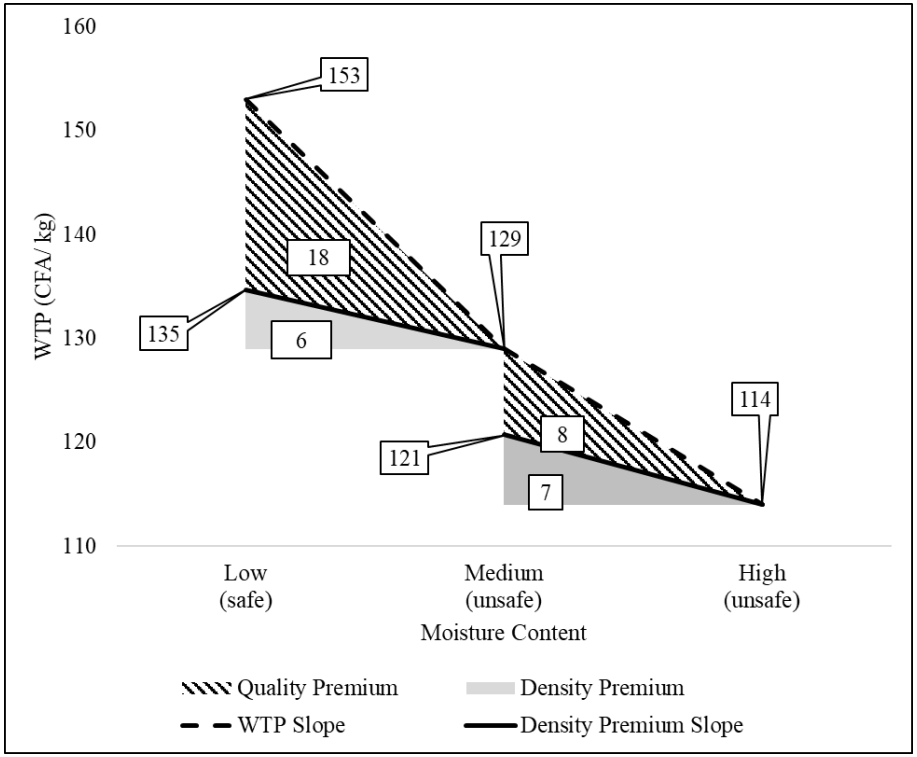


Figure 1: Calculated quality and density premiums for labeled maize.

- Most/all of the discount is due to quality premium.
- Especially for safe to store maize
- **Further evidence that they care when they know!**

Visualizing the quality vs. density premium

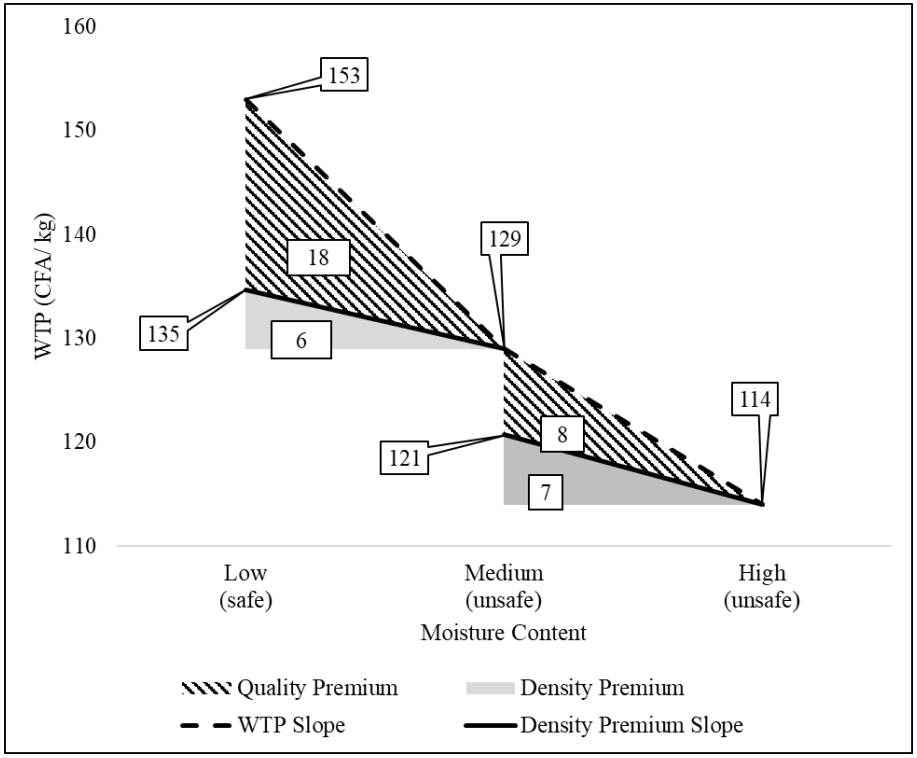


Figure 1: Calculated quality and density premiums for labeled maize.

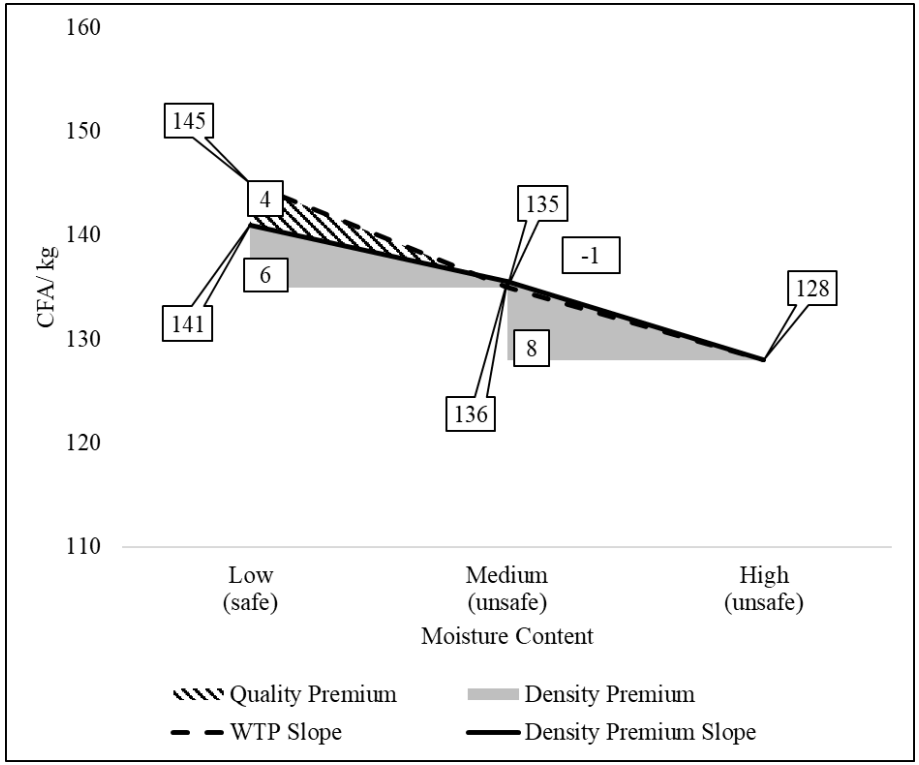


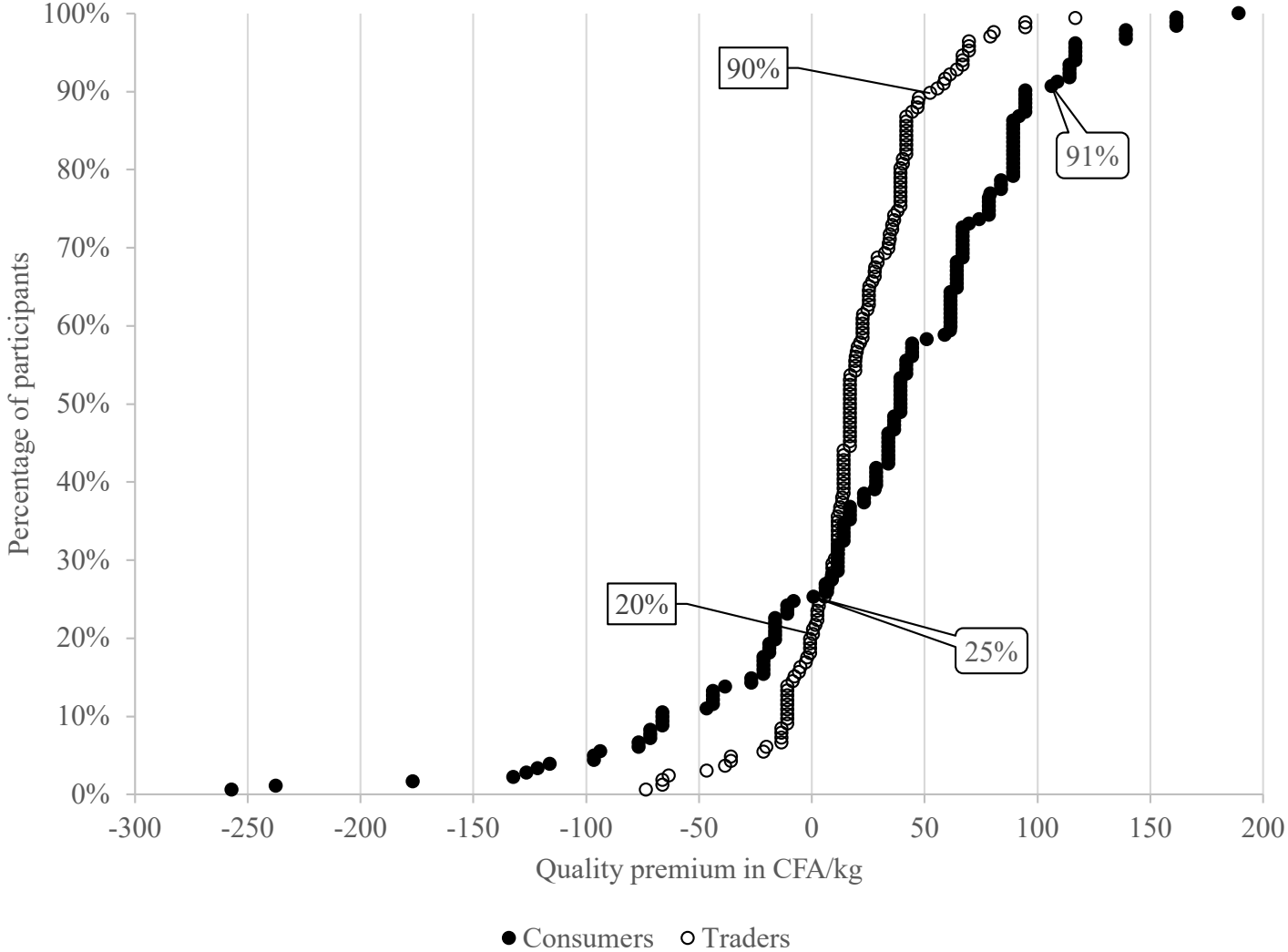
Figure 2. Calculated quality and density premiums for unlabeled maize.

- Most/all of the discount is due to quality premium.
- Especially for safe to store maize
- **Further evidence that they care when they have information!**

- Most/all of the discount is due to density, following formula

Distribution of quality premium

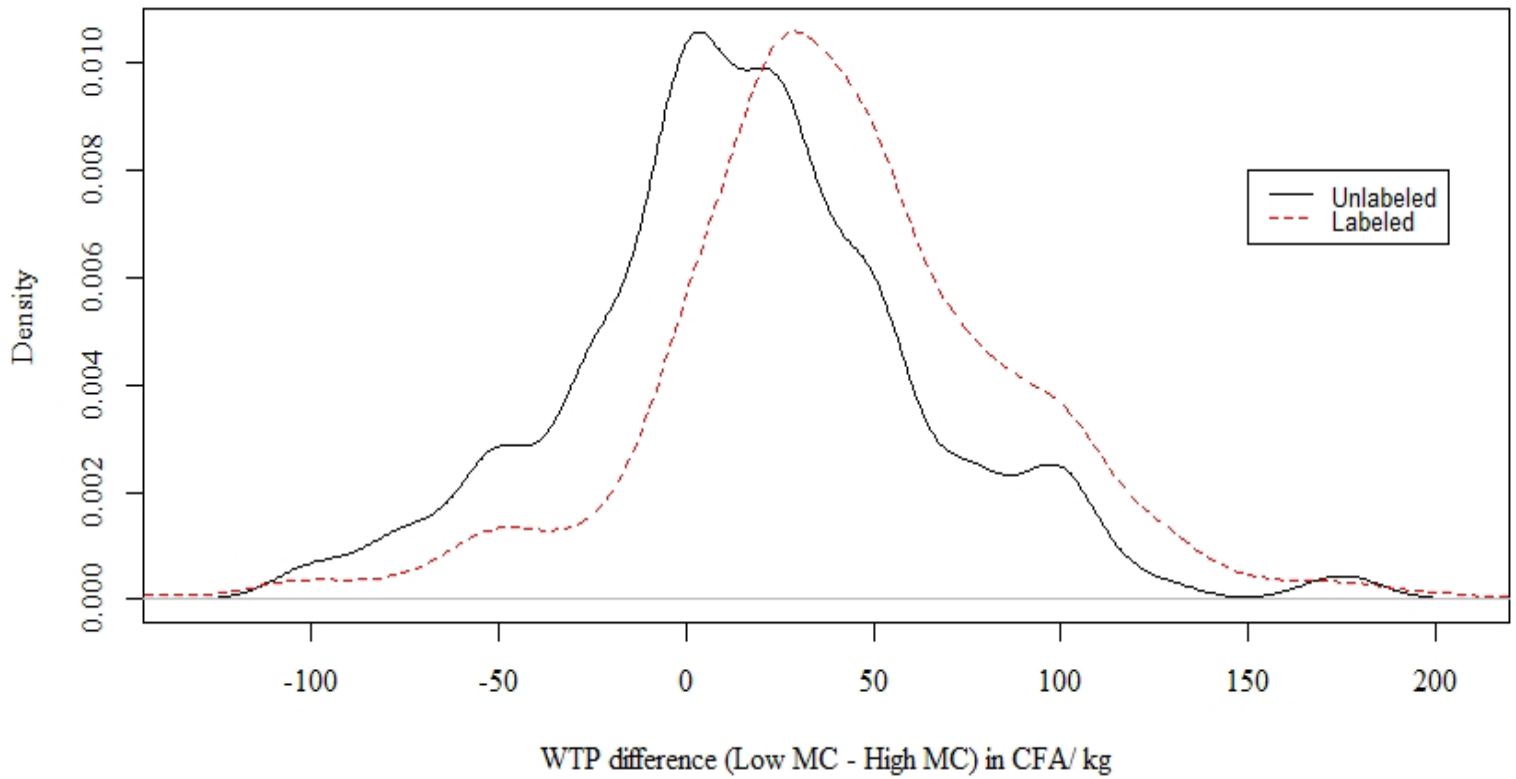
Figure 3. Consumer and trader quality premiums for low vs. high MC labeled maize.



- Negative values indicate that buyer WTP did not fully compensate for the density premium between the maize-grades.
- 75-80% if sample had a positive quality premium for Low MC vs. High MC maize.
- Less variation in quality premium for traders than for consumers.

Distribution of quality premium (continued)

Figure 4. Probability density functions for the differences in WTP between low and high MC for labeled and unlabeled maize.



- Labeling seems to have pushed the WTP distribution for Low MC vs High MC maize to the right.

Conclusions

- Buyers seem to be willing to pay for maize that is dry enough for safe long term storage when it is labeled.
- and buyers seem to recognize that traditional methods are unreliable.
- Two options:
  1) Trade maize and other grains on weight and volume (agree on standard bucket)
  2) Develop and disseminate low cost moisture meters.

  - Some potential options are available.

Outline of methods

1. Revealed preference methods
   - Prieto et al. (2021)
   - **Channa et al. (2021)**

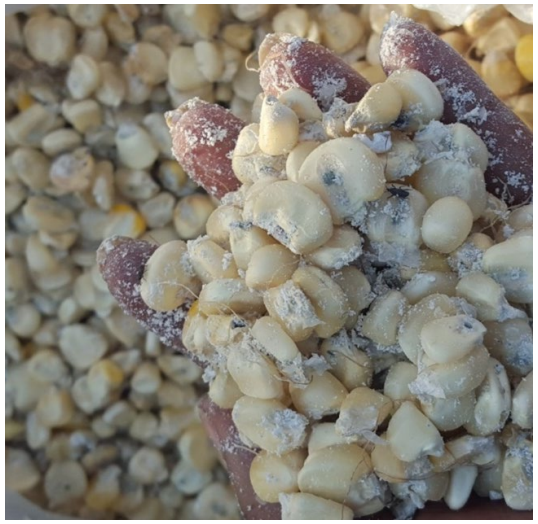
2. Stated preference methods
   - Mahmud et al. (2020)
   - General example of contingent valuation

Willingness to pay for a new farm technology given risk preferences

Hira Channa[†], Jacob Ricker-Gilbert[†], Hugo De Groote[¥], Jonathan Bauchet[†], [†] Purdue University,
[¥]International Maize and Wheat Improvement Center (CIMMYT)
Conditional Acceptance at *Agricultural Economics*

Motivation

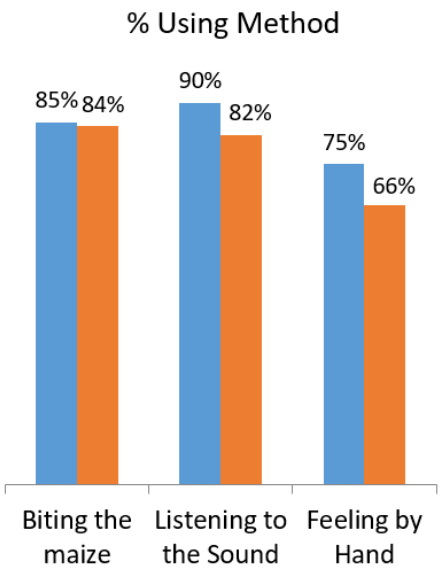
- Moisture meters, used in developed world are expensive (> US $100)
  - Unattainable and unavailable for most smallholders and small-scale traders.
- Economic issues:
  - Moisture not fully observable without meter
  - Kenyan cereal board(NCPB) purchases only if moisture content is below 13%

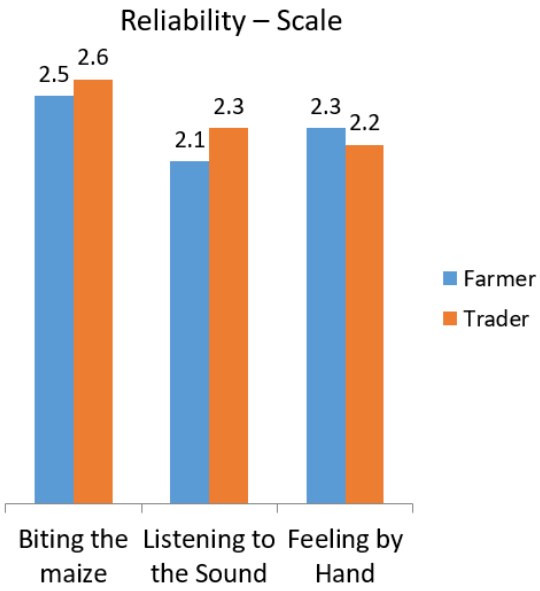


Previous literature on the topic is relatively sparse.

Recent work by Channa et al. (2018) from Kenya suggests many are not confident in their own ability

Variety of "local" methods used to test moisture (western Kenya)





Very Reliable	5
Reliable	4
Somewhat Reliable	3
Can make mistakes sometimes	2
Not reliable at all	1

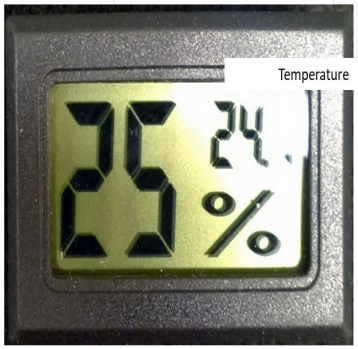
People recognize that traditional methods are error prone!

Our Intervention: Hygrometer and DriCard

- Hygrometer
  - Standard household device calibrated at Purdue University's Food Processing and Post-Harvest Handling (FPL) Innovation Lab
  - Provides a numeric reading
  - Imported from China
  - Est. Wholesale price = US $0.90
  - **More expensive + more accurate**
- DryCard
  - Strip of cobalt chloride infused paper
  - Developed at University of California at Davis Horticultural Innovation Lab
  - Can be made locally in Africa
  - Est. Wholesale price = US $0.15
  - **Cheaper + less accurate**

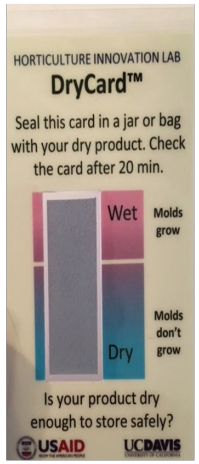
Devices

Hygrometer



Estimated Price
USD 0.90

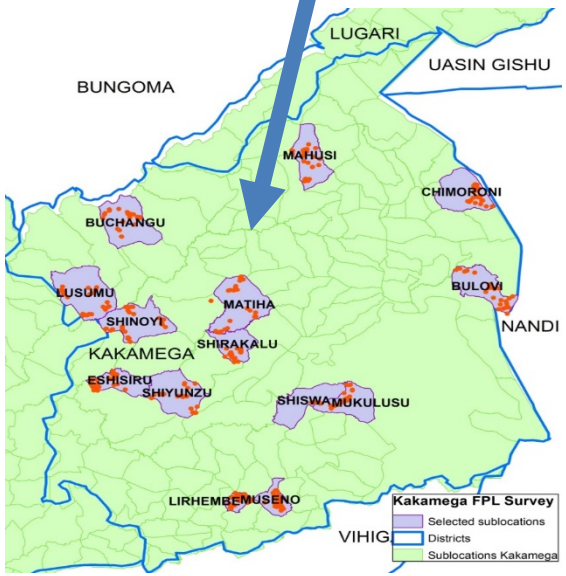
DryCard



Estimated Price
USD 0.15

Sample

Who	Surveyed 589 individuals 305 farmers-13 “sub-locations” and 284 maize traders-13 different markets
When	**March – April** 2017 End of short rains harvest, beginning of long rains planting
Where	Kakamega District



Demonstration

- Four bags of maize were carried by enumerator
  - 2 bags with dry and 2 bags of wet maize
- Hygrometer and DriCard were each put in a dry and wet bag of maize respectively

Becker De Groot Maschak (BDM) Auction

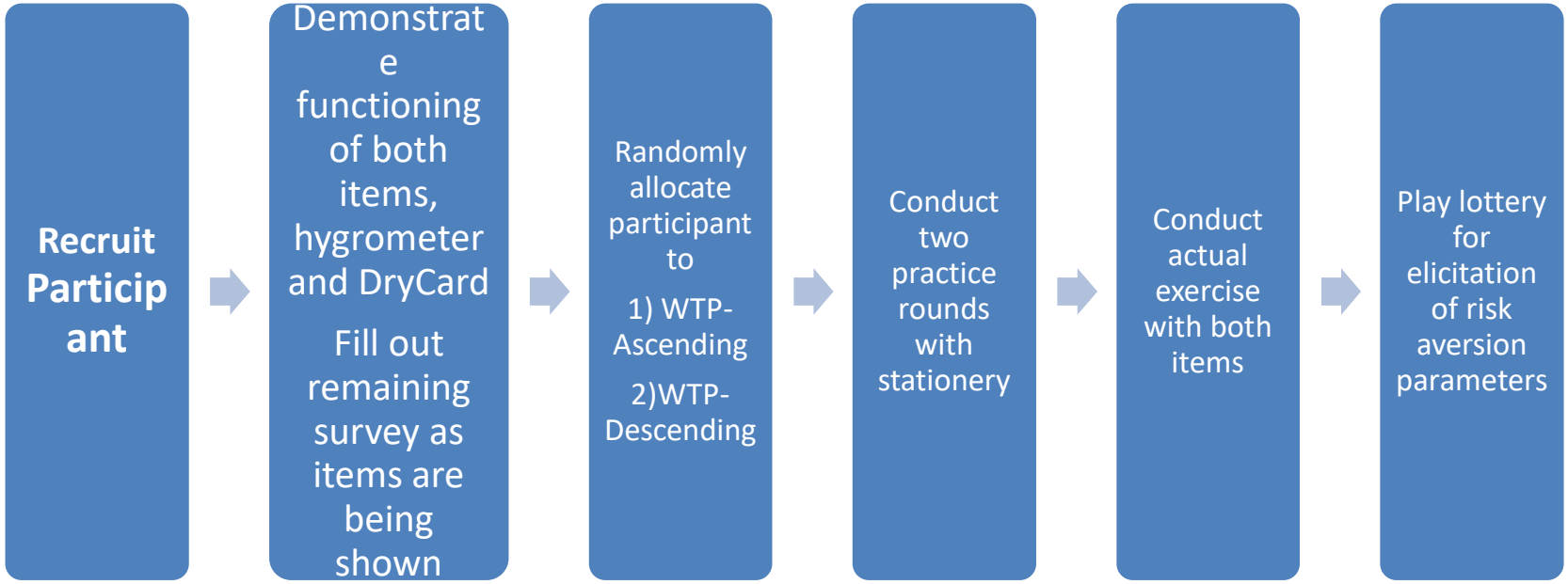
Benefit

- Involves actual purchase
- Possible on a one to one basis
- Price actually paid is random
- Since product was completely new, we asked people their willingness to pay in randomly selected ascending or descending order.

Process

- Participant bid is compared to random price
- If random price is higher then no transaction

Methodology Overview

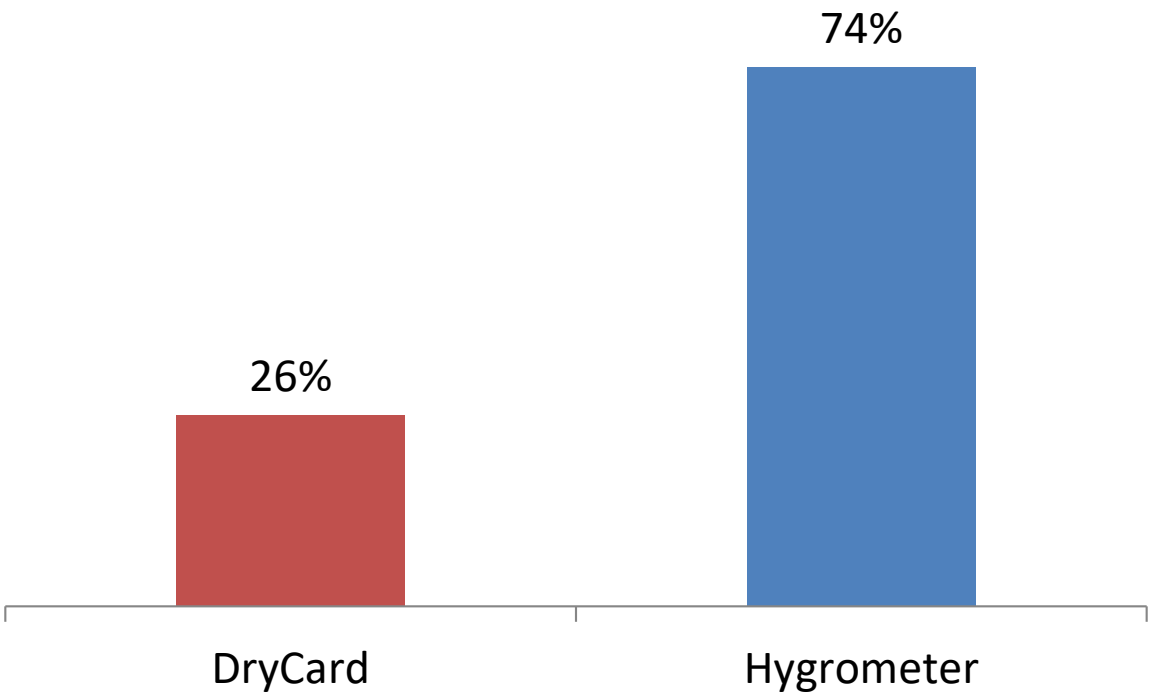


Empirical Analysis- WTP estimation

$$WTP_{d,i} = \beta_1 H_{d,i} + \beta_2 \theta_i + \beta_3 M_i + \beta_4 T_i + \beta_5 X_i + u_i$$

- $WTP_{d,i}$ is the willingness to pay for each individual(i) and for each device(d)
- $H_{d,i}$ =1 if device is hygrometer, $H_1 0$: $\hat{\beta}_1 = 0$; different WTP between devices (hygrometer and DryCard)
- θ_i Estimated risk parameter, power utility function. $H_2 0$: $\hat{\beta}_2 > 0$; risk averse people willing to pay more for moisture devices
- M_i =1 if ordering of bid prices is low – high bid: $H_3 0$: $\hat{\beta}_3 = 0$; tests if ordering of prices matters for WTP
- T_i =1 if respondent is a trader; $H_4 0$: $\hat{\beta}_4 = 0$; tests if WTP differs by occupation
- X_i is a set of controls
- u_i is iid error term
- Also interact key covariates
- OLS estimator with clustered standard errors at individual respondent level,

If both devices were available to you at the price you bid which one would you prefer?



Regression results: estimating factors affecting willingness to pay

VARIABLES	Dependent Variable is Willingness to Pay (KsH)					
Dummy for Respondent Type, =1 Trader	-43**				-33*	-55***
	(19.61)				(19.84)	(20.74)
Binary Variable for device, =1 is Hygrometer		32***			32***	29***
		(2.709)			(2.74)	(3.75)
Method Used, = 1-Low to High			-16***		-17***	-39 ***
			(5.632)		(5.73)	(7.83)
Risk Parameter assuming power utility function				2	2	4*
				(1.633)	(1.66)	(2.21)
Interaction: Hygrometer dummy * Trader dummy						6.965
						(5.49)
Interaction between Low to High * Trader Dummy						46***
						(11.10)
Interaction: risk parameter * Trader Dummy						-2
						(3.26)
Observations	1,178	1,178	1,178	1,178	1,168	1,168
R-squared	0.052	0.094	0.062	0.056	0.114	0.14

Other Controls suppressed in results for clarity
Robust(clustered at household level) standard errors in parentheses
Sub location/Market level Fixed Effects included
*** p<0.01, ** p<0.05, * p<0.1

More risk averse farmers have slightly higher WTP for moisture devices

Traders pay 7 KSH more with low high than high low (-39 + 46)

Conclusions

- Results suggest that there is a segment of the market willing to purchase both technologies at commercially scalable prices
  - Hygrometer preferred but DryCard more profitable to sell.
- Increased levels of risk aversion increase willingness to pay for both devices for farmers, but not traders.
  - Context of technology matters when examining the role of risk aversion.
  - Since devices reduce risk, seems that risk averse farmers willing to pay slightly more - consistent with Shimamoto et al. (2018).
  - Demonstration and training can be effective in reducing the uncertainty on the outcome from a technology.
- BDM method is susceptible to bias
  - More problematically it depends on population characteristics. Traders bid affected by ordering (low to high > high to low)
  - One way of controlling starting-point bias is to use multiple starting points as in our paper

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What Aspects of Formality Do Workers Value? Evidence from a Choice Experiment in Bangladesh

Minhaj Mahmud, Italo A. Gutierrez, Krishna B. Kumar, and Shanthi Nataraj

World Bank Economic Review 2020

1. Introduction

- A large share of workers in developing countries are part of the informal economy.
- Presence of informality presents a concern for a variety of reasons.
  - Informal workers subject to poor working conditions,
  - Receive few or none of the benefits available to formal workers (written contracts or paid leave).
- Attempts to extend formal job protections to informal workers or enforce existing protections are difficult for many regulatory bodies with limited resources.

- Paper uses choice experiment of 2,000 workers in Bangladesh to elicit demand (preferences) for specific benefits associated with formal employment.
  - Worker presented with two alternative jobs, differed in terms of levels of five attributes.
    - (a written contract, termination notice, paid leave, working hours, and access to a retirement fund).
  - Then asked to select which job he or she would select given the opportunity to select between two alternatives.
  - Used the tradeoff between monthly income and each of the other attributes to estimate WTP.
- One key finding is that workers have strong preference for job stability
- Second finding is that workers exhibit substantial heterogeneity in their preferences for job attributes.
  - Women willing to earn less income for fewer hours.
  - Government employees placed higher value on long term contracts.

Contribution

- One of only a handful of studies to use choice experiments that examine preferences for job attributes.
- Traditional approaches use hedonic methods to observable data on monetary and non-monetary job attributes.
  - Benefits are revealed preference, based on market transactions.
  - Problem is that tradeoffs in labor market choices are not randomly assigned
    - Probably based on unobservable productivity characteristics of the individual and unobservable characteristics of the firm.

- **Choice experiment advantages**:
  - when respondents asked to choose between two hypothetical options each with different attribute levels, the attributes can be randomized.
  - Make it possible to estimate the valuation for job attributes that do not vary substantially across workers and thus may be difficult to identify using revealed preferences. (eg: paid vacations are standard, so not much variation).
  - Can also evaluate novel attributes that are not included in standard surveys.
  - Choice experiments make it possible to recover average valuation of attributes in the study population, as opposed to valuations from hedonic wage regressions that reflect preferences of marginal workers in jobs without the attribute being examined.

- **Choice experiment disadvantages.**
  - Hypothetical, may not be what they really do.
  - Particularly the case when people faced with choices for things they don't normally do.
    - Study tries to mitigate this by carefully selecting job benefits that could be common in Bangladesh.
    - Study only covered working adults who had some idea of trade-offs in job attributes.
    - Tested method using pilot surveys, and modified attributes where appropriate.
    - Asked questions to make sure that respondents understood the choice exercise.
  - Cite evidence from Mas and Pallais (2017) that well designed choice experiments can produce results close to revealed preference experiments.

2. Survey method: Data

- 2,000 workers surveyed in two major administrative divisions of Bangladesh.
- Two stage sampling design and the mouza level as the PSU.
- 30 households in each mouse selected
- Enumerators selected to visit each 10th house and interview all members.
- 3,787 working adults identified (out of 10,690 hh members)
  - Men much more likely to be working than women.

Table 1. Sample Selection

	Male			Female		
	Roster	Target	Sample	Roster	Target	Sample
All adults (18+)	3,695	N/A	N/A	3,544	N/A	N/A
Working adults (18+)	3,040	1,254	1,270	747	747	694
Wage workers	1,770	749	708	561	561	505
Self-employed workers	1,270	505	562	186	186	189

Source: Authors' analysis based on survey data.

Note: Number of adults in the initial survey roster, number targeted for sampling, and number included in the final sample, by gender.

3. Conceptual/empirical model

Table 2. Example Choice Scenario

	Job A	Job B
Written contract	6 months initially	1 year initially
Termination notice	15 days	15 days
Working hours	30–45 hours per week	45–60 hours per week
Amount of paid leave (not including major government holidays/festival leave)	10 days	10 days
Provident Fund	No	No
Monthly income	20% higher than your current monthly income from main economic activity	10% higher than your current monthly income from main economic activity

Source: Authors' selection of levels from choice experiment used in survey.
Note: Example of a choice set presented to respondents during the survey.

- Respondents given two hypothetical choice opportunities, each with different levels of the following attributes: a written contract, termination notice, paid leave working hours and a retirement fund, and monthly income.
- Alternatives were unlabeled, and not identified as "formal" or "informal"
- Asked to assume that all other attributes were identical between jobs.
- Attributes selected based on review of labor law, and refined through a series of discussions with Bangladesh policy makers, workers, and a pilot survey

Table 3. Full Set of Attributes and Levels

Attribute	Levels
Written Contract	None 6 months initially 1 year initially Long term
Termination Notice	None 15 days 30 days 60 days
Working hours	30–45 hours per week 45–60 hours per week 60–75 hours per week
Amount of paid leave (excluding government holidays and festival leave)	None 5 days 10 days 15 days
Provident Fund	Yes No
Monthly income	Same as now 10% increase over current income 20% increase over current income 30% increase over current income 40% increase over current income 50% increase over current income

Source: Authors' choice experiment used in survey.

Note: Full set of attributes and levels from the choice experiment presented to respondents during the survey.

- *Experimental design*
- Given number of attributes and levels it was not possible to include all combinations of them in the choice experiment.
- Used experimental design to create a set of choice sets (Ngene software)
- 48 choice sets in 8 blocks each with 6 choice sets.
- Each respondent given 1 block of 6 choice sets.
- Blocks randomly assigned to respondents
- Choice sets randomly ordered within each block.

Table 4. (*continued*)

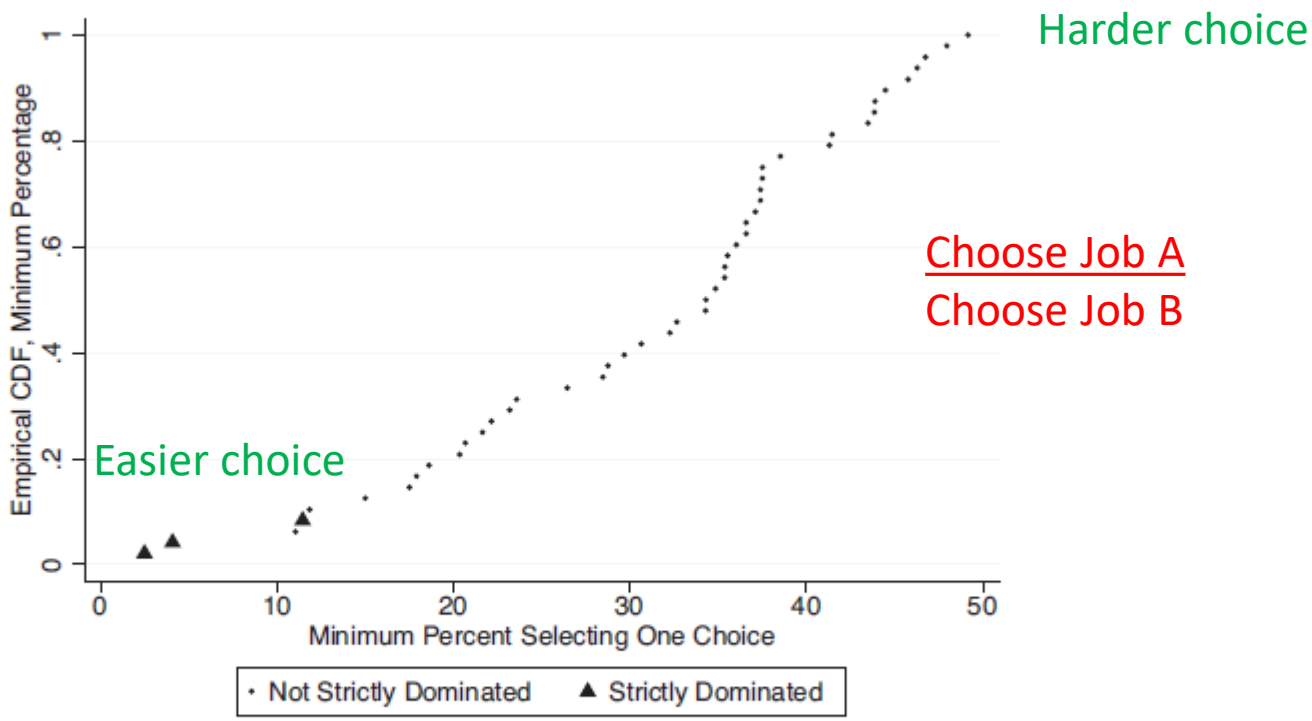
Employment type	Monthly earnings in 2016 Taka (USD in parentheses)					
	25% percentile		50% percentile		75% percentile	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Panel (d): Monthly income						
Government employee	15,000	15,000	25,000	23,000	30,000	30,000
	(191)	(191)	(319)	(293)	(383)	(383)
Private employee	6,000	6,913	8,000	9,000	15,000	15,000
	(77)	(88)	(102)	(115)	(191)	(191)
Casual worker	3,500	6,000	7,500	7,500	10,500	12,000
	(45)	(77)	(96)	(96)	(134)	(153)
Self-employed alone/with family	6,500	7,500	11,500	15,000	15,000	20,000
	(83)	(96)	(147)	(191)	(191)	(255)
Self-employed (with non-family)	15,000	15,000	20,000	20,000	30,000	30,000
	(191)	(191)	(255)	(255)	(383)	(383)
Family worker	2,500	3,500	7,500	7,500	15,000	15,000
	(32)	(45)	(96)	(96)	(191)	(191)

Source: Authors' analysis based on survey data.

Note: Summary statistics for individuals in survey. Results are shown with and without sampling weights. In Panel (c), the study only includes wage workers who were able to provide an answer. In Panel (d), if respondents did not provide an exact monthly income, but did indicate the bin into which their income fell, the study used the median value from the bin for their income.

Strictly dominates scenarios

Figure 1. Empirical CDF of Minimum Percent Selecting One Scenario



Source: Authors' analysis based on survey data.

Note: CDF of the minimum percent of respondents who chose one of the two alternatives. A minimum of 50 percent would indicate that half of the respondents selected each alternative. Strictly dominated choices are shown as triangles.

Shows that most scenarios not strictly dominated, some people picked each.
Three scenarios were dominated (which ones were they?)

Table 6. Marginal Values of Attributes

	Coefficient (1)	Marginal value in terms of % income (β_k/β_w) (2)	Labour law requirement (3)	Marginal value × labour law requirement (4)
Contract, 6 months	0.97	19.0		
Contract, 1 year	1.37	26.9		
Contract, long-term	2.22	43.5		
Notice (days)	0.020	0.39	30 days	11.7
Hours (median)	−0.021	−0.41		
Leave (days)	0.027	0.53	10 days	5.3
Provident Fund (Yes)	0.91	17.8		
Percent change in income	0.051	1.0		

Source: Authors' analysis based on survey data.

Note: Coefficients and associated marginal values of each attribute relative to income. Marginal value is calculated by dividing coefficient on attribute by coefficient on percent change in income. Labour law is based on requirement for typical workers given in the 2006 Bangladesh Labour Law.

- Average working willing to forgo and increase of 5% of monthly income for 10 days of paid leave? (how does 5% of monthly income translate into work days?)
- Typical worker willing to forgo 12% of monthly income for 30 days of notice for termination.

Table 7. Conditional Logit Coefficient Estimates by Gender and Education

	Male		Female		Less than Primary		Secondary	
	Coefficient (se) (1)	WTP (2)	Interaction (se) (3)	WTP (4)	Coefficient (se) (5)	WTP (6)	Interaction (se) (7)	WTP (8)
Contract, 6 months	0.99***	18.7	−0.093	19.5	0.86***	16.9	0.19*	20.7
	(0.065)		(0.11)		(0.085)		(0.11)	
Contract, 1 year	1.43***	27.0	−0.30***	24.5	1.15***	22.5	0.37***	30.0
	(0.071)		(0.11)		(0.090)		(0.12)	
Contract, long-term	2.31***	43.6	−0.45**	40.3	1.81***	35.5	0.68***	49.1
	(0.11)		(0.18)		(0.14)		(0.19)	
Notice	0.020***	0.38	−0.0019	0.39	0.018***	0.35	0.0028	0.41
	(0.0010)		(0.0018)		(0.0014)		(0.0018)	
Hours	−0.020***	−0.38	−0.0093***	−0.64	−0.020***	−0.39	−0.0026	−0.43
	(0.0015)		(0.0027)		(0.0021)		(0.0027)	
Leave	0.028***	0.53	−0.0066	0.46	0.028***	0.55	−0.0028	0.50
	(0.0029)		(0.0049)		(0.0040)		(0.0051)	
Provident Fund	0.94***	17.7	−0.20*	16.1	0.93***	18.2	−0.032	17.7
	(0.063)		(0.11)		(0.091)		(0.11)	
Perc. change income	0.053***	1.0	−0.0069**	1.0	0.051***	1.0	−0.00030	1.0
	(0.0021)		(0.0035)		(0.0029)		(0.0037)	
Observations	23,568				23,496			

Source: Authors' analysis based on survey data.

Note: WTP = willingness to pay. Columns (1) and (5) show the baseline coefficients for men and for workers with primary or lower education, while columns (3) and (7) show interactions for women and for workers with secondary or higher education, respectively. The WTP for each attribute for women is calculated by summing the coefficients on that attribute in columns (1) and (3), respectively, and dividing by the sum of the coefficients on income in columns (1) and (3). A similar calculation is used for those with a secondary or higher education level. Omitted level for contract is none. Omitted level for Provident Fund is none. Standard errors are clustered at the respondent level. *, ** and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

- WTP for shorter hours much higher for women than for men.
- More education means higher WTP for contracts.

Table 8. Conditional Logit Coefficient Estimates by Employment Type

	Private employee		Govt. employee		Casual worker		Self-employed	
	Coefficient (se) (1)	WTP (2)	Interaction (se) (3)	WTP (4)	Interaction (se) (5)	WTP (6)	Interaction (se) (7)	WTP (8)
Contract, 6 months	1.00***	18.5	0.22	24.9	−0.0074	16.6	−0.090	19.0
	(0.085)		(0.23)		(0.18)		(0.12)	
Contract, 1 year	1.47***	27.2	0.36	37.3	−0.042	23.9	−0.26*	25.3
	(0.090)		(0.27)		(0.18)		(0.13)	
Contract, long-term	2.33***	43.1	0.88**	65.5	0.066	40.1	−0.37*	41.0
	(0.14)		(0.41)		(0.30)		(0.20)	
Notice	0.021***	0.39	0.0026	0.48	0.0015	0.38	−0.0026	0.38
	(0.0014)		(0.0040)		(0.0030)		(0.0020)	
Hours	−0.023***	−0.43	−0.0083	−0.64	−0.0039	−0.45	0.0047	−0.38
	(0.0020)		(0.0058)		(0.0044)		(0.0028)	
Leave	0.029***	0.54	−0.0049	0.49	−0.0037	0.42	−0.0031	0.54
	(0.0039)		(0.011)		(0.0084)		(0.0055)	
Provident Fund	0.98***	18.1	−0.038	19.2	−0.026	16.0	−0.15	17.4
	(0.086)		(0.23)		(0.18)		(0.12)	
Perc. change income	0.054***	1.0	−0.0050	1.0	0.0058	1.0	−0.0062	1.0
	(0.0028)		(0.0082)		(0.0057)		(0.0040)	
Observations	23,568							

Source: Authors' analysis based on survey data.
Note: WTP = willingness to pay. Column (1) shows the baseline coefficients for private employees, while columns (3), (5), and (7) show interactions for government employees, casual workers, and self-employed workers, respectively. The WTP for each attribute for government employees is calculated by summing the coefficients on that attribute in columns (1) and (3), respectively, and dividing by the sum of the coefficients on income in columns (1) and (3). A similar calculation is used for casual workers and the self-employed. Omitted level for contract is none. Omitted level for Provident Fund is none. Standard errors are clustered at the respondent level. *, ** and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

- variables interacted with type of worker.
  - Government workers place value on type of contracts that are longer term (which way does that causality go)?

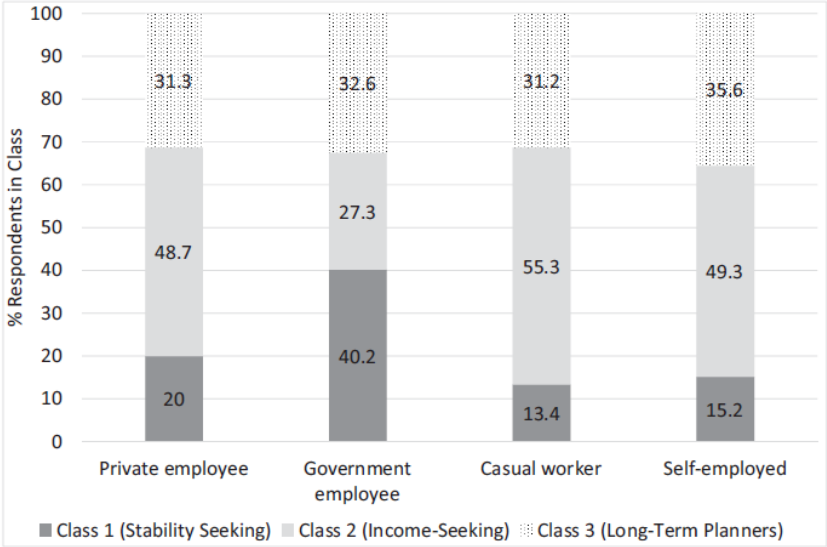
	Class 1 ("Stability Seeking")		Class 2 ("Income Seeking")		Class 3 ("Long-Term Planners")	
	Coeff (se) (1)	WTP (2)	Coeff (se) (3)	WTP (4)	Coeff (se) (5)	WTP (6)
Contract, 6 months	2.62***	44.4	0.55***	5.7	0.86***	29.7
	(0.49)		(0.19)		(0.25)	
Contract, 1 year	3.87***	65.6	1.24***	12.8	1.05***	36.2
	(0.84)		(0.19)		(0.19)	
Contract, long-term	6.27***	106.3	1.83***	18.9	2.2***	75.9
	(0.84)		(0.54)		(0.25)	
Notice	0.017***	0.29	0.019***	0.20	0.034***	1.17
	(0.003)		(0.002)		(0.004)	
Hours	−0.028***	−0.47	−0.041***	−0.42	−0.028***	−0.97
	(0.01)		(0.006)		(0.005)	
Leave	0.004	0.07	0.056***	0.58	0.018	0.62
	(0.018)		(0.008)		(0.011)	
Provident Fund	0.73	12.4	0.75***	7.7	1.64***	56.6
	(0.78)		(0.23)		(0.31)	
Perc. change income	0.059**	1.0	0.097***	1.0	0.029**	1.0
	(0.029)		(0.007)		(0.013)	
Class share	0.198		0.467		0.335	
# (%) workers assigned to class	367 (18.7%)		949 (48.3%)		648 (33.0%)	

Source: Authors' analysis based on survey data.

Note: WTP = willingness to pay. Results from a latent class analysis. Sampling weights are not applied. Omitted level for contract is none. Omitted level for Provident Fund is none. *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

- Identifies latent classes based on what they seek.

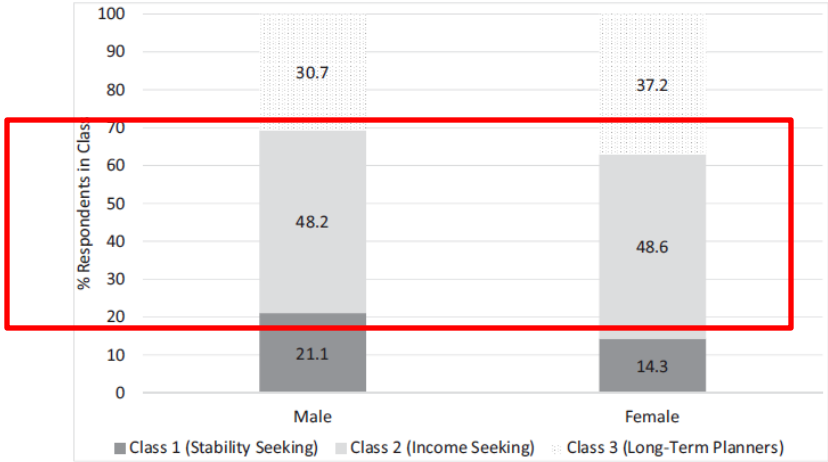
Figure 2. Latent Class Results—Assigned Class by Employment Type



Source: Authors' analysis based on survey data.
Note: Percent of respondents assigned to each class in the latent class analysis, by type of employment at the time of the survey. Respondents were assigned to the class to which they had the highest posterior probability of belonging.

Most people looking for income

Figure 3. Latent Class Results—Assigned Class by Gender



Source: Authors' analysis based on survey data.
Note: Percent of respondents assigned to each class in the latent class analysis, by gender. Respondents were assigned to the class to which they had the highest posterior probability of belonging.

5. Conclusions

- Used choice experiment to understand what job attributes workers in Bangladesh value most.
- Job stability most important
  - Average worker willing to forgo and increase of about 19 percent of monthly income for 6 month contract
  - 27% for a one year contract
  - 44% for a long term contract (relative to no contract).
- Also find substantial heterogeneity in contracts.
  - Women want fewer work hours for cultural reasons.
- Lends support for use of choice experiments to estimate WTP for job choice as opposed to hedonic price models
- Provides recommendations to policy makers on what workers value.

Outline of methods

1. Revealed preference methods
   - Prieto et al. (2021)
   - Channa et al. (2021)

2. Stated preference methods
   - Mahmud et al. (2020)
   - **General example of contingent valuation**

Sometimes asking general WTP/WTA questions can be informative

- For example at a project baseline.
- When deciding how to allocate funds.

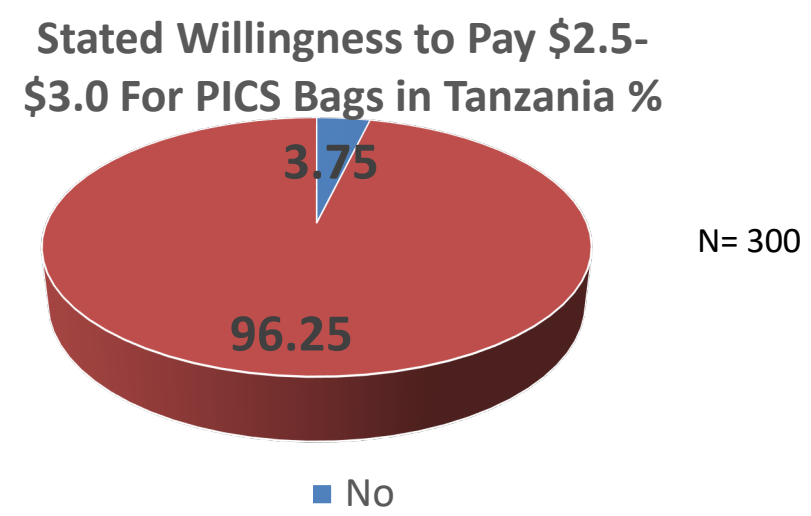
Baseline Survey conducted in Velingara Department of Senegal during May and June 2016.

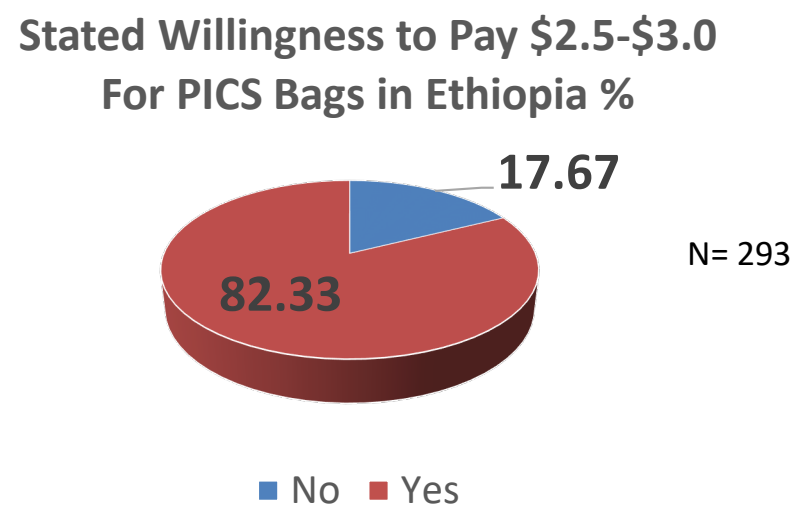
Willing to purchase a 10 m^2 tarp for 3,000 CFA (5.36 USD) / hygrometer for 1,000 CFA (1.79 USD)?

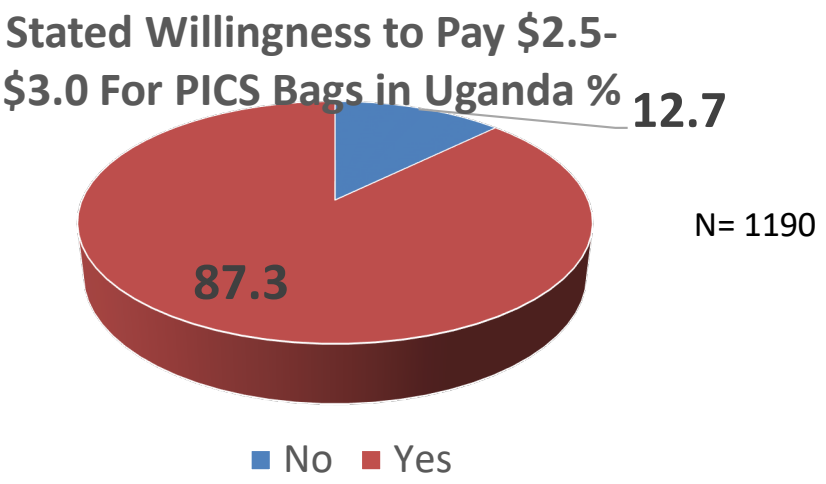
	Yes (%)	Yes (n)	No (%)	No (n)
Tarp	89 %	1,777	10 %	208
Hygrometer	87 %	1,742	12 %	246

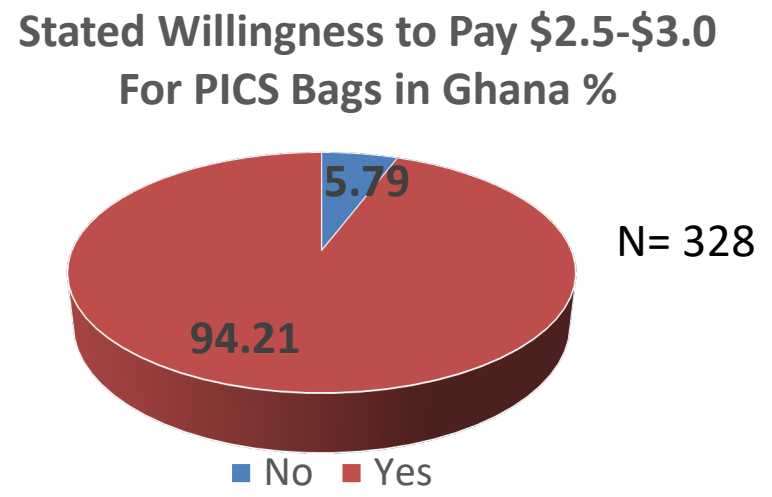
How much are you willing to pay for a solar dryer that dries 100 kg shelled maize/ day to a level sufficient for storage?

	Mean (median)
USD	62.04 (26.79)
CFA	34,743 (15,000)


Stated Willingness to Pay $2.5-$3.0 For PICS Bags in Tanzania %
3.75
96.25
N= 300
No


Stated Willingness to Pay $2.5-$3.0 For PICS Bags in Ethiopia %
17.67
82.33
N= 293
No
Yes


Stated Willingness to Pay $2.5-$3.0 For PICS Bags in Uganda %
12.7
87.3
N= 1190
No
Yes


Stated Willingness to Pay $2.5-$3.0 For PICS Bags in Ghana %
5.79
94.21
N= 328
No
Yes

Overall all thoughts/conclusions on experimental methods for demand

- *Ceteris paribus* revealed preference experiments preferred to stated preference.
  - Must do practice rounds so participants understand
  - Some issues with participation fee or not.
- Start with revealed preference idea, think about if it is feasible or if need to go to stated preference.
  - Ease of implementation or budget limitations not a reason in and of itself
- If going to stated preference, justify why.
  - Eg: product doesn't exist, may want to vary multiple attributes
  - Baseline information for a project

Thank you for your time. Questions?

jrickerg@purdue.edu

Figure A1. Maize density at various moisture content levels.

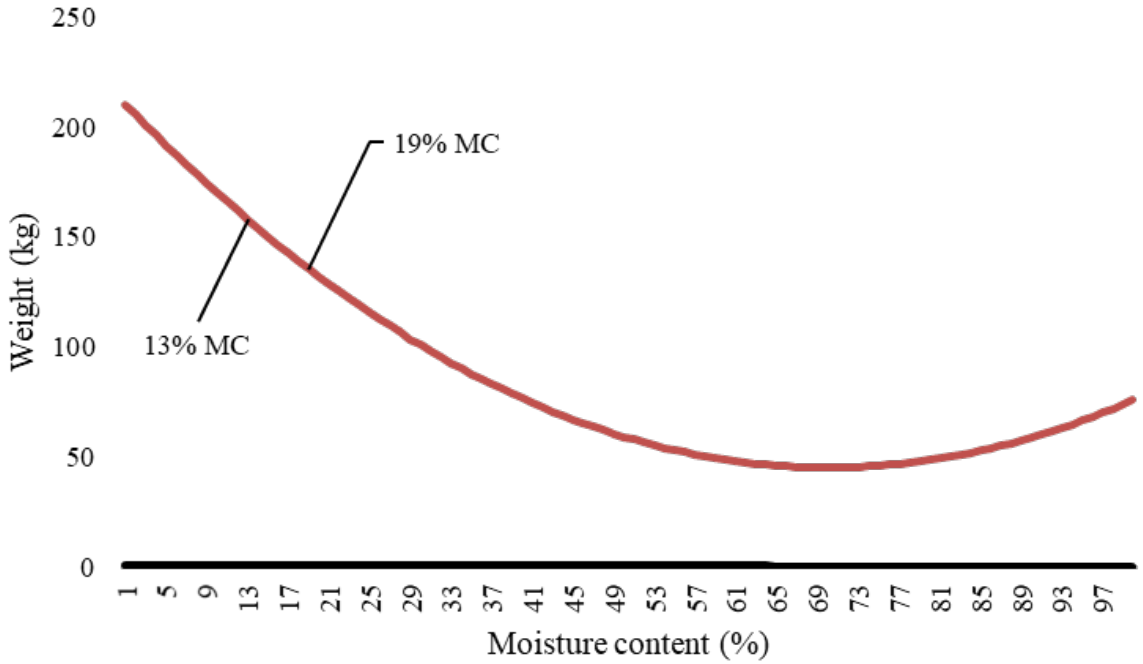


Table A1. Change in weight of maize contained in 0.072 m^3 at varying moisture content levels.

Moisture content (MC; %)	Density (kg/m^3)	Weight (kg)
19	695.45	50.0
18 (high MC)	707.36	50.9
17	720.24	51.8
16	734.08	52.8
15 (medium MC)	748.88	53.8
14	764.64	55.0
13 (low MC)	781.36	56.2

We use the standard grain bulk density equation for maize, where maize density (kg/m3) = 1086.3 – 2971 * MC + 4810 * MC2 (Brusewitz, 1975). In this equation, MC is the wet, not dry, basis MC. Wet basis MC is the type most commonly measured by moisture meters. Using the example of 19% MC maize, we calculate its density to be 695.45 kg/m3, and 50 kg of maize (a standard bag, and the amount we asked traders to bid on) at 19% MC occupies a volume of 0.072 m3. We then choose to keep volume constant and measure the change in weight for various moisture content levels. We choose to base the calculations on a standard bag of 50 kg, at 19% MC (Table A1); the specific mass used in the calculation does not matter because we focus on the percent change in weight for various moisture content levels.

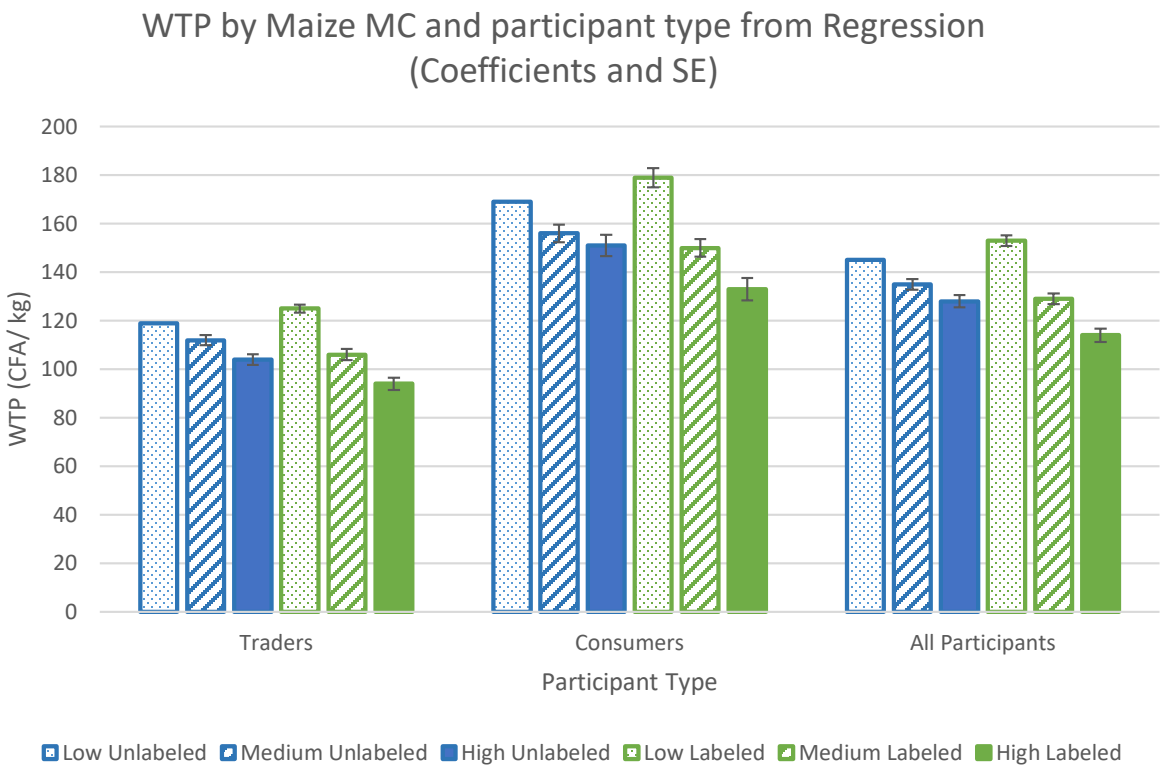

WTP by Maize MC and participant type from Regression
(Coefficients and SE)
WTP (CFA/ kg)
200
180
160
140
120
100
80
60
40
20
0
Traders
Consumers
All Participants
Participant Type
Low Unlabeled
Medium Unlabeled
High Unlabeled
Low Labeled
Medium Labeled
High Labeled

Table 5. Hypotheses tests based on regression coefficients.

Research question	Hypothesis test	Coefficients in Table 4	Simplifies to	Sample	Test result (F or χ^2)
(1)	Is WTP identical for labeled maize of low, medium, and high MC?	$(\widehat{\beta_0} + \hat{\alpha}) = (\widehat{\beta_0} + \widehat{\beta_1} + \hat{\alpha} + \widehat{\gamma_1}) = (\widehat{\beta_0} + \widehat{\beta_2} + \hat{\alpha} + \widehat{\gamma_2})$	$(\widehat{\beta_1} + \widehat{\gamma_1}) = (\widehat{\beta_2} + \widehat{\gamma_2}) = 0$	All participants Consumers only Traders only	278.8*** 207.8*** 83.7***
(2)	Is the difference in estimated WTP between labeled *low-MC and high-MC* maize ≤ the density premium (10.5%)?	$(\widehat{\beta_0} + \hat{\alpha}) - (\widehat{\beta_0} + \widehat{\beta_2} + \hat{\alpha} + \widehat{\gamma_2}) \leq (\widehat{\beta_0} + \widehat{\beta_2} + \hat{\alpha} + \widehat{\gamma_2}) * 0.105$	$1.105 * (\widehat{\beta_2} + \widehat{\gamma_2}) + 0.105 * (\hat{\alpha} + \widehat{\beta_0}) \geq 0$	All participants Consumers only Traders only	286.2*** 211.8*** 86.8***
(2)	Is the difference in estimated WTP between labeled *medium-MC and high-MC* maize ≤ the density premium (5.9%)?	$(\widehat{\beta_0} + \widehat{\beta_1} + \hat{\alpha} + \widehat{\gamma_1}) - (\widehat{\beta_0} + \widehat{\beta_2} + \hat{\alpha} + \widehat{\gamma_2}) \leq (\widehat{\beta_0} + \widehat{\beta_2} + \hat{\alpha} + \widehat{\gamma_2}) * 0.059$	$1.059 * (\widehat{\beta_2} + \widehat{\gamma_2}) + 0.059 * (\widehat{\beta_0} + \hat{\alpha}) - (\widehat{\beta_1} + \widehat{\gamma_1}) \geq 0$	All participants Consumers only Traders only	106.5*** 31.6*** 16.0***
(2)	Is the difference in estimated WTP between labeled *low-MC and medium-MC* maize ≤ the density premium (4.3%)?	$(\widehat{\beta_0} + \hat{\alpha}) - (\widehat{\beta_0} + \widehat{\beta_1} + \hat{\alpha} + \widehat{\gamma_1}) \leq (\widehat{\beta_0} + \widehat{\beta_1} + \hat{\alpha} + \widehat{\gamma_1}) * 0.043$	$1.043 \cdot (\widehat{\beta_1} + \widehat{\gamma_1}) + 0.043 * (\hat{\alpha} + \widehat{\beta_0}) \geq 0$	All participants Consumers only Traders only	46.4*** 83.2*** 29.4***
(3)	Are the unlabeled maize-grade slopes equal?	$\widehat{\beta_0} = \widehat{\beta_0} + \widehat{\beta_1} = \widehat{\beta_0} + \widehat{\beta_2}$	$\widehat{\beta_1} = \widehat{\beta_2} = 0$	All participants Consumers only Traders only	51.7*** 33.2*** 20.5***
(3)	Are the differences in WTP between low and high MC equal for unlabeled and labeled maize?	$\widehat{\beta_0} - (\widehat{\beta_0} + \widehat{\beta_2}) = (\widehat{\beta_0} + \hat{\alpha}) - (\widehat{\beta_0} + \widehat{\beta_2} + \hat{\alpha} +$	$\widehat{\gamma_2} = 0$	All participants Consumers only Traders only	*** for all. See coefficients $\widehat{\gamma_2}$ in Table 4.
(4)	Do traders and consumers differ in their ability to detect maize MC between low and high levels?	$\widehat{\beta_{0\,C}} - (\widehat{\beta_{0\,C}} + \widehat{\beta_{2\,C}}) = \widehat{\beta_{0\,T}} - (\widehat{\beta_{0\,T}} + \widehat{\beta_{2\,T}})$	$\widehat{\beta_{2\,C}} = \widehat{\beta_{2\,T}}$	All participants	0.31
(4)	Do traders and consumers differ in their ability to detect maize MC between low and medium levels?	$\widehat{\beta_{0\,C}} - (\widehat{\beta_{0\,C}} + \widehat{\beta_{1\,C}}) = \widehat{\beta_{0\,T}} - (\widehat{\beta_{0\,T}} + \widehat{\beta_{1\,T}})$	$\widehat{\beta_{1\,C}} = \widehat{\beta_{1\,T}}$	All participants	1.67