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Eliciting Consumer WTP for Food Characteristics in a Developing Context: Comparison of four methods in a field experiment.

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Abstract. —This paper aims at answering two objectives;1) assess consumer preference and willingness to pay for organic and food safety inspected tomatoes in a traditional African food market; 2) compare willingness to pay for the tomato attributes in four different elicitation techniques. We elicit willingness to pay for conventional, organic and/or food-safety-inspected tomatoes using methods that can be conducted with one respondent at a time: the Becker–DeGroot–Marschak mechanism, multiple price lists, multiple price lists with stated quantities, and real-choice experiments. All methods show that consumers are willing to pay a premium for organic and food-safety-inspected tomatoes. However, the size of the premium is significantly larger when consumers choose between alternatives than when they indicate their reservation price. Throughout the paper, we discuss method implementation issues for this context and make method recommendations for future research.

Key words — elicitation methods, framed field experiments, organic, food-safety inspected, Tanzania, WTP[1]

JEL: C93, D12, Q10, Q13

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1. Introduction

Most consumer valuation studies presented in academic journals come from the US or Europe. The traditional way of conducting these studies is through surveys, but in recent years there has been a growing literature using lab and field experiments, where products have been evaluated and sold using various experimental valuation methods (Alfnes & Rickertsen 2011). Implementing these methods in developing countries can be challenging due to technological, logistical, and literacy problems, but a few studies have been conducted (Alphonce & Alfnes 2012; De Groote et al. 2011; Lagarkvist et al. 2011; Masters & Sanogo 2002; Morawetz et al. 2011; Probst et al. 2012).

The most frequently used experimental valuation methods worldwide have been Vickrey-style sealed-bid auctions with endogenously determined market prices and the Becker–DeGroot–Marschak (BDM) mechanism with exogenously determined prices (Becker et al. 1964; Vickrey 1961). Recently, researchers have also used non-hypothetical choice (Alfnes et al. 2006; Lusk & Schroeder 2004) and price-list experiments (Andersen et al. 2006; Corrigan et al. 2009; Kahneman et al. 1990). In these experimental valuation methods, the participants submit a bid, choose a product, or state at which prices they are interested in buying a product. For the methods to be incentive compatible, it must be in the best interest of the participants to reveal their true preferences.

The methods used in the literature differ with respect to how easy it is to explain the rules, how easy it is to understand the participant's dominant strategy, how time consuming they are, and how many participants are needed at a time. In this paper, we use and compare four experimental valuation methods that are relatively easy to explain, have a dominant strategy that is not very difficult to understand, are relatively quick to conduct, and can be conducted with one participant at a time. The four methods are the BDM, the multiple-price-

list (MPL), the multiple-price-list with stated quantities (MPLX), and the real-choice experiments (RCE) [2]. The easiness of explaining and understanding the four methods and that they can be done relatively quickly with one participant at a time makes them suitable for eliciting willingness to pay (WTP) in a busy market environment like a traditional African food market. These markets often include illiterate consumers, product information given orally by the seller, no labels or information on the products, only one seller and one buyer involved in each transaction, and a buying behavior that involves consumers being part of the price setting. We compare the WTP values, efficiency of the method and easiness in explaining and understanding the methods, through investigating Tanzanian consumer WTP for organic and/or food-safety-inspected tomatoes.

The study contributes to the literature assessing whether elicitation methods matter in estimating WTP (Lusk & Schroeder 2002; Lusk et al. 2008), in addition the study includes less often used but potentially very useful elicitation methods in field experiments. The study use a framed field experiment in a traditional African food market with people going to buy tomatoes using their own money (no windfall money), making it one of the first studies to use such a design in this type of setting. Due to the market institutions and the literacy problem among participants, the study contributes to the knowledge about the use of experimental

[2] It is worth noting here that we do not include the popular Vickrey-type auctions. The reason for this is that these auctions have several features that make them difficult to conduct in a sometimes chaotic traditional market. First, they include multiple bidders bidding simultaneously on the same product. This moves the buying process far away from the typical one-on-one haggling process between the buyer and the seller in these markets. Second, the price-setting mechanism using the highest losing bid is confusing for most participants, and needs extensive explanations and training, which can be hard to conduct in such a market place.

valuation methods in such a setting. The results have implications for researchers' choice of methods and implications on project evaluation and policy recommendations.

2. Background

2.1. Traditional food markets in an African context

Traditional markets in African countries such as Tanzania, Uganda, and Kenya, are characterized by fresh produce being sold in piles in open air. The products are not labeled and the seller is the only source of information about credence attributes like origin and product variety[3]. Consumers choose their produce mainly based on its physical attributes, including size, freshness, shape, cosmetic damage, and color.

Consumers in these markets are used to finding a posted price on piles of produce; the various piles can be differentiated by variety, origin, or physical characteristics. A consumer chooses the amount he/she wants and either pays the price or negotiates on the price for the chosen product. Similar traders selling the same produce are found in the same open market, mostly just a meter or two away from each other. Hence, the markets are highly competitive, giving the consumer some market power when negotiating.

Despite the markets being characterized by poor hygiene and sanitation, the traditional markets are the main points of purchase for many urban consumers (Tschirley 2007; Tschirley & Ayieko 2008). For example in a consumer study, Tschirley and Ayieko (2008) reported that consumers living in Nairobi believed that vegetables from the high-end markets were the

[3] Credence attributes are attributes that consumers cannot ascertain. Unlike experienced goods, consumers cannot measure their utility from consuming goods with credence attributes after consuming them. Utility can only be realized when the attributes are communicated to the consumers. Such attributes include the vitamin, nutrition, safety, or eco-friendly status of products.

safest, but still the traditional market had 90% of the market share during the time of the study (Tschirley & Ayieko 2008). In Tanzania, fresh produce have only recently been introduced in high-end markets and these markets holds a very low market share for fresh produce. According to Lagerkvist et al. (2013), the produce in these markets are usually perceived to be safer than those from the traditional markets, but unfresh and expensive.

2.2. Consumer studies on organic and food-safety-inspected food in Africa

Due to increasing awareness and health concerns among consumers, healthy eating is currently one of the major trends in the world's food markets. Healthy eating encompasses nutrition and safety, and both are important for wellbeing. This revolving trend for healthy eating is also evident in developing African countries. For example, Ngigi et al. (2011) found that nutrition and food safety were among the three most important factors driving food choices in Kenya.

Only in recent years has consumer studies related to food safety started to emerge in developing countries. The African studies include a study on the WTP for safer leafy vegetables in Nairobi (Ngigi et al. 2011), and a study on WTP for safer tomatoes in Tanzania (Alphonce & Alfnes 2012). Both studies found that consumers in these markets were willing to pay a significant and positive premium for safer foods. In addition, the WTP premium was positive and significant across income and gender groups, though women were willing to pay a much higher premium for food safety related attributes.

Other consumer studies related to food safety in Africa include; studies on genetically modified (GMO) products conducted in Tanzania, Uganda, and Kenya (Kikulwe et al. 2011; Kimenju & De Groote 2008; Lewis et al. 2010); and a study on the perceptions of health risks among the players in the vegetable value chain (Lagerkvist et al. 2013).

3. Experimental design and methods

3.1. Experimental design

The experiment was conducted in a traditional food market in Morogoro, Tanzania, in May 2011. Morogoro is a town with a population of about 200,000 (URT 2006), located 190 km west of Dar es Salaam. The main economic activities are agriculture and educational services, and is labeled Tanzania's food basket.

We sold tomatoes using four different elicitation methods by setting up a table close to other tomato sellers. The elicitations methods were selected from the food-valuation literature based on their ability to be conducted with one respondent at a time (for an overview of the non-market valuation methods, see Alfnes and Rickertsen (2011)). The selected methods were the BDM, RCE, MPL, and MPLX.

By conducting the experiments in the field, we are able to elicit preferences in the context we are interested in studying. Compared with conducting a lab experiment, where participants show up at some university or hotel and make their choices, a field experiment allow us to include several sought-after field characteristics.

The traditional market is where consumers in Morogoro usually make most of their purchases for fresh produce. The participants came to the market to buy tomatoes among other things and used their own money to buy the tomatoes in the experiment. The experiments were conducted just a few meters away from other sellers with similar products.

In the experimental economics literature, this means real context, real consumers, real economic incentives (no windfall money), and real outside options. All highly sought-after characteristics of a food valuation experiment. The down side is reduced control and reduced time to explain and train the participants.

3.2. Products

The products were 500 g portions of tomatoes. We included four types of tomatoes: (1) conventional tomatoes, (2) organic tomatoes, (3) food-safety-inspected conventional tomatoes, and (4) food-safety-inspected organic tomatoes. In the paper, we will refer to the latter two types as inspected tomatoes and inspected organic tomatoes, respectively. Information about the credence attributes in the last three types of tomatoes is normally not conveyed in the traditional markets; hence, consumers assume that all the tomatoes in the market are conventional. We presented the four tomato alternatives and answered any questions the consumers had about the products.

Tomatoes were chosen because they are used by the majority of households and food vendors. In recent years, production of many types of products such as tomatoes has shifted from a subsistence to a commercial basis. In this process, there has been a growing concern about bad agricultural practices, as more examples have been revealed of poor pest-management practices, use of unsafe irrigation water, and production in areas highly susceptible to heavy metals (Ngowi et al. 2007; Shemdoe 2010). Tomatoes therefore represent a familiar and frequently purchased product where there is likely to be a demand for improvements in the production processes.

3.3. Subjects

Consumers attending the market were asked to participate in a study on food market decision making conducted by a group of researchers from the local agricultural university. Consumers were randomly selected based on two screening questions: 1) whether they were interested in buying tomatoes that day, and 2) whether they were involved in the family's food decision making. Only those consumers who answered "yes" to both questions were invited to

participate in the experiment. To avoid a windfall money effect (Ackert et al. 2006; Harrison 2007), we diverted from the practice of most valuation experiments and did not pay the participants to take part in the experiment. Instead, participants were rewarded with a small bag of onions for their participation after the experiment. In other words, they were not given any money for their participation, and the money they used in the experiment was the money they had originally planned to spend on purchasing food.

We recruited a total of 254 participants, of which 76 were assigned to the BDM, 69 to the MPL, 44 to the MPLX, and 65 to the RCE. The number of participants in each method depended on the turn up and time in conducting the experiments:- the MPL and RCE were conducted during the weekend, while the BDM[4] and MPLX were conducted during the week. We used quota sampling to avoid systematic variation in gender and income between the four methods. The income sampling was based on appearance, and in the survey, the income assessment was confirmed or nullified. We recruited a higher number of women than men, because in Tanzania women are the main shoppers and food decision makers. The characteristics of the participants in each method are summarized in Table 1.
An ANOVA test failed to reject the null hypothesis that the participants' characteristics between the valuation methods were identical.

3.4. Experimental valuation methods

To enhance the participants' understanding, we explained the methods and procedures one-to-one (details of the experimental procedures are in Appendix A). The treatments were as similar as possible, and in all treatments we followed nine steps: (1) the four different tomatoes were presented with logos and their attributes explained; (2) the participants were

[4] The experiment took five days, the BDM was run in two days, while all the other methods were run in one day.

told how the respective experimental valuation method worked; (3) an example of the method was given; (4) the participants made a bid or choice; (5) a binding product was randomly drawn; (6) a binding price or choice set was randomly drawn; (7) the participants who were to buy tomatoes did so at the price determined by the random choices in steps 5 and 6; (8) the participants received onions for their participation; and (9) the participants completed a short survey.

3.4.1. Becker–DeGroot–Marshak (BDM) mechanism

In the BDM mechanism, a participant is asked to bid for a product, and he/she has to buy the product at a randomly drawn price if the bid equals or exceeds the drawn price. Each participant bids on the four tomato products simultaneously. To avoid diminishing effects from multiple purchases, only one of the products was randomly selected as binding.

As the price is randomly drawn, the participants' bids only determine if they are allowed to buy or not. Therefore, their dominant bidding strategy is to bid their WTP for the product and thereby reveal their true preferences.

3.4.2 Multiple price-list (MPL) format

In the MPL format, participants are given an array of ordered prices in a table, one per row, and asked to indicate whether they are willing to buy a product at each price level. Then, one of the prices is randomly drawn as binding. For it to be a multiple price list there must be more than one row of prices. The price list used had four columns of prices, one for each of the four tomato products. The price list had a new price point for every 50 TZS.

Each participant indicated their willingness to buy the different tomatoes at the various prices on the price list. Then one price and one product was randomly drawn as binding, and

participants who had indicated that they would buy the drawn product at the drawn price did so.

As the price is randomly drawn, the participants' choices only determine if they are allowed to buy or not. Therefore, their dominant strategy is to say "yes" to buying at all prices up to their WTP price, and thereafter "no". Thereby, they reveal their true WTP.

One of the known weaknesses of price-list methods is that the consumers' stated valuations are affected by the range of prices on the price list (Andersen et al. 2006). To test for an anchoring effect, a between-sample design using two different price lists was used. A price list with lower prices started at 50 TZS and ended at 1,000 TZS, and a price list with higher prices started at 350 TZS and ended at 1,250 TZS. To differentiate between the two price lists, we refer to them as MPL-L and MPL-H, respectively. The market price for a 500 g portion of conventional tomatoes was approximately 350 TZS (ranging between 300 TZS and 400 TZS) in the market at the time of the experiment.

3.4.3 Multiple price list with quantity statements (MPLX) format

The MPLX format has the same setup as the MPL format, but instead of indicating whether they want to buy or not, the participants indicate the number of units of the product they want to purchase at the different prices. The price range was the same as in the high-price version of the MPL, with prices between 350 TZS and 1,250 TZS. As in the first two methods, one of the products and one of the prices were randomly drawn as binding. In the MPLX a participant buys the number of portions indicated in the binding product at the binding price for each product. As the price is randomly drawn, the participants' choices only determine if and how many units they are going to buy. Therefore, their dominant strategy is to state the number of units they want to buy at each of the prices. Thereby, they reveal their true WTP.

The MPLX design is inspired by Corrigan et al.'s (2009) open-ended choice experiments, in which they fixed the price for the generic product (conventional rice) and had a price list for the new product (GMO rice). Participants were asked to indicate how much they wanted of the two alternatives at the various prices. In our experiment, we wanted to test multiple products and treat all four products equally, therefore we used a price list for all four products, including the generic tomatoes (conventional tomatoes). To our knowledge, this is the first paper using the MPLX in a field experiment.

3.4.4. Real-choice experiment (RCE)

In the RCE, participants choose between various products through a series of choice scenarios. Then, one of the scenarios is randomly drawn as binding. We adopted the design by Lusk and Schroeder (2004), by letting all the products be available in each of the choice sets and only used a fractional factorial design to vary the prices between the choice sets. The fractional factorial design was generated from SPSS, with 16 profiles, which were divided into two blocks. Therefore, each participant faced eight independent shopping scenarios.

In our design, we decided to exclude the no-choice option, because in the experiment we only included consumers who were coming to the market to buy tomatoes that day. Therefore, we are only able to estimate WTP for the tomato characteristics, and not WTP for the whole tomato.

The dominant strategy for participants is to choose the alternative that they think gives them the highest utility in each of the choice sets, thereby revealing their true preferences.

4. Data analysis

4.1. A comparison of WTP estimates from the four methods

We investigated consumer WTP for organic and food-safety-inspected tomatoes using four different elicitation methods, as described above. The data for the different methods come in different formats. Three of these formats use non-comparative scales (BDM, MPL, and MPLX), where the participants indicate their WTP for each type of tomato, and one format (RCE) uses a comparative scale, where the participants compare the alternatives and choose one. The BDM where the participants state a WTP yields continuous WTP data for 500 g of tomatoes. The MPL, where the participants indicate the prices they would be willing to buy at from a list of prices, yields interval WTP data for 500 g of tomatoes. The MPLX yields interval WTP data for both 500 g of tomatoes and multiples of 500 g. Finally, the RCE yields discrete preference data that can be used to estimate the average WTP for 500 g of one type of tomato relative to another type.

Owing to the differences in data, the four methods have different estimation methods. To simplify comparison of the methods, using results from the estimated models, we focus on the one measurement that all four methods can be used to find; consumers' WTP price premium for one unit of three premium varieties of tomatoes (organic, inspected, and organic inspected) relative to the conventional tomatoes.

We use the four types of data to find the following money metric WTP equation:

$$WTP_{ij} = \beta_0 + \beta_1 Organic_j + \beta_2 Inspected_j + \beta_3 OrganicInspected_j, \quad (1)$$

where WTP_{ij} is the WTP of participant *i* for 500 g of product *j;* $Organic_j$ is a dummy for the organic tomatoes; $Inspected_j$ is a dummy for the inspected tomatoes; $OrganicInspected_j$ is a dummy for the inspected organic tomatoes; and the betas are the corresponding money metric parameters. The constant term is the estimated WTP for the reference product (the conventional tomatoes). For the RCE, the constant is not included and we only find the price

premiums. Owing to the differences in the data described above, we use three different estimation methods to obtain this money metric WTP equation.

4.2. Econometric models

For the BDM data, we follow the common practice used in BDM studies and estimate a panel Tobit model censored at zero (Lusk & Shogren 2008). This gives the following Tobit model:

(2) $$WTP_{ij} = \beta_0 + \beta_1 Organic_j + \beta_2 Inspected_j + \beta_3 OrganicInspected_j + v_i + \varepsilon_{ij},$$

where WTP_{ij} is the WTP of participant *i* for 500 g of product *j*; v_i is the individual specific random term, and ε_{ij} is the normal distributed error term. The rest is as in equation (1). The model is estimated with the *xttobit* command in STATA 12.

For the MPL data, we follow the common practice used in MPL studies and estimate an interval regression model (Andersen et al. 2006). For the MPLX, we examine the WTP for the first unit when we compare methods. In this case, there is no difference between the data from the MPL and the MPLX, so we also use the interval regression model for MPLX. This gives the following interval regression model for both MPL and MPLX:

(3) $$WTP_{ij}^{*} = \beta_0 + \beta_1 Organic_j + \beta_2 Inspected_j + \beta_3 OrganicInspected_j + v_i + \varepsilon_{ij},$$

where WTP_{ij}^{*} is the WTP of participant *i* for 500 g of product *j*. WTP_{ij}^{*} is not directly observed, but we observe an interval around WTP_{ij}^{*}, or at least an upper or lower limit for WTP_{ij}^{*}. The lower limit is the highest price at which the participant wanted to buy and the upper limit is the lowest price at which they did not want to buy. The rest is as in equations (1) and (2). The model is estimated with the *xtintreg* command in STATA 12.

For the RCE data, we follow the common practice used in most recent choice experiment studies and estimate a mixed logit model (McFadden & Train 2000). This gives us the following random utility model:

(4) $$U_{ij} = \alpha_{1i} Organic_j + \alpha_{2i} Inspected_j + \alpha_{3i} OrganicInspected_j + \alpha_P Price_j + \varepsilon_{ij},$$

where U_{ij} is the utility of participant *i* for 500 g of product *j*; similar to equation (1-3) $Organic_j$ is a dummy for the organic tomatoes; $Inspected_j$ is a dummy for the inspected tomatoes and $OrganicInspected_j$ is a dummy for the inspected organic tomatoes. In addition to the other equations is $Price_j$ which is the price for product *j*.

The alphas are the respective utility parameters; where α_{1i}, α_{2i} and α_{3i} are random parameters and α_p is a fixed parameter; ε_{ij} are iid extreme value distributed error term. The model is estimated with the *mixlogit* command in STATA 12.

To transfer the results of the random utility model to a money metric WTP model such as equation (1), we divide all the other parameters in the random utility model by the negative of the price parameter. As discussed above, because we did not include a non-choice option in the RCE design, the resulting money metric WTP model only includes the WTP for the organic and inspected attributes, not WTP for the whole tomato. Thus, the RCE yields the following WTP model that provides WTP for the attributes, which can be compared with the WTP results for the attributes from the other methods:

(5) $$\overline{WTP_j} = -\left[\frac{\alpha_1}{\alpha_P} Organic_j + \frac{\alpha_2}{\alpha_P} Inspected_j + \frac{\alpha_3}{\alpha_P} OrganicInspected_j\right].$$

5. Results and Discussion

5.1. Implementation challenges in a traditional African food market

The four methods we implemented differed on how easy it was for the participants to understand them. This is an important characteristic in the choice of methods because the

participants are in the market to shop and are not prepared to take part in a lengthy experiment. Furthermore, it would be difficult to implement extensive training in a busy traditional market. The participants asked the fewest questions in relation to the methods based on price lists (MPL and MPLX), but as we will see later, price lists with very low prices affected their behavior, in a way indicating that not all understood their dominant strategy. The choice in the RCE was very easy to explain, but some of the participants had problems understanding the independence of the various choice scenarios.

The BDM was the method that gave most questions, and where the participants needed most repetition of the instructions. A seller that first asks how much the buyer is willing to pay and then wants to sell the product at a lower price than the price offered by the buyer seemed counter intuitive to the participants. As a result, they struggled to understand their dominant bidding strategy and thought that they could influence the price through their bidding. This is a typical finding in bid-based valuation methods, and therefore extensive training with other products is usually conducted in the BDM and other bidding-based valuation methods (Drichoutis et al. 2011).

The consumers in a traditional market are used to negotiating on the prices put forward by the seller. In the RCE, they are asked instead to choose between alternatives with predefined prices, as in a supermarket, which is an unfamiliar method of buying fruits, vegetables, and other products in these markets. Furthermore, the prices changed from scenario to scenario, possibly sending confusing price–quality signals. Moreover, in the BDM, there is no price to start the negotiation, adding to the unfamiliarity. In the MPL, the participants have a list of possible prices. This makes it easier for the participants because they can make a binary decision at each price point, “yes” or “no.” In the MPL, the participants seemed to negotiate with themselves down the price list, hence imitating the

typical market behavior where consumers negotiate on prices with the seller. For the MPLX, it seemed as if the participants negotiated with themselves for the number of portions of tomatoes as they went down the price list. The price and type of tomatoes had an effect on the decision to buy or not, and as the price decreased the number of portions that one was willing to buy increased for all types of tomatoes.

Since some of the consumers were illiterate, all the information about the methods and products were given orally. We also used pictures of logos to identify the different attributes, and sometimes explained the different attributes several times to ensure understanding of the presented products and methods.

5.2. WTP estimates from econometric models

Table 2 presents the estimated WTP results from the money metric models for the four valuation methods. The results show that consumers are willing to pay a premium for organic and food-safety-inspected tomatoes in all methods. In all five models, organic inspected tomatoes are the most valued and conventional tomatoes are the least valued, and no significant difference in WTP is found between organic and inspected tomatoes.

There are two very notable differences among the results of the four methods. First, the very low WTP for the conventional tomatoes from the MPL, with the price list (MPL-L) starting at 50 TZS. Recall that all participants had indicated that they were interested in buying tomatoes at the market and that during the experiment there were no tomatoes available for less than 300 TZS anywhere in the market. We therefore consider the WTP result for conventional tomatoes from the MPL-L to be unreasonably low. This is also supported by the three other WTP estimates for conventional tomatoes, which were much closer to the market price. Since the WTP for the other products seems less affected by the

low prices in the MPL-L method, the price premiums from the MPL-L method are large relative to the BDM, MPL-H, and MPLX. We discuss the MPL-L further when we test for specification effects later, but we also note that the BDM has some of the same tendencies of having WTP values lower than the market price for conventional tomatoes and relatively large premiums.

The second thing we should note is that the size of the premiums is significantly larger when consumers choose between alternatives in the RCE than when they use the non-comparative valuation scales in the other three methods. For example, consumers are willing to pay a premium that is more than four times higher for organic inspected tomatoes in the RCE than in the MPLX method. For the RCE, the high premium could mean that the consumers put more focus on variations in product attributes than on variations in price. In the literature studies have shown that, in choice experiments, the prices presented could affect WTP estimates (Hanley et al. 2005; Ryan & Wordsworth 2000).

5.3. WTP Distributions

Figure 1 presents the WTP distributions for the four types of tomatoes. Only the BDM gives direct WTP estimates for each participant. Therefore, in the figure we: (1) used the midpoints of the intervals as the WTP for the price-list methods (MPL-L, MPL-H, MPLX); and (2) assigned zero WTP to participants that were not interested in buying at any price on the price list. Our RCE only provided WTP for the organic and inspected attributes and not for the whole tomato, therefore WTP distribution for tomatoes elicited in the RCE are not included.

Figure 1 fits well with the estimated WTP results in Table 2. The choice of methods affects the valuation, but not the ordering of the products. The difference is mainly observed in the dispersed values (i.e., when the WTP values are either very low or very high), and more

similar values are observed around the average WTP. Of the methods represented here, the MPL-H and the BDM provide the highest values and the MPL-L the lowest values.

Combining data from the BDM, MPL, and MPLX we find that only 9% of the participants were willing to pay more than 400 TZS for the conventional tomatoes. This seems reasonable, as 400 TZS was at the high end of the prices observed in the market at the time of the experiment. For the organic tomatoes and the inspected tomatoes, about 25% were willing to pay at least 400 TZS, whereas for the organic and inspected tomatoes, 50% of the participants were willing to pay more than 400 TZS.

5.4. Distribution of price premiums

We obtain the distributions for the price premiums (hereafter referred to as marginal WTP or MWTP) for the value-added attributes by randomly drawing 1,000 draws from the estimated parameter distributions. We choose to resample the estimated parameters from the respective models so as to be able to make a comparison on MWTP between all the methods, including the RCE. Figure 2 presents the MWTP distributions for the simulated BDM, MPL-L, MPL-H, MPLX, and RCE data.

For robustness, we use an ANOVA and k-means nonparametric test (Siegel 1957) and reject the hypothesis of equality of means ($p<0.01$) between the MWTP for all the product attributes. Then, a post-estimation Bonferroni test[5] (Dunn 1961) was performed and it also shows a significant difference ($p<0.01$) in MWTP between all the valuation methods.

[5] The Bonferroni test is a post-estimation test used to counteract the problem of multiple comparisons. Unlike the t-test, it reduces the chances of committing type I errors when multiple pair-wise tests are performed on a single data set.

The results from the post-estimation test confirms the previous findings and shows that the greatest difference is between the comparative and non-comparative methods, with the RCE method giving generally higher values than all the other methods for all product attributes. The MPL-L because of very low valuation on the conventional tomatoes, gives the highest MWTP values among the non-comparative methods for all product attributes.
In Figure 2 and Table 3, we can generally see that the difference in MWTP between the valuation methods increases when a product is embedded with more attributes.

5.5. Testing for specification effects

5.5.1. Comparing WTP estimates between MPL methods with different price lists

One of the weaknesses of the MPL method is that the method could be susceptible to framing effects. Therefore, we use two different price-list designs, MPL-L and MPL-H, to test for such effects.

We run the interval regression model for the price-list data with a dummy variable to assess the effect of the price frame on WTP. Our results confirm the results of early studies that the price frame used in the MPL method has a significant effect on the WTP results (Andersen et al. 2006). The dummy variable for MPL-H indicates that the WTP estimates from the MPL-H were on average 107 TZS higher than the estimates from the MPL-L. This significant difference ($p>0.01$) corresponds to approximately 30% of the market price for conventional tomatoes.

From the previous estimation, we know that the difference in average WTP is largest for the lowest-valued tomatoes (187 TZS for conventional tomatoes) and lowest for the highest-valued tomatoes (33 TZS for organic inspected tomatoes). In other words, the cutoff point of the price list has the largest effect on the products valued at close to the cutoff point,

and the least effect on products valued significantly over the cutoff point; see Table 2, columns 3 and 4, and Table 3, row 5.

Based on these results, we can say that it is important to consider the price range when using the MPL method and that unrealistically low prices should be avoided.

5.5.2. Comparing WTP estimates between MPL and MPLX

Although MPL-H and MPLX used the same price lists, in MPLX, the participants could indicate that they wanted to buy more than one unit of a product. We run the interval regression model with a dummy variable to test if there is a significant difference in WTP between MPL-H and MPLX for the first 500 g unit of tomatoes. The model reveals that the type of method used has a significant effect on the WTP estimates ($p>0.01$). That is, the WTP elicited with MPL-H was 58 TZS higher than the WTP from MPLX, which corresponds to 17% of the market price for conventional tomatoes. Similarly, the Bonferroni post-estimation test shows higher MWTP values for attributes valuated by MPL-H compared with MPLX; see Table 3, row 6. The lower values in the MPLX could be explained by the diminishing marginal utility experienced when consumers stated the number of 500 g tomato portions they were willing to buy at the indicated prices in the price list. In MPLX the WTP for every extra additional unit was most likely less than the previous unit hence resulting in lower WTP values.

5.5.3. Comparing relative efficiency between methods

We use the Krinsky and Robb confidence intervals (CI) to compare the relative efficiency[6] in WTP estimates between the four valuation methods by dividing the CI by the mean. Table 4

[6] The relative efficiency measure is the CI normalized by the mean/median WTP

presents the Krinsky and Robb CI and relative efficiency measures for the four valuation methods. From the table, we can see that the RCE gives the widest confidence intervals, whereas the MPLX gives the most efficient WTP estimates, and the results are consistent for all products.

6. Conclusions and Recommendations

In this study we investigate the WTP for organic and food safety inspected tomatoes in a typical African food market using four different elicitation techniques. We compare the WTP estimates between the four methods, and compare their efficiency and suitability for eliciting products in a field experiment in a developing context.

All the four methods reported that consumers are willing to pay a price premium for organic and food-safety-inspected tomatoes, and the order of the premium is the same across the methods. We find that WTP estimates from the methods where participants indicated the price at which they were interested in buying (BDM, MPL, and MPLX) are closely related. The RCE, which uses choices between products priced at different levels to elicit preferences, gave much higher WTP estimates for the attributes. The high WTP estimates from the RCE are consistent with findings from studies conducted in the US and Europe (Gracia et al. 2011; Lusk & Schroeder 2006). The differences in WTP between the valuation methods could partly be explained by the fact that different valuation techniques assess preferences differently (Lusk & Schroeder 2006). However, the difference could also be attributed to design effects or the specific context. For example, the low prices in MPL-L had a large impact on the estimated WTP for the lowest-valued products, but not so much for the higher-valued products.

Based on the results, the external validity of the valuations for conventional tomatoes, and our experience of participants' ease in understanding the various methods, we make six recommendations for conducting experiments in a developing context such as in a traditional African food market.

First, we recommend conducting the experiments as field experiments. It gives the experiment the right context, the participants are real consumers coming to the market to buy the products at the market, they bring money and can therefore use their own money to make purchase in the experiment, and it eases the recruitment of participants. This comes at the cost of full control over all factors affecting a participant's decision, but we think the pros outweigh the cons.

Second, we recommend a non-comparative method. These methods focus more on the price, because the participants' task is to indicate a price. This emphasis on the price resembles the negotiation on prices, taking place in these markets. The price premiums we obtained from the RCE were on the other hand suspiciously higher than the valuations from the other methods.

Third, we recommend using a method that is as transparent as possible so that it is easy to explain to the participants; and it avoids misconceptions or misinterpretations of the method. The participants have limited time, and the busy market setting is a less than optimal place to teach participants complex methods. With partly illiterate participants, the methods must be explained by a moderator, and this must often be done one-on-one and can be very time consuming. The BDM was the most difficult for the participants to understand. The Vickrey auction, which is the most frequently used method in lab valuation experiments, has an additional level of complexity in that the price is determined by the lowest non-buying bid, making it even less transparent to the participants. Hence, considering the experiences in the

field, we recommend the price-list methods. These methods were very easy to understand, even by illiterate consumers. It was also relatively easy for participants to see that truthful revelation was in their best interest, hence can reduce errors caused by misconceptions or misunderstandings of methods.

Fourth, we recommend avoiding price lists that have prices that are much lower than the market price of the substitute products. We found that the price list that started at less than 20% of the market price for the generic tomatoes, induced attempts for strategic behavior, where participants who had said they were interested in buying tomatoes in the recruitment phase only indicated interest in buying the generic tomatoes in the experiment at a price much lower than the market price. This kind of misguided strategic behavior could likely be reduced by extensive training using MPL on other products, thereby teaching them that the dominant strategy is to reveal their true WTP. However, as discussed above, extensive training is difficult in this setting, and we therefore recommend using a price list starting just below the market price.

Fifth, among the price-list methods, the MPLX seems to have a comparative advantage over the other methods. It provided the most efficient WTP measures, closely reflected the market price for conventional tomatoes, and allowed heterogeneity with respect to the amount purchased. In the other methods where the quantity is fixed, consumer's WTP could have been affected because they were only allowed to buy one portion.

Our overall assessment of the four methods is that, the MPLX method with a price list starting just below the market price for the lowest priced product seemed to be the method that worked best in our setting. Since this is a new method, more testing in other contexts and with other products is needed to assess the validity and reliability of the method.

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Table1. Descriptive statistics for the samples

Valuation	N	Descriptive	Income[a]	Age	Gender[b]	Education[c]
BDM	76	Mean	563	40	0.83	2.35
		Std Dev	894	10.81	0.37	1.00
		Min	30	25	0	1
		Max	7000	65	1	4
MPL	69	Mean	748	36	0.89	2.03
		Std Dev	1392	7.25	0.30	1.12
		Min	30	25	0	1
		Max	10000	53	1	4
MPLX	44	Mean	584	41	0.86	2.18
		Std Dev	622.95	10.78	0.35	0.99
		Min	50	21	0	1
		Max	3000	62	1	4
RCE	65	Mean	749	38	0.85	2.12
		Std Dev	1553	10.57	0.36	1.10
		Min	30	16	0	1
		Max	12000	60	1	4

[a] Monthly income in 1,000 TZS. TZS 1,000 = USD 0.64. Hence, TZS 30,000 = USD 19.20 and TZS 12,000,000 = USD 7,680 (May 31, 2011 values according to www.oanda.com).

[b] One if female, zero if male.

[c] Graduate and above = 1, Certificate, Diploma, and high school = 2, Secondary o-level = 3, Primary or less = 4.

Table 2. WTP premium estimation results from the econometric models in TZS

	BDM (N=76)	MPL-L (N=33)	MPL-H (N=36)	MPLX (N=44)	RCE (N=65)
Organic & inspected	211.19***	307.12***	153.95***	132.93***	578.64***
	(20.37)	(33.91)	(22.96)	(12.69)	(47.07)
Organic	80.92***	151.55***	86.50***	101.51***	272.82***
	(20.37)	(34.08)	(23.08)	(12.72)	(37.81)
Inspected	94.55***	151.40***	84.24***	67.50***	123.58**
	(20.38)	(33.99)	(23.12)	(12.86)	(55.91)
Constant	273.68***	162.33***	348.87***	308.00***	
	(20.60)	(30.87)	(24.76)	(13.67)	
Sd υ[b]	127.95***	107.32***	106.51***	57.87***	
	(12.97)	(18.10)	(15.09)	(7.53)	
Sd ε	125.16***	133.30***	89.71***	44.72***	
	(5.96)	(1.30)	(2.46)	(1.06)	

* p<0.10, ** p<0.05, *** p<0.001.

[a] Numbers in parentheses are standard errors.

[b] Sd υ is the standard deviation of the individual specific random term.

[c] Sd ε is the standard deviation of the error term.

[d] When interpreting the price, recall that the market price for conventional tomatoes was around 350 TZS during the experiment.

Table 3. Bonferroni post-estimation test comparing MWTP between methods in TZS

Difference in valuation methods[a]	Product Attributes			
	Organic Inspected	Organic	Inspected	Conventional
RCE vs BDM	367.24***	191.29***	23.13***	
RCE vs MPL-L	270.76***	120.03***	–33.71***	
RCE vs MPL-H	424.20***	185.51***	33.13***	
RCE vs MPLX	445.49***	170.76***	50.07***	
MPL-H vs MPL-L	–153.45***	–65.48***	–66.84***	186.37***
MPL-H vs MPLX	21.29***	–14.75***	16.94***	40.30***
MPL-H vs BDM	–56.96***	5.78***	–9.99***	75.01***
MPL-L vs BDM	96.49***	71.26***	56.85***	–111.36***
MPL-L vs MPLX	174.74***	50.73***	83.79***	–146.07***
MPLX vs BDM	–78.5***	20.53***	–26.93***	34.71***

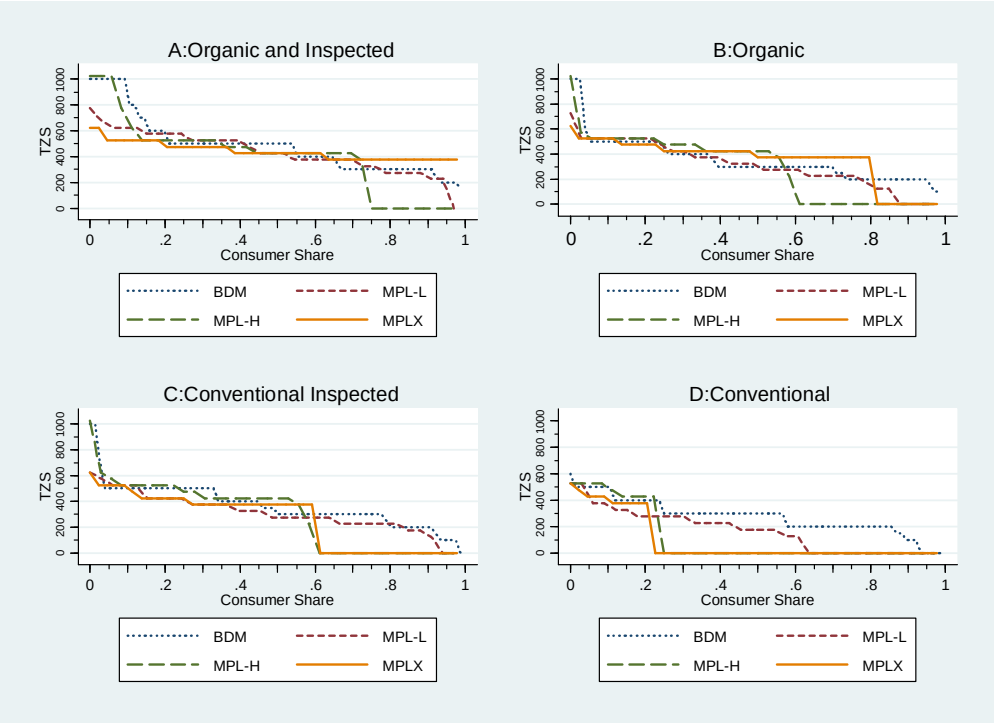
* p<0.10, ** p<0.05, *** p<0.001.

[a] The values in the columns are the difference in MWTP in TZS between the valuation methods for the respective attributes.

Table 4. Krinsky and Robb confidence interval at 95% level.

Attributes	Method	Mean	Lower Limit	Upper limit	Width	Efficiency[a]
Organic Inspected	BDM	211.19	171.39	251.38	79.99	0.38
	MPL-L	307.12	239.49	374.28	134.51	0.44
	MPL-H	153.95	109.47	198.97	89.50	0.58
	MPLX	132.93	108.01	158.05	50.04	0.38
	RC	577.76	488.53	675.29	186.76	0.32
Organic	BDM	80.92	40.54	121.24	80.7	1.00
	MPL-L	151.55	84.32	220.64	136.32	0.90
	MPL-H	86.50	41.49	132.39	90.90	1.05
	MPLX	101.51	76.81	126.94	50.13	0.49
	RC	271.93	200.83	349.74	148.91	0.55
Inspected	BDM	94.55	54.53	134.27	79.74	0.84
	MPL-L	151.40	85.96	217.67	131.71	0.87
	MPL-H	84.24	38.60	129.68	91.08	1.08
	MPLX	67.50	41.47	93.14	51.67	0.77
	RC	117.18	8.18	228.97	220.79	1.88
Conventional	BDM	273.68	233.08	313.43	80.35	0.29
	MPL-L	162.33	101.48	223.06	121.58	0.75
	MPL-H	348.87	299.83	396.64	96.81	0.28
	MPLX	308.00	280.89	335.16	54.27	0.18

[a] The most efficient method yields lower ratios of CI/mean; i.e., efficiency = width/mean.



Note: The price list for MPL-L ranges from 50 to 1,000 TZS whereas the price list for MPL-H and MPLX ranges from 350 to 1,250 TZS. If participants are not willing to buy at the lowest price on the price list, their willingness to pay is recorded as zero.

Fig.1. Total willingness to pay for the four types of tomatoes: Comparison of three valuation methods.

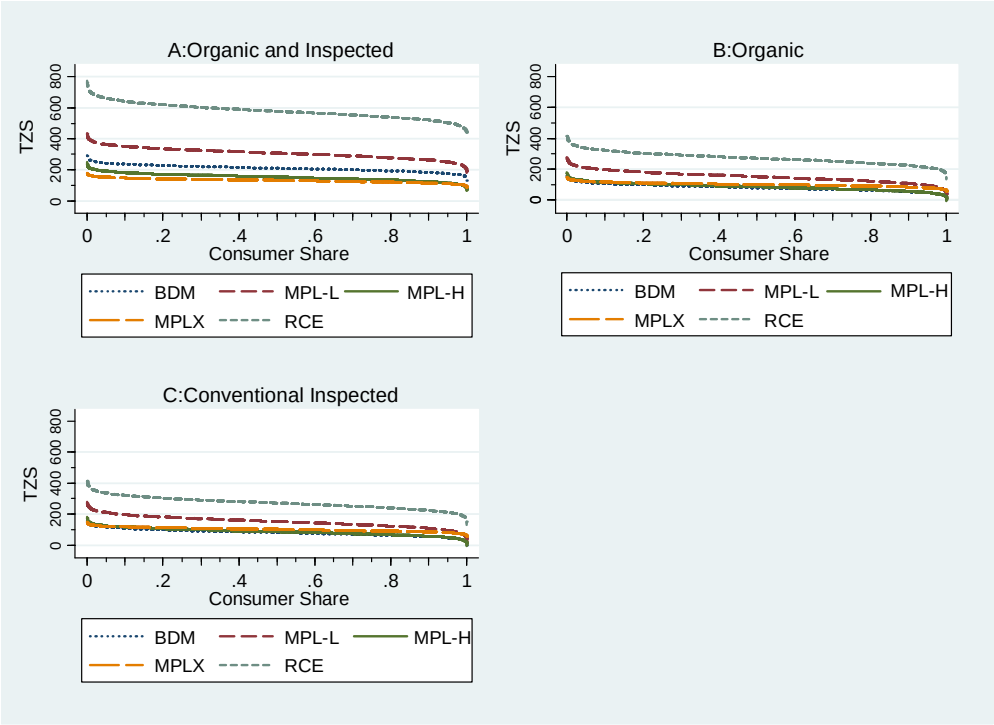


Fig.2. MWTP for three tomato attributes: Comparison of four valuation methods.

Appendix A
Instruction and Experimental Procedures for the Market Experiments

Introduction

I am a researcher at the Sokoine University of Agriculture conducting a study on consumers' market decision making. Are you involved in food decision making in your family? Or are you just sent to the market? Among the things in your shopping list are tomatoes included?

If the respondent says yes to both questions then we proceed

I would like to ask you to therefore participate in the market study on food and food choices, which will take about 10-15 minutes. For appreciation of your time you will receive 500g of onions for your participation in the study.

Product Presentation

In front of you are four portions of tomatoes, 500g each. Although the tomatoes look the same, they differ by two attributes. 1) In terms of how they were produced and; 2) whether they were inspected or not. We present the two attributes using two different logos.

1-The green logo (Have you seen it before?); we use it to label tomatoes which have been naturally produced. By naturally produced, we mean no artificial fertilizers and pesticides were used. That is tomatoes that have been produced using only natural fertilizers such as chicken and cow dung and natural pesticides like aloe vera, neem tree and hot pepper. Just like in the old days.

If the tomatoes are not labeled with this logo, then it means they were not naturally produced. Meaning that they were produced with artificial chemical fertilizers and sprayed with artificial pesticides.

2-The Black TBS (Tanzania Bureau of standards) logo (Have you seen it before?). We use this logo to label tomatoes which have been inspected by local health officers to meet the standards set by the Tanzania Bureau of standards. If the tomatoes are not labeled with this logo, then it means they were not inspected by local health official to ensure standards set by the TBS.

From the presentation of the tomatoes in front of you (the order of the presentation was changed after every 10^{th} person to control for order effect)

1. Organic Inspected tomatoes- You can see the green and black logo present, these are naturally produced tomatoes (meaning they were produced with organic fertilizer like

cow dung and pesticides like aloe vera or naturally with nothing added) which have been inspected by local health officials to meet the standards set by TBS.

2. Organic tomatoes- You can see we only have the green logo present, these are naturally produced tomatoes, meaning they were produced with organic fertilizer like cow dung and pesticides like aloe vera or naturally with nothing added.

3. Inorganic Inspected tomatoes- You can see we only have the black logo present, these are tomatoes which have been inspected by local health officials to meet the standards set by TBS and they were produced using artificial chemical fertilizer and pesticides.

4. Inorganic tomatoes- You can see we don't have any of the logo present in this product, these are tomatoes which have been produced by artificial chemical fertilizers and pesticides and they have not been inspected by the local health officials.

Can you tell me what these four tomato portions represent again? (the respondent describes the four products; if they show to not have understood the difference in the tomato attributes and products; the explanation is repeated to ensure understanding)

Buying Products

You will now be allowed to buy some tomatoes, but the way we do it here differs a bit from how it is done elsewhere in the market. Please have a good look at the products.

The way we sell tomatoes here is as follows:

(a) BDM instructions

FORM: Here you have a form. In the heading of the form you can see the description of the four products which are the same as you can see on the labels in the four portions of tomatoes.

YOU: You should write down the highest price you are willing to pay for each of the four portions presented on the table in front of you keeping in mind the production and inspection attributes (the green and black logo).

PRICE: The price will be randomly drawn from a list of prices. The prices on the list inside this bowl range from prices found at farm-gates to prices found at big international supermarkets. After you submit your WTP price for each product, you will randomly draw the market price from the prices presented in this bowl; then you will also randomly draw the product we will sell to you at the drawn market price. Note that the drawing of the product means that you cannot buy more than one product here today.

BUY: If your stated price for the drawn tomatoes equals to or is above the drawn price, you will be allowed to buy the randomly drawn tomatoes at the drawn price. But if your stated

price for the drawn tomatoes is lower than the drawn price you will not buy any tomatoes today.

WHAT SHOULD YOU DO: It is in your best interest to state the highest price that you would be willing to pay for the various tomatoes keeping in mind the production and inspection attributes. If you state a lower price than your true WTP, you might miss a good deal and If you state a higher price than your true WTP, you might end up buying a product at a price which is higher than what you think is an acceptable price.

EXAMPLE: For example, if you state your WTP for a 500g of inorganic tomatoes as 500TZS and you randomly draw 1000TZS as the market price; you will not buy the tomatoes because the market price is higher than the price you are willing to buy. But if you randomly draw 200TZS as the market price, then you will buy the tomatoes at 200TZS because the market price in this case is lower than the price you are willing to buy the tomatoes.

SURVEY: After we have finished the buying process you fill in a short questionnaire.

ONIONS: And get a half a kilo of onions as a gratitude for your participation.

(b) RCE instructions

FORM: Here you have a form. In the heading of the form you can see the description of the four products which are the same as you can see on the labels in the four portions of tomatoes. The form has eight rows with prices.

YOU: You should choose your best alternative from the four alternatives on the table in front of you keeping in mind the differences in production, inspection and price. You should also keep in mind that each price row in the form represents an independent buying situation. Tick on the product you would prefer to buy given the prices in the 1st price row. Continue in a similar manner with row 2, and continue till you have made your choice in all eight rows. For the row with the same price for all the products (300TZS); rank your preference.

DETERMINING THE PRICES AND BUYING: One of the eight rows (buying scenarios) will be randomly drawn as the binding buying scenario. And you will buy your selected choice in the randomly drawn buying scenario. However you have to make a choice in all the eight buying scenarios bearing in mind that the randomly drawn buying scenario is binding.

For the buying scenario with equal prices for all products, the first choice is binding. Note that, random drawing one buying scenario out of the eight buying scenarios; means you cannot buy more than one portion of tomatoes here today.

WHAT SHOULD YOU DO? It is in your best interest to choose your best choice keeping in mind the differences in production, inspection and price. Furthermore, you should only choose the products with prices that are not higher than what you are willing to pay for the

respective tomatoes here today nor choose inferior product because they are cheaper while you are willing to buy your preferred product at the offered price.

If you choose an inferior product you might miss a good deal but if you choose you're most preferred product at a price which is beyond your true WTP, then you might end up buying a product at a price which is higher than your acceptable buying price.

EXAMPLE: If you choose inorganic tomatoes offered at 500TZS in buying scenario number 6 and you randomly draw row 6, then you will buy your choice in buying scenario 6 where you had chosen inorganic tomatoes at 500TZS.

SURVEY: After we have finished the buying process you will fill in a short questionnaire.

ONIONS: And get a half a kilo of onions as a gratitude for your participation.

(c) MPL instruction

FORM: Here you have a form. In the heading of the form you can see the description of the four products which are the same as you can see on the labels in the four portions of tomatoes. Please observe that in the first column the form has a list of prices.

YOU: For each price you should tick if you are interested in buying the respective tomatoes at the price in the given row keeping in mind the production and inspection attributes.

PRICE: The market or buying price will be randomly drawn from the list of prices (from 50-1000, some from 350-1250). We will also randomly draw the product that we will sell to you. Note that the drawing of the product means that you cannot buy more than one portion of tomatoes here today.

BUY: If you have ticked off the drawn price for the drawn tomatoes you will be allowed to buy the drawn tomatoes at the drawn price. But if for the drawn tomatoes; you did not tick off the drawn price you will not buy any tomatoes.

WHAT SHOULD YOU DO? It is in your best interest to tick off all the prices that you are willing to buy the respective tomatoes keeping in mind the production and inspection attributes. If you do not tick off a price that is lower than what you think is an acceptable price you might miss a good deal. But if you tick off a price that is higher than what you think is an acceptable price, you might end up buying a product at a price that is higher than your acceptable buying price.

EXAMPLE: If inorganic tomatoes are randomly drawn and 500TZS randomly drawn from the price rows as the market price. Then you will buy the inorganic tomatoes at 500TZS if you had ticked off the price for inorganic tomatoes when it was 500TZS in the price row; but you will not buy any tomatoes if you had not ticked off the inorganic tomatoes at 500TZS in the price row.

SURVEY: After we have finished the buying you fill in a short questionnaire.

ONIONS: And get half a kilo of onions as a gratitude for your participation.

(d) MPLX instruction

FORM: Here you have a form. In the heading of the form you can see the description of the four products which are the same as you can see on the labels in the four portions of tomatoes. Please observe that in the first column the form has a list of prices.

YOU: For each price in the row, you should write how many portions of tomatoes you are interested in buying at the offered price in the price row for each tomato product. Keeping in mind the production and inspection attributes. Please keep in mind that the prices in the rows are the price for one portion of tomatoes.

PRICE: The market or buying price will be randomly drawn from the list of prices (from 350-1250). We will also randomly draw the product that we will sell to you. Note that the drawing of the product means that buy more than one type of tomatoes here today. But you will buy the number of portions you indicated in the drawn product at the randomly drawn price for each portion. If the number of portions for the drawn product is zero, you will then not buy any tomatoes

BUY: If you have chosen one or more portions of tomatoes on the drawn price for the drawn tomatoes, you will be allowed to buy the allocated number of tomato portions of the drawn tomatoes at the drawn price. That is if the number of portions for the drawn product is zero, you will then not buy any tomatoes, if it is one you will buy one portion of the drawn tomatoes and if its two then you will buy two portions of the drawn tomatoes at the drawn price for each portion

WHAT SHOULD YOU DO? It is in your best interest to indicate portions of tomatoes that you are willing to buy for respective tomatoes at the respective prices keeping in mind the production and inspection attributes. If you do not indicate a quantity for a product when the indicated price is lower than what you think is an acceptable price you might miss a good deal. But if you indicate a positive quantity for a product when the indicated price is higher than what you think is an acceptable price, you might end up buying a product or a portion of products at a price that is higher than your acceptable buying price. For either 1 or 2 or 3 portions.

EXAMPLE: If inorganic tomatoes are randomly drawn and 500TZS randomly drawn from the price rows as the market price. Then you will buy the indicated portions for the inorganic tomatoes at 500TZS each (that is 500TZS/portion), that is if you indicate two portions for the inorganic tomatoes when the price is 500TZS you will pay a total of 1000TZS. But if you had

indicated zero quantities for inorganic tomatoes when the price in the price row was 500TZS and it is the randomly drawn price, then you will not buy any tomatoes today.

SURVEY: After we have finished the buying you fill in a short questionnaire.

ONIONS: And get half a kilo of onions as a gratitude for your participation.