Eliciting consumer willingness to pay for food quality attributes: Experiments conducted in Tanzania, Norway and the US

Forbrukernes betalingsvillighet for kvalitetsegenskaper ved mat: Eksperimenter gjennomført i Tanzania, Norge og USA

Philosphiae Doctor (PhD) Thesis

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Ås 2014

Thesis Number 2015:4
ISSN 1894-6402
ISBN 978-82-575-1258-3

Dedication

I dedicate this work to my Dad A. J. Shayo-Ngowi, you gave us a great foundation, among all the people in the world, I bet you are the most proud.

To my mom who has always loved and overprotected me from any pain, you accepted our shortfalls and understood us, thank you for giving us a great childhood.

To my beloved husband Amani, you always believed in me and always gave me that positive energy, without you this PhD wouldn't have been such a smooth journey.

To my beautiful daughter Malaika, I am sorry I had to leave you at such a young age, thank you for taking care of your little brother when I needed it the most, thank you for putting a smile on my face.

To my cute little baby boy Rodrick, thank you for making my last days of my PhD journey exciting.

I love you all

Acknowledgements

This PhD thesis has been accomplished with help and support of many people and institutions.

My supervisor Frode Alfnes has been my mentor from the beginning of this PhD to the end. You have guided me not only on how to work in consumer research and experimental economics, but also on how to be specific in professional writing, what courses to take, what conferences to attend, setting targets for me not to procrastinate , and making sure my social life was calm. You have been more than a supervisor to me, no words can ever express my gratitude, Tusen Takk!

I would also like to convey my gratitude to the Norwegian Program for Development, Research and Education (NUFU) which through the project on “Empowering women to participate in the higher level of fruit and vegetables value chain through production of dried fruits and vegetables,” has funded my PhD studies. And NMBU School of Economics and Business for hosting me and providing all the necessary logistical support during my stay at the school. I am specifically grateful to the project leaders Trude Wicklund and Anna Temu for their flexibility, financial and social support during the whole period of my PhD studies; and to the head of the Business School, Associate professor Ragnar Øygard for all logistical support and for constructive discussions during my seminal presentations.

My extended gratitude goes to all members of staff at NMBU School of Economics and Business and to all fellow project members and PhD students (past and present). I specifically owe gratitude to Kyrre Rickertsen and Elin Kubberød for contributions during my seminar presentations and for reading and improving part of my PhD thesis. Shuling Lillemo, Thabbie Chilongo, Benedicta Ndabikuze, Valerie Almli, Kathrine Strøm, Siv Berit, Yoheni Mitani, Alexander Schjøll, Maren Bachke, Livingstone Senyonga and Shose Rodrick you have in one way or another added to the quality of my work, which I am very grateful for. I am also thankful to Lise Thoen, Reidun Aashem, Inge-Lise Labugt and Stig Danielsen for all logistical and technical support. Lisa your willingness to help has always been amazing.

Further, I would like to thank all our friends and the African community in Ås. Special gratitude goes to Samuel Makokha’s family, you were not just there when we needed you the most, but you put smiles on our faces; Mama Hendrick and family you brought a lot of laughter to our family; Mona Liam the bible studies gave me a greater meaning to life; Mama Omary; Mama Takondwa; Mama Rediet; Mama Samuel; Mama Mwaseba; Beatrice Kilima;

Ronnie’s family, Meron, Therese, Xianwen and all our friends from all around the world. You brought not just social but also spiritual blessings to our lives.

Now I would also like to thank all my family and friends in Tanzania, special thanks goes to my late father in law Rodrick Mashayo and mother in law Monica Mashayo for taking good care of my daughter Malaika, for giving her love so great that she didn’t need her mother’s love. I am grateful to my mom and dad for their love and support from childhood to adulthood, Daddy I know you have always believed in me, at this moment I am very happy to make you proud. I am thankful to all my brothers and sisters; special gratitude goes to Catherine and Shose for always being there when I needed you the most.

My sincere and heartfelt gratitude goes to my beloved Husband Amani Rodrick Mashayo, for leaving everything behind and supporting me throughout my PhD studies. I specifically thank you for taking care of our kids when I had to travel or work long hours. Malaika and Rodrick thank you for your patience. I love you and you made this journey worthwhile.

Lastly, I praise and thank God the Almighty for good health upon me and my family, for granting me peace, love and blessings throughout my life.

Roselyne Alphonce

Ås, November 2014

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List of Papers

This PhD thesis contains the following papers:-

- **Paper 1: Consumer willingness to pay for food safety in Tanzania: an incentive aligned conjoint analysis** by Roselyne Alphonce and Frode Alfnes, Published in International Journal of Consumer Studies, 2012.
- **Paper 2: Eliciting consumer WTP for food characteristics in a developing context: comparison of four methods in a field experiment** by Roselyne Alphonce and Frode Alfnes.
- **Paper 3: Consumer vs. citizen willingness to pay for restaurant food safety** by Roselyne Alphonce, Frode Alfnes and Amit Sharma, Published in Food policy, 2014.
- **Paper 4: European consumer preference for sensory and credence characteristics for African dried fruits** by Roselyne Alphonce, Valérie Lengard Almli, and Anna Temu.

Summary of the thesis

In measuring consumer preference and willingness to pay for product attributes, many things matter, among them context and choice of methods. This thesis focuses on (1) assessing preference for food quality attributes in different context (all papers) and (2) comparison of results from different methods (paper 2 and 3). The thesis includes data collected in four different experiments in three countries: Tanzania (paper 1 and 2), US (paper 3) and Norway (paper 4). The thesis contributes to the literature on consumer preference studies in Africa, Europe and the US, on experimental valuation methods related to food in Africa, and to the duality literature on preference for food safety standards in restaurants. The four papers should be read independently.

The first paper assess the willingness to pay for food safety related attributes in an artefactual field experiment in Tanzania. The paper finds that consumers in Tanzania are concerned with food safety, and the results are consistent across low and high-income consumers, and across both genders. Men generally have a higher willingness to pay for the food products, however women are willing to pay more for food safety related attributes. Preference for food safety does not however translate into preferences for origins associated with better agricultural practices, meaning consumer probably do not associate origin with safety but rather with other attributes like sustainability or taste. For example, in the study consumers show royalty towards their country and antipathy towards South Africa.

In paper 2, we compare four different experimental valuation methods that can be conducted with one respondent at a time in a traditional African food market. The traditional way of conducting food preference studies was through surveys, but in the past two decades there has been a growing literature using lab and field experiments in Europe and the US. In these experiments, products are evaluated and sold using various non-market valuations techniques. Studies using the different experimental methods have also started to emerge in developing countries. However due to technological, logistical and literacy related challenges, implementing most of these methods can be challenging in lab and field experiments in developing countries. Therefore, we select four non-market valuation methods that are relatively easy to explain, have a dominant strategy that is not difficult to understand, that are quick to implement, and that can be conducted one-on-one. We then compare the willingness to pay, the efficiency of the methods, and the easiness in explaining and understanding the methods.

The paper finds consistent results across all the four methods. Consumers are willing to pay a premium for organic and food-safety-inspected tomatoes. However, the size of the premium differs between valuation methods where the consumers choose between alternatives, and non-comparative methods were the consumers indicate their willingness to pay. Due to the easiness in conducting the experiments and efficiency of the measurements, we recommend the use of the price list methods.

In paper 3, we investigate whether a consumer-citizen duality exists in the willingness to pay for food safety standards in restaurants. Relying on consumer studies focusing on the buying context to advice on public issues may underestimate the actual support for public regulations. Studies addressing the consumer-citizen duality have mainly been in the environmental economics, and this is one of the first to investigate a possible consumer-citizen duality in consumer preferences for food products. We find that the duality does exist in the willingness to pay for food safety standards in restaurants. Voting citizens exhibit higher willingness to pay for improved food safety standards in restaurants than buying consumers.

Paper 4 is a consumer preference study involving both preference for sensory and credence attributes. The paper mainly aims at making recommendations to producers in Africa, trying to position value-added products for maximum revenue from Europe. Despite the significant contribution of studies on organic, fair-trade and country-of-origin, there is still limited understanding on attributes that are most likely to add value to products like dried fruits exported to Europe.

To be able to advice African producers about European consumer preferences, we investigate sensory attributes driving consumer preference and assess the willingness to pay for dried fruits with and without credence attributes in Norway. We also use a hierarchical approach to identify factors driving choices for specific product origins. The study finds that naturalness is preferred over uniform taste, and fruit aroma is the most driving factor for the liking of the products, and that extreme hardness and acidity were the most rejected attributes. On the other hand, consumers were either attracted by a sweet taste or by an acidic/sour taste. Consumers were also willing to pay a premium for dried fruits with an organic and fair-trade label, but favored fair-trade the most. We identify three consumer segments, two with distinct reasons for preferring a country-of-origin and a third one indifferent to the origin of the dried fruits.

Sammendrag

Ved måling av forbrukernes preferanser og betalingsvillighet for produktegenskaper er det mange ting som teller, blant annet kontekst og valg av metoder. Denne avhandlingen fokuserer på (1) måling av preferanse for matkvalitetsegenskaper i ulike sammenhenger (alle artikler) og (2) sammenligning av resultater fra ulike metoder (artikkel 2 og 3). Avhandlingen bruker data samlet inn i fire forskjellige eksperimenter i tre land: Tanzania (artikkel 1 og 2), USA (artikkel 3) og Norge (artikkel 4). Avhandlingen bidrar med ny kunnskap om forbrukerpreferanser i Afrika, Europa og USA, på bruk av eksperimentelle verdsettelsesmetoder knyttet til mat i Afrika, og til dualitetslitteraturen om preferanse for matvaresikkerhet i restauranter. De fire artiklene bør leses uavhengig av hverandre.

Den første artikkelen omhandler betalingsvillighet for mattrygghet og er basert på et eksperiment med vanlige forbrukere i Tanzania. Studien viser at forbrukere i Tanzania er opptatt av mattrygghet, og resultatet er gjelder på tvers av både inntekt og kjønn. Menn har generelt en høyere betalingsvilje for matvarer, mens kvinner er villige til å betale mer for mattrygghetsrelaterte kvaliteter. Preferanse for mattrygghet kan imidlertid ikke oversettes til preferanser for matens opprinnelse forbundet med bedre jordbrukspraksis, noe som betyr at forbrukeren sannsynligvis ikke forbinder opprinnelse med mattrygghet, men heller med andre egenskaper som bærekraft eller smak. For eksempel viser studien at forbrukerne fra Tanzania viser lojalitet til sitt land og antipati for produkter fra Sør-Afrika.

I artikkel 2, sammenlignes fire ulike eksperimentelle verdsettelsesmetoder som kan gjennomføres med en respondent om gangen i et tradisjonelt afrikansk matmarked. Den tradisjonelle måten å drive matpreferansestudier har vært gjennom spørreundersøkelser, men de siste to tiårene har det blitt mer vanlig å bruke lab- og felteksperimenter i Europa og USA. I disse eksperimentene blir produkter evaluert og solgt ved hjelp av ulike ikke-markedsbaserte teknikker. Slike eksperimentstudier har også begynt å dukke opp i utviklingsland. Men implementeringen av slike metoder basert på lab- og felteksperimenter kan være utfordrende i utviklingsland på grunn av teknologiske og logistiske begrensninger og manglende leseferdigheter. Derfor valgte vi fire ikke-markedsverdsettelsesmetoder som er relativt lette å forklare, har en dominerende strategi som ikke er vanskelig å forstå, kan implementeres raskt, og som kan bli gjennomført en-til-en. Deretter sammenligner vi betalingsviljen, metodenes effektivitet og hvor lette metodene er å forklare og forstå.

Studien viser konsistente resultater på tvers av alle de fire metodene. Forbrukerne er villige til å betale ekstra for økologisk og mattrygghets-kontrollerte tomater. Men størrelsen på denne betalingsviljen varierer mellom verdsettelsesmetoder der forbrukerne velger mellom alternativer, og ikke-komparative metoder hvor forbrukerne indikerer hvor mye de er villige til å betale. På grunn av deres lette gjennomføring og effektive målinger, anbefaler vi metodene som er basert på bruk av prislister.

I artikkel 3 undersøker vi om det finnes en forbruker-borger dualitet i betalingsviljen for mattrygghetsstandarder i restauranter. Bruk av forbrukerstudier som fokuserer på kjøps-konteksten når man skal gi råd om samfunnsspørsmål kan undervurdere den faktiske støtten for offentlige reguleringer. Undersøkelser rettet mot forbruker-borger dualitet har i hovedsak vært gjennomført i miljøøkonomi, og dette er en av de første studiene som undersøker forbruker-borger dualitet i preferanser for matvarer. Studien viser at det finnes en slik dualitet i betalingsviljen for mattrygghetsstandarder i restauranter. Stemmegivere har større betalingsvilje for mattrygghet i restauranter enn forbrukere.

Artikkel 4 er en forbrukerpreferansestudie som omhandler både preferanse for sensoriske og troverdighetsegenskaper. Artikkelen tar i hovedsak sikte på å komme med anbefalinger til produsenter i Afrika, prøver å posisjonere produkter for maksimal inntekt fra Europa. Til tross for betydelig bidrag fra studier på økologiske, fair-trade og opprinnelsesmerkede produkter, vet vi fortsatt lite om hvilke egenskaper som kan bidra til verdiøkning for produkter som for eksempel tørket frukt som eksporteres til Europa.

For å kunne gi råd til afrikanske produsenter om europeiske forbrukerpreferanser, undersøker vi hvilke sensoriske egenskaper som styrer forbrukerpreferansene og vurdere betalingsvilje for tørket frukt med og uten troverdighetsegenskaper i Norge. Vi bruker også en hierarkiske tilnærming for å identifisere faktorene som påvirker valg av foretrukken produktopprinnelse. Studien finner at naturlighet er å foretrekke fremfor uniform smak, og fruktaroma er de viktigste smaksfaktorer for produktene, og at ekstrem hardhet og surhet var de minst likte egenskaper. På den annen side ble forbrukerne enten tiltrukket av en søt smak eller en sur / sur smak. Forbrukerne var også villig til å betale en premie for tørkede frukter med en økologisk og fair-trade etikett, men fortrakk fair-trade. Vi identifiserer tre forbrukersegmenter, to med forskjellige grunner til å foretrekke en opprinnelse og en tredje likegyldig til opprinnelsen av tørkede frukter

Part I: Introduction

1. Background

Choices for food attributes are among choices consumers make every day. Measuring and understanding consumer preferences for different food attributes is important for farmers, producers, retailers, policymakers and other stakeholders related to the food value chain. In the past decades, economist have adopted new theories for studying consumer choices, including Lancaster's hedonic consumer demand theory (Lancaster 1971; Lancaster 1966; Waugh 1928); prospect theory (Kahneman & Tversky 1979); expected value theory (Fishbein 1967; Luce & Tukey 1964; Rosenberg 1956), and the theory of planned behavior (Fishbein & Ajzen 1975). Simultaneously new methods have been developed including stated and revealed preference methods (Alfnes & Rickertsen 2011; Carlsson 2011).

Lancaster (1971; 1966) modified the traditional economic theory by stipulating that consumers seek to acquire not goods themselves but characteristics they contain. The theory better fits the current market with highly differentiated goods containing different combination of attributes for heterogeneous consumer preferences. Before and parallel to Lancaster, researchers in social psychology and marketing developed the expected value models (Fishbein 1967; Rosenberg 1956) and conjoint analysis (Luce & Tukey 1964), which also use multi-attribute models to explain consumer decision making.

When consumers make choices, often many attributes other than the ones the researcher can include in their models affects their choices. McFadden (1974) combines Lancaster's model, with the random utility maximization model from Thurstone (1927) and Marschak (1960). McFadden linked unobserved preference heterogeneity to a fully consistent description of the distribution of demands. As a result, McFadden's random utility theory divides the latent utility into systematic (explainable component) and random (unexplainable component) elements.

To obtain consumer data that is richer and has more variation than market data, stated and revealed preference methods have been developed. Stated preference methods assess values for product and product characteristics in a hypothetical setting. In stated preference methods there has been advancement from focused groups, surveys, and contingency valuation to conjoint analysis and stated choice experiments (Carlsson 2011). Revealed preference methods measure consumer's actual actions. Revealed preference methods include scanner

data, lab and field experiments. In lab and field experiments, consumers make either consequential bids or choices with real products and money (Alfnes & Rickertsen 2011).
In the last two decades, there has been advancement in control for realism, by moving from conventional lab experiments to natural field experiments, where real consumers participate in an experiment without knowing. There has also been advancement in elicitation mechanisms used in experiments, and I will discuss some of the new methods later.

Despite the advance in methods for studying and estimating consumer choices, measuring preference and willingness to pay (WTP) for credence attributes in food products has been challenging. This is because many of the credence attributes like fair trade, organic, country of origin (COO), food safety and animal welfare, have a normative dimension. Studies have typically shown consumers having a positive attitude and preference for these ethical characteristics, but when it comes to the actual market or actual consumption, there seems to be less interest (Bray et al. 2011; Hamilton et al. 2003; Harvey & Hubbard 2013; Verbeke et al. 2007). The literature point out several reasons for this gap; social desirability bias - consumers making choices in the study that puts oneself in a desirable light (Clavin & Lewis 2005; Fisher 1993; Fisher & Katz 2000; List et al. 2004; List 2006; Lusk et al. 2006; Toma et al. 2011); hypothetical bias - consumers overstating their interest or WTP for a product in a hypothetical setting (Carlsson 2011; Fox et al. 1998; List & Shogren 1998; List & Gallet 2001; List & Shogren 2002); consumer-citizen duality - individuals carry a citizen role taking a holistic view when voting for or against a proposition, writing letters, or participating in an associations to voice out opinions, while they carry a consumer role focusing more on their personal needs and cost when making purchases (Alphonce et al. 2014; Hamilton et al. 2003; Vanhonacker et al. 2007). Together the biases and the duality can result in relatively large deviations between stated and actual behavior. As a result, food researchers are increasingly including real products, economic incentives, and other aspects of the market when making evaluations for credence attributes.

In this thesis, we mostly assess consumer preference and WTP for food quality involving goods with public, quasi-public and private credence attributes, using both stated and revealed preference methods. In the next sections, I will briefly review on the literature related to food quality, experimental and elicitation methods. Then, I will finish the introduction by discussing the objectives, methods used and summarizing the four papers.

1.1 Food quality

In an Economic conference presenting my first paper, I was surprised when one reviewer asked "why are you studying consumer preference for food safety, while there is still a problem with food security in most developing African countries?" Well according to WHO food security involves both food quantity and food quality, where in WHO quality entails nutrition and safety.

Grunert (1996) developed the total food quality model that integrates a multi-attribute and hierarchical approach to quality perception, to explain how perceptions on quality influence food choices. Food quality attributes are search, experience or credence. For the search and experienced attributes consumers can verify the quality, while for credence attributes there are no easily available methods for the consumers to verify the quality, not even through consumption. For search attributes quality can be verified prior to purchase, while for experience attributes, consumption of the product verifies the quality. Therefore for experienced attributes, consumers' satisfaction with the experience, influences future purchases or choices (Nelson 1974). While for credence attributes, consumers cannot verify the quality. Hence, new information like advertisement or news are the main reasons for changing quality perception and future choices for credence attributes (Darby & Karni 1973).

Consumers usually use extrinsic cues (from search and credence attributes) to form quality perceptions about intrinsic attributes (Grunert 2006; Hoffmann 2000). For instance price is sometimes used as a cue for quality (Grunert 2005; Lambert 1972; Rao 2005); organic as a cue for better taste or food safety (Grunert 2005; Grunert 2006; Lusk & Briggeman 2009); animal welfare labeling as a cue for healthy products or taste (Hoffmann 2000; Lagerkvist & Hess 2011); and COO as a cue for taste, safety or sustainability (Combris et al. 2009; Hoffmann 2000; Lusk & Briggeman 2009).

Food safety and taste has been identified as the most important quality attributes in food (Grunert 2005; Lusk & Briggeman 2009). Food safety is especially important when; food scares like BSE or E. Coli arise; or when unfamiliar production technologies like GMO or food irradiations are introduced (Grunert 2005). The importance of taste and food safety related attributes is vivid, from the massive research on quality attributes related to sensory attributes (Alfnes et al. 2006; de Melo et al. 2009; Lusk & Schroeder 2004; Stefani et al. 2006; Yue et al. 2009) and food safety (Loureiro & Umberger 2007; Lusk et al. 2006;

Mørkbak et al. 2011), in the US and Europe. In developing countries, consumer research has only started to erupt in the last decade, with a majority of research focusing on nutrition (De Groote et al. 2011; Masters & Sanogo 2002; Meenakshi et al. 2012) and a few on food safety (Alphonce & Alfnes 2012; Kikulwe et al. 2011; Kimenju & De Groote 2008; Lagerkvist et al. 2013).

1.2 Experimental methods

In the past two decades, experimental and behavioral economists interested in consumption and marketing of food, have started to use experiments to understand human behavior. Like in physical science, experiments are conducted in a controlled environment in a research lab or in the field. Similar to the physical science, experiments in social science also vary in the level of control and realism. Lab experiments have high control while the field experiments have high realism (for a detailed review of Field versus Lab experiments see Harrison and List (2004)). Experiments in economics have mainly been conducted in the lab, but in the last decade, economists have increasingly moved the experiments out of the tight control of the lab to the field, where there is more realism in context hopefully resulting in improved external validity.

Harrison and List (2004) divide experiments into conventional lab experiment, artefactual field experiment, framed field experiment and natural field experiment. The division is based on the nature of; - the subject, the information given, the commodity used, the task or rules applied, the stakes and the environment. In this thesis, I used artefactual and framed field experiments. The artefactual field experiment with field context in commodity in paper 1 and the framed field experiment with field context in commodity, task, stakes, information and environment in paper 2. The experiments in paper 2 were more related to the natural field experiment, except that the subjects knew their behavior was being scrutinized. In paper 3 and 4, we used field experiments with stated preference elicitation methods.

There are challenges in using both the lab and field experiments. For example social desirability bias, house money bias, randomization bias, substitution bias and sample selection bias. These biasness are often less pronounced as one moves closer to the natural field experiment. However, natural field experiments have their own challenges. The challenges include, less control over external factors possibly compromising the internal validity, less control on background variables, the need for interpersonal skills to be able to work with other agencies, difficulty in replicating the experiments, and the potential for publication bias (Falk & Heckman 2009; Levitt & List 2009).

1.3 Why choose or not choose to use experimental methods

When measuring preference, researchers have to decide on which method to use. There are advantages and disadvantages of using all methods, and therefore a combination of different empirical methods as well as econometric methods can improve the understanding of most economic questions (Townsend 1994). Below are some of the pros and cons of using experimental methods over other methods

Pros of experimental methods

- Experiments allow control and realism (Ehmke & Shogren 2009; Falk & Heckman 2009; Harrison & List 2004)
- Experiments can disentangle and measure the effect of parameters in a complex relationship, like parameters in market interaction or policy change (Plott 1989).
- In the absence of information like consumer preference and marginal cost, experiments can allow to test economic measures like elasticity of demand (Hensher et al. 2000).
- Experiments can be used to measure sales or market shares when products are not available in the market (Alfnes & Rickertsen 2011; Hensher et al. 2000).
- Experiments can allow controlled exogenous variation (Applebaum & Spears 1950; Levitt & List 2009)
- It is easier to control for sample selection bias in experiments through RCT and by going to the natural context of your population you want to study. For example List went to experts selling sports cards and created the experiment in the traders natural environment (List 2006).
- Randomization bias is less likely to affect food and market experimental research, especially in natural field experiments, but in other data sources, subjects are likely to have been subjected into programs or treatments using a certain criterion, or self-select themselves based on their desired treatments (Barrett & Carter 2010; Harrison et al. 2009; Levitt & List 2009).
- Experiments use randomization as an instrumental variable, balancing the unobserved variables across the treated and untreated variables, hence experiments allow better

control for complex issues (external validity) (Al-Ubaydli & List 2013; Fisher 1935; List 2011)

- Compared to non-experimental methods, experiments require minimum assumptions inorder to give identifiable and reliable results (Blundell & Dias 2002).
- In most surveys and lab experiments shoppers are forced to consider new attributes when valuating products, while in real world shopping and natural field experiments shoppers can be ignorant to new quality attributes (Grunert 2005).

Cons of experimental methods

- Experiments require bigger budgets (Levitt & List 2009).
- Informed consent could be an ethical concern in experiments, especially in natural field experiments (List 2008).
- The sample sizes in most experimental studies are small (Levitt & List 2009; Schjøll 2014), and in some cases the use of student samples is considered to be unrepresentative (Falk & Heckman 2009).
- Since randomization is used as an instrumental variable in experimental methods. If randomization bias occurs, it is a greater concern in experiments than in other methods (Barrett & Carter 2010; Ehmke & Shogren 2010; Levitt & List 2009).
- Experimental methods like the natural field experiments can in some cases limit control of important background variables (Harrison & List 2004; Schjøll 2014)

1.4 Selection of methods

Economist, psychologist and marketers are interested in determining the value people place on market and non-market goods, for variety of reasons including;-forecasting new product success, understanding consumer behavior, determining welfare effects of public policy or technological innovation, and carrying out cost-benefit analysis (Lusk & Shogren 2008).
Figure 1 presents a summary of the main WTP elicitation methods.

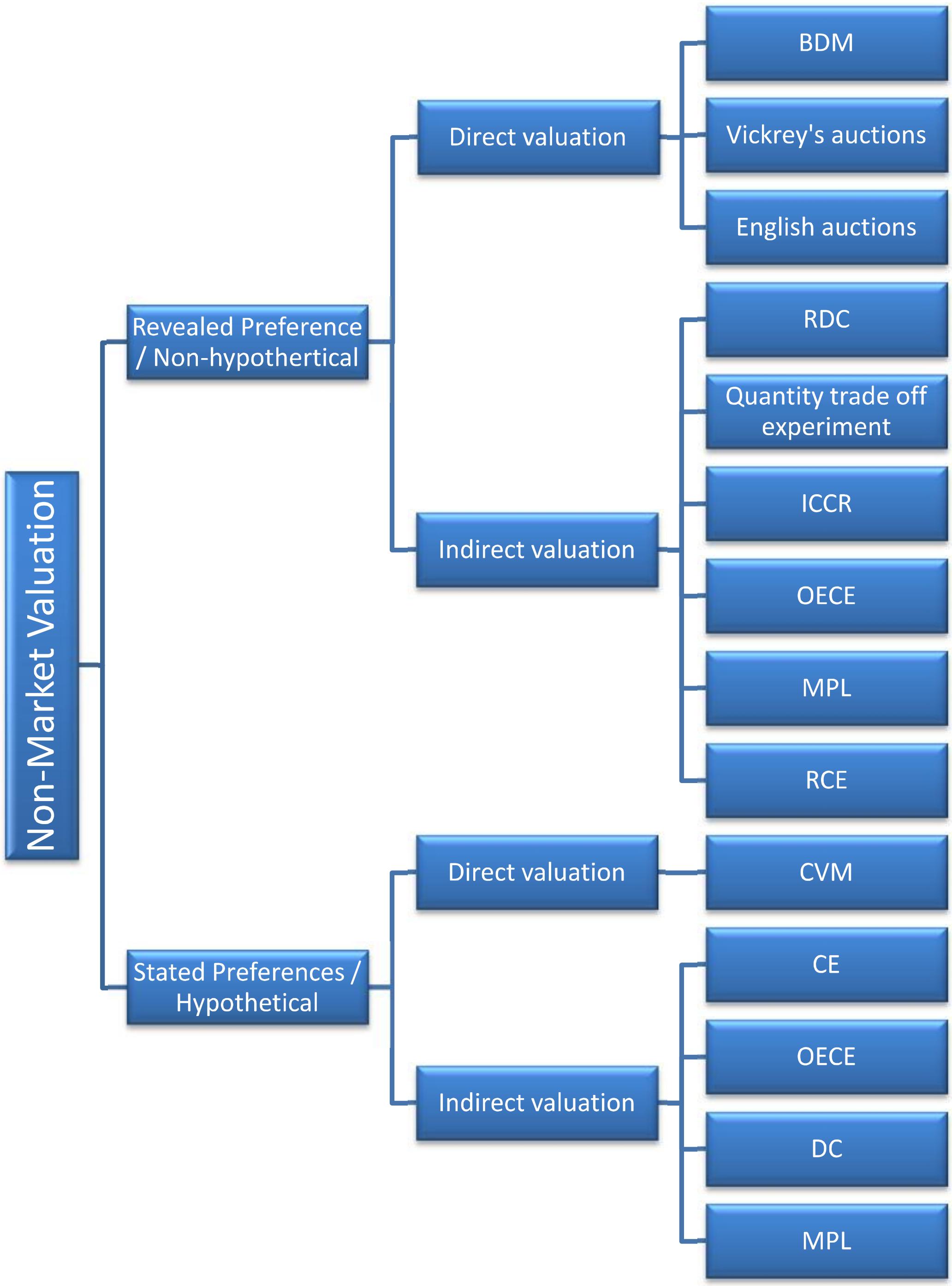

Fig 1:Willingness-to-pay elicitation methods.

Note: Choice Experiment (CE); Open Ended Choice Experiment (OECE=MPLX); Double Bounded Dichotomous Choice (DC); Multiple Price List (MPL); Contingent Valuation Method (CVM); Real Dichotomous Choice Experiment (RDC); Incentive Compatible Conjoint Ranking Mechanism (ICCR); Real Choice Experiment (RCE); Becker-DeGroot-Marschak Mechanism (BDM).

The elicitation methods can be divided in revealed preferences/ non-hypothetical methods and stated preference/ hypothetical methods. Revealed preference methods involve real economic incentives to avoiding the hypothetical bias (List & Gallet 2001), while stated preference methods involve non-consequential WTP questions in surveys. Revealed preference methods include experimental methods and market data, but here I limit my discussion to non-market valuation methods.

The second distinction between the methods, are whether WTP questions are asked directly or whether WTP is estimated from choices consumers make. Direct valuation provides a convenient way to obtain each individual's WTP with no or minimum assumptions, while indirect valuation relay on statistical models and require assumptions about the functional form for the utility functions (Lusk & Shogren 2008).

This gives us four classes of methods:

(1) Revealed preference direct valuation methods include the Becker-DeGroot-Marschak Mechanism (BDM), Vickrey auctions (Vickrey 1961) and the English auction. In the BDM mechanism, which is used in paper 1 and 2, consumers state a reservation price and a market price is drawn. If the reservation price is higher than or equal to the market price, the consumer must buy the product at the market price (Alphonce & Alfnes 2012; Becker et al. 1964; Miller et al. 2011).

(2) Revealed preference indirect valuation methods include the Open Ended Choice Experiment (OECE=MPLX); Multiple Price List (MPL); Real Dichotomous Choice Experiment (RDC); Incentive Compatible Conjoint Ranking Mechanism (ICCR)(Lusk et al. 2008); and Real Choice Experiment (RCE). In paper 2, RCE, MPL and MPLX are included. In the RCE consumers make choices in a series of shopping scenarios, where one shopping scenario is randomly drawn as binding, and the consumer pays the price and receives the product chosen in the binding scenario (Alfnes et al. 2006; Lusk & Schroeder 2004; Pessemier 1960).

In a MPL method, consumers are given a list of prices, to indicate if they will buy or not buy at the respective prices, then one price row is randomly drawn, and the consumer choice for that row is implemented (Andersen et al. 2006; Kahneman et al. 1990). The MPLX method is an extension of the price list format, where consumers are given a price list to indicate the number of units of goods they want to purchase at the different prices. Similar to MPL, one of the price row is randomly drawn, and the consumer buys the indicated quantities at the drawn price (Corrigan et al. 2009).

(3) Stated preference direct valuation methods include the contingency valuation methods (CVM). In a CVM, which is used in paper 3&4, consumers are asked a hypothetical question on how much they are willing to pay for a product attribute in either, an open ended question or a closed question (Hamilton et al. 2003).

(4) Stated preference indirect valuation methods include indirect valuation methods in a hypothetical setting like CE, OECE, DC and MPL.

The advantages of the revealed preference methods include the use of real products and real money. Individuals are put in an active market environment where they can get market feedback, and there is a real economic consequence from choosing or stating a preference different from what they actually want. The downside to revealed preference methods in non-market valuation is the inability to collect data on non-existing products or product attributes without breeching research ethics like deception. In stated preference methods, such hypothetical manipulation can be done. It is also cheaper to use stated preference methods and easier to control most aspects of the study, like unobserved variations in heterogeneous products (Carlsson 2011).

The downside to stated preference methods includes; it's prone to strategic manipulations, its chances of individuals lacking cognitive effort due to lack of economic effect hence making the methods prone to hypothetical bias. Contrary to revealed preference methods, stated preference methods lack the availability of a constraint budget. Table 1 elaborate on the elicitation methods used in this thesis. For detail descriptions of other non-market elicitation methods, see Alfnes and Rickertsen (2011).

Table 1. Elicitations methods

Elicitation mechanism	Procedure	Market Price	Rule	Conditions
BDM	Simultaneously submit a sealed bid for each product profile	Randomly drawn price from an exogenous distribution of prices	Randomly draw a binding product Participant pays the market price for 1 unit, if the bid equals or exceeds market price Participant does not buy the product if the bid is below the market price.	Participants have a weakly dominant strategy to submit a bid equal to their true value Participants are not in an active market. Can involve one participant
CVM	State the highest amount WTP in an open ended or closed question	Hypothetical	Submit a WTP value equal to their true value for the product Tick off/cross or say yes/no to a price or price on a list	Can involve one participant Less control Easier cheaper
MPL	Tick off or say/vote yes if WTP at the price on the list, and cross off or say/vote no otherwise.	Randomly select one price row	Randomly draw a binding product Participant's choice for the row is implemented	Can be hypothetical Can involve one participant Weakly strategy to say yes to a value they are WTP Prone to scaling bias
OECE	Simultaneously submit quantities willing to buy at different prices on the list	Randomly select one price row	Randomly draw a binding product Buy the quantities indicated	Can be hypothetical Can involve one participant Weakly strategy to have a positive quantity to a value they are WTP Prone to a scaling bias
RCE	Choose alternatives in multiple scenarios	Randomly drawn binding scenario	Choice made in the binding scenario is implemented	Can involve one participant. Weakly strategy is to choose a scenario giving the highest utility Analysis involve joint preference

Note: WTP is used for both willingness to pay and willing to pay.

2.0 Objectives

There are two main objectives in this thesis, and each paper has more specific objectives discussed in the summary of the papers.

Main Objective 1: Assess consumer preferences for food quality in different context

Paper 1 and 2 assess consumer WTP for attributes related to food safety in Tanzania, paper 3 assess WTP for food safety in US restaurants, and paper 4 assess Norwegian consumer preferences for sensory and other attributes of dried fruits from Africa.

Main Objective 2: Test for difference between WTP elicitation methods

Paper 2 compares Tanzanian consumer's WTP for conventional, organic and/or inspected tomatoes in a traditional food market using four different elicitation techniques. Paper 3 assess whether there exist a consumer-citizen duality in WTP for food safety. Specifically the study investigates if people in the US are willing to pay more for food safety in restaurants when the WTP question is framed as a voting question than when the question is framed as a buying question.

3.0 Methodology

This thesis uses primary data from a combination of surveys, lab and field experiments in Tanzania, Norway and the US. Table 2 below summarizes details of the different data sets, objectives and methods.

Table 2. Summary of the data and methods used in the thesis

Paper	Country	Methodology	Attributes evaluated
Paper 1	Tanzania	Artefactual field experiment with local consumers including a survey for background variables. WTP elicited using BDM	Search -Size -Weight Credence -Organic -Origin -Food safety inspected
Paper 2	Tanzania	Framed field experiments in a traditional food market including a survey for background variables. WTP elicited using BDM, MPL, MPLX, RCE. Recruited food decision makers coming to buy tomatoes at an outdoor market. Experiment conducted at a table close to other tomato sellers. Consumers used their own money	Tomatoes -Conventional -Organic -Food safety inspected -Organic and food safety inspected
Paper 3	USA	Survey conducted before a food safety experiment at a university restaurant in the US. Hypothetical MPL framed as: -Consumer oriented question -Citizen oriented question	Restaurant food safety standards: -25% risk reduction -50% risk reduction -75% risk reduction
Paper 4	Norway	Experiment with sensory evaluation and market survey. -WTP elicited with hypothetical CVM questions. -Sensory evaluation with a descriptive and hedonic analysis.	Fruits (bananas, pineapples, mangoes) Sensory characteristics -Aroma -Sweetness -Acidity -Hardness Credence characteristics -Conventional -Organic -Fair-trade -COO

The data from Tanzania is used in paper 1 and 2. The data was collected in May 2011, at a university town in Morogoro, Tanzania. The data was collected in two stages; first in an artefactual field experiment at the university (paper 1), then in a framed field experiment, in a traditional food market in Morogoro (paper 2). In addition to the experimental methods, a survey including socio-demographic variables was conducted in both experiments.

To elicit the WTP for food safety related attributes in tomatoes we use the BDM method in the artefactual field experiment and the BDM, MPL, MPLX and RCE in a framed field experiment. Tomatoes were chosen because they are mostly used among consumers, and from our pre-interviews, tomatoes were among products believed to be the most prone to poor agricultural practices.

Data from the US is used in paper 3. The study included a hypothetical MPL survey conducted in 2010 at a university restaurant in the northeast of the US. Participants were recruited from both the university and the local community, therefore including a wide range of demographic characteristics. The sample was split into citizen and consumer treatments, where each participant answered either a citizen or consumer oriented WTP question.

Finally, in paper 4 data from Norway is used to answer a research question on consumer preferences for natural tropical dried fruits from Africa in Europe. The study included a sensory evaluation and a market survey. A sensory measurement was important because the dried fruits differed from what is sold in stores, and because taste is one of the most important attribute when consumers evaluate food (Grunert 2005; Lusk & Briggeman 2009; Schjøll 2014). The market survey was important for evaluating the potential market for dried fruit from Africa in Europe, and for strategizing to penetrate the dried fruit market.

4.0 Summary of the papers

Paper 1: Consumer willingness to pay for food safety in Tanzania: an incentive-aligned conjoint analysis *(co-authored with Frode Alfnes, published in the International Journal of Consumer Studies, 2012, Vol 36(4))*

Objective: Assess consumer preference and WTP for food safety in Tanzania. More specifically the paper compares gender and income effects; and assess consumer WTP for experienced and credence attributes related to food safety.

Method: The artefactual field experiments involved 18 experimental sessions in an enclosed room. Each session included an average of 16 participants giving a total of 269 participants who completed both the survey and experimental session. During the experiment participants were explained the product attributes and trained how the BDM works, they were also paid beforehand their participation fee to give them a sense of ownership. Each respondent used the BDM mechanism to independently evaluate 12 tomato profiles. The tomato profiles included a combination of the physical and credence attributes generated in a fractional factorial design.

Using the BDM, participants formulated independent bids for each product profile; then each participant randomly picked one of the product profiles as binding, and then randomly picked an exogenous determined price (market price). If the bid for the binding tomato profile was greater than or equal to the randomly picked price, then the consumer paid the randomly picked price and received the binding product, but if the bid for the binding product was less than the randomly picked price, then he/she paid nothing and received nothing. During the BDM training, participants were explained their weakly dominant strategy through an illustration using onions.

Empirical analysis: Six panel data Tobit models censored at zero were analysed to estimate the marginal WTP (MWTP) for tomato attributes. The first model estimated the MWTP for the full sample; the second and third model split the sample by gender and estimated the MWTP for each gender; while the fourth, fifth and sixth model, split the sample by income, and estimated the MWTP for each income group (Low (>250,000(160USD)/month), Medium (250,000-820,000/month), and High(<820,000/month)).

Research findings: The study finds that an average consumer is willing to pay a premium price for food under strict food regulations. Consumers are willing to pay 216 TZS/kg more for tomatoes which are inspected to meet the standards set by the TBS (Tanzania Bureau of Standards); and 113 TZS/Kg more for tomatoes produced using organic methods. Consumers somehow seemed not to associate origin with better agricultural practices, but rather with consumer ethnocentrism. They seemed to show royalty towards their country (Tanzania) and antipathy towards South Africa. Consumers also prefer big sized compared to small sized tomatoes, and tomatoes sold in smaller portions (100-200g portions). The smaller portions were more important for female and lower income consumers.

Even though men are generally willing to pay more for tomato products than women, women are willing to pay higher premiums for food safety related attributes. Income which is likely to be correlated to education is correlated to MWTP for both physical and credence attributes, however low income consumers are willing to pay more for organic attributes than medium income consumers. High income consumers (probably due to education) discount tomatoes from South Africa the least.

Paper contributions: The study contributes to the food safety valuation literature, as it is among the first studies to use non-market valuation methods, to study consumer preference for food safety related attributes in an African context. The study also contributes to the food preference literature, as both experienced and credence attributes are evaluated in an African context. And finally the study sheds light to policy makers (in Africa and donor countries) on the importance of the safety component when promoting food security.

Paper 2: Eliciting consumer WTP for food characteristics in a developing context: comparison of four methods in a field experiment *(co-authored with Frode Alfnes)*

Objective: The paper aims at answering two objectives; 1) assess consumer preference and WTP for organic and food safety inspected tomatoes in a context close to a typical purchasing situation. 2) Comparing WTP between four experimental valuation methods in a framed field experiment.

Method: To be able to test non-market valuation methods popularly used in experimental studies in the US and Europe, in a traditional African market, we choose methods that: -were easy to explain, have a dominant strategy that is easy to understand, somehow reflects the typical one-on-one haggling process between buyers and sellers in these markets, and, were simple and easy to be conducted with one person at a time. The chosen methods from the literature are the BDM, the multiple price-lists (MPL), the multiple price-lists with stated quantities (MPLX), and the real-choice experiments (RCE).

A table was set next to other tomato sellers, where tomatoes were sold using either of the four valuations methods. Quota sampling was used to get an equal balance in gender and income across the four methods, where consumers coming into the market were randomly selected into each of the methods following the quota sampling. Since consumers were expected to buy tomatoes with their own money, we recruited only consumers coming to the market to buy tomatoes, and who were involved in food decision making.

During the experiment each participant, one at a time was explained the credence attributes for the tomato products to be sold (Organic tomatoes; Food safety inspected tomatoes; conventional tomatoes; tomatoes which are inspected and produced organically), then they were explained their respective methods for buying tomatoes; lastly they were given an opportunity to buy tomatoes using the elicitation method described to them.

Empirical analysis: From the four methods we obtained four different datasets, where three different estimation methods were used to estimate the WTP. For the BDM treatment, a panel Tobit model censored at zero was used to estimate the WTP; for MPL and MPLX, an interval regression model was used to estimate the WTP, for MPLX the WTP for the first unit was used. A mixed logit model was used to estimate the utility for the RCE, and then results were transferred to get the MWTP for each tomato attribute.

In comparing the four methods we 1) used our experiences from the field to comment on the implementation challenges 2) compared WTP estimates from the four estimated models 3) compared the WTP distributions (from the raw data presented in a figure) 4) compared MWTP distributions for organic and/or food safety inspected through simulations (by randomly drawing 1,000 draws from the estimated parameter distributions from the respective models) (we also present the differences in a figure) 5) used the Krinsky and Robb CI to compare the relative efficiency in WTP estimates 6) used the interval regression model to compare the difference between MPL and MPLX; and the MPL with different price scales (in assessing price scale effects).

Research findings: All the four methods reveal that consumers are willing to pay a premium for organic and /or food safety-inspected tomatoes, and the order of the premium is the same across all the methods. However the size of the premium is significantly larger, when consumers choose between alternatives (RCE) than when they indicate their reservation price (BDM, MPL, MPLX).

The price list methods were the most convenient and efficient methods; however there is a scaling bias. Which is evident when consumers valuate on low-value products like conventional tomatoes, but the effect disappears when higher value products like organic and food safety inspected tomatoes are valued.

Paper contributions: By assessing whether the elicitation method matters in estimating the WTP, we contribute to the non-market valuation literature. We also contribute to the literature on experimental studies, when assessing if the elicitation methods matters when used in a traditional food market in Africa, hence able to discuss the challenges and recommend on methods to be used in such settings. Finally, we contribute to the literature on food preference studies in Africa, specifically on preference for food safety related attributes.

Paper 3: Consumer vs citizen willingness to pay for restaurant food safety (*Co-authored by Frode Alfnes and Amit Sharma, published in Food Policy, 2014, Vol.49*)

Objective: The paper sets to answer two objectives; (1) assess whether there is a WTP for increased food safety standards in restaurants in the US, (2) assess whether a consumer-citizen duality in WTP exists for food safety standards in restaurants.

Method: Using a split sample WTP survey, participants in the consumer treatment answer a WTP buying question using a typical price list method, while participants in the citizen treatment answer a WTP voting question using a price list method with a series of yes or no votes at the different price levels. Moreover the price intervals were the same for both questions, except that the consumers had a box for ticking when they were not willing to pay at the lowest price interval, while the voters could just vote no for the lowest price interval. Both the consumer and citizen oriented questions involved three versions that varied in the degree of reduced food safety risks (25%, 50% and 75%). Each participant received a question with either of the three risk reduction levels.

Empirical analysis: Because we only know the interval around the WTP, we estimate WTP using an interval regression model. For estimating the WTP, the highest price interval consumers are willing to pay and voters are willing to vote yes to, are picked. We estimate four interval regression models to analyse the difference in WTP between consumers and citizens associated with difference in:-the risk reduction levels (25%, 50%, 75%), gender and/or age groups.

Findings: We find that a duality does exist on the WTP for food safety standards in restaurants. Both consumers and citizens are willing to pay a premium for reduced food safety risks in restaurants, but citizens are willing to pay twice as high for the reduced risks. The difference is consistent for all the three risk reduction levels; however the risk-reduction levels don't affect the willingness to pay.
We further find that women and men both have similar preference for reduced food safety risks at society level, but at an individualistic level, women are more willing than men to pay to protect themselves in a restaurant.

Paper contributions: The paper assess whether the difference in the elicitation questions yield different results, therefore the study contributes to; the duality literature, to the literature on elicitation methods, to the literature on consumer preference for food safety; and to policy makers and researchers on the importance of considering the design of methods when answering questions which could answer different objectives.

Paper 4: European consumer preference for sensory and credence characteristics from African dried fruits (*co-authored with Valérie Almli Lengard and Anna Temu*)

Objective: The paper aims to assess consumer preferences toward dried fruits from Africa. More specifically the paper aims to:- identify sensory attributes driving consumer preference for tropical dried fruits from Africa; valuate the amount consumers are willing to pay for conventional dried fruits, and for dried fruits with credence attributes (organic and fair-trade); and identify credence attributes that producers in Africa should cling on, when selling such products in Europe.

Method: Because the assessed dried fruits differ from what is typically sold in stores, and taste is important in product evaluation, the paper combines a sensory evaluation and a market survey. The sensory evaluation included a hedonic evaluation on the fruit samples, and a descriptive analysis of the fruit's hardness, sweetness, acidity and aroma in a 9-point Likert scale. The market survey included WTP questions in a contingency valuation form, COO preferences and hierarchical questions on the motivations underpinning consumer choice for a COO.

Empirical analysis: In the sensory analysis to establish the association between the descriptive sensory attributes and the hedonic scores; and identify preference patterns, an internal preference mapping was done in a partial least square regression (PLS-R). And in assessing the potential consumer groups for dried fruits from Africa, a PCA and an agglomerative hierarchical cluster analysis with a complete linkage method was run to uncover patterns between consumer characteristics, attitudes, COO preference and WTP premiums. For the WTP estimates we run three Tobit models censored at zero (for the conventional, organic and fair-trade dried fruits).

Findings: We find that consumers have a strong preference for naturalness over uniform taste; however sensory characteristics should not be ignored. Consumer preferences are mainly driven by strong aroma, sweetness or acidity. And consumers preferring sweet flavors are different from those preferring strong acidic flavors. Consumers also value both dried fruits with an organic and fair-trade label, but are willing to pay a higher premium for fair-trade. Three consumer groups were identified: 1) Fair-trade group: - mostly preferring dried fruits from black African countries, and are likely to be willing to pay a higher premium for organic and fair-trade compared to the other two groups. 2) Country involvement group: - mostly preferring exotic dried fruits from Brazil, South Africa and Thailand. 3) Indifferent to COO:-this group involves mostly low educated women, with some preference for naturalness and fair-trade.

Paper contributions: The paper highlights on important sensory and credence attributes for selling dried fruits from Africa in Europe. The paper also contributes to the literature on food preference; specifically to the literature on fair-trade and organic.

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Paper 1

International Journal of Consumer Studies

International Journal of Consumer Studies ISSN 1470-6423

Consumer willingness to pay for food safety in Tanzania: an incentive-aligned conjoint analysis

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Keywords
Conjoint analysis, food safety, incentive-compatible method, organic, tomatoes, Tanzania.

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doi: 10.1111/j.1470-6431.2011.01067.x

Abstract

In this paper, we present results from a consumer experiment in Tanzania focusing on food safety. We elicit consumers' willingness to pay (WTP) a premium for tomatoes that have been inspected by health officials to meet the standards set by the Tanzania Bureau of Standards. We also elicit consumers' WTP for tomato attributes that can be associated with different food safety standards: conventional vs. organically produced and various origins. Two hundred sixty-nine urban consumers from Morogoro, Tanzania took part in the experiment where they evaluated tomatoes using the Becker–deGroot–Marschak mechanism. The results show that on average, consumers in Tanzania are willing to pay a premium for inspected and organically produced tomatoes. Consumers have a strong preference for tomatoes produced in Tanzania and do not discount tomatoes produced in areas associated with poor agricultural practices. However, consumers do significantly discount tomatoes imported from South Africa.

Introduction

As African economies grow, demand for food quality is likely to increase. In Tanzania, for example, the income per capita[1] has more than doubled from 2000 (US$ 732) to 2011 (US$ 1491) and is predicted to continue to rise in the coming years (International Monetary Fund, 2011). One important factor of food quality is food safety. In this paper, we present the results of an experiment conducted to investigate how urban consumers evaluate attributes that can be associated with food safety.

Residues of pesticides or heavy metals are not detectable by ordinary consumers, either before or after consumption. Sellers of food products are unlikely to provide information about these food hazards. Hence, consumers concerned about these hazards have to rely on credence attributes like food being inspected to meet certain standards or organically produced, or having a geographical identity associated with good agricultural practices.

Until recent years, vegetables like tomatoes, spinach, cabbage and amaranthus were perceived to be organically grown in Tanzania. However, due to the rise in demand, vegetable production has shifted from a subsistence level to commercial production. Many farmers have intensified production and have been tempted to use poor agricultural practices, and even produce product in areas highly susceptible to heavy metals (Bahemuka and Mubofu, 1999; Ndengerio-Ndossi and Cram, 2005; Ngowi *et al*., 2007; Shemdoe, 2010).

Due to the rise in awareness of these poor practices, there has been a rise in government and consumer concerns that unhealthy foods could be found in markets. On March 15, 2011, *The Guardian* reported the Tanzania Minister of Trade's concerns for strengthening food safety and quality control systems, through promoting good agricultural and animal husbandry practices (Andrew, 2011). Recently, there has been a government debate in Tanzania to lift the ban on dichlorodiphenyltrichloroethane (DDT) for use in controlling malaria. This has raised consumer concerns for food safety issues. For example, Ndengerio-Ndossi and Cram (2005) found the presence of pp-DDT in many samples of food at the table-ready stage, which indicated there was already a use of DDT in agricultural production despite the ban.

In this paper, we use an incentive-aligned conjoint analysis to investigate how consumers value credence attributes that can be associated with food safety. The outline of the remaining paper is as follows. First is a short literature review of consumer studies on food safety. Second is the description of the experimental design and methods. Third is the description of the data. Fourth is the description of the econometric model used to analyse the data. Fifth comes the results, and last we conclude.

[1]The International Monetary Fund's estimates for gross domestic product based on purchasing power parity per capita.

Consumer studies on food safety

There has been significant research regarding consumer knowledge, perception, attitudes, preferences, and willingness to pay (WTP) for credence attributes associated with food safety in the US and Europe. In a study of food values among US consumers, Lusk and Briggeman (2009) found that food safety was the most important food value, followed by nutrition, taste and price. Loureiro and Umberger (2007) found that the United States Department of Agriculture food safety inspection label, steak tenderness label and traceability were the most important credence attributes for beef. Mørkbak *et al*. (2011) showed that Danish consumers were willing to pay a premium for food safety when they were introduced to products with additional food safety characteristics. A study by Loureiro and Umberger (2003) found that US consumers were willing to pay a premium for steaks labelled 'Guaranteed USA: Born and raised in the US'. The reason for preference for the country of origin label included food safety concerns, desire to support their local producers and belief that US beef was of higher quality.

Most studies done in Europe and the US report education, gender and income to have a significant effect on the evaluation of credence attributes that can be associated with food safety. For example, Byrne *et al*. (1992) found women and highly educated consumers to have a higher probability of purchasing organic foods. Loureiro and Umberger (2003) found higher concern on food safety among female and high-income shoppers. Wang and Sun (2003) found younger consumers with smaller households and larger incomes were more likely to purchase organic produce. And Smith *et al*. (2009) found that education and income influence the probability of a person purchasing fresh organic produce.

In developing countries, very few consumer studies focusing on preference and WTP for food safety have been conducted. A closely related study is Lagarkvist *et al*. (2011), who study consumer WTP for safer leafy vegetables in Nairobi. They analysed consumer WTP across four major market outlets (open air, roadside, supermarket and specialty shops) and reported WTP for safer vegetables to be market-specific and multifaceted. Trust and perceived risks were identified as the most important factors influencing WTP where income played only a subordinate role. Another related consumer study done in rural China found households consume more higher-quality foods as their incomes increased (Yu and Abler, 2009).

Other consumer studies related to food safety in developing countries include studies on biotechnology products conducted in Tanzania, Uganda, Kenya and the Philippines. In Tanzania, a qualitative study on genetic modification (GM) technology found very poor knowledge, understanding and awareness of the potential risks and benefits of the technology among farmers. However, the study found a high potential for demand and use of GM products in Tanzania (Lewis *et al*., 2010). Kikulwe *et al*. (2011) studied consumer perceptions towards GM bananas in Uganda and found that consumers were willing to buy GM bananas if they had the same price as conventional bananas, but had better quality (more nutritious, tasted better, or required fewer pesticides). They found income and education negatively influence attitudes to GM bananas, but no gender effect. A similar study on consumer awareness and perception of GM maize meal in Kenya found high-income consumers to have the lowest benefit perception and highest environmental risk perception on GM foods. However, more than 68% of the respondents were willing to buy GM maize meal at the same price as their favourite maize meal brand (Kimenju and De Groote, 2008). Depositario *et al*. (2009) found gender and age to have a significant effect on WTP for GM rice among Filipino consumers, while education, income and awareness had a negative though insignificant effect on WTP for GM rice.

Experimental design and methods

We conducted a conjoint analysis with the incentive-compatible Becker–DeGroot–Marschak (BDM) mechanism (Becker *et al*., 1964). Conjoint analysis is a widely applied marketing research method used to investigate consumer preferences for a large number of product attributes (Wittink *et al*., 1994). Conjoint analysis has been widely used both with rating-based conjoint methods (see, for example, Otter *et al*., 2004) and choice-based conjoint methods (see, for example, Vermeulen *et al*., 2008). Conjoint studies have been widely done in developed countries, but until recently, there have been very few studies reported from developing countries.

Our design departs from that of other rating- and choice-based conjoint studies in that it uses a well-tested incentive-compatible method from the non-market valuation literature to rate products. Whereas most rating-based conjoint studies ask the respondents to rate their liking for products on a scale (Otter *et al*., 2004), our respondents showed their liking by the amount of money they were willing to pay for the product in the BDM mechanism.

In the BDM, the subject formulates a bid. The bid is compared with a price determined by a random number generator. If the subject's bid is greater than the price, he or she pays the price and receives the item being auctioned. If the subject's bid is lower than the price, he or she pays nothing and receives nothing. The optimal strategy in the BDM is to submit a bid that is equal to your maximum WTP, and thereby reveal your preferences. The incentive-compatible BDM mechanism has been widely used in non-market valuation studies in developed countries (Lusk and Shogren, 2008). However, until recently, few studies have used the BDM mechanism in developing countries. Two exceptions are the consumer studies on micronutrient by Kiria *et al*. (2010) and De Groote *et al*. (2011).

Product attributes in the conjoint experiment

We investigated consumers' WTP for tomatoes with different credence and physical attributes. The credence attributes included inspection (inspected or not), production methods (organic or not), origin (Tanzania or imported from South Africa), and different geographical indications within Tanzania: (1) the Uluguru Mountains, which are located right outside Morogoro municipality, are less populated, have no industries, and small-scale farmers mainly produce using traditional agriculture; and (2) Kihonda, which is located within the Morogoro municipality, is highly populated, farmers practice intensive vegetable production and industries are present. Physical attributes include weight (1, 0.5, 0.2 or 0.1-kg portions) and size (big- or small-sized tomatoes). Table 1 describes the product attributes.

Table 1 Description of the product attributes

Variable	Definition	Levels
Inspected tomatoes	Tomatoes inspected by health officials and confirmed to meet the standards set by the Tanzania Bureau of Standards.	0 = Not inspected 1 = Inspected
Organic tomatoes	Naturally grown: grown with organic manure and sprayed with organic pesticides.	0 = Inorganic 1 = Organic
Origin	Production place for the tomatoes. Tanzania without further information on locality. Uluguru Mountains represent local traditional production. Kihonda represents local area with industry. South Africa is imported.	0 = Tanzania 1 = Uluguru Mountains 2 = Kihonda 3 = South Africa
Size	Size of the tomatoes.	0 = Small sized 1 = Big sized
Weight	The weight of the tomatoes.	0 = 0.1–0.2 kg 1 = 0.5 kg 2 = 1 kg

Table 2 Examples of the evaluated tomato profiles

Product number	Inspection	Organic	Origin	Size	Weight (kg)
1	None	Inorganic	Kihonda	Big	1.0
2	None	Organic	South Africa	Small	0.5
3	Inspected	Organic	South Africa	Big	1.0
4	None	Inorganic	Tanzania	Big	0.2
5	Inspected	Inorganic	Mountain	Small	0.1

Fractional factorial design for the conjoint experiment

We used a macro from SAS software (*%mktex*) to generate a fractional factorial design with 36 tomato profiles so that the attributes were not correlated among the products we presented at each session. The 36 tomato profiles were divided into three blocks of 12 profiles. Therefore, each respondent evaluated 12 tomato profiles. Examples of the tomato profiles presented to consumers are shown in Table 2. SAS reported a D-efficiency of 99.22 (100 being the max) for the total design. For a description of the SAS macro, see Kuhfeld (2010).

Procedure in the conjoint experiment

The experiment involved 18 experimental sessions conducted in May 2011. Each session lasted approximately 1 h and included 16 participants. The sessions had several parts, but in this paper, we will discuss only the incentive-aligned conjoint experiment using the BDM valuation mechanism to elicit consumer valuations for tomato attributes.

In the experiment, the participants were welcomed and were told that the session was about consumer market decision making. They were told that the objective of the study was to investigate their preference for different product attributes. The participants were presented with an envelope that included their ID number, a consent form, bidding sheets, and a monetary endowment for the participation. The participants were paid beforehand to give them a sense of ownership of their monetary endowment.

The participants were told that there would be two parts to the experiment. The first part included a hypothetical valuation experiment where they could bid on picture profiles and the second part, an incentive-aligned conjoint experiment where they could bid on real products. In the second part, they had the opportunity to buy the products using the BDM mechanism. The participants were told that the two parts were completely independent and they were asked to state the maximum amount they were willing to pay in both parts. Furthermore, we specified that we were only interested in their WTP for that particular day and not for a different day or season. For this study, we will analyse only the second part: the incentive-aligned conjoint using the BDM mechanism.

Before the BDM, (1) the different product attributes were elaborated; (2) the participants were told how the BDM mechanism worked; (3) a trial round to illustrate the BDM mechanism was done using 500-g portions of onions; (4) it was emphasized that participants were not allowed to communicate with each other; and (5) the participants inspected the different pictures and products labelled with the attribute information.

Data

Experimental area

The experiments took place in Morogoro, which is about 190 km west of Dar es Salaam. Morogoro is a town with a population of about 200 000 (URT, 2002). The main economic activities are agriculture and educational services, and the area is considered the Tanzania food basket.

Table 3 Descriptive statistics for the sample

Sample	Variable	Number of respondents	Mean	Standard deviation	Min	Max
Total sample	Female[a]	269	0.69	0.46	0	1
	Age	267	37.07	11.50	18	62
	Education[b]	269	4.39	2.67	1	10
	Income[c]	266	703.51	966.55	15	8000
Female	Age	185	36.40	10.68	18	62
	Education[b]	185	3.98	2.56	1	10
	Income[c]	184	724.69	1079.65	15	8000
Male	Age	82	38.57	12.99	18	62
	Education[b]	84	5.27	2.66	1	9
	Income[c]	82	656.00	647.81	15	2800
Low income	Female[a]	100	0.68	0.46	0	1
	Age	100	35.90	12.03	18	62
	Education[b]	100	2.65	1.42	1	7
	Income[c]	100	118.73	63.44	15	240
Medium income	Female[a]	99	0.70	0.46	0	1
	Age	98	35.79	10.78	18	62
	Education[b]	99	4.35	2.58	1	9
	Income[c]	99	478.01	176.05	250	800
High income	Female[a]	70	0.67	0.47	0	1
	Age	69	40.57	10.88	18	59
	Education[b]	70	7.00	1.99	1	10
	Income[c]	67	1913.26	1271.10	822	8000

[a]One if female, 0 if male.

[b]No education = 1; Primary = 2; Dropout secondary = 3; Secondary O-level = 4; A-level = 5; Certificate = 6; Diploma = 7; Degree = 8; Masters = 9; PhD = 10.

[c]Monthly income in 1000 TZS. TZS 1000 = US\$ 0.64. Hence TZS 15 000 = US\$ 9.60 and TZS 8 000 000 = US\$ 5121 (31 May 2011 values according to http://www.oanda.com/).

Sample

Although the study includes only consumers from the Morogoro region, the participants represented a wide range of demographic characteristics: ages ranged between 18 and 62 years; education ranged from no education to postgraduate level (PhD); total family income ranged from 15 000 TZS/month to 8 000 000 TZS/month; and both genders were well represented in the experiment.

Participants were recruited based on their perceived income and knowledge on food and health. Participants were recruited from low- and medium-income residential areas and some were recruited at work. Every third house in each street was selected, and in case of absenteeism, the next house was selected for recruitment.

We recruited only people who participated in food purchase decisions in the family, which included either the household head or spouse. Two hundred seventy-six participants participated in the experiment, but only 269 participants completed both the survey and the experimental session. Because Tanzanian women do the majority of food shopping and make most of the decisions about food, two-thirds of those recruited were female (185) and one-third were male (84).

For the estimation, participants were divided into three income levels. Low-income consumers included 101 participants with an expected monthly income of less than 250 000 TZS (equal to US\$ 160 on 31 May 2011 according to the currency converter at http://www.oanda.com/). Medium-income consumers included 98 participants with an expected monthly income between 250 000 TZS and 820 000 TZS. High-income consumers included 67 participants with an expected monthly income greater than 820 000 TZS. Table 3 summarizes the descriptive statistics for both the total sample and the subsamples used in the estimation.

Econometric model

Each of the 269 participants (i = 1–269) evaluated 12 out of the 36 product profiles (j = 1–12) by stating their WTP for the tomatoes. The product profiles had three two-level categorical attributes: inspection (x_{1ij}: 1 = inspected, 0 otherwise); production methods (x_{2ij}: 1 = organically grown, 0 otherwise); size (x_{3ij}: 1 = large, 0 otherwise); a four-level categorical attribute coded as a series of three dummies: source (x_{4ij}: 1 = Uluguru mountains, 0 otherwise; x_{5ij}: 1 = Kihonda, 0 otherwise; x_{6ij}: 1 = South Africa, 0 otherwise); and a three-level categorical attribute: weight coded with two dummies (x_{7ij} 1 = 0.5 kg, 0 otherwise; x_{8ij} 1 = 1 kg, 0 otherwise).

We analysed the data with an additive model.

$$Y_{ij} = \beta' X_{ij} + \nu_i + \varepsilon_{ij} \tag{1}$$

Where Y_{ij} is the WTP/kg by participant i for the j-th product profile, X_{ij} is a vector including the attributes of the j-th product profile offered to participant i, ν_i is the individual-specific random

Table 4 Estimated marginal WTP for tomato attributes

		Sample split on gender		Sample split on income		
	Total sample	Female	Male	Low	Medium	High
Credence attributes						
Inspected	215.58***	226.53***	188.35***	180.35***	213.81***	264.28***
	(26.69)	(32.88)	(45.65)	(45.07)	(42.09)	(54.63)
Organic	113.30***	119.80***	115.51**	137.76**	34.05	188.98***
	(26.30)	(32.01)	(46.63)	(43.61)	(42.95)	(53.21)
Mountain	–89.67**	–54.51	–158.40**	–72.87	–105.53*	–57.88
	(39.50)	(48.18)	(69.28)	(66.49)	(63.06)	(80.20)
Kihonda	–27.17	6.54	–95.31*	–8.15	–35.97	–30.74
	(33.16)	(40.44)	(57.83)	(55.21)	(53.11)	(67.28)
South Africa	–197.18***	–202.69***	–183.66**	–203.29***	–287.18***	–80.30
	(35.05)	(42.88)	(60.98)	(58.90)	(56.47)	(70.28)
Physical attributes						
Big size	110.64***	101.91***	125.24***	92.63***	85.91**	173.55***
	(25.08)	(30.66)	(43.55)	(41.81)	(40.14)	(51.02)
500-g bag	–140.95***	–172.25***	–74.06	–176.15***	–152.78*	–89.56
	(29.93)	(36.51)	(52.14)	(49.97)	(48.10)	(60.07)
1000-g bag	–221.14***	–220.73***	–222.95***	–299.75***	–206.14***	–133.56**
	(34.18)	(41.01)	(62.28)	(56.17)	(57.42)	(66.75)
Constant	433.02***	396.35***	506.96***	406.90***	543.38***	310.42***
	(48.87)	(57.72)	(90.92)	(77.30)	(83.90)	(96.78)
Sd ν	516.46***	489.67***	564.35***	467.57***	565.23***	510.18***
	(26.70)	(31.10)	(50.77)	(41.75)	(46.77)	(52.15)
Sd ε	651.25***	654.42***	640.68***	659.33***	629.55***	659.60***
	(10.47)	(12.91)	(17.78)	(17.55)	(16.67)	(21.09)
# Bid	3176	2176	1000	1183	1158	802
# Sample	269	185	84	101	98	67

Tobit analysis censored at zero. Significant results: *$P < 0.10$, **$P < 0.05$, ***$P < 0.001$.
Standard errors are in parenthesis.

term, and ε_{ij} is the residual. We followed the common practice used in similar valuation studies and estimated the BDM data with a panel Tobit model censored at zero (Lusk and Shogren, 2008).

Results

We present an analysis of WTP/kg for tomato attributes for the total samples and for subsamples divided on income and gender. When looking at the price premiums, we found in the experiment, one should keep in mind that during the experiment, the price for a kilo of tomatoes ranged between 800 TZS and 1200 TZS in Morogoro markets.

Econometric model results for the total sample

The first column with results in Table 4 presents the results for the total sample. The results show that on average, participants are willing to pay more for inspected than for uninspected tomatoes (216 TZS/kg) and more for organic than conventional tomatoes (113 TZS/kg). Both these results indicate that consumers are willing to pay a premium for foods produced under stricter food regulations. When it comes to origin, the results are a bit surprising. Firstly, the consumers preferred a generic Tanzanian origin to the two specific origins we used, both areas close to the study site. The results are understandable for tomatoes from the industrialized area Kihonda, which is associated with poor agricultural practices (–27 TZS/kg); however, it is surprising that the mountain area, which is associated with traditional agricultural practices, is discounted even more (–90 TZS/kg). The results could be an indication of people preferring products from areas they are closely associated with (consumer ethnocentrism) because our sample is drawn from the urban population in Morogoro. Alternatively, it could be that the participants are used to farmers from the mountains selling their products at low prices, and translating that into low bids in the experiment. In other words, participants anchored to prices observed outside the experiment.

Consumers also significantly discounted tomatoes from South Africa relative to tomatoes from Tanzania (–197 TZS/kg), although South Africa is believed to have higher food safety controls and regulations relative to most countries in sub-Saharan Africa. This could be due to people tending to have either loyalties towards their own country or antipathy towards other countries (Lusk *et al*., 2006). The literature on consumer preference for country of origin in the US and Europe finds similar results (Alfnes and Rickertsen, 2003; Loureiro and Umberger, 2003; Lusk *et al*., 2006; Ehmke *et al*., 2008; Costanigro *et al*., 2010).

Consumers are willing to pay a premium of 111 TZS/kg for big-sized compared with small-sized tomatoes. These results were expected, as in the focused group discussion, size, colour, firmness and non-spotted tomatoes were the most important physical attributes.

Consumers discount the 500-g tomato portions by 141 TZS/kg and the 1-kg portion by 221 TZS/kg compared with the presented 100- or 200-g portions. One of the explanations could be due to the daily shopping habits of low-income consumers. They are used to buying small portions of 100–500 g. Therefore, they most probably prefer smaller portions than a kilogram of tomatoes.

Econometric model results by gender

Comparing the bids from men and women, we can find that men bid significantly higher than women (649 vs. 577 TZS/kg). To explore their underlying preferences, we ran our Tobit model separately for the two groups. The results are presented in the second and third column of Table 4. We can see that female participants are willing to pay slightly, but not significantly, more for inspected (227 TZS/kg) and organic tomatoes (120 TZS/kg) compared with the male participants (188 and 116 TZS/kg, respectively). However, for both male and female participants, the preferences for food safety do not translate into their preferences for origins associated with better agricultural practices. Both discount tomatoes from safer areas compared with unsafe areas, and both show loyalties towards their country and antipathy towards South Africa. Women have a higher and more significant discount for tomatoes from South Africa, while men have a significant discount for tomatoes from the mountains and have a significant preference for tomatoes from Tanzania.

Econometric model results by income

Comparing the bids over the three income groups, we find that average bids are correlated with income. High-income consumers have the highest WTP (648 TZS/kg) followed by middle-income consumers (625 TZS/kg) and then low-income consumers (538 TZS/kg). To explore their underlying preferences, we ran our Tobit model separately for the three income groups. The results are presented in the last three columns of Table 4. Consumers in all income groups are willing to pay a significant premium for inspected tomatoes, and their WTP is correlated with income. However, we do not see the same income effect when comparing WTP for organic tomatoes. The participants in the high-income group are willing to pay the highest premium for organic tomatoes (189 TZS/kg). However, the low-income consumers are willing to pay a significantly higher premium for organic tomatoes (137 TZS/kg) than the middle-income consumers (34 TZS/kg). The results on WTP for organic for the low- and medium-income groups are somehow contrary to the literature on income effect (Wang and Sun, 2003; Smith *et al*., 2009; Yu and Abler, 2009; Kikulwe *et al*., 2011).

None of the groups are willing to pay a premium for products from safe compared with unsafe origins in Tanzania. Furthermore, participants from all income groups discount tomatoes from South Africa compared with Tanzania, but the highest income group had the least discount. This could be influenced by education, knowledge, income and experience. It is likely that participants in the high-income group had better knowledge than the others about differences in food safety standards between Tanzania and South Africa, but the decision in all groups are likely affected by ethnocentrism.

Conclusion

In recent years, there have been studies showing poor food safety practices in Tanzania, but until now, the market has not provided Tanzanian consumers with much choice with respect to food safety. From the findings of this study, we can conclude that consumers of both genders and all income groups have preferences for food safety and are willing to pay a premium for product attributes that can be associated with food safety. From the study, we can conclude that inspection is the most valued attribute associated with food safety, and it is significant across the different income and gender groups. Organic production is also an important attribute when considering pesticide residues and heavy metals. The price premium for organic products is positive, but in some groups insignificant. When it comes to origin, it seems like ethnocentrism outweigh food safety considerations when consumers make their decisions.

Acknowledgements

The authors are grateful for the financial support from the Norwegian Agency for Development Cooperation (Norad) through the NUFU project: ‘Empowering women to participate in higher level of fruits and vegetables value chain through production of dried fruits’. We specifically thank the project leaders, Dr Anna Temu and Professor Trude Wicklund, for their cooperation in this work. We also thank Shose Rodrick for assisting in preparing and conducting the experiments.

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Paper 2

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]

[1] **Acknowledgements.—** The authors are grateful for the financial support from the Norwegian Agency for Development Cooperation (NORAD) through the NUFU project: 'Empowering women to participate in higher level of fruits and vegetables value chain through production of dried fruits'. We are also grateful to Kyrre Rickertsen, Elin Kubberød and Thabbie Chilongo for contributing to the improvement of this work.

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

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[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.

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 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.

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[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.

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 experiments were conducted within five days, with the first two days for the BDM and one day for each of the other methods. The turn up and time we needed varied between the days and therefore the number of participants varies between the methods.

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.

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.

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 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:

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

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; ν_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) $$U_{ij} = \alpha_1 Organic_j + \alpha_2 Inspected_j + \alpha_3 OrganicInspected_j + \alpha_P Price_j + v_i + \varepsilon_{ij},$$

where U_{ij} is the utility of participant i for 500 g of product j; $Price_j$ is the price of product j; the alphas are the respective utility parameters; and ε_{ij} are iid extreme value distributed error term. The rest is as in equations (1–3). 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).

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.

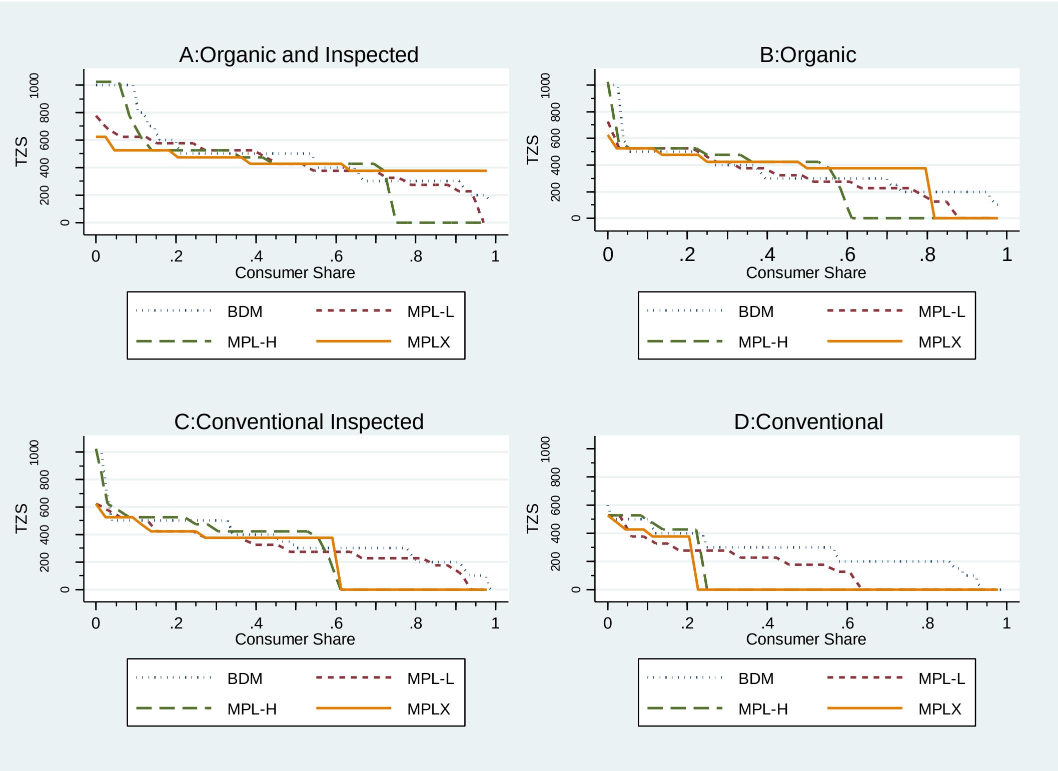
[d] When interpreting the price, recall that the market price for conventional tomatoes was around 350 TZS during the experiment.

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.



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.

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[4] (Dunn 1961) was performed and it also shows a significant difference ($p<0.01$) in MWTP between all the valuation methods.

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.

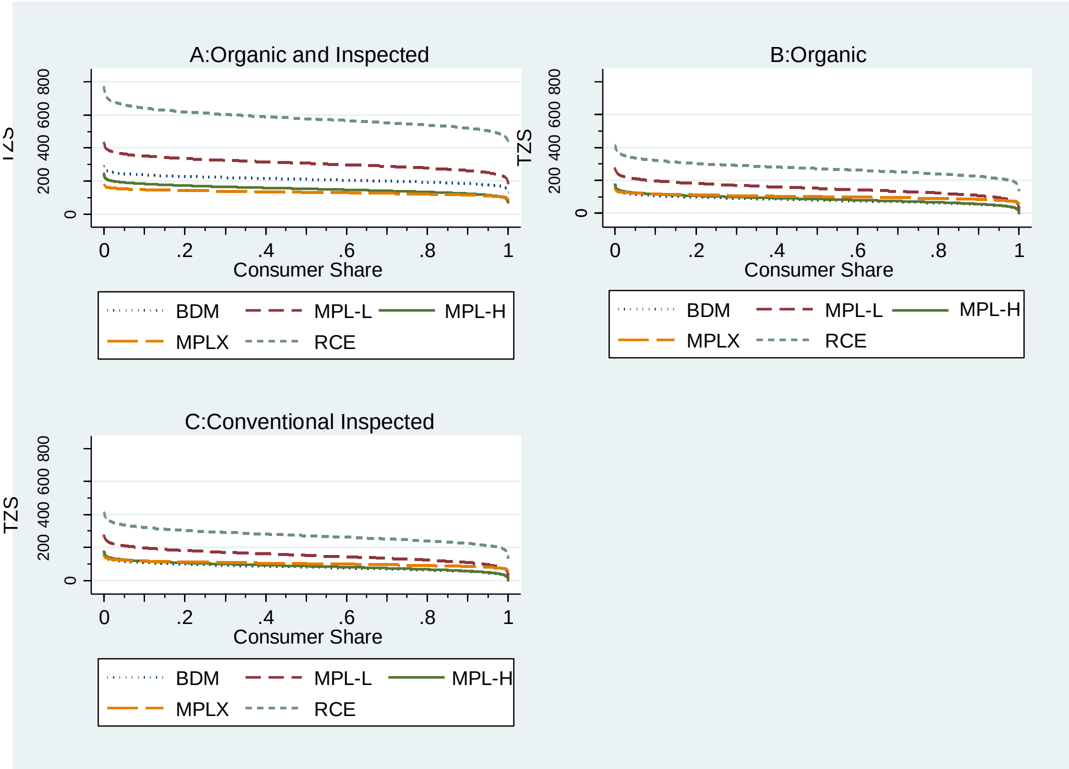


Fig.2. MWTP for three tomato attributes: Comparison of four valuation methods.

[4] 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.

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.

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[5] in WTP estimates between the four valuation methods by dividing the CI by the mean. Table 4 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.

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

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.

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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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 1^{st} 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.

Paper 3

Food Policy 49 (2014) 160–166

Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

Consumer vs. citizen willingness to pay for restaurant food safety

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ARTICLE INFO

Article history:
Received 21 October 2013
Received in revised form 19 April 2014
Accepted 30 June 2014

Keywords:
Consumer–citizen duality
Restaurant food safety
Willingness to pay

ABSTRACT

Individuals may display different preferences for food regulations when acting as a voting citizen than as a buying consumer. In this paper, we examine whether such a duality exists between citizens and consumers in the willingness to pay for food safety standards in restaurants. Using a split-sample willingness to pay survey, we find that individuals exhibit a higher willingness to pay for improved food safety standards in restaurants when acting as voting citizens than as buying consumers. Relying on consumer studies that focus on the buying context may therefore underestimate the support found among the public for new food regulations. This finding is important for policy makers using consumer studies in decision support and for researchers attempting to understand individual preferences.

Introduction

Individuals have multiple roles in life. For instance, in their role as consumers, they make purchases, while as citizens, they vote on laws that regulate the products they purchase. Vanhonacker et al. (2007) labeled this the consumer–citizen duality, and pointed out that the same individual may exhibit preferences as a citizen that differ from those expressed as a consumer. A recent example is the 2008 ballot proposition in California on animal welfare where Californians voted overwhelmingly in support of a proposition prohibiting battery-farm-produced eggs, which at the time of the vote were the most popular type of eggs purchased and consumed in California (Norwood and Lusk, 2011, pp. 264–5). This example alone suggests that when eliciting preferences over food characteristics, it could matter whether we approach respondents as consumers or citizens. In this paper, we investigate the degree of consumer–citizen duality in the context of food safety standards in restaurants.

With the exception of Hamilton et al. (2003), who investigate consumer–citizen duality in a study comparing consumer willingness to pay (WTP) for pesticide-free food and support for regulation to reduce pesticide use in agriculture, little research in food economics has focused on the notion of consumer–citizen duality. However, there has been an ongoing debate in the environmental economics literature (Ajzen et al., 1996; Blamey et al., 1995; Curtis and McConnell, 2002; Nyborg, 2000; Ovaskainen and Kniivilä, 2005; Russell et al., 2003; Sagoff, 1990). Sagoff (1990), for example, argues that individuals pursue their own goals when they act as consumers, whereas as voting citizens they are also concerned about what is good or right for the community. On this basis, he argues that any attempt to capture environmental values through market-mimicking mechanisms or monetary valuation studies draws on the false assumption that the preferences an individual exhibits as a citizen are the same as those the individual displays as a consumer.

Following this argument in Sagoff (1990), a consumer is likely to be concerned about price, taste, and nutrient content when buying food. In contrast, the citizen is also likely to be concerned about issues such as the place of origin, animal welfare, environmental friendliness, and fair trade. This listing corresponds well with some of the recent food quality regulations intensely debated in Europe and the United States (US). Some of the more contentious proposals include: the total or partial elimination of antibiotic use in livestock production (Lusk et al., 2006), a ban on the use of swine gestation crates or battery cages (Tonsor et al., 2009), a reduction in the amount of pesticide residuals permitted in fresh and processed foods (Florax et al., 2005), a requirement for the mandatory labeling of genetically engineered food (Lusk et al., 2005), and mandatory country-of-origin labeling (Loureiro and Umberger, 2003). Oddly, even though many of these issues are prone to the consumer–citizen duality, and public regulations are often the preferred policy instrument, the exploration of citizen preferences in the literature is more or less nonexistent. Instead, market-mimicking mechanisms, such as choice experiments where consumers choose between products with different labels, or experimental auctions where participants bid for different

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http://dx.doi.org/10.1016/j.foodpol.2014.06.009
0306-9192/

products, are the chosen methods of most studies. As a result, the most common output is an estimate of the average price premium consumers are willing to pay for products with specific attributes in a market setting (Alfnes and Rickertsen, 2011; Carlsson, 2011).

A focus on consumer buying behavior, as in most of the food economics and marketing literature, is appropriate for the purposes of food retailers and producers, but does not necessarily give the correct preference measure for policy makers. For proper economic analysis and recommendations, it is instead very important to identify the objectives before designing a study. If the objective is to provide decision support to marketers, then we should examine consumer-buying decisions. However, if the objective is to provide decision support to policy makers, then in addition to consumer preferences, we should also consider citizen preferences.

We employ a split-sample survey to investigate consumer–citizen duality in WTP for new food safety standards in restaurants. More specifically, we assess the following four points. First, the degree to which consumers and citizens are willing to pay for reduced food safety risks in restaurants. Second, whether framing the WTP question as a citizen-oriented voting question or a consumer-oriented buying question affects the results. Third, whether the posted levels of risk reduction matters. Finally, whether there are demographic differences in the WTP for decreased food safety risk.

Since both voluntary and mandatory changes in food safety practices will result in increased food prices in restaurants, both the citizen-oriented voting question and the consumer-oriented buying question use restaurant price increases as payment vehicle. In the citizen oriented voting question, participants were asked if they would vote yes or no to new food safety standards if the new standards would result in restaurant price increases, while in the consumer oriented buying question participants were asked how much extra they would be willing to pay if a restaurant implemented new food safety standards.

Consumer–citizen duality

Public and social choice theory suggests individuals have multiple preference orderings and that the one they use depends on the particular context (Arrow, 1951; Harsanyi, 1976; Mueller, 1987; Russell et al., 2003; Sagoff, 1990; Sen, 1977). Here, we are interested in the consumer–citizen duality found when individuals exhibit different preferences when they vote on regulations than when they act as consumers (Vanhonacker et al., 2007).

When voting individuals respond as citizens, they tend to place greater emphasis on public value than when making choices as consumers. For example, individuals tend to express more altruistic preferences when they assume the role of a citizen than when they assume the role of a consumer (Ajzen et al., 1996; Blamey et al., 1995; Hamilton et al., 2003; Harvey and Hubbard, 2013; Ovaskainen and Kniivilä, 2005; Wiser, 2007). For instance, in analyzing consumer preferences for a public good, Blamey et al. (1995) found that the responses in a referendum were influenced by citizen judgment concerning social goals. On this basis, they argued that this was because the referendum had more in common with political choices than consumer decisions in the market. On the contrary, a study by Curtis and McConnell (2002) found no difference in WTP between altruistic and purely private preference in a referendum to control deer population in the USA.

Some of the possible reasons for the discrepancy in preferences between citizens and consumers include trust, free riding, and the relative emphasis on prices in different contexts. For example, individuals are only willing to pay if they trust that the premium paid will contribute to improving the public good (Harper and Henson, 1999; Toma et al., 2011). For goods with a public good element, it is in the individual's best interest to free ride and let others carry the cost of the public good. This results in individuals only being willing to pay when they are sure everybody else also is paying (Harvey and Hubbard, 2013). For instance, Wiser (2007) found respondents were willing to pay a higher premium when confronted with a collective payment mechanism than with a voluntary payment mechanism. Likewise, Loureiro and Hine (2004) found that participants were willing to pay a higher tax rate to support a mandatory versus a voluntary labeling system for genetically modified (GM) products. Also Carlsson et al. (2007) found that consumers preferred free-range eggs produced under regulations where battery-cage-produced eggs were banned to those produced under regulations where they were not. Furthermore, it could be that individuals perceive cost differently in different contexts. In a grocery store for example, the individual receives direct feedback when making the purchase, hence the consumer concentrates on all attributes, including price. In contrast, in a voting booth, there is no direct feedback on cost, and therefore a citizen could concentrate more on the non-price attributes when making a voting decision (Lusk and Norwood, 2011).

A number of studies assessing the consumer–citizen duality are included in the literature on public and semipublic good valuation (Ajzen et al., 1996; Blamey et al., 1995; Curtis and McConnell, 2002; Hamilton et al., 2003; Nyborg, 2000; Ovaskainen and Kniivilä, 2005; Russell et al., 2003; Wiser, 2007). With the exception of Curtis and McConnell (2002), who find no difference in WTP between citizen and pure private preference, the results of these studies indicate that respondents given citizen-oriented WTP questions exhibit a higher WTP than those given consumer-oriented WTP questions. These results indicate a willingness to regulate away, even at cost, something they would not willingly pay extra for to avoid as a consumer. For example, Wiser (2007) found a higher WTP for renewable energy when participants were confronted with a collective payment mechanism than with a voluntary payment mechanism. Elsewhere, Ovaskainen and Kniivilä (2005) found that participants in a citizen role gave fewer zero-WTP responses and indicated a higher WTP to sustain conservation areas. Lastly, Hamilton et al. (2003) reported that some participants who supported the ban on use of pesticides in agriculture were somewhat inconsistently unwilling to pay a premium for pesticide-free food.

A related literature focuses on the differences between the attitudes and actions of individuals (the so-called attitude–behavior gap). Here, individuals say that they are concerned about ethical issues, such as animal welfare, fair trade, and sustainability, but these concerns are to a lesser degree expressed in buying behavior (Bray et al., 2011; Cowe and Williams, 2000; de Barcellos et al., 2011; Harper and Henson, 1999; Harvey and Hubbard, 2013; Verbeke et al., 2010).

Food safety and regulatory issues

Safety is one of the most important characteristics of food in most countries (Alphonce and Alfnes, 2012; Lusk and Briggeman, 2009). Most public policies relating to food safety are the outcome of a complex trade-off between the interests of different groups affected by the policy (including consumers, farmers, consumer groups, retailers, manufacturers, and taxpayers).

We can divide the literature on preferences to food safety into a number of strands. One of the strands, including Hayes et al. (1995), Nayga et al. (2006), and Teisl and Roe (2010), consider the WTP for food treated using some new method to reduce the risk of foodborne pathogens. For the most part, they find a significant and positive WTP in supporting measures to reduce such risks. Another strand in the literature assesses the WTP for a reduction in pesticide residuals (Baker, 1999; Baker and Crosbie, 1993; Buzby et al., 1995; Hamilton et al., 2003; Roosen et al., 1998). They also find a significant positive WTP to reducing such risks.

Most studies assessing the WTP for safer foods or assessing the cost–benefit ratio of reduced food safety risks are set-up as marketing studies and do not question respondents about what they want authorities to do. However, despite this, most studies derive policy advice from the results. One exception is work by Hamilton et al. (2003), which undertook both a market study and a regulation study and compared the WTP from both scenarios.

The country of origin of food is an issue that is also often associated with food safety. Both the European Union (EU) and the US now have mandatory country-of-origin labeling (COOL) on many food products. In general, studies of preferences toward COOL that have been used for policy recommendations have mainly been in the form of marketing studies investigating consumer preferences and choice (see, e.g., Alfnes and Rickertsen, 2003; Loureiro and Umberger, 2003; Loureiro and Umberger, 2005; Mabiso et al., 2005).

Method and data

The survey data we use is part of a restaurant study conducted in 2010 at a university campus in the northeast of the US. A total of 864 participants were recruited to take part in the study and were offered a free meal for their participation.

The participants were recruited from the university and the local community. The local community represented approximately 25% of the final sample. The university participants were diverse and included (undergraduate and postgraduate) students, faculty, and other staff members. To avoid revealing the purpose of the study, there was minimal information given to the participants upon recruitment.

Survey questions and design

We used two multiple-price-list (MPL) questions to elicit the WTP for improved food safety standards in restaurants. As seen in Table 1, we formed the first question as a consumer-oriented buying question and the second as a citizen-oriented voting question. The consumer question is a typical price list, whereas the citizen question is a series of yes or no votes at the different price levels. The price lists had six price intervals and were the same for the two questions. The lowest level being not willing to pay a 1% increase, or voting no to a 1% increase, and the highest level being willing to pay more than 30% or voting yes to an increase of more than 30%.

Both questions came in three versions, which varied in the degree of reduction in the probability of getting a food-related illness (25%, 50%, and 75%). To investigate the differences between the two question formats and the three risk-reduction levels, we randomly assigned each participant to one of these six combinations.

Sample

Table 2 presents the descriptive statistics for the sample. As stated, while the study included consumers from a university town, the participants represented a wide range of demographic characteristics. In sum, age ranged from less than 25 years to more than 60 years, education ranged from less than Grade 12 to a PhD degree, and income ranged from a household income of less than \$20,000 per year to more than \$150,000 (all dollar values in US dollars). However, females were overrepresented, with almost twice as many female as male participants. The sample also included students, employees, the unemployed, part-time workers, and retired people. Household size varied from those living alone to households with up to eight individuals. We tested for differences in participant characteristics between the consumer- and citizen-oriented subsamples using Hotelling's multivariate paired-comparison *T*-squared test, but were unable to reject the null hypothesis of equal sample characteristics ($p = 0.29$). We included the six characteristics in Table 2.

Econometric model

We follow common practice used in MPL studies and estimate an interval regression model (see, e.g., Andersen et al., 2006). This is because while the WTP is not observable, we do know an interval around the WTP. The consumers' WTP are based on the highest interval they said they would be willing to pay, and the citizens' WTP are based on the highest interval they said they would vote yes to.

In our analysis, we wish to investigate the differences in WTP associated with differences in risk reduction, the method of elicitation, and preferences over gender and age groups. To do this, we estimate the following four models (hereafter referred to as Models 1, 2, 3, and 4):

$$(1)\quad WTP_i^* = \beta_0 + \beta_1 50\%RR_i + \beta_2 75\%RR_i + \varepsilon_i$$

$$(2)\quad WTP_i^* = \beta_0 + \beta_1 50\%RR_i + \beta_2 75\%RR_i + \beta_3 Vote_i + \varepsilon_i$$

$$(3)\quad WTP_i^* = \beta_0 + \beta_1 50\%RR_i + \beta_2 75\%RR_i + \beta_3 Vote_i + \beta_4 female + \beta_5 femvote + \varepsilon_i$$

$$(4)\quad WTP_i^* = \beta_0 + \beta_1 50\%RR_i + \beta_2 75\%RR_i + \beta_3 Vote_i + \beta_4 yfem + \beta_5 ymale_i + \beta_6 omale_i + \beta_7 vyfem_i + \beta_8 vymale_i + \beta_9 vomale_i + \varepsilon_i$$

where WTP_i^* is the percentage of the meal price that participant *i* is willing to pay or vote yes to support reduced food safety risks, β_0 is the constant term, and the remaining beta values measure the effect of the corresponding independent variables. The variables $50\%RR_i$ and $75\%RR_i$ are dummy variables taking values of one if participant *i* is questioned about a 50% and a 75% reduced risk, respectively, and zero otherwise. In Model 2, we include $Vote_i$, which is a dummy variable taking a value of one if participant *i* is in the citizen-oriented voting treatment and zero otherwise. In Model 3, we add $female_i$, which is a dummy variable taking a value of one if participant *i* is female and zero otherwise, and $femvote_i$, which is a dummy taking a value of one if participant *i* is a female voter and zero otherwise. In Model 4, we replace $female_i$ and $femvote_i$ with six dummies to capture the differences between the age and gender segments. The variables $yfem_i$, $ymale_i$, and $omale_i$ are a series of dummy variables indicating young female, young male, and older male respondents, respectively, while $vyfem_i$, $vymale_i$, and $vomale_i$ are a series of dummy variables denoting young female voters, young male voters, and old male voters, respectively. ε_i is the normally distributed error term. We estimate the models with the *intreg* command in STATA 12.

Results and discussion

Willingness to pay

Fig. 1 and Table 3 present the results from the citizen-oriented voting questions and the consumer-oriented buying questions for all three levels of reduced food safety risk (25%, 50%, and 75%). Commencing with the figure, we can see that for both buyers (in

Table 1
Willingness to pay questions.

A. Consider the restaurant in your neighborhood. Please indicate how much extra you would be willing to pay if this restaurant implemented food safety standards that reduced the chances of getting a food-related illness by 25% / 50% / 75%?

- ☐ I am not willing to pay extra to ensure safe food
- ☐ 1%–5% of meal price
- ☐ 6%–10% of meal price
- ☐ 11%–20% of meal price
- ☐ 21%–30% of meal price
- ☐ More than 30% of meal price

B. Please indicate if you would vote "Yes" or "No" to new food safety regulations that would reduce food safety risk at your neighborhood restaurant by 25% / 50% / 75% and increase the price of the restaurant meals by the following amounts.

% of meal price increase	**How would you vote?**	
1%–5% of meal price	☐ Yes	☐ No
6%–10% of meal price	☐ Yes	☐ No
11%–20% of meal price	☐ Yes	☐ No
21%–30% of meal price	☐ Yes	☐ No
More than 30% of meal price	☐ Yes	☐ No

Table 2
Sample descriptive statistics.

Variable	Full sample				Split treatment groups							
					Buyers				Voters			
	Mean	Std. dev.	Min.	Max.	Mean	Std. dev.	Min.	Max.	Mean	Std. dev.	Min.	Max.
Age[a]	3.30	1.67	1	6	3.31	1.70	1	6	3.28	1.64	1	6
Female[b]	0.67	0.47	0	1	0.66	0.47	0	1	0.68	0.47	0	1
Income[c]	4.33	2.14	1	8	4.42	2.08	1	8	4.25	2.19	1	8
Education[d]	4.00	1.09	1	6	4.00	1.07	2	6	3.90	1.10	1	6
Under 5[e]	0.12	0.33	0	1	0.11	0.31	0	1	0.14	0.34	0	1
HH size[f]	2.63	1.26	1	8	2.61	1.27	1	7	2.67	1.27	1	8

[a] Age scale: less than 25 years = 1, 26–30 years = 2; 31–40 years = 3, 41–50 years = 4, 51–60 years = 5, and >60 years = 6.
[b] One if female, 0 if male.
[c] Income scale: less than \$20,000 = 1, \$20,001–\$30,000 = 2, \$30,001–\$40,000 = 3, \$40,001–\$50,000 = 4, \$50,001–\$70,000 = 5, \$70,001–\$100,000 = 6, \$100,001–\$150,000 = 7, and >\$150,000 = 8.
[d] Education scale: less than grade 12 = 1, high school = 2, college = 3, bachelor's degree = 4, master's or professional degree = 5, and doctoral degree = 6.
[e] One if have a child under 5 years, 0 otherwise.
[f] HH size: Number of people living in a household

the first column) and voters (in the second column) there is no notable difference in the WTP across the risk-reduction levels. However, comparing the figures across the columns, we can see a difference in the WTP between buyers and voters for all three levels of food safety risk reduction. As shown by the 50% reduction in food safety risk, 25% of buyers were unwilling to pay anything, while the corresponding figure for citizens was only 11%. Further, 60% of buyers were willing to pay less than 6%, while the corresponding figure for citizens was 41%. Furthermore, the median WTP, which is important for a majority vote, differ between the two question formats. The consumer-oriented buying question gave a median in the 1–5% interval, while the citizen-oriented voting question gave a median in the 6–10% interval. We found similar results for the 25% and 75% reduced food safety risks.

Table 3 presents the estimation results from the four models. We estimate Model 1 using a split sample with the results

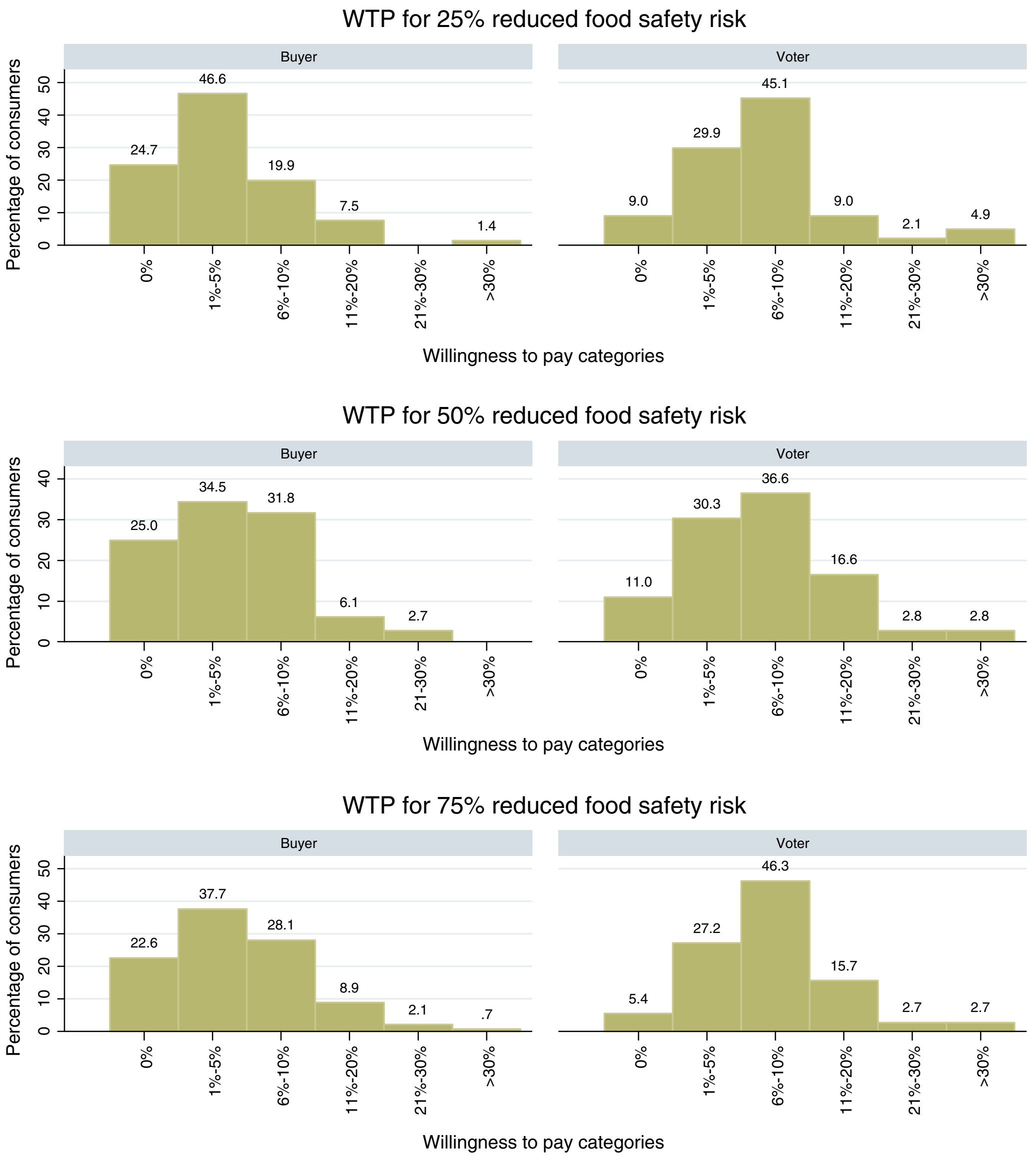

Fig. 1. Willingness to pay for food safety improvements by buyers and voters. Note: Consumers were asked if they were willing to pay an increase in price for better food safety, while the voters were asked if they were willing to vote yes to new food safety regulations increasing food prices. The zero category for buyers are those that said they would not pay anything for increased food safety, while the zero category for the voters are those that said they would vote no to any regulation increasing the price.

presented in columns 1 and 2. Columns 3–5 provide the pooled sample results for Models 2, 3, and 4, respectively. For the most part, these results confirm the patterns depicted in Fig. 1. For example, in the first two columns including only the reduction in risk levels as explanatory variables, we see from the goodness of fit measure that the explanatory variables do not have a significant impact on the WTP. In the next three columns, also including question format as an explanatory variable, we can see from the goodness of fit measure that the explanatory variables have a significant impact. In line with that, we find in the full-sample estimations a significant difference in the WTP between buyers and voters, and no significant differences across risk-reduction levels. The latter results are consistent with the lack of scale effects found in much of the literature investigating consumer WTP for reduced risks in food (see, e.g., Hayes et al. (1995) and Lichtenstein (1978)).

In Model 1, we found that on average participants answering the consumer-oriented buying question were willing to pay a 3.96% (=3.44% + 0.52%) price increase for a 50% reduction in food safety risk, while those that responded to the citizen-oriented voting question were willing to pay a price increase of 7.44% (=7.60% – 0.16%). We find similar differences in the remaining three models and for the other risk-reduction levels. To obtain a monetary value for the WTP, these percentages should be used together with the average amounts of $5.60, $7.80, and $13.60 the respondents said they would spend in a restaurant for breakfast, lunch, and dinner, respectively. As for the other sample characteristics, there were no significant differences between the two subsamples with respect to how much they spent in restaurants.

The differences in WTP between the consumer-oriented buying question and the citizen-oriented voting question accord well with the limited literature on consumer–citizen duality for food and nonfood products (see, e.g., Ovaskainen and Kniivilä (2005) and Hamilton et al., 2003).

Demographic differences

When we include demographic effects in Models 3 and 4, gender becomes statistically significant. On average, female participants were willing to pay 1.45% more than male participants for risk reduction. Model 3 shows that on average, male and female buyers

Table 3
Willingness to pay for reduced food safety risk.

Variables	Split sample		Full sample		
	Model 1 Buyers	Model 1 Voters	Model 2	Model 3	Model 4
Constant	3.44***	7.60***	3.55***	2.58***	4.39***
	(0.58)	(0.64)	(0.51)	(0.72)	(0.70)
50% reduced risk	0.52	−0.16	0.17	0.15	0.16
	(0.81)	(0.91)	(0.61)	(0.61)	(0.61)
75% reduced risk	1.04	0.59	0.81	0.85	0.84
	(0.81)	(0.90)	(0.61)	(0.61)	(0.61)
Voting			3.88***	4.88***	2.95***
			(0.50)	(0.88)	(0.86)
Female				1.45*	
				(0.76)	
FemaleVoting				−1.51	
				(1.07)	
YoungFemale					−0.77
					(0.88)
YoungMale					−2.01**
					(1.03)
OldMale					−1.57
					(1.11)
VoteYoungFemale					0.86
					(1.22)
VoteYoungMale					1.85
					(1.43)
VoteOldMale					2.14
					(1.63)
N	431	433	864	884	864
Log likelihood	−699.09	−794.26	−1496.06	−1494.24	−1493.63
LR chi^2	1.63	0.77	60.51	64.15	65.37
Prob > chi^2	0.44	0.68	0.00	0.00	0.00

Note: standard errors in parenthesis.
* $P < 0.10$.
** $P < 0.05$.
*** $P < 0.01$.

were willing to pay respective price increases of 2.73% (=2.58% + 0.15%) and 4.18% (=2.58% + 0.15% + 1.45%) for a 50% reduction in risk. The corresponding percentages for voters are 7.61% (=2.58% + 0.15% + 4.88%) and 7.55% (=2.58% + 0.15% + 1.45% + 4.88% − 1.51%). Hence, gender had a significant effect on WTP among those given the consumer-oriented buying question, but no effect was found on WTP among those given the citizen-oriented voting question. When including age-gender segments in Model 4, we see that the biggest difference in WTP among those given the consumer oriented buying question were between the older women and the young men, but again the differences cancel out for the voters. Young male buyers were willing to pay 2.01% less than older female buyers for risk reduction, but the voters were only willing to pay 0.16% less (=−2.01% + 1.85%), and the latter differences were insignificant. This indicates that while men and women have a similar WTP for a reduction in the foodborne risk level at a society level, women are more willing than men to pay to protect themselves when at a restaurant. This is in line with previous findings that suggest women worry more about food safety than men (Baiardi et al., 2012; Chattopadhyay and Duflo, 2004).

Design and sample issues

As most studies, this study also has its weaknesses. Most important is the fact that it uses non-consequential survey questions, and therefore is likely to suffer from hypothetical biases, which are inflating the WTP for improved food safety. The second weakness is the university town sample, which even though it is relatively large and has a reasonable good spread in characteristics, is unlikely to be fully representative of the population. A third issue is the use of the multiple price list format. We chose it because it works in both question formats, but neither in buying nor in voting situations are people used to such price list. A fourth issue is that in the citizen question the participants have to vote no to all the price increases to give a zero WTP, while in the consumer question there is a zero WTP alternative.

In our mind, these design and sample issues do not change the main conclusion and recommendations. However, more research is required.

Conclusion and recommendation

The question is whether it matters whether we elicit consumer or citizen preferences when valuating food safety. For example, US citizens often vote for different propositions in elections, and can potentially vote for regulations with an effect on both private and/or public values, such as food safety, animal welfare, sustainability and the environment. However, most studies investigating the WTP for such attributes use market-mimicking mechanisms that are unlikely to reflect how people want public policies to change.

In this study, we used a split-sample to see if respondents responded to a consumer-oriented WTP question differently from a citizen-oriented WTP question. We find that people are willing to pay twice as high a price premium if asked a voting question than if asked a buying question. In the consumer-oriented buying question, women show a significantly higher WTP for improved food safety than men, but this gender difference disappears when we move to the citizen-oriented voting question. Furthermore, the median WTP, which is important for a majority vote, is also higher in the citizen-oriented voting question. This indicates that people show different preferences when they act in different roles, and that they behave differently when they are voting for a proposition than they do when they act as consumers. Consequently, consumer behavior studies that do not account for these differences could poorly predict the results of a regulatory study, and vice versa.

The fact that consumer preferences may be different from citizen or political preferences has implications on how we design valuation or WTP surveys. Our results suggest that the use of a market-mimicking approach could significantly underestimate the WTP for public policy. In fact, our market-mimicking question yields a WTP that is only about half of what we obtained from our citizen-oriented voting question. Therefore, it is important for researchers to consider exactly what their objective is when designing a valuation study, identify whether they are interested in measuring consumer or citizen preferences, and then apply the appropriate approach for the specific goal. We find that both consumer-oriented and citizen-oriented participants are willing to pay a premium for reduced food safety risks in restaurants. We also find evidence of a consumer–citizen duality, in the sense that the valuation of food characteristics differs in the two settings. However, the level of reduced food safety risk does not appear to matter.

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Paper 4

European Consumer Preference for Sensory and Credence Characteristics for African Dried Fruits

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Abstract. This paper assesses European consumer preferences and willingness to pay for tropical dried fruits from Africa. The paper specifically investigates sensory and credence characteristics driving consumer preferences. Data on sensory descriptive analysis and hedonic evaluation for seven samples representing three fruit types: mango, pineapple and banana was collected together with data on COO preference and willingness to pay for conventional, organic and fair-trade labelled dried fruits among Norwegian consumers (N=96). The results show that consumer preferences for a dried fruit are affected significantly, by its typical aroma intensity, and that consumers are willing to pay a premium for both organic and fair-trade products. Two consumer groups expressing distinct country-of-origin preferences for tropical dried fruits and a third group with no country preferences are revealed. This study provides useful insights for dried fruit producers and market strategists in tropical countries attempting to position value-added products for maximum revenue.

Keywords: dried fruits, Africa, sensory evaluation, consumer preferences, willingness to pay, organic, fair trade, country of origin, PCA. [1]

[1] The authors are grateful for the financial support from the Norwegian Agency for Development Cooperation (NORAD) through the NUFU project: 'Empowering women to participate in higher level of fruits and vegetables value chain through production of dried fruits'. We specifically thank the project leader Professor Trude Wicklund, for her cooperation for the entire research process in this work. We also thank Siv Berit Lundberg and Kathrine Strøm for their help in collecting the data; and Professor Frode Alfnes for his comments and suggestions in helping shape this paper. The paper was submitted to a peer-reviewed journal in September 2014

Introduction

To increase the value of products in the world market, producers of dried fruits in developing countries must understand consumer preferences in high-income markets. In this paper, we contribute to the understanding of European consumer preferences and willingness to pay (WTP) for tropical dried fruits from Africa. Specifically, we assess consumers' sensory acceptance of dried fruits and their preferences for organic, fair trade and country of origin (COO) attributes.

There has already been a number of studies on organic, fair trade and COO attributes conducted in European countries (Chryssochoidis et al. 2007; Didier & Lucie 2008; Menapace et al. 2011; Poelman et al. 2008). Therefore, the aim of this study is not to identify consumer preferences for these attributes in general, but rather to understand which attributes help increase the value of tropical dried fruits from Africa. In particular, our study will attempt to investigate consumer preferences towards COO from Tanzania. If consumers perceive a Tanzanian origin as a positive attribute, marketers can use COO as a quality cue. If viewed negatively, then they have to develop ways to minimize the effect. This can possibly be done by using credence attributes such as naturalness, fair trade and organic.

Exports of fruits and other horticultural products from developing countries to Europe are characterized by significant uncertainty because of the perishability of the products, unreliable supplies (seasonal variability) and strict quality standards. These challenges could be reduced by exporting solar-dried fruits from these countries. Solar-drying technology can increase shelf life and the reliability of supply and is easily adopted among small-scale farmers and entrepreneurs. This technology can create business opportunities for small-scale farmers and thereby increase household and national income. Agona et al. (2002) studied the market for dried fruits in Europe and found a potential demand for dried fruits, yet little is known about the sensory and credence attributes consumers want from dried fruits from Africa.

Therefore, because of the high failure rates for new food products in the food sector, a consumer preference study in Europe will help in strategizing the best way for African dried fruits to penetrate the European market. As sensory attributes are important and affect consumer satisfaction (Lusk & Briggeman 2009; Schjøll 2014), we conduct a sensory evaluation and a market survey.

Literature Review

Consumer food choices

Human health, food safety and environmental concerns, along with other characteristics such as nutrition, taste, freshness and appearance influence consumer preferences for food products (Kvakkestad et al. 2011; Lusk & Briggeman 2009). However, there are different theories that explain consumers' food choice behaviour. The classical frameworks of consumer behaviour propose that food choices are the results of consideration of intrinsic (e.g. colour, texture, taste) and extrinsic (e.g. retail environment) factors moderated by consumer demographic and socio-economic characteristics.

In recent years, consumers in Europe and other developed countries have become more critical in their food choices, hence demand credence attributes such as healthiness, environmental benefits, fair trade and animal welfare to affect their food choices (Didier & Lucie 2008; Harper & Henson 2001; Rijswijk et al. 2008). The credence attributes are properties that cannot be evaluated by consumers even after having consumed the good, but have perceived value to them (Darby & Karni 1973). Therefore, when buying products with such attributes, consumers need to trust labels or any signal used to claim a credence attribute. However, the effect of credence attributes on food choices could disappear over time in favour of intrinsic attributes, which are experienced during consumption (Grunert 2005).

European consumer preferences for organic and country of origin attributes

Attributing health benefits to organically grown food and fearing food poisoning, antibiotics, hormones and related scandals within the food industry, European consumers tend to prefer organic to conventional produce (Didier & Lucie 2008; Hughner et al. 2007; Kvakkestad et al. 2011; O'Donovan & McCarthy 2002). For example, Norwegian consumers identify pesticides and antibiotics as the most important factors for choosing organic foods (Kvakkestad et al. 2011; Schjøll 2014). The literature also reports that because of trust, consumers use COO as a proxy for food safety, tradition and taste, and they prefer domestic products to imported products (Illichmann & Abdulai 2013; Kvakkestad et al. 2011; Schjøll 2014; Storstad 2001). Such consumers are willing to pay a greater premium for conventional domestic products than for organic foreign products. For example, in a study assessing the domestic bias for organic food, Schjøll (2014) found that Norwegian consumers preferred and were willing to pay more for domestically labelled meat than they were for foreign organic meat. Consumers not only prefer products originating from their own country, but also tend to discount imported products from developing countries, such as those in Africa, compared with imported products from developed countries (Alfnes 2004). Studies from non-European countries also report consumer preferences for domestic products, and product discounts from less-developed countries. For example, Constanigro et al. (2010) found that Colorado consumers preferred local to imported organic apples despite the apples being certified by the United States Department of Agriculture; and Juric and Worsley (1998) found that New Zealand consumers poorly rated products from Hungary and Thailand, compared to Australia and the US in terms of safety, nutritional value, quality and the environment. These studies show that consumers' expectations and perceptions of food products from less-developed countries could influence their WTP for these products.

Besides health, safety and trust issues, some consumers prefer organic products because of their taste and their concerns for animal welfare and the environment (Kvakkestad et al. 2011; Makatouni 2002; Schjøll et al. 2013; Shepherd et al. 2005; Torjusen et al. 2001; Wilkins & Hillers 1994).

European consumer preferences for fair trade

Consumption of fair-trade products is seen as a solidarity-based commitment by consumers in developed countries, whose concerns mainly relate to the well-being of workers and farmers in developing countries. In 2011, worldwide fair-trade sales were up 12% to $6.6 billion (Huet 2013). Between 2009 and 2011, Australia and New Zealand increased sales by 258%, Czech Republic by 386%, UK by 40%, Germany by 27% and Norway by 16% (Fairtrade International 2012) . The widespread use of fair-trade labels for cocoa, sugar, bananas, wine and spices are one reason for a large increase in fair-trade sales of these products.

Studies on fair trade have mostly been done on fair-trade coffee, which is probably because it was the first product in the late 1980s to be certified with a fair-trade label. In most of these studies, the results show consumers are willing to pay a price premium for fair-trade labels (Cailleba & Casteran 2011; De Pelsmacker et al. 2005; Didier & Lucie 2008; European-Commission-DGVI 1997; Loureiro & Lotade 2005; Mahé 2010; Rotaris & Danielis 2011). For example, in a Eurobarometer survey conducted in the European Union in 1997, 70% of the consumers were willing to pay at least a 10% premium for products with a fair-trade label.

Methodology

Study design

A total of 96 participants aged between 19 and 64 years old were recruited at a university town in Norway. They completed both a sensory evaluation and a market survey, including WTP questions using a contingency valuation form and hierarchical questions on the motivation underpinning consumers' choice for a COO. A summary of the socio-demographic characteristics of the participants is presented in Table 1. Sixty per cent of the participants were female, 64% had college or university education and 64% were dried fruit consumers with a consumption frequency of at least once a month.

Table 1. Socio-demographic characteristics

Variable	Mean	Standard deviation	Min	Max
Age	28.67	11.18	19	64
Gender[1]	0.60	0.51	0	1
Education[2]	0.64	0.48	0	1
Consumption frequency[3]	0.64	0.48	0	1

[1]1=Female, 0=Male; [2]1=Higher education, 0=Secondary education or lower; [3]1=high (at least once a month), 0=low (atmost once in the past six months).

Product samples

The participants tested dried fruit samples of four types: banana, pineapple, mangoes from cultivars Dodo (a local cultivar in Tanzania) and Keitt (a hybrid cultivar). The fruits were either cabinet or tunnel dried in Tanzania before they were exported to Norway. There were four cabin-dried and three tunnel-dried fruits, producing seven samples for consumer testing. Because of the maturity variations between fruits before entering the different dryers, the dryer effects should be interpreted with caution.

Sensory evaluation

For each sample, the participants first performed a descriptive sensory analysis on the hardness, sweetness, acidity and aroma attributes. During this task, participants were asked to give an objective evaluation of each attribute's intensity. Nine-point scales anchored from, e.g. "Not aromatic" to "Very aromatic" were used. Although the method is more suitable for trained assessors, high similarities between trained and untrained panels have been reported with respect to important performance criteria like discrimination and consensus (Worch et al. 2010). Then the participants evaluated their overall liking on a 9-point unstructured Likert scale anchored from "I don't like it at all" to "I like it a lot". In this task, the participants gave a subjective hedonic evaluation of the samples. The participants tested the fruits in random order, but always took samples from the same fruit variety consecutively. The samples were marked with a three-digit random code, and participants tasted the samples in the order listed on the questionnaire. Water was available to rinse the mouth between samples.

Market data

The market survey used a short questionnaire following the sensory evaluation session. Participants first indicated their most preferred dried fruit among the three evaluated fruits (bananas, pineapples and mangoes). They then answered contingency valuation questions on WTP for a 50 g packet of: 1) their most preferred dried fruit (conventional condition), 2) their most preferred organic dried fruit (organic condition) and 3) their most preferred dried fruit produced and dried by a poor farmer (fair-trade conditions). The participants also indicated their preferred COO for dried fruits among five alternatives in Africa, Asia and South America, as well as answering a hierarchical question on the motivation underpinning their COO preferences collected in an open question. Finally, the questionnaire collected the participants' socio-demographic characteristics.

Statistical analysis

Sensory data analysis

Internal preference mapping was performed using a partial least squares regression (PLS-R) approach to identify preference patterns among participants as well as to establish a relationship between descriptive sensory attributes and hedonic scores (Næs et al. 2010). Equation 1 presents the model equation expressed in regression coefficients.

$$L_{ij} = \beta_0 + \beta_n A_n + \varepsilon_{ij} \qquad (1)$$

where L_{ij} is the Hedonic score for participant i for product j (j =banana, pineapple, mango Dodo, mango Keitt), A_n are the independent variables (hardness, sweetness, acidity, aroma), the betas are the regression coefficients and ε_{ij} is a normally distributed error term.

Since we used untrained assessors to evaluate the samples, the data were standardized, allowing us to compensate for individual differences in scale usage.

WTP analysis

We estimate the WTP for a 50 g packet of the participants' favourite dried fruit type under three credence attribute conditions: conventional, organic and fair trade. Thus, if participant *i* preferred dried bananas the most, then he/she stated his/her WTP for conventional dried bananas, for organic dried bananas and for fair-trade dried bananas. As WTP is censored to the left, i.e. zero is the lowest possible WTP value, the common practice used in valuation studies was followed, and tobit models censored at zero were estimated (Lusk & Shogren 2008). We estimate the following econometric model:

$$WTP_{ij} = \beta_0 + \beta_n X_n + \varepsilon_{ij} \qquad (2)$$

where WTP_{ij} is the WTP of participant *i* for 50 g of their most preferred product under credence attribute condition *j* (*j* =conventional, organic, fair trade) and X_n are the independent variables (gender, age, education, frequency of dried fruit consumption and a series of dummies indicating motivations for preferred COO). Open ended answers from the motivation for preferred COO were coded into three binary variables: D1=Experience with preferred COO (contact, travel, previous experience and know/have experience with the country hygiene and fruit quality), D2=Fair trade (like to support fair trade, support poor farmers, support development policies) and D3=Neutral (is indifferent to the origin of the dried fruits). The betas are the corresponding money metric parameters and ε_{ij} is the normally distributed error term.

Cluster analysis

A principal component analysis (PCA) was performed using the following factors: age, gender, education, dried fruit consumption (frequency), preferred COO for dried fruits (Tanzania, Uganda, South Africa, Brazil and Thailand) and the motivation behind this preference (D1=Experience with COO, D2=Fair trade, D3=Neutral). Then the PCA scores from five principal components were used in an agglomerative hierarchical cluster analysis with complete linkage to identify consumer groups favourable to the import of dried fruits from Africa, in particular Tanzania.

Multivariate models (PLS-R and PCA) were performed with The Unscrambler X (v. 10.3; Camo Software AS, Oslo, Norway).

Results and Discussion

Descriptive sensory evaluations

The profile data analysis showed little agreement between assessors on the descriptive sensory evaluations. A two-way analysis of variance (ANOVA) reveals a strongly significant assessor effect on the evaluations (p<0.001 on each of the four attributes) (PanelCheck v. 1.4.0; Nofima, Tromsø, Norway). This is expected in data from untrained assessors, as neither attribute recognition training nor scale usage and calibration training are conducted prior to the evaluations[2]. For a description of the classical descriptive analysis as well as novel methods that can be used with untrained assessors/consumers in sensory characterization we refer to (Varela & Ares 2014). Importantly, the weaknesses of the descriptive panel in this study were minimized by the low number of descriptive attributes that were evaluated (four), the simple terminology of these attributes (hardness, sweetness, acidity and aroma/taste ("smak" in Norwegian)) and the large number of consumers involved (96, against about 10 in a trained panel). This allows us to obtain a clear and significant pattern in the sensory profiles of the products despite the panel not being trained.

Figure 1 presents the sensory characteristics of the seven dried fruit samples based on mean intensity scores from consumers. Significant product differences were detected on the attributes hardness, sweetness, acidity and aroma (p<0.001). The banana samples were moderately sweet and aromatic with low acidity, while the mango samples were aromatic but present different sensory attributes depending on the cultivar and dryer. For example, mango Dodo from the cabinet dryer is acidic, moderately sweet and moderately hard, while mango Dodo from the tunnel dryer is very hard, very acidic and poorly sweet. However, it is important to note that the taste of the Dodo variety and most tropical fruits vary depending on the degree of maturity during harvesting, and the level of ripening during drying. The Dodo

[2]Although untrained assessors are more and more frequently used in descriptive sensory analysis of food products, often because of economical and convenience aspects, several methods adapted to untrained subjects have been developed and may be adopted in future experiments (Varela & Ares 2014). Alternatively, a more complete and more reliable profile description, i.e. including more than just four attributes and conducted by a trained sensory panel, may be recommended in follow-up studies.

samples placed in the tunnel dryer were somewhat less mature and therefore sourer than those placed in the cabinet dryer. In this particular case, the sensory characteristics of dried fruits most probably reflected the harvesting and ripening practices before drying rather than a drier effect.

Conclusions on systematic dryer effects should not be drawn from this study and should be investigated under comparable conditions on fruit maturity and ripening levels. On the other hand, Keitt mango is characterized by sweetness and mango aroma, with low acidity and hardness, while the pineapple samples from the two dryers present similar sensory descriptions. They are aromatic, sweet, moderately acidic and moderately hard.

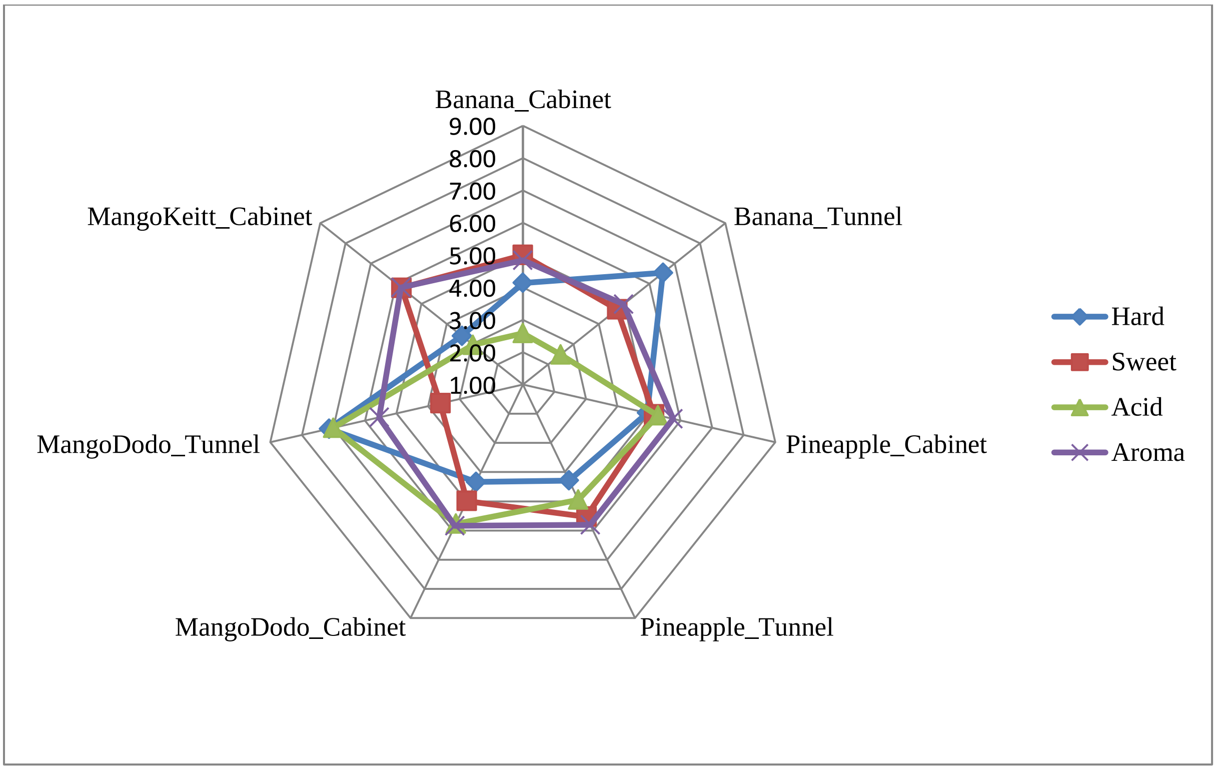

Fig. 1. Descriptive sensory profile of the four dried fruits based on average intensity scores from all consumers

Hedonic sensory evaluations

Overall, and across dryers, mangoes were the most preferred fruits (53.1%) and bananas the least preferred (10.4%). Mango Dodo (cabinet-dried samples) had the highest mean hedonic scores, while bananas (tunnel-dried samples) had the only mean hedonic score under the midpoint (neither like nor dislike) of the 9-point Likert scale (Figure 2).The internal preference map in Figure 3 presents the seven fruit samples, their descriptive sensory attributes (95% explained variance on two factors) and consumer acceptance (55% explained variance). First, we note from the map the relationships between sensory attributes for this set of samples. A strong fruit aroma tends to be either compatible with high acidity (along Factor 1) or with high sweetness (along Factor 2). Hardness is negatively correlated to sweetness, which may reflect that the hardest fruits were the least mature ones. Second, the map shows that consumers' hedonic scores were positively driven by a strong fruit aroma because most consumers are projected in the direction of increasing aroma intensity. This attribute characterizes mango Dodo from the cabinet dryer and pineapples from the tunnel dryer. Depending on the individual, consumers were in addition attracted either by a sweet taste, projected in the direction of mango Keitt, or by an acidic taste, with better acceptance for mango Dodo from the tunnel drier than consumers were in general. Dried fruits with low aroma (bananas from the tunnel dryer) and high hardness (bananas and mango Dodo from the tunnel dryer) were rejected by a large majority of consumers. In summary, dried fruits of characteristic aroma, moderate hardness and presenting a sweet and sour/acidic balance were the most appreciated. Therefore, to be able to meet the desired attributes, we recommend that dried fruit producers should concentrate on the appropriate harvesting time, appropriate variety and proper standardization of fresh fruits, by measuring the fruit's acidity and sugar content levels before drying. Producers should also be able to control the moisture content of the final product, and through further research identify the drying technology producing the most desirable texture.

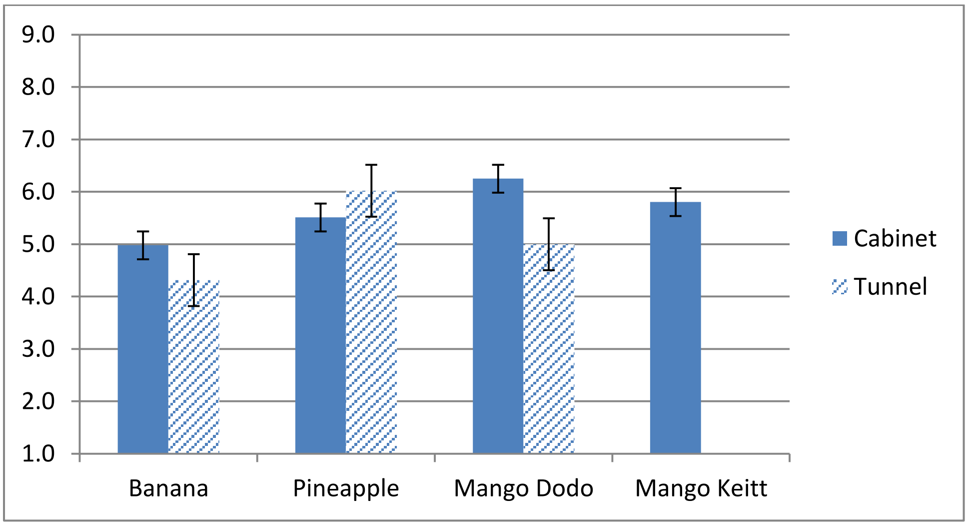

Fig. 2. Mean hedonic scores of the dried fruits

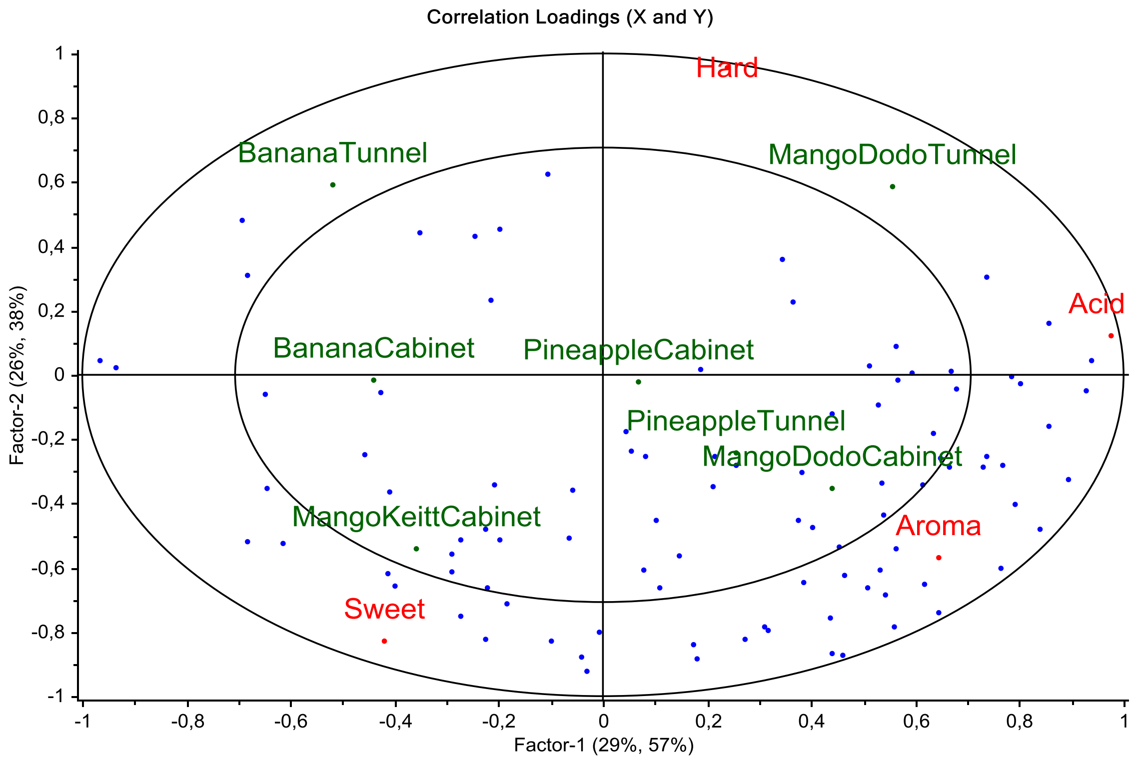

Fig. 3. Internal preference map of the dried fruits showing the products, their sensory attributes and consumer liking. Unlabeled dots represent the consumers.

Consumer preferences and WTP

Consumers on average are willing to pay 25 NOK (Norwegian kroner, 1 NOK = €0.125) for a 50 g packet of dried fruits, 29 NOK (16% premium) for organic dried fruits and 33 NOK (32% premium) for fair-trade dried fruits. These results are in line with studies by Didier and Lucie (2008) and Loureiro and Lotade (2005), where consumers rated fair trade higher than organic and conventional products. However, these WTP estimates are likely to suffer from hypothetical biasness, because we use non-consequential contingency valuation WTP questions (List & Gallet 2001). Furthermore, a small group of consumers (less than 5%) expressed negative attitudes towards organic dried fruits and dried fruits produced by poor farmers, while 38% and 20% were neutral towards organic and fair trade, respectively. This could be because some consumers view organic and fair-trade foods as not necessarily having added value compared with conventional products, or it could be that they perceive organic products to be presenting a sanitary risk (Guilabert & Wood 2012). The study also reports consumers generally (70%) prefer naturally produced products (i.e. dried fruits with neither additives, sugar, nor preservatives added) to products of more stable taste[3]. However, former research indicates that taste is a very important factor for consumer acceptance and cannot be neglected (Lusk & Briggeman 2009).

Table 2 presents estimation results for the WTP for a 50 g packet of dried fruits produced under conventional, organic and fair-trade conditions. The first column of results presents the WTP results for conventional dried fruits, the second column for organic dried fruits and the third column for fair-trade dried fruits. The results from the econometric models show that the WTP for dried fruits is influenced by gender and education. Female consumers are willing to pay 5 NOK (€0.6) more than male consumers for the dried fruit of their liking (significant at the 10% level), and they are willing to pay an even higher price compared with men for dried fruits with organic (9 NOK, €1.2) and fair-trade (11 NOK, €1.4) labels. These results corroborate previous research results, where women prove to have more altruistic characters and are more health cautious than men (Chattopadhyay & Duflo 2004; De Pelsmacker et al. 2005; Yang et al. 2012).

Individuals with more education (consumers with a diploma or university education) are also willing to pay more for credence attributes, although the results are only significant for the organic attribute (5 NOK, €0.6). This is probably because highly educated consumers are more aware of healthiness, show more environmental concern and at the same time benefit from higher purchasing power (Baiardi et al. 2012). These results are in line with the literature on WTP for organic produce, where educated consumers seem to care more for organic than the less educated (Smith et al. 2009).

[3] This category of consumer is willing to forgo a guaranteed or stable taste for a natural product.

Table 2. Willingness to pay for preferred dried fruit in conventional, organic and fair-trade conditions for varying consumer characteristics

Consumer variable	WTP conventional (N=96)	WTP organic (N=96)	WTP fair trade (N=96)
Demography			
Gender: female	4.98*	8.91***	10.75***
	(2.11)	(2.38)	(3.09)
Age*10	–0.57	–1.56	–0.61
	(0.09)	(0.10)	(0.13)
Education: higher education	2.39	4.64*	3.67
	(2.12)	(2.44)	(3.05)
Consumption rate: high	1.04	0.59	2.30
	(2.12)	(2.43)	(3.04)
D_1-COO-Fair trade	–0.61	0.76	4.94
	(2.85)	(3.27)	(4.09)
D_2-COO-Experience	–0.37	1.60	1.78
	(2.32)	(2.66)	(3.33)
Model details			
Constant	26.19***	32.69***	34.05***
	(3.32)	(3.81)	(4.76)
Sigma-constant	9.65***	11.07***	13.85***
	(0.70)	(0.81)	(1.00)
Log-likelihood			
Prob > Chi-squared	–352.88	–364.65	–388.54
LR Chi (6)	0.22	0.004	0.01
	8.24	19.05	16.23

Note: Tobit analysis censored at zero. Significant results: $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.001$. Standard errors are in parentheses.

D_1-COO-Fair trade and D_2-COO-Experience are dummies coded from the open-ended answers on the motivations underpinning the COO preferences.

Consumer groups

A PCA and an agglomerative hierarchical cluster analysis with a complete linkage method[4] were run to uncover patterns between consumer characteristics, attitudes and WTP premiums. The cluster analysis results are separated into three consumer groups: a fair-trade group (19.8%), a country-involvement group (29.2%) and a consumer group indifferent to COO (51%) (see Table 3). These groups are highlighted on the PCA score plot presented in Figure 4. Principal component 1 (PC1, 20% explained variance) separates consumers indifferent to COO from consumers with a preferred COO (Figure 5). Within the present consumer sample, men chose a specific COO more frequently than women (Figure 5 and Table 3). And highly educated consumers are more likely to be found in the fair-trade and country-involvement groups (Table 3) than lower educated consumers. PC2 (17% explained variance) splits consumers evoking fair trade (fair-trade group) from those evoking previous involvement or experience as a reason for their preferred COO (country-involvement group). Consumers who selected Black African countries (such as Tanzania and Uganda) did so for fairness in trade. They were also more likely to be experienced dried fruit customers, and they tended to show a higher WTP for fair trade and organic products than the other two consumer groups did (Figure 5 and Table 3). Consumers who selected other countries producing exotic dried fruits (such as Brazil, South Africa or—to some extent—Thailand) often did so because of previous involvement or experience with these countries (Figure 5 and Table 3).

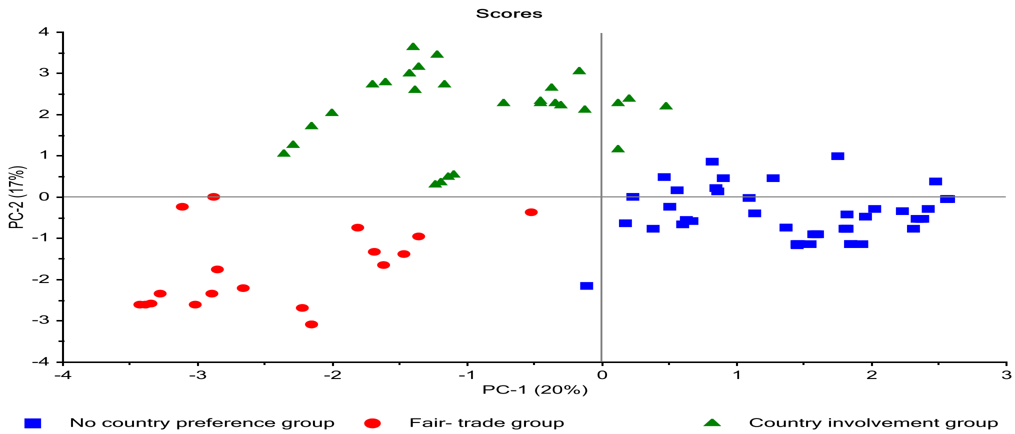

Fig. 4. A visualization of the clusters for the first two components of the PCA scores Three consumer clusters are defined based on consumers' stated reasons for preferring dried fruits from a specific country.

[4] PCA scores from the first five components were used. Five components give a reasonable amount of explained variance (61%); although the first two components restitute the main structured patterns (37% explained variance).

Table 3. Mean characteristics of the three consumer groups from cluster analysis

Variables (mean)	Fair trade (N=19)	Country involvement (N=28)	No preference (N=49)
Age	30 (21–59)	27 (19–58)	29 (18–64)
Gender (1=female)	0.32	0.46	0.78
Education (1=educated)	0.79	0.75	0.53
Consumption (1=frequent)	0.79	0.57	0.61
Preferred attributes			
Organic (1=organic)	0.84	0.54	0.49
Fair trade (1=fair trade)	0.95	0.68	0.76
Preferred COO			
Tanzania	0.84	0.21	0.10
Uganda	0.79	0.10	0.04
South Africa	0.11	0.68	0.08
Brazil	0.05	0.71	0.06
Thailand	0	0.25	0

Note: A multivariate test was run to compare the difference between the three clusters for all the variables except COO, revealing that the groups are significantly different at a 1% test level.

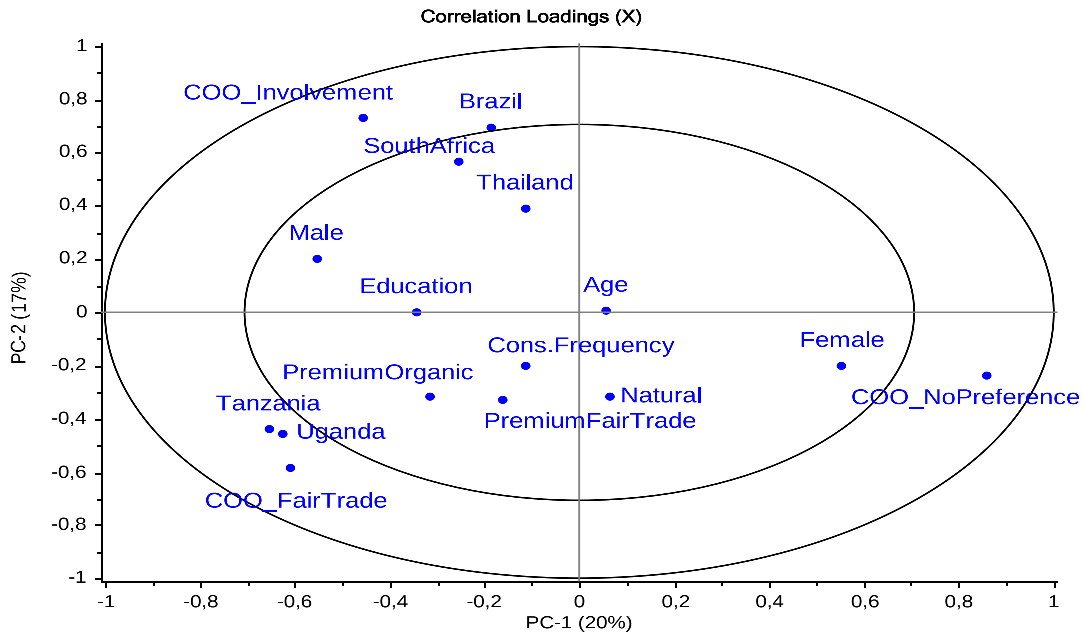

Fig. 5. Correlation loadings from PCA on consumer characteristics and attitudes. "Premium" indicates the price premium for fair-trade and organic compared to conventional products.

Conclusions and Recommendations

This study aimed to provide a better understanding of European consumer preferences for African dried fruits. To achieve this, we first identified sensory attributes driving consumer preferences for dried fruits, then we estimated consumer WTP for conventional, organic and fair-trade dried fruits. Finally, we identified consumer groups based on their interest in specific COO, attitudes towards COO preferences, consumer characteristics and WTP premiums. From our analysis the following conclusions were reached.

Consumers preferred dried mangoes and pineapples. Moreover, preferences for a fruit were driven mainly by strong aroma, sweetness or acidity intensity. On the contrary, lack of aroma, extreme hardness and low sweetness combined with high acidity were sensory properties that were rejected the most by consumers. Therefore, to be able to capture consumer preferences, dried fruit producers should concentrate on better selection of fruit varieties that fulfil the desired characteristics, such as ripe mango Dodo. Fruits with different flavours may also be labelled with descriptive sensory attributes because consumers who prefer sweet flavours differ from those preferring strong, acidic flavours or sweet and sour flavours. Despite consumers' preference for naturalness over uniform taste, we recommend that producers strive to deliver products of preferred and uniform sensory quality attributes by selecting the appropriate raw material qualities that meet a desired taste. This calls for the development of strict grades and standards for raw materials.

Furthermore, consumers valued both organic and fair-trade labelled dried fruits, but were willing to pay a higher premium for fair-trade dried fruits than for organic dried fruits. The study divides consumers into three segments. The first is the country-involvement group, which values a specific COO because of previous knowledge about the country. The second consumer segment includes those who care about fair trade and supporting low-income farmers, thus showing altruistic characteristics. The third segment includes consumers with no preference for a particular COO, but who may have a preference for fair-trade products.

Therefore, to be able to target the different consumer segments, we recommend a combination of fair trade, organic and naturalness labels together with labels describing the sensory characteristics, as a marketing strategy for dried fruits. Based on our data, these credence attributes create more added value than does information on COO from different developing countries.

This study concentrated on dried fruits as snacks to be eaten directly from a packet. However, there are different ways that dried fruits can be used in food preparation. For example, they can be used in fruit/vegetable/potato salads, breakfast cereals and as ingredients in baking. In these food preparations, negative attributes such as “too hard”, or “too sour/acidic” might be considered to be positive attributes. Therefore, we recommend consumer studies on the use of dried fruits with different sensory attributes in various food preparations.

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Appendices

Appendix A: Recording Sheets for Experiments in Tanzania

✓ **RCE-MAKE A CHOICE AND TICK YOUR CHOICE ON EACH ROW INDEPENDENTLY**

A 1	ORGANIC	CONVENTIONAL	ORGANIC FOODSAFETY INSPECTED	CONVENTIONAL FOODSAFETY INSPECTED
1	800	500	300	500
2	300	800	500	800
3	300	300	300	300
4	500	300	800	300
5	500	300	500	500
6	300	500	800	300
7	800	800	300	300
8	300	300	300	800

✓ **TICK IF YOU ARE WILLING TO BUY AT THE PRICE ON EACH ROW AND CROSS "X " IF YOU ARE NOT WILLING TO BUY.**

B1	ORGANIC	CONVENTIONAL	ORGANIC FOODSAFETY INSPECTED	CONVENTIONAL FOODSAFETY INSPECTED
50				
100				
150				
200				
250				
300				
350				
400				
450				
500				
550				
600				
650				
700				
750				
800				
850				
900				
1000				

✓ **TICK IF YOU ARE WILLING TO BUY AT EACH PRICE ON THE ROW AND CROSS ”X ” IF YOU ARE NOT WILLING TO BUY.**

C1	ORGANIC	CONVENTIONAL	ORGANIC FOODSAFETY INSPECTED	CONVENTIONAL FOODSAFETY INSPECTED
350				
400				
450				
500				
550				
600				
650				
700				
750				
800				
850				
900				
950				
1000				
1050				
1100				
1150				
1200				
1250				

FILL THE NUMBER OF PORTIONS YOU ARE WILLING TO BUY AT EACH PRICE

D1	ORGANIC	CONVENTIONAL	ORGANIC FOODSAFETY INSPECTED	CONVENTIONAL FOODSAFETY INSPECTED
350				
400				
450				
500				
550				
600				
650				
700				
750				
800				
850				
900				
950				
1000				
1050				
1100				
1150				
1200				
1250				

STATE YOUR MAXIMUM WILLINGNESS TO PAY FOR EACH PORTION?

E1	ORGANIC	CONVENTIONAL	ORGANIC FOODSAFETY INSPECTED	CONVENTIONAL FOODSAFETY INSPECTED
TSHS				

Appendix B: A Sample of the Labels used to Label Products in the Experiments in Tanzania

ORGANIC

FOODSAFETY INSPECTED

Roselyne Alphonce was born in Kilimanjaro, Tanzania. She holds an MSc. Degree in Agricultural Economics from the Sokoine University of Agriculture in Tanzania (2007). Roselyne is currently employed at Sokoine University of Agriculture in Tanzania as an Assistant Lecturer.

In assessing and measuring consumer preference and willingness to pay for quality attributes, many things matter including context and choice of methods. This thesis focuses on two themes; (1) assessing consumer preference for food quality in different context and (2) testing for difference between WTP elicitation methods. The thesis contains four independent papers based on data from experiments conducted in Tanzania, Norway and the US.

Paper 1 and 2 assess consumer WTP for attributes related to food safety in Tanzania. On top of assessing consumer preference, Paper 2 also compares consumer WTP in four different elicitation techniques. Both paper 1&2 find that consumers in Tanzania are concerned with food safety, and the results are consistent across all the four methods, across gender and consumers income level (low or high)..
Paper 2 finds that the size of the premium between the valuation methods differ when consumers choose between alternatives than when consumers indicate their willingness to pay. This underscores the importance of choice of the elicitation method in valuation of goods. Paper 3 investigates whether there exist a consumer-citizen duality in WTP for food safety standards in restaurants. The paper finds that both consumers and citizens are willing to pay for improved food safety standards, however voting citizens exhibit higher willingness to pay than buying consumers. The study suggests that relying on consumer studies focusing on the buying context to advice on public issues may underestimate the actual support for public regulations. Paper 4 assess Norwegian consumer preferences for sensory and other attributes of dried fruits from Africa. The paper mainly aimed at making recommendations to producers in Africa trying to position value-added products for maximum revenue from Europe. The results suggest that consumers have strong preference for naturalness over uniform taste. However sensory characteristics are still important. The study identifies three consumer segments, two with distinct reasons for preferring a country-of-origin and the third is indifferent to the country of origin of the dried fruits. The study suggests the use of naturalness and fair-trade as a marketing strategy for selling such products in Europe.

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ISSN 1894-6402

ISBN:978-82-575-1258-3