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Stated preferences with survey consequentiality and outcome uncertainty

A split sample discrete choice experiment

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

JEL Codes: 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 a 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 (see, 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, 2019). 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 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). Taking this into account, a growing literature includes 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., 2009), 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 treatments (standard, survey consequentiality, and outcome uncertainty treatments), where the information presented on survey consequentiality and outcome uncertainty is varied. In the survey consequentiality treatment, 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., 2022; Oehlmann and Meyerhoff, 2017; Lewis et al., 2016), we use the random assignment to survey consequentiality treatment 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, 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. In the standard treatment, respondents were presented with a standard improvement scenario and choice sets, without being provided any indication about the survey consequentiality and outcome uncertainty. 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 an outage in Tanzania between July 2015 and May 2019 was 2 hours and 30 minutes. 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 1,004 micro and small business enterprises in Dar es Salaam to understand 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-hour 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 treatment and outcome uncertainty treatment groups are more sensitive to the increase in the cost of electricity and exhibit a stronger preference 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 treatment and survey consequentiality treatment groups. This indicates that the consequentiality information may have a modest and limited effect, concentrating on cost increments (e.g., Aanesen et al., 2023). The relatively stronger effect of the consequentiality script on the perception of consequentiality (Likert scale measure of policy consequentiality), which does not significantly affect WTP estimates, provides further evidence supporting the notion of limited effects on preferences across the treatments.

Incorporating outcome uncertainty affects preferences not only for the attribute with uncertainty (e.g., duration of power outages) but also for advanced notice about outages. This effect 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-hour 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.

Two opposing effects come into play when expressing the differences in preferences across treatments in terms of 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. Our study shows slight yet significant variations in marginal WTP estimates for specific attributes of power outages across the standard and the other two treatments. However, there are no statistically significant differences in total marginal WTP estimates between these treatments. This highlights that incorporating outcome uncertainty and a consequentiality script in a stated preference study may not lead to substantial economic and statistical implications for overall welfare estimates, though it could enhance the credibility of the study.

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 study 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 have 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 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 (see, 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 covering July 2015 – May 2019, with 2 hours and 30 minutes 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).

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 hour, one hour, one and a half hours, two hours
Notification	Prior notification about the outages	No notification	No prior notification, 24 hours prior notification via radio/TV
Cost	Increment in cost of electricity per kWh (in TZS)	0	5, 15, 30, 45, 60

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

[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

duration of power outage data from the 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. Fig. 1 shows an example of a choice set for respondents in the standard treatment and survey consequentiality treatment groups.

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 systems 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 description of the scenario. 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 quasi-public good enhancement.

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 to 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.

2.2 Sampling and treatments 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 1,004 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. Fig. 2 displays the distribution of the 1,004 sample business enterprises across the Dar es Salaam region (the study area).

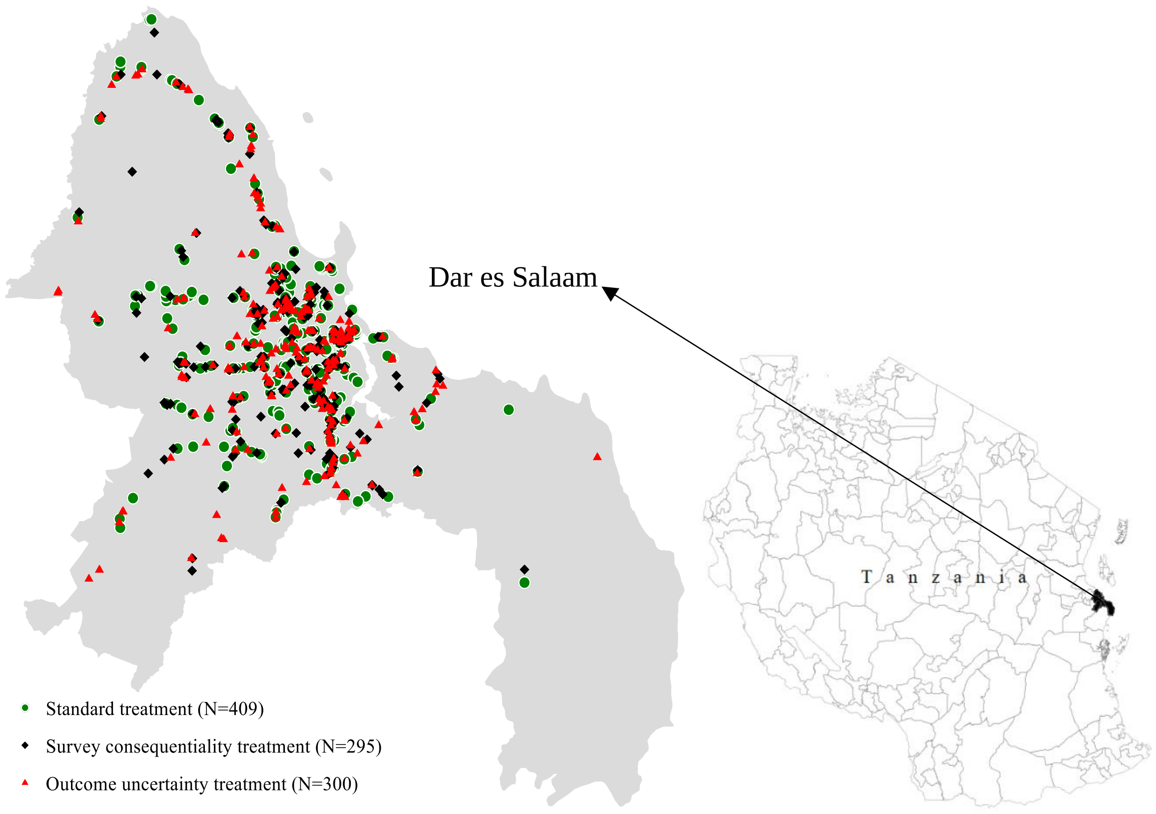

Fig. 2. Distribution of the sample business enterprises across the Dar es Salaam region (study area)

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 groups: standard, survey consequentiality, and outcome uncertainty treatments.

Standard treatment group: 409 of the total sample, 1,004 business enterprises, are assigned to this standard discrete choice experiment.[2] 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 were not provided any indication of the survey consequentiality and outcome uncertainty

[2] 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.

treatments as this group serves as a reference group 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 survey consequentiality treatment group. 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 italic at the beginning of the scenario description).

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. Field workers 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 were 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.

Outcome uncertainty treatment group: this comprises the remaining 300 sample enterprises. For survey respondents in this treatment, the descriptions 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 duration of electricity supply interruptions relative to the status 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 outage to be the same as the proposed alternatives in the standard treatment group.[3] 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 will be expected. To consider this, we have introduced a different possible duration of outages with some probabilities." However, respondents were not provided information on the causes for the uncertainty to minimize any potential confounding factors that affect both the cause of uncertainty and the respondents' valuation. Fig. 3 shows an example of a choice set for respondents in the outcome uncertainty treatment that corresponds to Fig. 1 in the standard treatment. 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).

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	20% chance of four hours 80% chance of one and a half hour	20% chance of three and a half hours 80% chance of one hour
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. 3. Sample choice set in outcome uncertainty treatment

The only difference among the three treatments 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

[3] Concern about respondents' familiarity and understanding of the probabilities of 80% and 20% is minimal, considering their engagement in business activities, managerial positions, and educational background as per the descriptive statistics.

et al., 2019). They were also asked whether they believe that the electric 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 (Mattmann et al., 2019); 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; Carlsson et al., 2020). 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., 2017; Börger et al., 2021; Blackman et al., 2022), 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 $i \in \{1, \ldots, N\}$ choosing alternative $j \in \{1, \ldots, j\}$ in a choice set $t \in \{1, \ldots, T\}$ 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 $var(\varepsilon^*_{ijt}) = \mu_i{}^2(\pi^2/6)$, 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 allows 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).[4]

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.[5]

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

where the dependent variable, WTP_i, is the marginal WTP estimates for 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 in relation to the baseline scenario. $\mathrm{Consequentiality}_i$ and $Uncertainty_i$ are dummy variables equal to one if the survey respondent belongs to the survey consequentiality treatment or outcome uncertainty treatment and zero if respondents are from the standard treatment. 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 instead of the status quo alternative). 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.[6]

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

[5] 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).

[6] 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

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 as an instrumental variable. For this, we limited our analysis to sample respondents assigned to the standard and survey consequentiality treatments and specify the effects of the Likert scale measure of policy consequentiality on WTP estimates as follows.

$$WTP_i = \pi_0 + \pi_1 Policy\_scale_i + \psi' Z_i + \epsilon_i \qquad (6)$$

In the first stage, we use OLS to estimate:

$$Policy\_scale_i = \delta_0 + \delta_1 \text{Consequentiality}_i + \phi' Z_i + \eta_i \qquad (7)$$

where the dependent variable 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.

2.4 Descriptive statistics

Table 2 provides descriptive statistics of the sample enterprises across the three treatment groups. Column 1 reports the summary statistics for the full sample. 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 (home or outside the 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. Some are partnership, 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

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double-selection LASSO approach (Belloni et al., 2014), which addresses concerns regarding variables that are potentially correlated with the treatments and outcomes.

bills are approximately 312,714 TZS (US$136), and 80,000 TZS (US$35), respectively, with prepaid being a dominant billing payment system (94%).[7] 84% reported that electricity was very important for their eneterprise'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 used electricity for several electric power-driven machinery or equipment. Even though 86% stated their enterprise had experienced power interruptions in the past 12 months, only 11% used backup facilities for electric power like a standby diesel generator. Such facilities may be too costly, as indicated by 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 2. Descriptive statistics of the sample enterprise across treatment groups

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Full sample	Standard treatment	Survey conseq.	Outcome uncertainty	Differences	
					(2)–(3)	(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)		
Districts:						
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

[7] 1US$ was approximately 2,300 TZS (Tanzanian shilling) during the survey period (September 2019).

	(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)		
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 2 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 while the values for F-test are the F-statistics. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table 2 Columns 2–6 provides the summary statistics for the enterprises in the sample across the three treatment groups for the discrete choice experiment and their differences compared to the standard treatment group. For almost all variables, the differences in observable characteristics between the standard treatment group and the other two treatment groups are not statistically significant. We only observe a weakly significant difference between those in the standard treatment 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 is jointly insignificant, suggesting the balance of the covariates across the treatment groups.

Next, we provide a summary and difference of the self-reported follow-up Likert scale questions, which are widely adopted in discrete choice experiment studies, across the three treatments. Table 3 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 treatment and the other treatments. However, the difference in the Likert scale answers to the policy consequentiality question is statistically significant at 10% level. Compared to the standard treatment group, respondents in the survey consequentiality treatment group are more likely to believe (have 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.

Table 3. Summary of the Likert scale follow-up questions across sample groups

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

Table 3 shows the mean values of the Likert scale answers to the 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.

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 hours prior notification' and ASC (alternative specific constant) are specified as dummy variables. Columns (1) – (2) of Table 4 show mixed logit model results with normal distributions for non-cost coefficients 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.[8] To account for individual heterogeneity, all the coefficients of the attributes are specified to vary across respondents, resulting in the estimated parameters containing both mean and standard deviations.

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.[9] On the other hand, the positive and strongly significant coefficient on the dummy of '24 hours prior notification' shows that respondents prefer an outage with prior notification compared to an outage without any advance notification. The mean coefficient of the ASC, which is equal to one if it's the proposed alternatives ('Option A' or 'Option B'), is positive and statistically significant. It indicates that due to factors other than the included attributes of an outage, respondents are more likely to choose the proposed alternatives over the status quo. Among others, those factors include a low voltage electricity supply damaging equipment, timing of outages (day of a week or hour of a day), and expensive fuel costs to operate a backup diesel generator, which was indicated during the focus group discussions. 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).[10]

[8] 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.

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

[10] 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. 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 hours 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	28.40***	15.97***	21.13***	31.00***	9.09***	19.11***	7.77***	16.91***
alternatives, 0 if status quo)	(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)	
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 hours 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 hours 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	
No. of respondents	1,004		1,004		1,004		1,004	

Note: Table 4 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 (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.

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 serving as a reference (in Columns 3– 4 of Table 4). 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), all coefficients including the cost coefficient are assumed to be normally distributed. In columns (7) – (8), the cost coefficient is fixed whereas the non-cost coefficients are still specified to be normally distributed.[11]

The estimated coefficients of the attributes of power outages without interaction terms are for respondents in the standard treatment. Except for duration, all coefficients are significant and consistent with the results of the pooled sample in Columns 1– 2 of Table 4. 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, only the interaction terms for cost and ASC are statistically significant, suggesting differences in preferences for these attributes between the standard and survey consequentiality treatments. The negative coefficient of the cost attribute indicates that respondents in the survey consequentiality treatment 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 other hand, the positive coefficient of ASC implies that respondents in the survey consequentiality treatment are more likely to prefer the proposed alternatives over the status quo due to factors beyond the included attributes. The lack of significant differences in preferences for frequency, duration, and prior notification attributes potentially implies that the consequentiality information might have a modest and limited effect, concentrating on cost increments (e.g., Aanesen et al., 2023).

Respondents who are assigned to the outcome uncertainty treatment exhibit higher sensitivity to increases in electricity cost and prefer the proposed alternatives over the status quo, compared to those in the standard treatment. In addition, they show stronger preferences for reducing the duration of outages and receiving prior notice about the outages, as compared to respondents in the standard treatment. The strongly significant and negative coefficient of

[11] Results of the treatment effects on preferences are robust to different model specifications; see columns (5) – (8) of Table 4.

the interaction of duration 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. Unlike those earlier studies, incorporating uncertainty not only affected preferences for the specific attribute with uncertainty (i.e., duration of power outages) but also preferences for other attributes, such as advanced notice about the outages. This effect is likely because individuals tend to assign greater weight to avoiding deterioration relative to the current situation compared to seeking improvement in the attribute with uncertainty. As a result, they tend to favor precautionary measures, such as receiving a 24-hour 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 4 do not have a straightforward interpretation; instead, we estimate marginal WTP to reflect the marginal rate of substitution between the increment in 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 large tail resulting in unreasonable very small WTP estimates. Taking this into account, 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 directly compare across standard treatment and the other two treatments (Aanesen et al., 2023; Rose and Masiero, 2010).

Table 5 reports the marginal WTP estimates for the non-cost attributes in Tanzanian shillings (TZS), with 1 USD ≈ 2,300 TZS at the time of the survey, for the pooled sample from models in WTP space. All coefficients are specified to be random, with lognormal distribution for the cost coefficient and normal distributions for the non-cost attributes. The negative and strongly significant mean WTP coefficient on the frequency of 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-hour 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 due to unobserved attributes. 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 4.

Table 5. Marginal WTP (in TZS) for full (pooled) sample from models in WTP space

Variables	(1)	(2)
	Mean Coeff.	St.dev.
Frequency	-32.72***	16.68***
	(3.43)	(5.93)
Duration	-14.39***	0.75
	(3.02)	(5.40)
24 hours prior notification	54.28***	58.30***
	(5.81)	(6.13)
ASC (1 if chose proposed	577.38***	1,203.98***
alternatives, 0 if status quo)	(103.32)	(176.65)
Loglikelihood	-3,048	
AIC	6,115	
BIC	6,192	
No. of observations	15,060	
No. of respondents	1,004	

Note: Table 5 shows 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 attributes. 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.

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 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 6 presents the average 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 in the standard treatment, which are all significant at the 1% level.

The results in Table 6 show slight yet statistically significant differences between the standard treatment and two other treatments 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 the increase in the cost of electricity lowers the WTP estimates, the stronger preferences for non-cost attributes increase the WTP estimates. 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 6). Additionally, 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).

Table 6. OLS results of the effects of survey consequentiality and outcome uncertainty 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	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004
R-squared	0.01	0.00	0.02	0.00	0.05	0.01	0.03	0.03

Note: Table 6 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.

We further examine the effects of the treatments on the overall welfare estimates. The marginal WTP estimates reported in Tables 5 and 6 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 7. 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 attributes that affect respondents' preferences for improved electricity supply.

Table 7. 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-hour prior notification	No	Yes	Yes	Yes

Table 8 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-hour 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 and 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 a consequentiality script into stated preference studies does not affect the overall welfare estimate.

Table 8. OLS results of the effects of survey consequentiality and outcome uncertainty 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	1,004	1,004	1,004	1,004	1,004	1,004

Note: Table 8 reports the effects of survey consequentiality and outcome uncertainty 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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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 treatment and survey consequentiality treatment groups. Table 9 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, both without and with additional controls of respondents' characteristics, demonstrates the validity of the instrument. That is, the survey consequentiality script strengths the perception of consequentiality. However, the results of the instrumental variable models in Table 9 show that all the estimated coefficients are not statistically significant, indicating no effects of the Likert scale measure of policy consequentiality on marginal WTP estimates.[12] This provides further evidence supporting the notion of limited effects of the consequentiality script on preferences across the treatments. 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.

Table 9. Effects of Likert scale measure of policy consequentiality on marginal WTP estimates using an instrumental variable approach

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

[12] 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.

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

Note: Table 9 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 treatments. 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 survey versions and randomly assign respondents to one of three treatment groups: standard, survey consequentiality, and outcome uncertainty. Each treatment group receives different information concerning 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 causal relationship between the Likert scale measure of policy consequentiality and WTP estimates, using random assignment to the survey consequentiality treatment 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 were 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-hour 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 demonstrate slight yet significant variations in marginal WTP estimates and preferences for certain attributes of power outages across the standard treatment and the other two treatment groups. However, there are no statistically significant differences in total WTP estimates between these treatment groups. The findings indicate that incorporating outcome uncertainty and survey consequentiality in a stated preference study may not lead to substantial economic and statistical implications for overall welfare estimates, though it could enhance the credibility of the study.

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Appendix A. Tables

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 hours 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 hours 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	-5,099	-3,048	-2,895	-2,825
AIC	10,208	6,113	5,809	5,670
BIC	10,246	6,182	5,886	5,746
Observations	15,060	15,060	15,060	15,060
No. of respondents	1,004	1,004	1,004	1,004

Note: 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)	(2)	(3)	(4)
	Frequency	Duration	Prior notification	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	1,004	1,004	1,004	1,004

Note: 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 place 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 hours 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 minutes 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 hours 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 hour. 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 place 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 will 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* *80% chance, one and half hour*	*20% chance, three hours* *80% chance, half-hour*
Prior notification about the outages	No prior notification	24 hours 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 minutes 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 hours 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.