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Stated Preferences with Survey Consequentiality and Outcome Uncertainty: A Split Sample Discrete Choice Experiment

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Abstract

Stated preference studies are often based on the assumptions that proposed outcomes would realize with certainty and respondents believe their survey responses are consequential. This paper uses split sample treatments to test whether survey consequentiality and outcome uncertainty lead to differences in welfare measures, focusing on a discrete choice experiment on improving quality of electricity supply among business enterprises in Tanzania. Our results show that incorporating uncertainty not only affects the preferences for the attribute with uncertainty (duration of power outage) but also for a choice attribute with a precautionary feature (advanced outage notification). While outcome uncertainty and an additional survey script (a formal letter from a state-owned electric utility) to strengthen consequentiality have some influence on preferences and willingness to pay (WTP) estimates for certain attributes, we do not find significant implications on overall welfare estimates.

Keywords Stated preferences · Survey consequentiality · Outcome uncertainty · Discrete choice experiment · Power outages · Business enterprises · Tanzania

JEL Classification D22 · D81 · L94 · Q58

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1 Introduction

This paper uses split sample treatments to examine the effects of survey consequentiality and outcome uncertainty on stated preferences study in a developing country context, with low willingness to pay (WTP) estimates for a wide range of goods and services (Whittington 2010). Stated preferences techniques such as contingent valuation and discrete choice experiments are widely used to elicit preferences and estimate WTP for non-marketed goods and services (e.g., Hanley and Czajkowski 2019; Johnston et al. 2017; Whittington 2010). These methods involve asking survey respondents to value a hypothetically developed scenario. For valid stated preference studies, the survey design should be incentive-compatible (Carson and Groves 2007), ensuring respondents reveal their preferences truthfully.

A key aspect of a valid stated preference study is the assumption that respondents perceive the survey as consequential. As such, eliciting consequentiality beliefs becomes an integral part of a stated preference study survey design (e.g., Herriges et al. 2010; Vossler and Watson 2013; Zawojska et al. 2019; Börger et al. 2021). To this extent, guidelines for stated preference studies, like those by Johnson et al. (2017), stress the importance of considering both policy and payment consequentiality to ensure valid WTP estimates. Likert scale follow-up questions are widely used to gauge perceived consequentiality and evidence suggests that WTP varies across stated levels of consequentiality (Zawojska et al. 2019). However, there are concerns that the typical follow-up Likert scale questions in a survey might not accurately capture a respondent's belief over consequentiality (Needham and Hanley 2020). Particularly, potential selection issues arise (Börger et al. 2021), as individuals' WTP estimates are likely to differ with how they perceive the consequentiality of the survey, influenced by observed and unobserved factors (Needham and Hanley 2020; Liebe et al. 2019; Oehlmann and Meyerhoff 2017; Vossler and Watson 2013; Groothuis et al. 2017; Herriges et al. 2010). In addition, a vast majority of the studies concentrate on applications in developed countries, with limited evidence in the context of developing countries, where WTP for a wide range of goods and services is low (Whittington 2010), partly due to the perception that the likelihood of implementing a described project is small (Kassahun et al. 2021) and issues associated with a payment vehicle (Kassahun et al. 2020).

Another important feature of a valid stated preference study is incorporating uncertainty into a scenario description (Johnston et al. 2017). Often, stated preference studies present outcomes associated with proposed policy changes as certain, yet in reality, deviations are likely to occur due to stochastic nature of the environment and ecosystems, and social, political and economic factors (Torres et al. 2017; Wu et al. 2022). Presenting outcomes with certainty would therefore make the scenario unrealistic and implausible to survey respondents.

Incorporating uncertainty into stated preference studies strengthens the credibility of the proposed scenario (Wielgus et al. 2009). It also reduces potential hypothetical bias and concerns about the validity of valuations that could arise from presenting the proposed outcome with certainty (Wielgus et al. 2009; Rolfe and Windle 2015). In light of this, a growing literature incorporates uncertainty in a discrete choice experiment by adding probabilistic outcomes to the proposed scenario (Venus and Sauer 2022; Bujosa et al. 2018; Torres et al. 2017; Lundhede et al. 2015; Wielgus et al. 2009), explicitly into the choice profiles' attributes and levels (Faccioli et al. 2019; Roberts et al. 2008), or as a standalone attribute in the choice tasks (Wu et al. 2022; Williams and Rolfe

2017; Rolfe and Windle 2015; Glenk and Colombo 2011). Nevertheless, there is limited evidence on the role of outcome uncertainty with potential improvement as well as deterioration relative to the status quo, except for Wu et al. (2022). This framing of the proposed change within the context of the gains and losses is particularly important, as individuals tend to assign more weight to losses than gains, according to prospect theory (Kahneman and Tversky 1979).

Considering the challenges and limitations in the literature regarding survey consequentiality and outcome uncertainty, we use a more rigorous evaluation approach and test whether outcome uncertainty and survey consequentiality result in differences in preferences and WTP estimates in a discrete choice experiment in the context of a developing country. We design three different survey versions and randomly assign respondents to one of the three treatment groups (standard, survey consequentiality, and outcome uncertainty), where the information presented on survey consequentiality and outcome uncertainty is varied. In the standard treatment group, respondents were presented with a standard improvement scenario and choice sets, without being provided any indication about the survey consequentiality and outcome uncertainty. In the survey consequentiality treatment group, we exogenously vary the information on the consequentiality of the survey by providing a script (a formal letter from a state-owned electric utility), stating the results of their survey will be used to improve future quality of electricity supply. On top of this, we ask the common follow-up Likert scale question on policy and payment consequentiality (Zawojska et al. 2019) in all three treatments. With the assumption that the survey script strengthens consequentiality (Welling et al. 2023; Oehlmann and Meyerhoff 2017; Lewis et al. 2016), we use the random assignment to the survey consequentiality treatment group as an instrumental variable and aimed to address the endogeneity issues associated with the Likert scale follow-up question on policy consequentiality. In the outcome uncertainty treatment group, we introduce risk (probabilities) to levels of a single attribute, which is identified as a more important attribute of the service under consideration during focus group discussions. The proposed change for this attribute is framed as improvement as well as worsening relative to the status quo, with the expected values equal to a certain improvement in the standard treatment group. All other aspects of the survey were identical for all three treatment groups.

This paper focuses on the valuation of improved quality of electricity supply among business enterprises in Dar es Salaam, the largest city and financial hub of Tanzania. Like in many other Sub-Saharan African countries, businesses connected to the electricity grid experience frequent and long-lasting electricity supply interruptions. Power outage data from the Tanzania Electric Supply Company Limited (TANESCO), the state-owned electricity provider, shows that the average duration of power outage in Tanzania between July 2015 and May 2019 was 2 h and 30 min. Business enterprises are an important engine of economic growth, with electricity increasingly becoming a crucial input for their operations. Unreliable electricity supply in developing countries, specifically in Sub-Saharan Africa, is among the main obstacles to business operations (World Bank 2020). While numerous studies have examined households' WTP for a better quality of electricity services using stated preference methods (e.g., Andresen et al. 2023; Meles et al. 2021; Meles 2020; Cohen et al. 2018; Oseni 2017; Cohen et al. 2018; Ozbafli and Jenkins 2016; Sullivan et al. 2015; Layton and Moeltner 2005; Carlsson and Martinsson 2007, 2008; Abdullah and Mariel 2010), with the exception of Ghosh et al. (2017), Morrison and Nalder (2009) and Carlsson et al. (2020), there is limited evidence regarding the value of improved electricity supply for the business sector, particularly in Sub-Saharan Africa, where power outages are frequent and long-lasting (World Bank 2020). This study therefore surveys a total sample of 1004 micro and small business enterprises in Dar es Salaam to gain insights into their valuation of an improved electricity supply, characterized by fewer power outages, shorter durations, prior outage notifications, and associated cost increments.

Our results from the models in WTP space for the pooled sample show that business enterprises in Dar es Salaam, Tanzania, are WTP approximately 4% more for an hour reduction in outage duration, 9% more for an additional reduction in outage frequency per month, and 16% more for a 24-h advanced outage notification, on top of the existing highest tariff rate of 350 TZS/kWh (US$ 0.15/kWh). Compared to the standard treatment group, respondents in the survey consequentiality and outcome uncertainty treatment groups are more sensitive to the increase in the cost of electricity and exhibit stronger preferences for the proposed alternatives over the status quo. However, we do not find significant differences in preferences for the other attributes (frequency, duration, and prior notification of outages) between the standard and survey consequentiality treatment groups. This indicates that an additional survey script (the formal letter from the state-owned electric utility) to strengthen consequentiality has a modest effect, concentrating on cost increments (e.g., Aanesen et al. 2023).

In contrast, the incorporation of outcome uncertainty affects preferences not just for the attribute with uncertainty (duration of power outages) but also for advanced notice about outages. This is likely due to individuals placing more importance on avoiding deterioration over seeking improvement in the attribute with uncertainty, leading to a preference for precautionary measures like receiving a 24-h prior notification. This is in line with the finding of Torres et al. (2017) that individuals adopt a precautionary strategy to mitigate adverse impacts, which aligns with concerns expressed by business enterprises in the focus group discussions about outage duration being a major concern. Although outcome uncertainty and the additional survey script to strengthen consequentiality have some influence on preferences and WTP estimates for certain attributes, we do not find significant implications on overall welfare estimates.

The remainder of the paper is organized as follows. Section two outlines the methodology and data, which involves choice experiment design, sampling and treatment groups design, econometric approaches, and data description. Section three presents and discusses the results. Section four provides a conclusion.

2 Methodology and Data

2.1 Discrete Choice Experiment Design

This paper conducts a discrete choice experiment on the valuation of improved quality of electricity supply among electricity-connected business enterprises in Dar es Salaam, Tanzania's largest city and financial hub. According to the International Energy Agency (IEA 2019), about 37% of the population in Tanzania has access to electricity, with 73% in urban areas and 24% in rural areas. The electricity mix is dominated by large-scale hydropower and natural gas, albeit the share of hydropower is declining over time relative to gas. The state-owned electricity provider, TANESCO, is responsible for managing electricity generation, transmission, distribution, and sales.

Like in many other Sub-Saharan African countries, electricity supply interruption is common in Tanzania. We learned from the discussions with representatives of the TANESCO research department that electricity generation is sufficient to meet current electricity demand, and the variability in hydropower generation is supplemented by natural gas. The ongoing power outages are mainly attributed to the grid networks' poor physical condition and low capacity. To minimize the outage problem, the utility has been upgrading and replacing aged grid networks and constructing additional power plants to meet growing demand. In this paper, we are interested in understanding what value business enterprises connected to the electricity grid place on improved quality of electricity supply.

Following the literature on the valuation of non-marketed goods and services (e.g., Louviere et al. 2000; Johnston et al. 2017), we developed a hypothetical scenario of improved quality of electricity supply and choice tasks that are described by different attributes and levels for quality of electricity supply, including frequency and duration of outages, advanced notification, and cost of the improvement. We then asked survey respondents for their preferred option among the alternatives in each choice task. From the choices made, we infer how much business enterprises are WTP for a better quality of electricity supply.

By consulting the existing literature on power outages (e.g., Meles et al. 2021; Carlsson et al. 2020; Ozbafli and Jenkins 2016; Morrison and Nalder 2009; Carlsson and Martinsson 2008), we first identified the attributes of power outages for our study. These attributes include frequency and duration of power outages, prior notification of outages, and the cost of the improvement. Our decision on attributes and levels was then informed by in-depth focus group discussions. We also had access to data from TANESCO, the state-owned electricity utility, on the monthly total frequency and hours of scheduled and unscheduled power outages in Tanzania from July 2015 to May 2019, with 2 h and 30 min average duration of an outage. Table 1 provides the final four attributes, their description, typical status quo levels at the time of the study, and the proposed alternatives in the improvement scenarios. The cost levels are based on the feedback from the focus group discussions with business enterprises, who indicated an additional payment of 10–16% per unit of electricity on top of the existing electricity tariff, which ranges from 152 TZS/kWh (US$ 0.07/kWh) to 350 TZS/kWh (US$ 0.15/kWh).[1] Also, during the focus group discussions, most participants indicated that outages occur 3 to 5 times in a typical month, depending on the districts, mainly without advanced notice. They preferred to receive prior notification about the outages through mass media (radio or TV).

The final design consists of 10 choice sets generated using the D-efficiency design for the conditional logit model.[2] We divided the 10 choice sets into two blocks of five choice sets. Respondents were randomly assigned to one of the two blocks and asked to choose their preferred alternative in sequentially presented five choice sets. Each choice set involves the current situation (status quo) and two proposed alternatives. Each alternative is described by four attributes, including a monetary attribute which is defined as an increase in the cost of electricity per kWh. The status quo alternative shows the average current condition in terms of frequency, duration, and notification of power outages and no change in the cost of electricity. This setting is informed based on the focus group discussions and the monthly frequency and duration of power outage data from the electric utility. The proposed alternatives are labeled as 'Option A' and 'Option B', depicting improvements in the quality of electricity supply in terms of frequency, duration, and prior notification of outages and an increase in the cost of electricity per kWh. Figure 1 shows an example of a choice set for respondents in the standard and survey consequentiality treatment groups.

[1] Depending on electricity usage capacity (e.g., high versus low voltage), the existing electricity tariff rate contains five categories: 350 TZS/kWh, 292 TZS/kWh, 195 TZS/kWh, 157 TZS/kWh, and 152 TZS/kWh.

[2] We use the DCREATE command in Stata 17 which is made available by Arne Risa Hole: https://sites.google.com/view/arnehole/publications

Table 1 Attributes and levels of the choice experiment

Attribute	Description	Current situation	Levels for the proposed alternatives
Frequency	Number of power outages in a typical month	Four times	One time; two times; three times
Duration	Duration of the power outages in hours	Two and a half hours	Half an hour; one hour; one and a half hours; two hours
Notification	Prior notification about the outages	No notification	No prior notification; 24 h prior notification via radio/TV
Cost	Increment in cost of electricity per kWh (in TZS)	0	5; 15; 30; 45; 60

Attributes	Current Situation	Option A	Option B
Number of power outages in a typical month	Four times	One time	Two times
Duration of the outages in hours	Two and a half hours	Two hours	One and a half hours
Prior notification about the outages	No prior notification	No prior notification	24 hours prior notification via radio/TV
Increment in cost of electricity per kWh (in TZS)	0 TZS	30 TZS	15 TZS
Which option would you prefer?	☐	☐	☐

Fig. 1 Sample choice set

Based on power outage data from the utility, consultation with utility representatives, and focus group discussions with business enterprises, the current power outages are mainly driven by poor physical conditions of the power distribution and transmission systems and a limited capacity of the grid network relative to power demand. Hence, the improvement scenario is described as the utility's investment in upgrading and replacing the existing power distribution and transmission systems. This improvement would reduce the frequency and duration of power outages during the enterprise's operation hours and raise electricity prices. For example, see a description of the scenario for the survey consequentiality treatment group in Appendix B.1. To help respondents understand the choice sets, we provided them with an example of a choice set and a brief explanation of it, following the scenario description. Respondents were reminded to consider their current situation and how valuable an improvement in electricity supply would be to their enterprise when making decisions.

While describing the developed scenario, respondents were reminded that the payment for electricity service improvements would be solely allocated to this purpose; it cannot be used for other purposes. They were also told that the decisions they make only affect the attributes identified and everything else remains as it is. In addition, a "cheap talk" script (Cummings and Taylor 1999) was included to mitigate potential problem of hypothetical bias in valuation. Respondents were also informed that proposed improvements would be implemented only if supported by a majority of respondents, aimed at preventing free-riding on this improvement of quasi-public good.

The final survey questionnaire consists of general information about the enterprise, the enterprise's energy costs, power outages, discrete choice experiments, individual preferences related questions, sales, employment, and other costs, respectively. Before the main survey, we carried out focus group discussions to obtain detailed information on the frequency and duration of power outages and WTP for improved quality of electricity supply. The focus groups were conducted primarily with owners and managers of enterprises in the three main districts in the Dar es Salaam region (Kinondoni, Ilala, and Temeke districts). Each of the three focus group discussions was conducted with 12–15 randomly selected participants for one to two hours. We also conducted a pilot test of the entire questionnaire with 39 randomly selected business enterprises before the main survey.

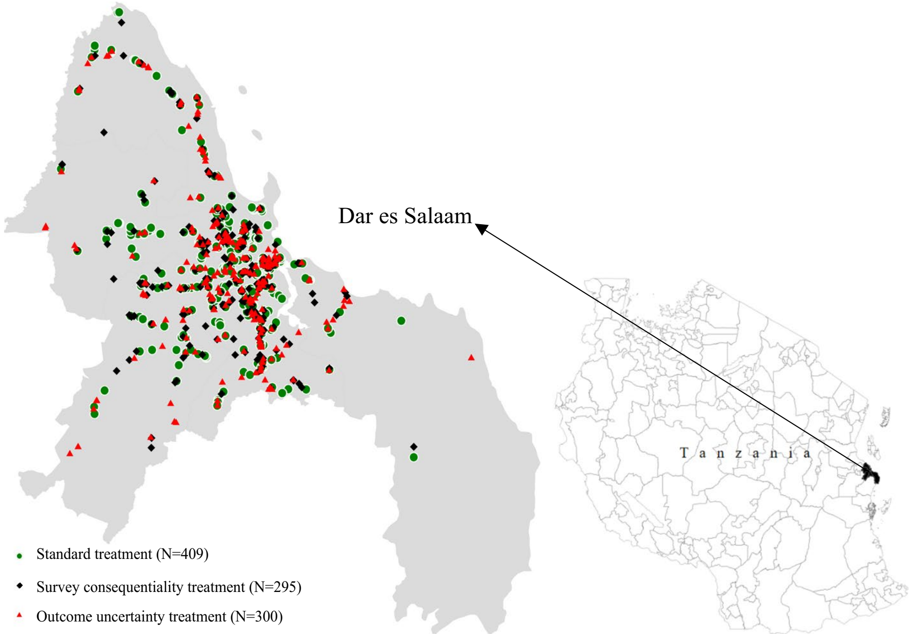

Fig. 2 Distribution of the sample business enterprises across the Dar es Salaam region (study area)

2.2 Sampling and Treatment Design

The data for this study comes from a business enterprise survey conducted in Dar es Salaam, Tanzania, from August 28 to September 30, 2019. The survey data covers a total sample of 1004 micro and small business enterprises, collected through face-to-face interviews using computer-assisted personal interviews (CAPI) in a local language, Swahili.

The sampling approach involves a random selection in proportion to the number of micro and small enterprises across districts in the Dar es Salaam region, with the aim of accounting for power outage variations across districts. A list of all enterprises in the city in 2016, obtained from the Tanzania National Bureau of Statistics, served as the basis for the sampling. Micro and small enterprises, which are the focus of this study, constitute more than 90% of the business establishments in the city. The list was created based on the previous administrative division of the city into three districts: Kinondoni, Ilala, and Temeke, compared to the current division, which consists of five districts (Kinondoni, Ilala, Temeke, Ubungo, and Kigamboni). Thus, the sampling and analysis cover the entire Dar es Salaam region, though assigned based on the earlier three districts. Figure 2 displays the distribution of the 1004 sample business enterprises across the Dar es Salaam region (the study area).

We implement and design split sample treatments. To account for potential variations in power outages across different districts, we randomly assign sample enterprises from each district into one of the three treatment groups: standard, survey consequentiality, and outcome uncertainty.

2.2.1 Standard Treatment Group

409 of the total sample, 1004 business enterprises, are assigned to this standard discrete choice experiment.[3] A survey respondent from a business enterprise was presented with a description of the proposed improvement scenario of electricity supply, followed by five different choice sets. Each choice set contains three alternatives: a status quo (existing typical situation) and two proposed improvements in electricity supply, characterized by either fewer outages, shorter durations, prior outage notification, or associated cost increments; see, Fig. 1 for a sample choice set. Respondents were then asked to choose their preferences among the alternatives in each of the five choice sets. Respondents in this treatment group received no information about the survey consequentiality and outcome uncertainty, serving as a reference for the other two treatment groups. The description of the developed scenario for the standard treatment group is the same as the scenario described in Appendix B.1, except no information was provided regarding the survey consequentiality. That is, we did not mention the study is being conducted in collaboration with TANESCO and did not show the formal letter from TANESCO (see the text in italics at the beginning of the scenario description).

2.2.2 Survey Consequentiality Treatment Group

This consists of 295 sample enterprises. Respondents in this treatment group were provided information about the consequentiality of their survey responses. To do so, we partnered with the single and state-owned electricity utility in Tanzania, TANESCO. Immediately before presenting the description of the scenario for improved electricity supply and choice sets, respondents were informed that the study was being conducted in collaboration with TANESCO. Enumerators then showed respondents a formal letter from TANESCO or read the content of the letter if the respondent could not read it. The letter stated that we are collaborating with researchers from the University of Dar es Salaam on a study on improving the quality of electricity services, and the results of the survey will be considered in future policies regarding improving electricity supply in Tanzania (see an English version of this in Appendix B.2). Except for mentioning the study is being conducted in collaboration with TANESCO and showing the formal letter from the utility on the survey consequentiality, the scenario description and the five choice sets are the same as in the standard treatment group. The letter from the utility was also presented in a local language, Swahili.

2.2.3 Outcome Uncertainty Treatment Group

This comprises the remaining 300 sample enterprises. For respondents in this treatment group, the description of the proposed improvement scenario and presentation of the five choice sets are similar to that of the standard treatment. However, to explore the role of uncertainty, we incorporate risk (probabilities) into the levels of a single attribute (duration of power outages) in the two proposed alternatives of a choice set. The uncertainty treatment, which describes levels of the attribute as risky, is specified as an improvement as well as deterioration in the duration of electricity supply interruptions relative to the status

[3] The number of respondents randomly assigned to the standard treatment is relatively large, comprising about 40% of the total sample. This is due to the initial plan to write a standalone research paper with sufficient statistical power for analysis.

Table 2 Levels of the duration of power outage attribute (in hours) across the standard and outcome uncertainty treatment groups

Standard treatment group	Outcome uncertainty treatment group
Levels in the proposed alternatives:	
0.5 h	20% chance of 50 min; 80% chance of 25 min
1 h	20% chance of 3 h; 80% chance of 0.5 h
1.5 h	20% chance of 3.5 h; 80% chance of 1 h
2 h	20% chance of 4 h; 80% chance of 1.5 h
Status quo (current situation):	
2.5 h	2.5 h

quo. The expected duration of outages (in hours) in the proposed alternatives of a choice set is the same as the certain improvement in outage duration in the standard treatment group. We set the improvement in outage duration from what is described in the status quo with a higher probability of 80% and of deteriorating with a smaller likelihood of 20%, by holding the expected hours of the outage to be the same as the corresponding proposed alternatives in the standard treatment group.[4] The inclusion of uncertainty in the duration attribute is based on insights from the focus group discussions with business enterprises, who identified hours of outages as their main concern among the attributes included in the discrete choice experiment. They pointed out that a longer duration is more severe to their business activities, specifically, they indicated that an electricity supply interruption with a longer duration is relatively worse than a more frequent one. In addition to introducing uncertainty to the duration of outages in the choice tasks, we included the following statements in the scenario description: "For an unforeseen reason, the duration of the power outages could be different from what would be expected. To consider this, we have introduced a different possible duration of outages with some probabilities." However, no information was provided to the survey respondents about the causes of the uncertainty, aimed at minimizing potential confounding factors that affect both the cause of uncertainty and the respondents' valuation. Table 2 shows the levels of power outage duration (in hours) in the proposed alternatives of a choice set across the standard and outcome uncertainty treatment groups, with the same status quo and expected values. A description of the developed scenario is provided in Appendix B.3 (the text in italics denotes variations from the scenario description in the standard treatment group).

The only difference among the three treatment groups is the discrete choice experiment survey, specifically the description of the developed scenario or associated choice sets, pertaining to survey consequentiality and outcome uncertainty. All other survey questions were identical across the three treatment groups.

Immediately after completing the five choice tasks, all survey respondents were asked the common Likert scale follow-up questions on policy and payment consequentiality (Zawojska et al. 2019). They were also asked whether they believe that the electric

[4] Considering respondents' engagement in business activities, their managerial positions, and educational background (see the descriptive statistics in Table 3), concern about respondents' familiarity and understanding of the probabilities of 80% and 20% is minimal. Nevertheless, we acknowledge a limitation in our study of not conducting a comprehensive test to assess respondents' ability to understand these probabilities. We suggest future research to incorporate a simple comprehensive test in their survey designs to address this issue.

Table 3 Descriptive statistics of the sample enterprise across treatment groups

Variables	(1) Full sample	(2) Standard treatment	(3) Survey conseq	(4) Outcome uncertainty	(5) Differences (2)–(3)	(6) (2)–(4)
Main activities of enterprise:						
1 if food and beverage	0.11	0.11	0.10	0.12	0.01	−0.01
	(0.01)	(0.02)	(0.02)	(0.02)		
1 if textile and leather products	0.11	0.12	0.12	0.07	−0.00	0.04*
	(0.01)	(0.02)	(0.02)	(0.02)		
1 if wood products and furniture	0.26	0.28	0.24	0.26	0.04	0.02
	(0.01)	(0.02)	(0.02)	(0.03)		
1 if metals, electrical equipment, and machinery	0.15	0.14	0.16	0.15	−0.02	−0.01
	(0.01)	(0.02)	(0.02)	(0.02)		
1 if construction and other non− metallic products	0.37	0.35	0.37	0.39	−0.02	−0.04
	(0.02)	(0.02)	(0.03)	(0.03)		
Location of an enterprise district:						
1 if Ilala	0.32	0.31	0.32	0.35	−0.00	−0.03
	(0.01)	(0.02)	(0.03)	(0.03)		
1 if Kinondoni	0.36	0.39	0.35	0.33	0.04	0.06
	(0.02)	(0.02)	(0.03)	(0.03)		
1 if Temeke	0.32	0.30	0.34	0.32	−0.03	−0.02
	(0.01)	(0.02)	(0.03)	(0.03)		
1 if located in commercial areas	0.69	0.70	0.68	0.66	0.02	0.04
	(0.01)	(0.02)	(0.03)	(0.03)		
1 if sole ownership	0.82	0.81	0.81	0.83	0.01	−0.02
	(0.01)	(0.02)	(0.02)	(0.02)		
Age of enterprise in 2019 survey (in years)	7.99	8.22	7.91	7.77	0.30	0.45
	(0.26)	(0.43)	(0.51)	(0.40)		

Table 3 (continued)

Variables	(1) Full sample	(2) Standard treatment	(3) Survey conseq	(4) Outcome uncertainty	(5) Differences	(6)
					(2)–(3)	(2)–(4)
Total number of employees	11.38	10.82	12.22	11.34	− 1.40	− 0.52
	(0.67)	(0.89)	(1.48)	(1.21)		
Typical monthly electricity bill (in TZS)	312,714	244,128	352,319	367,274	− 108,191	− 123,146*
	(28,432)	(34,777)	(61,183)	(56,298)		
1 if use a backup generator during outages	0.11	0.11	0.09	0.12	0.01	− 0.02
	(0.01)	(0.02)	(0.02)	(0.02)		
Respondent characteristics:						
1 if owner	0.62	0.61	0.63	0.64	− 0.02	− 0.03
	(0.02)	(0.02)	(0.03)	(0.03)		
1 if male	0.89	0.90	0.88	0.90	0.02	− 0.00
	(0.01)	(0.02)	(0.02)	(0.02)		
Age in years	38.55	38.15	38.95	38.70	− 0.80	− 0.55
	(0.31)	(0.48)	(0.58)	(0.57)		
1 if married	0.79	0.80	0.78	0.78	0.02	0.02
	(0.01)	(0.02)	(0.02)	(0.02)		
Years of education	9.78	9.84	9.60	9.86	0.24	− 0.03
	(0.11)	(0.16)	(0.19)	(0.21)		
Number of respondents	1004	409	295	300		
F-test of joint significance					0.80	0.90

Table 3 shows the mean values with standard deviations in parentheses of the sample business enterprises. The values displayed for the differences are the mean differences relative to the standard treatment group while the values for F-test are the F-statistics

***, **, and *indicate significance at 1%, 5%, and 10%, respectively utility will consider the survey results in future policy decisions. Following Zawojska et al. (2019), we asked respondents to indicate the degrees to which they agree with the following statements regarding policy and payment consequentiality separately:

- “The project of improving the quality of electricity supply will indeed be conducted in Tanzania in the next five years.”
- “For the purpose of improving the quality of electricity supply, the electricity price will indeed be changed in the next five years.”

Survey respondents express their agreement with each statement on a five-point Likert scale, which is rearranged in our analysis from 1 (‘definitely disagree’) to 5 (‘definitely agree’), with 3 standing for ‘do not know/hard to say’. Respondents were also asked, “To what extent do you believe that the decisions on the proposal from you and other survey participants will be taken into consideration by the utility (TANESCO)?” on a scale of 1 (‘not taken into account at all’) to 5 (‘definitely taken into account’), with 3 standing for ‘do not know/hard to say’.

In addition, all respondents were asked about their confidence over the choices they made of the five choice sets on a scale of 1–5, where 1 is not confident at all and 5 is very confident (e.g., Mattmann et al. 2019; Ready et al. 2010) and whether they paid attention to each attribute in the choice set, with three options: 1 = ‘not at all’, 2 = ‘in some but not all’ and 3 = ‘always’ (Carlsson et al. 2010, 2020; Scarpa et al. 2013). Furthermore, we asked the respondents about their trust in utility and its employees (Wilson and Eckel 2011; Johansson-Stenman et al. 2013) with four-option answers from 1 (do not trust at all) to 4 (trust completely); and their willingness to take a risk on a scale of 0 (completely unwilling to take risks) to 10 (very willing to take risks) (Dohmen et al. 2011).

2.3 Econometric Approaches

Following previous literature (e.g., Campbell 2007; Czajkowski et al. 2017a; Börger et al. 2021; Blackman et al. 2023), our econometric approaches involve two stages. In the first stage, we use a mixed logit model (also known as the random parameters logit model) to analyze the discrete choice experimental data and estimate the individual WTP estimates. A mixed logit model explicitly accounts for unobserved heterogeneity and the panel nature of the choice data (Revelt and Train 1998). In the second stage, we use ordinary least squares (OLS) to evaluate the effects of the treatments on WTP estimates, with and without additional controls on respondent and business enterprise characteristics.

In the first stage, we employ the mixed logit model with all coefficients specified as random. Following the random utility theory (McFadden, 1974), the indirect utility, V^*_{ijt} of a respondent $i \in \{1, ..., N\}$ choosing alternative $j \in \{1, ..., j\}$ in a choice set $t \in \{1, ..., T\}$ is given by:

$$V^*_{ijt} = -\alpha^*_i C_{ijt} + \beta^*_i{}' X_{ijt} + \varepsilon^*_{ijt}. \quad (1)$$

where C^*_{ijt} and X^*_{ijt} are the cost and non-cost attributes, including the alternative specific constant (ASC). While α^*_i is the individual-specific coefficient associated with cost attribute and β^*_i is a vector of individual-specific parameters for the non-cost attributes. ε^*_{ijt} is the error term that is independently and identically distributed extreme value type I, with a variance of $var\left(\varepsilon^*_{ijt}\right) = \mu_i^2(\pi^2/6)$, where μ_i is the scale parameter for respondent i. Dividing Eq. (1) by the scale parameter μ_i (which does not change the utility) provides:

$$V_{ijt} = -\alpha_i C_{ijt} + \beta_i{}' X_{ijt} + \varepsilon_{ijt} \quad (2)$$

where $V_{ijt} = (V^*{}_{ijt}/\mu_i)$, $\alpha_i = (\alpha^*{}_i/\mu_i)$, $\beta_i = \beta^*{}_i/\mu_i$, and $\varepsilon_{ijt} = (\varepsilon^*{}_{ijt}/\mu_i)$, with $var(\varepsilon_{ijt}) = \pi^2/6$. We use the 'mixlogit' Stata package (Hole 2007), with 1000 Halton draws to estimate the coefficients of the model in Eq. (2).

The specification in Eq. (2) parametrizes the utility in preference space and the implied marginal WTP for the non-cost attribute is the ratio of the attribute's coefficient to the cost coefficient: $WTP_i = \beta^*{}_i/\alpha^*{}_i = \beta_i/\alpha_i$. This is referred to as models in preference space (Train and Weeks 2005), where the distribution of WTP is derived from the estimated distribution of the coefficients, after specifying an appropriate distribution for the coefficients and the parameters of this distribution (mean and standard deviations) are estimated. However, estimating the marginal WTP from the ratio of two randomly distributed coefficients for some popular distributions such as normal, truncated normal, uniform, and triangular results in infinite moments of WTP distribution (Daly et al. 2012) and leads to unreasonably small or large WTP estimates in the case of a log-normal distribution (Train and Weeks 2005). A common alternative is a fixed cost coefficient specification that assumes preferences for a cost attribute do not vary across respondents, which is unrealistic (Scarpa et al. 2008) and may lead to inferior models (Daly et al. 2012).

To circumvent the problem with models in preference space, Scarpa et al. (2008) and Train and Weeks (2005) suggest models in WTP space, which allow direct specification of the WTP distribution instead of driving it through a ratio of two distributions. This is obtained by substituting the WTP definition $WTP_i = \beta_i/\alpha_i = \omega_i$ into Eq. (2) and rearranging the terms as follows:

$$V_{ijt} = \alpha_i(\omega_i{}' X_{ijt} - C_{ijt}) + \varepsilon_{ijt}. \quad (3)$$

Under the assumption that the error terms are independently and identically distributed, the probability that an individual i chooses alternative j in a sequence of T choices, with density function $f(\omega|\theta)$ and θ parameters of the assumed distributions, is given by:

$$P_{ij} = \int \prod_{t=1}^{T} \frac{\exp\left(\alpha_i(\omega_i{}' X_{ijt} - C_{ijt})\right)}{\sum_{j=1}^{J} \exp\left(\alpha_i(\omega_i{}' X_{ijt} - C_{ijt})\right)} f(\omega|\theta)\mathrm{d}w. \quad (4)$$

The integral in Eq. (4) does not have a closed-form solution, and the model parameters (mean and standard deviation of WTP distribution) are estimated using simulated maximum likelihood estimation (Train 2003). In this paper, we apply 1000 Halton draws to estimate the coefficients of the models using the 'mixlogitwtp' Stata package (Hole 2007).[5]

In the second stage, based on the individual marginal WTP estimates from models in WTP space, we estimate the effects of survey consequentiality and outcome uncertainty treatments on marginal WTP for the non-cost attributes as follows.[6]

$$WTP_i = \lambda_0 + \lambda_1 \text{Consequentiality}_i + \lambda_2 Uncertainty_i + \gamma' Z_i + v_i \quad (5)$$

[5] The 'mixlogitwtp' package is based on 'mixlogit' Stata package (Hole 2007), which we use to estimate the coefficients from models in preference space.

[6] The individual marginal WTP estimates from models in WTP space are obtained using the command 'mixlbeta' in Stata, after estimating coefficients of the model using 'mixlogitwtp' Stata package (Hole 2007).

where the dependent variable, WTP_i, is the marginal WTP estimate of respondent i from the models in WTP space. When considering this particular outcome of interest, we alternatively specify marginal WTP estimates for each non-cost attribute, as well as total marginal WTP estimates relative to the baseline scenario. $Consequentiality_i$ and $Uncertainty_i$ are dummy variables equal to one if the survey respondent belongs to the survey consequentiality or outcome uncertainty treatment group and zero if respondents are from the standard treatment group. λ_1 and λ_2 are the parameters of interest that capture the effects of survey consequentiality and outcome uncertainty treatments on marginal WTP for the non-cost attributes (i.e., frequency, duration, and prior notification of power outages and ASC, an indicator for choosing the proposed alternatives over the status quo). λ_0 is a constant term that can be interpreted as the average WTP estimate for the standard treatment. Z_i is a vector of respondent and business enterprise characteristics, with its corresponding vector of parameter, γ. v_i is an error term that is assumed to be normally distributed with zero mean.[7]

Finally, we attempt to address the endogeneity issues associated with the follow-up Likert scale measure of policy consequentiality, using the random assignment to the survey consequentiality treatment group as an instrumental variable. For this, we limited our analysis to sample respondents assigned to the standard and survey consequentiality treatment groups and specified the effects of the Likert scale measure of policy consequentiality on WTP estimates as follows.

$$WTP_i = \pi_0 + \pi_1 Policy\_scale_i + \psi' Z_i + \epsilon_i \tag{6}$$

In the first stage, we use OLS to estimate:

$$Policy\_scale_i = \delta_0 + \delta_1 Consequentiality_i + \phi' Z_i + \eta_i \tag{7}$$

where the dependent variable ($Policy\_scale_i$) is a respondent's answer to the Likert scale follow-up question on policy consequentiality that ranges from 1 ('definitely disagree') to 5 ('definitely agree'), with 3 standing for 'do not know/hard to say'. After estimating Eq. (7), we substitute $\widehat{Policy\_scale}_i$ into Eq. (6) and $\hat{\pi}_{1IV}$ is identified using exogenous variation in the Likert scale measure through random assignment to the survey consequentiality treatment group.

2.4 Descriptive Statistics

Table 3 provides descriptive statistics of the sample enterprises across the three treatment groups. Column 1 reports the summary statistics for the full sample (N = 1004). The sample enterprises are engaged in a wide range of business activities, including production of wood products and furniture (26%), food and beverage (11%), textile and leather products (11%), metals, electrical equipment, and machinery (15%), and construction and other non-metallic sectors (37%). The distribution of our sample enterprises across districts shows that 32% are located in Ilala, 36% in Kinondoni, and 32% in Temeke. In comparison, the distribution of all business establishments in the city across those districts is 35%, 31%, and 34%, respectively. Around 69% of the sample enterprises are located in commercial areas

[7] Similar specifications to Eq. (5) have been employed in other split-sample designs of stated preference studies (e.g., Ishihara and Ida 2022; Venus and Sauer 2022). We also check the robustness of our results using the double-selection LASSO approach (Belloni et al. 2014), which addresses concerns regarding variables that are potentially correlated with the treatments and outcomes.

(home or outside home), 25% in non-commercial areas, and 6% in industrial zones. Most enterprises are sole proprietorships (82%), with an average of 11 employees and around 8 years of operation. The rest are partnerships, share companies, cooperatives, or others.

Almost all the respondents (99%) stated that electricity is the most frequently used energy for their enterprise activities (compared to natural gas, diesel, gasoline, liquified natural gas (LPG), coal, firewood, and charcoal). The reported average and median monthly electricity bills are approximately 312,714 TZS (US$136), and 80,000 TZS (US$35), respectively, with prepaid being a dominant billing payment system (94%).[8] 84% reported that electricity was very important for their enterprise's activities and cannot undertake any activity without it. 14% stated it was somewhat important and the rest indicated that electricity was not very important, as they only use electricity for basic activities or do not use it at all. About 61% reported that their enterprise uses electricity for several electric power-driven machinery or equipment. Even though 86% of respondents reported experiencing power interruptions in the past 12 months, only 11% used a backup solution like a standby diesel generator, potentially due to high costs as indicated during the focus group discussions.

Approximately 62% of the survey respondents were the owners of their respective enterprises. The rest, non-owners, held general managerial or other managerial positions in the enterprise. The average age and education of respondents in our study were 39 years and 10 years, respectively. Most of the respondents are male (89%) and married (79%).

Table 3 Columns 2–6 provides the summary statistics for the business enterprises in the sample across the three treatment groups and their differences compared to the standard treatment group. For almost all variables, the differences in observable characteristics between the standard and the other two treatment groups are not statistically significant. We only observe a weakly significant difference between those in the standard and outcome uncertainty treatment groups for the reported average monthly electricity bill and whether the enterprise's main activity is textile and leather products. However, the F-test shows jointly insignificant, suggesting the balance of the covariates across the treatment groups.

Next, we provide a summary and differences of the self-reported follow-up Likert scale questions, which are widely adopted in discrete choice experiment studies, across the three treatment groups. Table 4 shows the average Likert scale answers, ranking respondents' agreement with the statements from the worst to the best. Overall, sample respondents reported high confidence in their choices, little attribute non-attendance, relatively high policy and payment consequentiality, and trust in the utility and its employees, and exhibited a moderate willingness to take a risk. For almost all the follow-up questions, we do not observe a statistical difference in the Likert scale answers between the standard and the other treatment groups. However, the difference in the Likert scale answers to the policy consequentiality question is statistically significant at a 10% level. Compared to the standard treatment group, respondents in the survey consequentiality treatment group are more likely to believe (have a higher average value) that the proposed improvement in electricity supply will be implemented, supporting the random assignment as a valid instrument for the follow-up Likert scale question on policy consequentiality.

[8] 1US$ was approximately 2,300 TZS (Tanzanian shilling) during the survey period (September 2019).

3 Results

We begin by presenting the discrete choice experiment results on the full (pooled) sample (N = 1,004) without considering the treatment effects. The cost, frequency, and duration attributes are specified as continuous variables, whereas '24 h prior notification' and ASC (alternative specific constant) are specified as dummy variables. Columns (1–2) of Table 5 show mixed logit model results with normal distributions for coefficients of non-cost attributes and lognormal distribution for cost coefficient, which exhibit a better fit to the data than the other alternative specifications, as indicated by the smallest absolute values of log-likelihood, AIC, and BIC.[9] To account for individual heterogeneity, all the coefficients of the attributes are specified to vary across respondents, which provides mean and standard deviations of the estimated parameters in the regression results.

The estimated mean coefficients on cost, frequency, and duration attributes of power outages are negative and statistically significant, indicating respondents are less likely to choose an alternative with a higher cost per kWh, more frequent, and longer duration of power outages.[10] On the other hand, the positive and strongly significant coefficient on the dummy of '24 h prior notification' shows that respondents prefer an outage with prior notification compared to an outage without any advance notification. The positive and statistically significant mean coefficients of ASC indicate that respondents favor the proposed alternatives over the status quo, suggesting a strong urge for change, dissatisfaction with the existing quality of electricity services, or potential unobserved factors influencing individuals towards considering a change. Given that respondents were explicitly informed in the scenario description that their decisions would only affect the identified attributes while everything else remains unchanged, the high and positive estimated coefficients of ASC can be interpreted as respondents conveying their discontent with the existing service provided by TANESCO, the electricity provider in Tanzania, and willingness to pay more for a better quality of electricity supply. This is supported by the adverse effects of outages discussed in the focus group, which entail damage to equipment and increasing production costs. Overall, the estimated coefficients of the choice attributes have the prior expected signs and are consistent with the literature (e.g., Carlsson et al. 2020; Morrison and Nalder 2009).[11]

In order to capture the effects of survey consequentiality and outcome uncertain treatments on preferences for improved quality of electricity supply, we introduce interactions of the attributes and treatment dummies, with respondents in the standard treatment

[9] See Table A.1 in the appendix for model results with different specifications, including conditional logit model and mixed logit models with different distributions of the attributes' coefficients. The estimated results remain similar across the different specifications, albeit with a few minor differences.

[10] It is important to note that an estimated parameter of a natural logarithm of a coefficient with mean $\widehat{\mu}_k$ *and standard deviation* $\widehat{\sigma}_k$, *the mean and standard deviation of the coefficient itself* (*without natural logarithm*) *is given by* $\exp(\widehat{\mu}_k + \frac{\widehat{\sigma}_k^2}{2})$ *and* $\exp(\widehat{\mu}_k + \frac{\widehat{\sigma}_k^2}{2})\sqrt{\exp\left(\widehat{\sigma}_k^2\right) - 1}$, respectively (Train 2003; Hole 2008).

[11] The estimated results also remain similar with different model specifications except for ASC in the conditional logit model, which has a negative sign. But, it does not account for individual heterogeneity (see, results in Table A.1 in the Appendix). This contradicts the estimated parameters on ASC from mixed logit model specifications, which are positive and account for taste heterogeneity across respondents. The high and strongly significant standard deviations highlight the presence of respondents with positive and negative estimated ASC coefficients.

Table 4 Summary of answers to the Likert scale follow-up questions across treatment groups

Variables	(1) Full sample	(2) Standard treatment	(3) Survey conseq	(4) Outcome uncertainty	(5) Diff. (2)–(3)	(6) Diff. (2)–(4)
Policy consequentiality on a scale of 1–5	3.72	3.65	3.81	3.72	−0.16*	−0.07
	(0.04)	(0.06)	(0.06)	(0.07)		
Payment consequentiality on a scale of 1–5	3.61	3.56	3.67	3.62	−0.12	−0.06
	(0.04)	(0.06)	(0.07)	(0.07)		
Electric utility will consider results on a scale of 1– 5	3.81	3.83	3.78	3.80	0.05	0.03
	(0.04)	(0.06)	(0.07)	(0.07)		
Confidence in choices on a scale of 1–5	4.36	4.42	4.35	4.29	0.08	0.13
	(0.04)	(0.05)	(0.06)	(0.07)		
Attention to attributes on a scale of 1– 3:						
Frequency	2.29	2.31	2.34	2.22	−0.03	0.09*
	(0.02)	(0.03)	(0.04)	(0.04)		
Duration	2.29	2.28	2.32	2.28	−0.04	−0.00
	(0.02)	(0.03)	(0.04)	(0.04)		
Prior notification	2.36	2.35	2.38	2.36	−0.03	−0.01
	(0.02)	(0.04)	(0.04)	(0.04)		
Cost per kWh	2.44	2.43	2.51	2.37	−0.08	0.06
	(0.02)	(0.03)	(0.04)	(0.04)		
Trust in electric utility on a scale of 1– 4	3.20	3.18	3.18	3.24	0.00	−0.06
	(0.03)	(0.04)	(0.05)	(0.05)		
Trust in electric utility employees on a scale of 1– 4	3.07	3.09	3.07	3.05	0.02	0.03
	(0.03)	(0.05)	(0.05)	(0.06)		
Willing to take risks on a scale of 0–10	6.14	6.30	6.00	6.04	0.30	0.26
	(0.11)	(0.18)	(0.21)	(0.21)		
Sample respondents	1,004	409	295	300		

Table 4 shows the mean values of the answers to the Likert scale follow-up questions, with standard deviations in parentheses. The values displayed for the differences are the mean differences relative to the standard treatment group

***, **, and *indicate significance at 1%, 5%, and 10%, respectively

Table 5 Mixed logit model results with different specifications

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mixed logit models with normal distributions for non-cost coefficients in all specifications whereas cost coefficient is:							
	lognormal (without interactions)		lognormal (with interactions)		normal (with interactions)		Fixed (with interactions)	
	Mean Coeff	St.dev	Mean Coeff	St.dev	Mean Coeff	St.dev	Mean Coeff	St.dev
ln (cost)	−4.77***	8.50***	−6.16***	3.62***				
	(0.23)	(0.44)	(0.20)	(0.08)				
Cost					−0.01**	0.07***	−0.01**	
					(0.01)	(0.01)	(0.00)	
Frequency	−0.71***	0.47***	−0.75***	0.53***	−0.51***	0.43***	−0.55***	0.16
	(0.06)	(0.09)	(0.08)	(0.10)	(0.08)	(0.11)	(0.06)	(0.27)
Duration	−0.27***	0.05	−0.10	0.01	−0.10	0.12	−0.13**	0.01
	(0.05)	(0.09)	(0.07)	(0.03)	(0.08)	(0.08)	(0.05)	(0.02)
24 h prior notification	1.23***	1.15***	1.20***	0.97***	1.66***	1.28***	0.90***	0.74***
	(0.09)	(0.10)	(0.11)	(0.11)	(0.17)	(0.17)	(0.09)	(0.09)
ASC (1 if chose proposed alternatives, 0 if status quo)	28.40***	15.97***	21.13***	31.00***	9.09***	19.11***	7.77***	16.91***
	(7.69)	(3.58)	(2.55)	(3.26)	(1.11)	(1.99)	(1.74)	(1.83)
Treatment effects (Ref: Standard treatment):								
ln (Cost * Consequentiality)			−9.45***	12.74***				
			(0.23)	(0.22)				
ln (Cost * Uncertainty)			−2.55***	22.15***				
			(0.12)	(0.17)				
Cost * Consequentiality					−0.02**	0.06***	−0.01***	
					(0.01)	(0.02)	(0.00)	
Cost * Uncertainty					−0.07***	0.07***	−0.04***	
					(0.02)	(0.02)	(0.01)	

Table 5 (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mixed logit models with normal distributions for non-cost coefficients in all specifications whereas cost coefficient is:							
	lognormal (without interactions)		lognormal (with interactions)		normal (with interactions)		Fixed (with interactions)	
	Mean Coeff	St.dev	Mean Coeff	St.dev	Mean Coeff	St.dev	Mean Coeff	St.dev
Frequency * Consequentiality			−0.08	0.32**	−0.07	0.40	−0.06	0.27*
			(0.12)	(0.13)	(0.14)	(0.28)	(0.09)	(0.15)
Frequency * Uncertainty			0.07	0.44**	−0.18	0.73***	0.08	0.43*
			(0.16)	(0.19)	(0.17)	(0.22)	(0.11)	(0.25)
Duration * Consequentiality			−0.08	0.05	−0.06	0.12	−0.06	0.01
			(0.10)	(0.04)	(0.12)	(0.12)	(0.08)	(0.02)
Duration * Uncertainty			−1.07***	1.20***	−1.02***	1.29***	−0.54***	0.53**
			(0.23)	(0.23)	(0.24)	(0.24)	(0.14)	(0.22)
24 h prior notification * Consequentiality			−0.25	0.28	−0.22	0.53	−0.32***	0.04
			(0.16)	(0.29)	(0.24)	(0.52)	(0.12)	(0.10)
24 h prior notification * Uncertainty			1.36***	2.29***	0.68*	2.14***	0.70***	1.69***
			(0.34)	(0.31)	(0.38)	(0.48)	(0.23)	(0.27)
ASC * Consequentiality			27.96***	13.72***	10.77***	27.12***	5.89***	22.79***
			(3.01)	(1.45)	(3.29)	(3.52)	(1.49)	(2.34)
ASC * Uncertainty			62.91***	26.02***	3.60***	19.57***	3.47*	13.63***
			(6.93)	(2.79)	(1.01)	(2.09)	(1.87)	(1.55)
Loglikelihood	−2,825		−2,811		−2,849		−2,988	
AIC	5,670		5,681		5758		6,031	
BIC	5,746		5,910		5987		6,237	
Observations	15,060		15,060		15,060		15,060	

Table 5 (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mixed logit models with normal distributions for non-cost coefficients in all specifications whereas cost coefficient is:							
	lognormal (without interactions)		lognormal (with interactions)		normal (with interactions)		Fixed (with interactions)	
	Mean Coeff	St.dev	Mean Coeff	St.dev	Mean Coeff	St.dev	Mean Coeff	St.dev
No. of respondents	1,004		1,004		1,004		1,004	

Table 5 presents mixed logit model results with non-cost coefficients normally distributed in all specifications. The cost coefficient in columns (1)–(4), which contains both the mean and standard deviations of the estimated parameters for the full sample without and with interaction terms of the treatment effects, is assumed to be lognormally distributed. The cost coefficient in columns (5)–(6) is normally distributed whereas in columns (7)–(8) it is specified to be fixed. The number of observations (15,060) equals the number of respondents (1004) multiplied by the five choice sets per respondent and three alternatives within a choice set

Robust standard errors clustered at the respondent level are in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

group serving as a reference (see, Columns 3–4 of Table 5). To check the robustness of the results of the treatment effects on preferences for improved electricity supply, we include two additional specifications. In columns (5–6) of Table 5, all coefficients including the cost coefficient are assumed to be normally distributed. In columns (7–8) of Table 5, the cost coefficient is fixed whereas the non-cost coefficients are still specified to be normally distributed.[12]

The estimated coefficients of the attributes of power outages without interaction terms are for respondents in the standard treatment group. Except for duration, all coefficients are significant and consistent with the results of the pooled sample in Columns 1–2 of Table 5. However, estimated parameters of the interaction terms of the attributes with survey consequentiality or outcome uncertainty treatment indicate variations in preferences for corresponding attributes compared to the standard treatment.

In the survey consequentiality treatment group, only the interaction terms for cost and ASC are statistically significant, suggesting differences in preferences for these attributes compared to the standard treatment group. The negative coefficient of the cost attribute indicates that respondents in the survey consequentiality treatment group are more sensitive to the increase in electricity cost. This finding is consistent with prior studies by Bulte et al. (2005) and Zawojska et al. (2019) and could potentially lead to lower marginal WTP estimates. On the contrary, the positive coefficient associated with the ASC implies that respondents in the survey consequentiality treatment group are more likely to favor the proposed alternatives over the status quo. Nonetheless, when it comes to preferences for other attributes like frequency, duration, and prior notification of outages, we do not find statistically significant differences between the standard and survey consequentiality treatment group. The lack of significant differences in preferences for frequency, duration, and prior notification attributes suggests that the effect of the survey consequentiality treatment is modest, mainly concentrating on the cost increments (e.g., Aanesen et al. 2023). It is worth noting that the scenario description for the standard treatment group already involves a certain degree of survey consequentiality, such as upgrading grid networks by the electricity provider, resulting in higher electricity tariffs and implementation of the proposed change upon majority support (see Appendix B.1). The survey script (formal letter from the state-owned electric utility) is, therefore, an additional measure to strengthen the consequentiality, which only marginally improves the perceived consequentiality. This is supported by slight yet statistically significant differences in answers to the Likert scale follow-up question on policy consequentiality between the standard and survey consequentiality treatment groups.

Respondents who are assigned to the outcome uncertainty treatment group exhibit greater sensitivity to increases in electricity cost and prefer the proposed alternatives over the status quo, compared to those in the standard treatment group. They also show stronger preferences for reducing the duration of outages and receiving prior notice about the outages, compared to respondents in the standard treatment group. The strongly significant and negative coefficient on the interaction of duration of power outage with outcome uncertainty treatment is in line with the literature (Aanesen et al. 2023; Lundhede et al. 2015; Glenk and Colombo 2011), which indicates that the preference for an attribute with uncertainty is unambiguously negative. Our study underscores that incorporating uncertainty not only affects preferences for the specific attribute with uncertainty (i.e., duration of power outages) but also preferences for other attributes,

[12] Results of the treatment effects on preferences are robust to different model specifications; see columns (5–8) of Table 5.

primarily advanced notice about the outages. This is likely due to individuals assigning greater weight to avoiding deterioration over seeking improvement in the attribute with uncertainty, relative to the status quo. As a result, they tend to favor precautionary measures, such as receiving a 24-h prior notification. This aligns with the findings of Torres et al. (2017) that people adopt a precautionary strategy to mitigate adverse impacts, which resonates with the concerns expressed by business enterprises during focus group discussions regarding the duration of outages as their main concern.

The results reported in Table 5 do not have a straightforward interpretation; instead, we estimate marginal WTP to reflect the marginal rate of substitution between the increment in the cost of electricity and the other attributes of power outages. However, with randomly specified coefficients, computing WTP as the ratio of two random parameters is problematic. The normal distribution of a cost coefficient does not guarantee that population moments of the resulting distribution are defined (Daly et al. 2012). The lognormal distribution of the cost coefficient produces a large tail resulting in unreasonable very small WTP estimates. Considering this, we directly estimate WTP distribution ('Models in WTP space') instead of estimating it by taking the ratio of two estimated parameters (see, e.g., Scarpa et al. 2008; Train and Weeks 2005). This direct estimation approach is appealing in terms of WTP interpretability and plausibility and the estimated WTP can be directly compared across the standard and the other two treatment groups (Aanesen et al. 2023; Rose and Masiero 2010).

Table 6 reports the marginal WTP estimates for the non-cost attributes in Tanzanian shillings (TZS), with 1 USD ≈ 2300 TZS at the time of the survey, for the pooled sample from models in WTP space. All coefficients are specified to be random, with a lognormal distribution for the cost coefficient and normal distributions for the non-cost coefficients. The negative and strongly significant mean WTP coefficient on the frequency of power outages shows that, on average, business enterprises in Tanzania are WTP approximately 32.72 TZS per kWh (US$ 0.01/kWh) for an additional reduction in the frequency of power outages per month. Similarly, the negative and statistically significant coefficient on the duration of an outage shows that business enterprises are WTP about 14.39 TZS (US$ 0.01/kWh) for a one-hour reduction in the duration of power outages, on average. Respondents are also WTP 54.28 TZS/kWh (US$ 0.02/kWh) more for a 24-h prior notification of power outages relative to no advanced notification. The positive and significant coefficient on the ASC, which is equal to one for the proposed alternatives and zero for the status quo, indicates that survey respondents are, on average, WTP 577.38 TZS/kWh (US$ 0.25/kWh) for an improved quality of electricity supply. The estimated standard deviations of all the coefficients except duration are statistically significant, indicating the presence of individual heterogeneity among the respondents. The estimated results are in line with that of the models in preference space in columns (1–2) of Table 5.

The marginal WTP estimates for the different attributes of an improved electricity supply show that business enterprises in Tanzania are WTP from 4% (for a reduction in duration) to 15.5% more (for a prior notification), on top of the existing highest tariff rate of 350 TZS/kWh (US$ 0.15/kWh). Depending on the tariff categories, business enterprises in Tanzania face an electricity tariff that ranges from 152 TZS/kWh (US$ 0.07) to 350 TZS/kWh (US$ 0.15/kWh). About 50% of the business enterprises that participated in our study reported they face a tariff rate of 350 TZS/kWh, with about 40% stating they do not know their tariff rates per kWh.

Next, in the second stage of our econometric approaches, we estimate the effects of survey consequentiality and outcome uncertainty treatments, by running an OLS regression

Table 6 Marginal WTP (in TZS) for full (pooled) sample from models in WTP space

Variables	(1) Mean coeff.	(2) St. dev.
Frequency	– 32.72***	16.68***
	(3.43)	(5.93)
Duration	– 14.39***	0.75
	(3.02)	(5.40)
24 h prior notification	54.28***	58.30***
	(5.81)	(6.13)
ASC (1 if chose proposed alternatives, 0 if status quo)	577.38***	1,203.98***
	(103.32)	(176.65)
Loglikelihood	– 3048	
AIC	6115	
BIC	6192	
No. of observations	15,060	
No. of respondents	1004	

Table 6 shows the mean and standard deviations of WTP estimates for the pooled sample from models in WTP space, with lognormal distribution for cost coefficient and normal distribution for non-cost coefficients. The number of observations (15,060) equals the number of respondents (1,004) multiplied by the five choice sets per respondent and three alternatives within a choice set. Standard errors are in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

of the individual WTP estimates from the first stage on dummies for treatment groups, and on additional control variables on respondent and business enterprise characteristics. We alternatively use marginal WTP and total marginal WTP estimates, as our dependent variables. Table 7 presents the average marginal WTP estimates, which reflect the marginal rate of substitution between increments in the cost of electricity and the other attributes, across treatment groups, corresponding to the specification in Eq. (5). The constant coefficients in the specifications without additional control variables are the marginal WTP estimates of the non-cost attributes for the standard treatment, which are all significant at the 1% level.

The results in Table 7 show slight yet statistically significant differences between the standard and the other two treatment groups only for two attributes: prior notification and frequency of outages. Compared to no advanced notification about outages, the WTP for prior notification of outages in the survey consequentiality treatment group is 7.00 TZS/kWh lower than that of the standard treatment group (54.77 TZS/kWh (US$ 0.02/kWh)), while in the outcome uncertainty treatment group, it is 5.41 TZS/kWh higher than that of the standard treatment group. The WTP for additional reduction in the frequency of monthly outages in the outcome uncertainty treatment group is 0.66 TZS/kWh higher than the standard treatment group (32.97 TZS/kWh or US$ 0.01/kWh). The lack of significant differences in marginal WTP estimates for attributes with strong preferences, including the attribute with uncertainty (duration of outages) and ASC, is due to two opposing effects on marginal WTP estimates. While the greater sensitivity to electricity cost increments leads to a reduction in the WTP estimates, the stronger preferences for non-cost attributes result in higher WTP estimates (in absolute values). Even after including additional controls on respondent and business enterprise characteristics, the differences in WTP estimates across the treatment groups remain consistent (See columns 5–8 in Table 7). Besides, applying post-double selection LASSO approach (Belloni et al. 2014), which addresses concerns regarding potentially correlated variables with the treatments and WTP, confirms the robustness of the results (See Table A.2 in the Appendix).

We further examine the effects of the treatments on the overall welfare estimates. The marginal WTP estimates reported in Tables 6 and 7 do not provide the total marginal WTP estimates for an improved electricity supply. To estimate respondents' total WTP for a proposed alternative, we construct three improvement scenarios, ranked from better to best in terms of the attribute levels of power outages, compared to the status quo (see Table 8). In the current (status quo) scenario, electricity supply interruption is characterized by an outage frequency of four times per month with an average duration of two and a half hours and no prior notification. The total marginal WTP for each respondent is computed as the difference between the existing scenario (*status quo*) and the proposed improvement in electricity supply. In estimating the total WTP for a proposed improved electricity supply, we have incorporated the ASC estimates, which capture unobserved factors affecting respondents' preferences for improved electricity supply.

Table 9 shows the results of treatment effects using total marginal WTP estimates (in TZS) for the three constructed scenarios of improvement in electricity supply, with and without additional control variables. For the first improvement scenario, characterized by three power interruptions per month, lasting an average of one and a half hours each, and 24-h prior notification, respondents in the standard treatment group are WTP, on average, about 677 TZS/kWh (US$ 0.29/kWh) for the improved electricity supply compared to the status quo. In scenario two, the total WTP estimate in the standard treatment group increases to 724 TZS/kWh (US$ 0.31/kWh), and in scenario three, it rises further to 757 TZS/kWh (US$ 0.33/kWh). The total marginal WTP estimates should not be considered as small in magnitude, given that they are expressed in the price of electricity per kWh, not in the monthly electricity bill (which averages 312,714 TZS or US$ 136 in our study). Although the survey consequentiality treatment tends to yield lower total marginal WTP estimates and the outcome uncertainty treatment higher estimates, compared to the standard treatment, the differences in total marginal WTP estimates across the treatment groups are not statistically significant, even after accounting for respondent and business enterprise characteristics. This highlights that incorporating outcome uncertainty and an additional survey script to strengthen consequentiality in stated preference studies does not affect the overall welfare estimate.

Finally, we examine the effects of the follow-up Likert scale measure of policy consequentiality on (total) marginal WTP estimates, using random assignment to the survey consequentiality as an instrumental variable for the Likert scale measure. To do so, we restrict our analysis to respondents randomly assigned to the standard and survey consequentiality treatment groups. Table 10 reports the results of instrumental variable models, implemented using Two-Stage Least Squares. The first stage instrumental variable model results are provided in Table A.3 in the appendix, in which the dependent variable is the Likert scale measure that ranges from 1 ('definitely disagree') to 5 ('definitely agree'), with 3 standing for 'do not know/hard to say'. The significant positive coefficient of the random assignment of survey participants to the consequentiality treatment group, both without and with additional controls of respondents' characteristics, demonstrates the validity of the instrument. That is, the additional survey script (formal letter from the electric utility) strengthens perceived consequentiality. However, the results of the instrumental variable models in Table 10 show that all the estimated coefficients are not statistically significant,

Table 7 OLS results of the effects of survey consequentiality and outcome uncertainty treatments on marginal WTP estimates

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variables: Marginal WTP estimates of each non-cost attribute from models in WTP space							
	Without additional control variables:				With additional control variables:			
	Frequency	Duration	Prior notification	ASC	Frequency	Duration	Prior notification	ASC
Reference: standard treatment								
1 if survey consequentiality	−0.29	−0.00	−7.00***	4.57	−0.40	0.00	−7.29***	46.83
	(0.35)	(0.01)	(2.42)	(72.65)	(0.36)	(0.01)	(2.49)	(73.41)
1 if outcome uncertainty	0.66*	0.00	5.41**	15.93	0.62*	0.01	5.36**	10.25
	(0.35)	(0.01)	(2.57)	(70.75)	(0.35)	(0.01)	(2.61)	(71.96)
Control variables	No	No	No	No	Yes	Yes	Yes	Yes
Constant	−32.97***	−14.40***	54.77***	574.39***	−31.88***	−14.42***	48.34***	797.40***
	(0.23)	(0.01)	(1.63)	(46.69)	(1.10)	(0.03)	(7.96)	(235.34)
No. of respondents	1004	1004	1004	1004	1004	1004	1004	1004
R-squared	0.01	0.00	0.02	0.00	0.05	0.01	0.03	0.03

Table 7 reports the effects of survey consequentiality and outcome uncertainty treatments on marginal WTP estimates using OLS estimation. The additional control variables included are dummies for the enterprise's main activities, location, ownership type, backup generator, age of the enterprise, typical monthly electricity bill, knowledge of the tariff rate per kWh, and respondents' characteristics such as managerial position, gender, age, marital status, and education. Robust standard errors clustered at the respondent level are in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

Table 8 Proposed three scenarios for improvement of electricity supply

Attributes of power outages	Existing situation	Proposed scenario of improvement in electricity supply:		
		Scenario 1	Scenario 2	Scenario 3
Frequency	Four times	Three times	Two times	One time
Duration	Two and a half hour	One and a half hour	Half hour	Half an hour
24-h prior notification	No	Yes	Yes	Yes

Table 9 OLS results of the effects of survey consequentiality and outcome uncertainty treatments on total marginal WTP estimates

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variables: Total marginal WTP estimates					
	Without additional control variables:			With additional control variables:		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Reference: standard treatment						
1 if survey consequentiality	−2.14	−1.85	−1.56	39.93	40.33	40.73
	(72.67)	(72.72)	(72.78)	(73.43)	(73.48)	(73.53)
1 if outcome uncertainty	20.68	20.01	19.35	14.98	14.36	13.74
	(71.06)	(71.07)	(71.08)	(72.29)	(72.30)	(72.32)
Control variables	No	No	No	Yes	Yes	Yes
Constant	676.53***	723.89***	756.86***	892.04***	938.34***	970.23***
	(46.80)	(46.82)	(46.85)	(235.39)	(235.45)	(235.51)
R-squared	0.00	0.00	0.00	0.03	0.03	0.03
No. of respondents	1004	1004	1004	1004	1004	1004

Table 9 reports the effects of survey consequentiality and outcome uncertainty treatments on total marginal WTP estimates using OLS estimation. The additional control variables included are dummies for the enterprise's main activities, location, ownership type, backup generator, age of the enterprise, typical monthly electricity bill, knowledge of the tariff rate per kWh, and respondents' characteristics such as managerial position, gender, age, marital status, and education. Robust standard errors clustered at the respondent level are in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

indicating no effect of perceived consequentiality, as measured by the Likert scale measure of policy consequentiality.[13] This provides further evidence supporting the notion of limited effects of the additional survey script to strengthen consequentiality on preferences for attributes of power outage across the treatment groups. It is also in line with the study by Lloyd-Smith et al. (2019), who address the potential endogeneity of consequentiality perceptions but do not find a significant impact of them on voting.

[13] The results remain insignificant with total marginal WTP estimates as well. For the sake of saving space, we reported only the effects on marginal WTP estimates.

Table 10 Effects of Likert scale measure of policy consequentiality on marginal WTP estimates using an instrumental variable approach

Variables	(1) Frequency	(2) Duration	(3) Prior notification	(4) ASC
Panel A: without additional controls:				
Likert scale measure of policy consequentiality (1–5)	– 1.85	– 0.00	– 44.76	29.24
	(2.43)	(0.07)	(29.15)	(463.39)
Constant	– 26.23***	– 14.39***	218.17**	467.66
	(9.04)	(0.26)	(108.45)	(1,721.77)
Sample respondents	704	704	704	704
Panel B: with additional controls:				
Likert scale measure of policy consequentiality (1–5)	– 1.94	0.00	– 45.88	64.00
	(2.48)	(0.07)	(29.97)	(471.54)
Controls	Yes	Yes	Yes	Yes
Constant	– 24.93***	– 14.38***	228.86**	250.65
	(9.57)	(0.26)	(114.38)	(1,819.25)
Sample respondents	704	704	704	704

Table 10 reports the results of the instrumental variable models on the effects of the Likert scale measure of policy consequentiality on marginal WTP estimates. The analysis is based on respondents assigned to the standard and survey consequentiality treatment groups. The additional control variables included are respondents' characteristics such as managerial position, gender, age, marital status, and education. Robust standard errors clustered at the respondent level are in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

4 Conclusion

In this paper, we use split sample treatments to investigate the effects of outcome uncertainty and survey consequentiality on a discrete choice experiment. The study focuses on improving electricity supply for business enterprises in Tanzania, with proposed improvements characterized by fewer power outages, shorter durations, advanced outage notifications, and associated cost increments. To analyze the treatment effects, we designed three different survey versions and randomly assigned respondents to one of the three treatment groups: standard, survey consequentiality, and outcome uncertainty. Each treatment group receives different information regarding survey consequentiality and outcome uncertainty.

In the outcome uncertainty treatment group, we introduce probabilities to levels of a single attribute (duration of power outages in hours) and describe the proposed changes as improvement as well as deterioration relative to the status quo, with the expected values equal to a certain improvement in the standard treatment. In the survey consequentiality treatment group, respondents received a script (a formal letter from a state-owned electric utility) stating that their survey results will be used to improve future quality of electricity supply in Tanzania, in addition to the improvement scenario and choice sets in the standard treatment group. Furthermore, respondents in all three treatment groups were asked the common follow-up Likert scale question on policy and payment consequentiality, which provides us an opportunity to shed more light on the relationship between the Likert scale measure of policy consequentiality and WTP estimates, using random assignment to the survey consequentiality treatment group as an instrumental variable. In the standard treatment group, respondents were presented with a standard improvement scenario and choice sets, with no information about the survey consequentiality and outcome uncertainty. The remaining parts of the survey are consistent across the three treatment groups.

Our results from the models in WTP space for the pooled sample (1,004 micro and small enterprises) show that, on average, business enterprises in Tanzania are WTP approximately 33 TZS/kWh (US$ 0.01/kWh) for an additional reduction in outage frequency per month. They are also WTP about 14 TZS/kWh (US$ 0.01/kWh) for an hour reduction in the duration of power outages, and 54 TZS/kWh (US$ 0.02/kWh) more for a 24-h prior notification of power outages relative to no advanced notification. These estimates represent an increment in the cost of electricity per kWh from 4 to 16%, on top of the existing highest tariff rate of 350 TZS/kWh (US$0.15/kWh). This highlights business enterprises' strong preferences for improved electricity supply reliability, urging policymakers and utilities to address power outages and consider possible adjustments to tariff rates.

Regarding the treatment effects, our results reveal that incorporating uncertainty not only affects preferences for the attribute associated with uncertainty, namely the duration of a power outage–a primary concern for business enterprises–but also influences preferences for an attribute featuring a precautionary element (advanced notice about power outages). The introduction of an additional survey script, in the form of a formal letter from the state-owned electric utility to strengthen consequentiality, marginally improves the perceived consequentiality and has a limited effect. Although the outcome uncertainty and the additional survey script (formal letter from the state-owned electric utility) to strengthen consequentiality have slight yet significant effects on marginal WTP estimates and preferences for certain attributes of power outages, we do not find significant statistical implications on overall welfare estimates.

Appendix A. Tables

See Tables A.1, A.2 and A.3

Table A.1 Model results for the full sample with different specifications

Variables	(1)	(2)	(3)	(4)
	Conditional logit	Mixed logit model with normal distribution for non-cost coefficients whereas cost coefficient is:		
	All fixed	Fixed	Normal	Lognormal
Cost	− 0.01***	− 0.02***	− 0.03***	
	(0.00)	(0.00)	(0.01)	
ln (Cost)				− 4.77***
				(0.23)
Frequency	− 0.34***	− 0.56***	− 0.54***	− 0.71***
	(0.02)	(0.04)	(0.06)	(0.06)
Duration	− 0.21***	− 0.24***	− 0.29***	− 0.27***
	(0.03)	(0.04)	(0.06)	(0.05)
24 h prior notification	0.74***	0.92***	1.58***	1.23***
	(0.04)	(0.06)	(0.14)	(0.09)
ASC (1 if proposed alternatives)	− 0.85***	9.80***	12.00***	28.40***
	(0.11)	(1.51)	(2.58)	(7.69)
Standard deviations of the random coefficients:				
Cost			0.08***	
			(0.01)	
ln (Cost)				8.50***
				(0.44)
Frequency		0.28**	0.51***	0.47***
		(0.11)	(0.12)	(0.09)
Duration		0.01	0.28	0.05
		(0.02)	(0.19)	(0.09)
24 h prior notification		0.99***	1.40***	1.15***
		(0.08)	(0.17)	(0.10)
ASC (1 if proposed alternatives)		20.42***	23.00***	15.97***
		(2.35)	(3.91)	(3.58)
Loglikelihood	− 5099	− 3048	− 2895	− 2825
AIC	10,208	6113	5809	5670
BIC	10,246	6182	5886	5746
Observations	15,060	15,060	15,060	15,060
No. of respondents	1004	1004	1004	1004

Table A.1 reports the results of the discrete choice experiment with different model specifications. The number of observations (15,060) equals the number of respondents (1,004) multiplied by the five choice sets per respondent and three alternatives within a choice set. Robust standard errors clustered at the respondent level are in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table A.2 Difference in Marginal WTP estimates across treatments using post-double selection LASSO approach

Variables	(1) Frequency	(2) Duration	(3) Prior notification	(4) ASC
Reference: standard treatment				
1 if survey consequentiality	−0.22	0.00	−7.40***	27.33
	(0.36)	(0.01)	(2.49)	(73.51)
1 if outcome uncertainty	0.68*	0.01	5.29**	13.35
	(0.35)	(0.01)	(2.61)	(71.77)
Sample respondents	1004	1004	1004	1004

Table A.2 reports the difference in marginal WTP estimates across the three treatments using the post-double selection LASSO approach, which addresses concerns regarding variables that are potentially correlated with the treatments and outcomes. The dependent variables are marginal WTP estimates for non-cost attributes of power outages. Robust standard errors are in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

Table A.3 First stage results of the instrumental variable approach

Variables	(1)	(2)
	Dep. variable: Likert scale measure	
1 if survey consequentiality treatment	0.16*	0.15*
	(0.09)	(0.09)
Respondent's characteristics:		
1 if owner		0.00
		(0.10)
1 if male		−0.15
		(0.13)
Age in years		−0.00
		(0.01)
1 if married		0.13
		(0.13)
Years of education		0.00
		(0.01)
Constant	3.65***	3.74***
	(0.06)	(0.26)
Sample respondents	704	704

Table A.3 reports the results of the first stage instrumental variable models using random assignment to the consequentiality treatment as an instrumental variable for the Likert scale measure of policy consequentiality. The analysis is based on respondents randomly assigned to the standard and survey consequentiality treatments. The dependent variable, which is the Likert scale measure, ranges from 1 ('definitely disagree') to 5 ('definitely agree'), with 3 standing for 'do not know/hard to say'

Appendix B. Scenario Description

Appendix B.1. Scenario Description for the Survey Consequentiality Treatment (Translated from Swahili)

Now we will ask you for information about the value that your enterprise places on improved electricity service.

This study is being conducted in collaboration with TANESCO.

Enumerator: Please show the formal letter from TANESCO regarding the study on the quality of electricity supply. In case, the respondent does not read, please read the content of the letter to the respondent.

As you might know, there are electric power outages in many parts of Tanzania, including Dar es Salaam. The current outages are mainly caused due to aged and poor physical conditions of the power distribution and transmission systems, lack of regular maintenance of the systems, and limited capacity of the systems relative to power demand.

To address the outages, TANESCO is considering investments to upgrade and replace the existing power distribution and transmission systems. These investments are expected to reduce the frequency and duration of power outages observed during your enterprise's operation hours. However, such investments are costly and would result in a rise in electricity prices.

In order to obtain information on how customers think about power outages, alternatives including the current typical situations are presented to you and you will be asked to choose among the different options. The features of each option will be described by the frequency and average duration of outages (in hours) in a typical month, notification of the outages, and increase in the cost of electricity in TSZ per kWh.

Let me show you an example [**enumerator shows the example and explains it to the respondent as follows**].

Attributes	Current situation	Option A	Option B
Number of power outages in a typical month	Four times	One time	Three times
Duration of the outages in hours	Two and a half hours	Two and a half hours	One hour
Prior notification about the outages	No prior notification	24 h prior notification via radio/TV	No prior notification
Increment in cost of electricity per kWh (in TZS)	0 TZS	60 TZS	5 TZS
Your choice	☐	☐	☐

If no action is taken to improve electricity services, **in the current situation**, it is expected that, on average, your enterprise will face power outages four times per month with an average duration of two hours and 30 min each. You will not receive prior notification about the power outages and the cost of electricity will be the same as now.

If action is taken to improve electricity service, two possible options are presented. In **Option A,** the number of outages will be reduced to one time per month, but the average duration of outage remains the same as the current situation. You will receive notification about the outages 24 h in advance via radio/TV. However, the cost of electricity will be increased by 60 TZS per kWh from the current unit cost.

In **Option B,** the number of outages will be reduced to 3 times per month and the duration of each outage will be also reduced to 1 h. However, you will not receive any prior notification about the outages and the cost of electricity will be increased by 5 TZS per kWh from the current unit cost.

Which alternative do you prefer? You will be asked to make 5 such choices. Please note that the choice you make only affects the attributes identified and everything else remains as it is now. Note also that money obtained from increasing electricity prices will be only allocated to improve the quality of electricity service by TANESCO.

Experience from previous similar studies shows that some respondents state their unwillingness to pay for improved electricity service not because they do not want improvements from the current situation but for other reasons. The reasons could be a belief that respondents have the right to uninterrupted electricity supply or that the money collected would not be used for the intended purposes. When choosing from the alternatives, we kindly request you not to think this way. But you might have other reasons and we would like you to tell us the reasons for this after making each of your choices.

Note that the project of improving the quality of the electricity supply will be implemented if the majority of the customers support it. When making decisions, please consider your current situation and how valuable is an improved electricity supply for your enterprise.

Appendix B.2. TANESCO Letter on Survey Consequentiality (Translated from Swahili)

Dear survey participant,

Manufacturing enterprise,

Dar es Salaam.

RE: Electricity Supply in Manufacturing Enterprise in Dar Es Salaam, Tanzania

Kindly refer to the above heading,

TANESCO in collaboration with researchers from the University of Dar es Salaam is conducting a survey on electricity services as well as the value that micro and small-scale manufacturing enterprises place on improved electricity supply.

The researchers are now collecting information from micro and small enterprises as part of the efforts of TANESCO to improve electricity services in the country. In this research, your identity will not be released in any form that you could be identified. Based on your responses and the results from the analysis**, TANESCO will receive the final report and will consider the results of the research in its efforts to improve the electricity supply in Tanzania in the future.**

Thank you for your participation.

Regards,

TANESCO

Appendix B.3. Scenario Description for the Outcome Uncertainty Treatment (Translated from Swahili)

Now we will ask you for information about the value that your enterprise places on improved electricity service.

As you might know, there are electric power outages in many parts of Tanzania, including Dar es Salaam. The current outages are mainly caused due to aged and poor physical conditions of the power distribution and transmission systems, lack of regular maintenance of the systems, and limited capacity of the systems relative to power demand.

To address the outages, TANESCO is considering investments to upgrade and replace the existing power distribution and transmission systems. These investments are expected to reduce the frequency and duration of power outages observed during your enterprise's operation hours. However, such investments are costly and would result in a rise in electricity prices.

In order to obtain information on how customers think about power outages, alternatives including the current typical situations are presented to you and you will be asked to choose among the different options. The features of each option will be described by the frequency and average duration of outages (in hours) in a typical month, notification of the outages, and increase in the cost of electricity in TSZ per kWh.

For unforeseen reasons, the duration of the power outages could be differed from what would be expected. To capture this, we have introduced a different possible duration of outages with some probabilities.

Let me show you an example [**enumerator shows the example and explains it to the respondent as follows**].

Attributes	Current Situation	Option A	Option B
Number of power outages in a typical month	4	1	3
Duration of the power outages in hours	2.5	*20% chance, six and half hours*	*20% chance, three hours*
		80% chance, one and half hour	*80% chance, half-hour*
Prior notification about the outages	No prior notification	24 h prior notification via radio/TV	No prior notification
Increment in cost of electricity per kWh (in TZS)	0 TZS	60 TZS	5 TZS
Your choice	☐	☐	☐

If no action is taken to improve electricity services, **in the current situation**, it is expected that on average, your enterprise will face power outages four times per month with an average duration of two hours and 30 min each. You will not receive prior notification about the power outages and the cost of electricity will be the same as now.

If action is taken to improve electricity service, two possible options are presented. In **Option A,** the number of outages will be reduced to one time per month and *the duration of outage could be six and half hours with a 20% chance or one and half-hour with an 80% chance*. You will receive notification about the outages 24 h prior notification via radio/TV. However, the cost of electricity will be increased by 60 TZS per kWh from the current unit cost.

In **Option B,** the number of outages will be reduced to 3 times per month and *the duration of each outage could be three hours with a 20% chance or half-hour with an 80% chance*. However, you will not receive any prior notification about the outages and the cost of electricity will be increased by 5 TZS per kWh from the current unit cost.

Which alternative do you prefer? You will be asked to make 5 such choices. Please note that the choice you make only affects the attributes identified and everything else remains as it is now. Note also that money obtained from increasing electricity prices will be only allocated to improve the quality of electricity service by TANESCO.

Experience from previous similar studies shows that some respondents state their unwillingness to pay for improved electricity service not because they do not want improvements from the current situation, but for other reasons. The reasons could be a belief that respondents have the right to uninterrupted electricity supply, or the money collected would not be used for the intended purposes. When choosing from the alternatives, we kindly request you not to think this way. But you might have other reasons and we would like you to tell us the reasons following your choices.

Note that the project of improving the quality of the electricity supply will be implemented if the majority of the customers support it. When making decisions, please consider your current situation and how valuable is an improved electricity supply for your enterprise.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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