Journal of Commodity Markets xxx (2017) 1–11

Contents lists available at ScienceDirect

Journal of Commodity Markets

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

Pricing electricity blackouts among South African households

Nomsa Phindile Nkosi, Johane Dikgang *

Public and Environmental Economics Research Centre (PEERC), School of Economics, University of Johannesburg, South Africa

ARTICLE INFO

Keywords:
Electricity
Outages
Scenario
Willingness to pay

ABSTRACT

South African households, like households in many other developing countries, are faced with regular power outages. This is a big problem, since the outages that the households experience are both frequent and long in duration. Efficient electricity infrastructure investment decisions are possible only if the welfare loss of electricity blackouts is determined. We estimate a measure for welfare analysis. We subject respondents to eight power outage scenarios. We use a random parameter panel Tobit model to account for both zero willingness to pay (WTP) and cross-sectional heterogeneity. In addition to exploring more scenarios, this study contributes as it extends basic analysis found in the literature by allowing for a proportion of the sample to have a zero WTP. A zero WTP is in many cases not unrealistic. The picture that emerges is that WTP increases with duration, which was expected. Overall, South African households place a significant value towards avoiding the interruption. The WTP values presented in this paper approximate the value of supply security. Improving reliability of supply to households requires significant and continuous investment in electricity infrastructure.

1. Introduction

At the end of 2007, South Africa began experiencing widespread blackouts, as electricity demand surpassed supply. This problem came about due to the government's failure to invest in new power plants, in the face of significant growth in the heavily energy reliant economy, and the electrification programme that was embarked on in 1994. In 2008, there were extensive blackouts, which had a negative effect on the economy and on households. Given the threat they posed to the national grid, 'load shedding' commenced. Load shedding is an emergency whereby one area is supplied with power and the other cut off to save the national power grid from total collapse.

Households are end-users of electricity, and their welfare is negatively affected by power cuts, due to increased electricity dependence over the years. South African households, like households in many other developing countries, are faced with regular power outages. This is a big problem, since the outages that the households experience are both frequent and long in duration. Despite every effort, South African households will continue to face electricity-supply challenges in the foreseeable future.

The primary objective of this study is to quantify household's willingness to pay (WTP) to avoid power cuts. In this study, the contingent valuation method (CVM) is used to elicit outage costs. Reliable power supply is increasingly important, especially as households have become more dependent on electricity. Our study contributes to the scant literature on WTP to avoid power outages in developing countries, particularly in Africa. It provides more information about households' WTP to avoid power outages in South Africa. Most importantly, this study extends work done in studies such as by Moeltner and Layton (2004); Carlsson and Martinsson (2007) by subjecting respondents to many more outage scenarios. We subject respondents to eight outage scenarios compared to two in

* Corresponding author.
E-mail addresses: phindilen@uj.ac.za (N.P. Nkosi), jdikgang@uj.ac.za (J. Dikgang).

http://dx.doi.org/10.1016/j.jcomm.2018.03.001
Received 26 October 2017; Received in revised form 3 March 2018; Accepted 17 March 2018
Available online xxxx

the latter study. Furthermore, we contribute by extending basic analysis found in the literature (see Praktiknjo, 2014; Ozbafli and Jenkins, 2015; Breit et al., 2016; Osiolo, 2017; Morrissey et al., 2018) by allowing for a proportion of the sample to have a zero WTP and accounting for cross-sectional heterogeneity. A zero WTP is in many cases not unrealistic.

Load-shedding is not a choice; it is not a strategy; it is an emergency that the policy makers want to avoid at all. Therefore, all that decision-makers can do is to minimize the costs of the implementation. The paper's purpose is to examine the different dynamics and linkages of households to their perceived loss due to power cuts. The policy makers cannot act based on that because the load-shedding schedules are based on geographical regions and not on demographics (income level for example) even though we know that these are reasons for the differentiations in impact.

Since households are also highly affected by power outages, it is probable that they will be WTP to avoid or reduce outages. Some of the outage elements households regard as important are the timing and frequency, and whether there is a warning beforehand (Hensher et al., 2013). Weather conditions also affect WTP. Households may be WTP more to avoid outages in winter than in summer. This analysis will determine the extent to which households are dependent on electricity service in different situations. The results from this study are relevant for the urban African energy context.

2. Literature review

Despite a growing number of studies in this area, studies focusing on household welfare losses due to power interactions remain limited, especially in developing countries. Kufeoglu and Lehtonen (2014) classify outages into three categories, namely 'brief'-lasts for a very short period – often a few seconds, 'sporadic' - stems from bad weather, and is longer in duration, and 'chronic' outages - caused by inadequate power generation, under-performance of old power plants or lack of infrastructure' and is relatively longer in duration. The latter type is the most common in developing countries, because of insufficient resources.

Carlsson and Martinsson (2007) study in Sweden about households' WTP per avoided outage found that people are likely to be WTP for longer outages. Moreover, there is a low WTP among respondents who do not live in big cities. WTP also has a positive relationship to income. Lim et al. (2014) found that on average, Korean households value a reliable and consistent electricity supply, and were WTP for that. However, WTP went down as the bid went up; meaning the respondents were only prepared to pay a base price, which was 10 Korean Won (KRW) per kilowatt-hour (kWh); but not the highest bid, of 60 KRW per kWh. Another study in South Korea by Kim et al. (2015) found that WTP was high for those households that consume more electricity, as well as in the high-income brackets. Respondents were WTP but were more sensitive to bid increases. It was concluded that WTP is higher for unannounced outages than it is for announced outages.

Woo et al. (2014a,b) found that more than half of the Hong Kong respondents would have traded some reliability for a lower electricity bill. On the other hand, about 23 percent of the respondents were WTP five percent more on their electricity bill to eliminate 5 min of outages; 13 percent were WTP 10 percent more for a 30-min outage reduction; while the rest did not want to pay more at all. Abdullah and Mariel (2010) WTP study using a choice experiments (CE) in Kenya, found that a warning before a power outage was a significant factor, as it allowed users to make the necessary arrangements, especially for households with home businesses. Furthermore, older people and people who had stayed in the area for a longer period were not WTP more for power reliability due to lost confidence in government policies.

Results from previous studies highlight several demographic and behavioural factors that influence WTP valuations. Households are generally WTP higher tariffs to reduce power outages, especially those that use electricity more and those that are self-employed. By contrast, when outages are frequent, some households may get used to outages, and end up not being WTP to avoid them. In addition, households from remote areas that are not usually given the same attention as big cities are not WTP to avoid power outages. This study will reveal the impact power outages have on households and their WTP for different outage scenarios. The study also sheds light on the significant determinants of WTP, which has generated vital information for policymakers.

In addition to studies mentioned above, we acknowledge that there are several studies that also account for zero WTP in their estimations of household welfare losses because of power cuts. Praktiknjo (2014) estimates power cut costs to households in Germany by using a two-staged regression approach. They firstly estimate probability of having an interruption cost using a binary model. Their second step entails using an OLS model, with WTP/willingness to accept (WTA) as a dependent variable. Ozbafli and Jenkins (2015) also run a binary model, namely, Probit model, to evaluate factors that influence household's chances of bidding a positive WTP. Thereafter, they run a spike model. In the first step of the spike model, they evaluate respondent's probability to participate in the contingent market. In the second step, they assess determinants of respondents WTP.

Our study differs from the above-mentioned studies in various ways. Our approach is novel and different in the sense that our CV questionnaire is experimental in nature, resulting in panel data. Because of this, we run a random parameter panel Tobit model to account for both zero WTP and cross-sectional heterogeneity. We use panel data, while studies referred to above use cross-sectional data. Panel data has several advantages over cross-sectional data (see Hsiao, 1985). Furthermore, we include various power outage scenarios with well defined base cases for each of the mentioned scenarios, which makes our main coefficients and significance levels interpretable. We also do robust checks, as well as assess impact of duration of power outage on WTP using panel models. Finally, we run spike models, with a Probit model used in the first stage, while the second stage involves running of the truncated regression. The latter part of our approach is like empirical approaches referred to in the literature, main difference is our spike model includes panel data models with various power outage scenarios. Our approach is not merely a two-stage regression approach.

Osiolo (2017) use a double bound, open-ended, CV approach where those who state a positive WTP are asked to state their maximum WTP. Valid zero WTP is considered. A Heckman's sample-selection technique is used to test sample selection bias, in addition to analysing the WTP function. Breit et al. (2016) assess household preferences pertaining to reductions in the frequency and duration of