

REPORT

Evaluation of the Zanzibar Interconnector Activity: Findings from the Hotel Study

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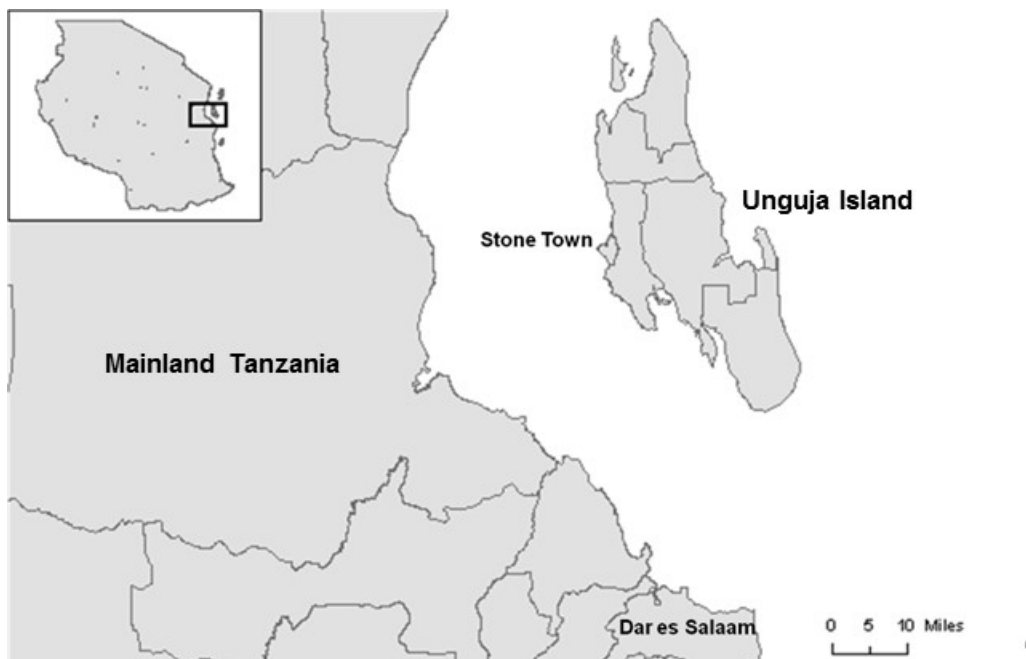
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I. INTRODUCTION

In an effort to promote economic growth and reduce poverty in Tanzania, the Millennium Challenge Corporation (MCC) funded an energy project that encompassed a number of activities, including one to increase the supply of reliable and high quality electricity service on Unguja, Zanzibar's largest island (Figure I.1). The Zanzibar archipelago has suffered two major blackouts since 2008, the most severe of which lasted three months, between December 2009 and March 2010. A key component of the MCC project activity in Zanzibar was the installation of a new submarine cable (the Zanzibar interconnector activity or "cable activity"). MCC, through the Millennium Challenge Account-Tanzania (MCA-T), funded a new 100 megawatt (MW) submarine cable to supplement an older 45 MW cable that was reaching its limits in terms of both capacity and lifespan.

Figure I.1. Zanzibar's Unguja Island



Source: ARCGIS shapefiles prepared by Tanzania National Bureau of Statistics. Available at <http://openmicrodata.wordpress.com/2010/12/16/tanzania-shapefiles-for-eas-villages-districts-and-regions/>.

Stakeholders, including MCC, MCA-T, and the Zanzibar Electricity Company (ZECO), anticipated that by improving the reliability and quality of electricity supply on Unguja Island, the cable activity would provide a range of economic benefits that would contribute to economic growth and poverty reduction in Zanzibar. MCC and MCA-T expected that a more reliable and better quality electricity supply would lead to the following outcomes: (1) increased investment and economic activity, (2) reduction of costs associated with having poor power quality and reliability, the most substantial of which is the cost of backup power, and (3) social gains in education and health (MCC 2007).

Our initial evaluation plan sought to study the relationship between the cable activity and the first two outcomes. The proposed analyses included both a pre-post case study of the cable activity on Unguja’s hotel sector—one of Zanzibar’s most important industries—and interrupted time series analyses of electricity consumption, outages, and quality using ZECO-supplied data. However, data quality issues prevented us from conducting the time-series analyses (see Hankinson et al. 2011 for details on the data quality). We did not examine the third set of hypothesized outcomes—changes in education and health outcomes—because resources spent to study these outcomes would not have produced commensurate value in learning about the impact on these outcomes. To measure these outcomes, the evaluation would have to field potentially expensive household surveys. Since the cable activity benefited all residents of the island and a credible counterfactual group cannot be identified, the evaluation could not have established the extent to which the new interconnector cable led to changes in education and health outcomes for residents of the island. We consulted with MCC about these issues, and decided that investing evaluation resources to carry household surveys would not produce valuable learning for MCC.

Our evaluation of the cable activity focuses on hotels in Zanzibar to assess how the new cable influenced outcomes for an important industry on Unguja Island. The hotel industry was chosen as a case study because it is an important segment of electricity consumers on the island and an important contributor to Zanzibar’s economy. At approximately US\$108 million in revenues in 2010, the tourism industry in Zanzibar—driven largely by hotel revenues—constituted 22 percent of GDP, was the source of about 80 percent of Zanzibar’s tax revenues, employed roughly 10,000 people directly, and was an indirect source of income for another 44,000 people (The Citizen 2010). The 30 hotels in the study employed about 1,322 Zanzibaris in 2010, approximately one-eighth of the total employment in Zanzibar’s tourism industry. The improvements in electricity supply resulting from the installation of the new cable were expected to reduce costs, increase revenues, and thereby improve economic outcomes for both the industry and the people employed in it. This case study of hotels can be seen as a proxy for how other businesses may be affected by power quality and reliability.

The hotel study involves a “pre-post” analysis that compares key outcomes collected before installation of the new cable (the pre-cable activity period) to those same outcomes after its installation (the post-cable activity period). Because the cable could potentially benefit all on the Unguja Island, a credible counterfactual for the hotel industry could not be identified, which led to the selection of a pre-post design for the hotel study. In 2010, we randomly selected 30 hotels from among the 45 largest hotels on Unguja Island, so that the findings from the hotel case study would represent the hotels that are likely to have the largest impact on the economy of Zanzibar. Mathematica, in collaboration with DHI Infrastructure (DHI) and MCC, conducted the pre-cable (2010) survey of the selected hotels. Then we surveyed these hotels again in 2014, after the installation of the new cable. The surveys provide a more detailed look at how the cable activity affected an industry that is sensitive to the reliability and quality of electricity. The study covers hotel outcomes related to energy costs, revenue, quality of electricity, number of staff, and guest satisfaction.

Hankinson et al. (2011) presented a report of the findings from the analysis of data from the pre-cable (2010) hotel survey. This pre-cable report found that reliability of electricity in Zanzibar had deteriorated in the years prior to the cable activity, and that low levels of reliability had negatively affected the hotel industry. Hotels reported substantial direct costs associated with

purchasing equipment to supplement the electricity supply and with replacing equipment damaged by poor quality electricity. The survey also found that the unreliable electricity supplies were associated with decreased revenues. The pre-cable report suggested that the cable activity could improve the reliability and quality of the electricity supply to Unguja Island, which would reduce costs and improve revenues for an important part of Zanzibar's economy, thereby advancing MCC's longer-term goals of increasing economic growth, reducing poverty, and improving the standard of living in Zanzibar.

This report presents findings from the analysis of quantitative and qualitative data from the post-cable survey. The remainder of this chapter contains an overview of the cable activity and a conceptual framework for the evaluation. Chapter II presents the research questions, data sources, and analytic methods. Chapter III describes the changes in hotel outcomes after the new cable was installed, followed in Chapter IV by hotel survey respondents' perceptions about the effects of the new cable on their hotels. We conclude with a summary of the findings in Chapter V.

A. Overview of the cable activity

MCC's compact with the Government of Tanzania entered into force in 2008. Through this compact, MCC invested about \$698 million to address infrastructural barriers to the country's economic growth and poverty reduction. The Government of Tanzania established MCA-T to manage the compact and implement project activities with MCC oversight. The compact funded projects in three sectors: roads, water, and energy. MCC invested about \$66 million on the cable activity under the \$206.5 million energy sector project. As part of the compact, ZECO agreed to a tariff increase to help improve the sustainability of the investment over time. MCA-T implemented the cable activity in cooperation with the Tanzania Electric Supply Company (TANESCO) and ZECO.

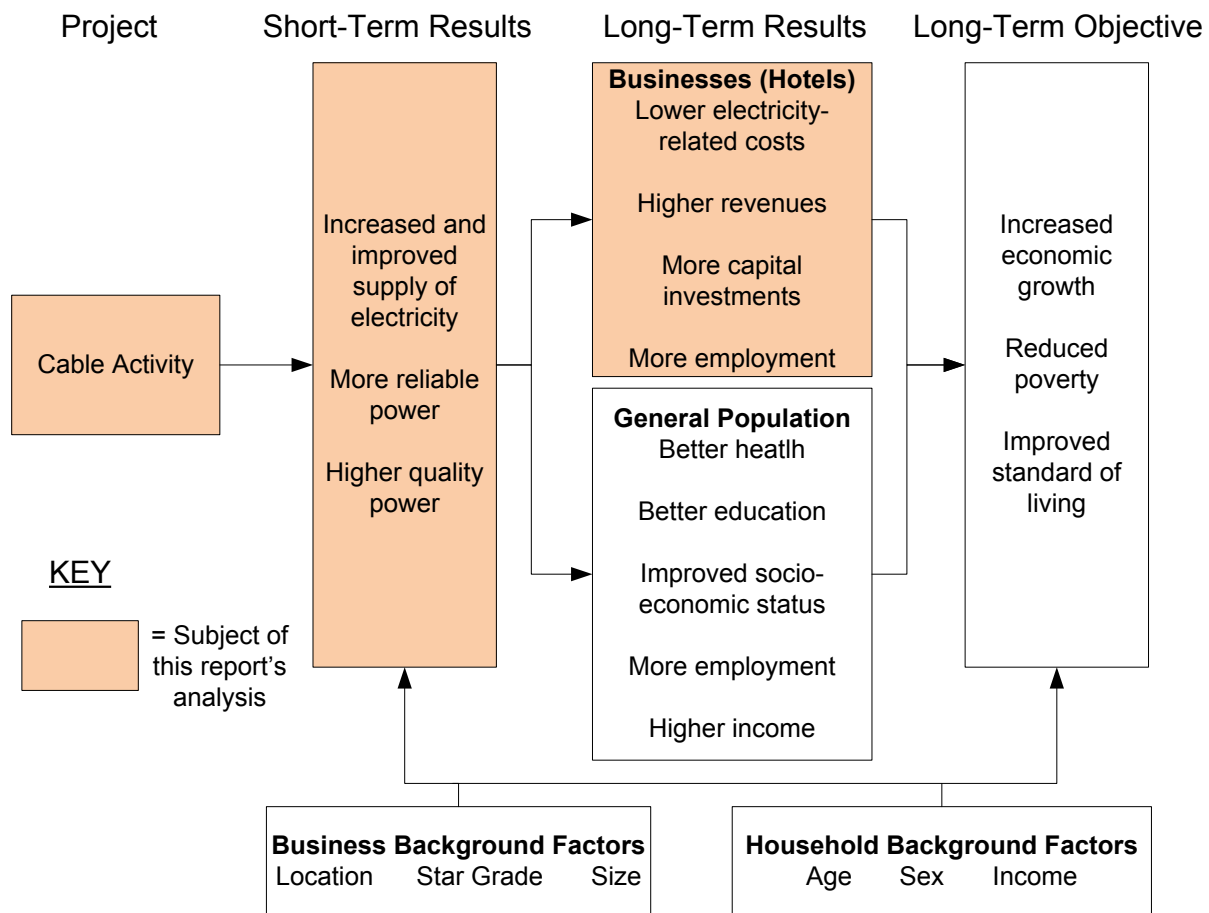
The cable activity involved the construction of a second submarine cable with 100 MW capacity as part of a new 132 kV interconnector from the Ubungo substation in Dar es Salaam, Tanzania, to the Mtoni substation on Zanzibar's Unguja Island (MCC 2013; Global Transmission Report 2012). The new submarine cable more than doubles ZECO's capacity to supply electricity and meet the current peak demand of 56 MW (MCC 2013). Key elements of the cable activity included a 39 kilometer undersea cable; 37 kilometer overhead transmission lines from Ubungo to a cable landing station adjacent to the existing Ras Kilomoni substation on the mainland, and from Ras Fumba in Zanzibar, where the submarine cable comes onshore, to Mtoni near Stone Town; and a new 120 MVA substation dedicated to the new cable at Mtoni from which electricity will be distributed throughout Unguja. The new submarine cable is a three-core 3x300mm² copper cable with a lifetime of approximately 40 years (Dineen and Silke 2012). The new cable was manufactured in Japan and installed on the seabed parallel to but at least 100 meters from the existing submarine cable. The new cable was inaugurated in April 2013.

B. Conceptual framework

The conceptual framework of the cable activity is illustrated in Figure I.2. The framework aligns with the investment rationale for the cable activity, namely that the improved reliability and quality of electricity was expected to increase investment and economic activity; and reduce

costs associated with providing backup power and replacing equipment damaged by voltage fluctuations.¹ These changes were expected to benefit individuals, households, and business alike by allowing them to use more electricity and use it more productively. For individuals and households, this was expected to lead to improvements in education and health outcomes. For businesses, better reliability and quality of electricity supply could also increase revenues, as it would enable them to improve the quality of existing services that depend on electricity, and provide additional services. Higher revenues and lower costs could increase both employment and investment in Zanzibar, which could lead to higher incomes, higher standards of living, and a consequent reduction in poverty levels.

Figure I.2. Conceptual framework for the cable evaluation



Note: “Star grade” of hotels refers to the number of stars as assigned by an international hotel grading system.

¹ It is important to note that while the cable activity may improve the potential reliability of electricity, actual reliability is affected by a number of other factors that the cable activity is not directly changing—for example, the quality of internal wiring in hotels, and the quality of the electricity generation and distribution systems .

II. RESEARCH QUESTIONS, DATA, AND ANALYTIC METHODS

This chapter describes the research questions addressed in the hotel study, how we collected the data, and our analytic approach.

A. Research questions

We designed the evaluation of the cable activity in close cooperation with MCC, MCA-T, and stakeholders in Zanzibar. The hotel study conducted under the evaluation addresses the following two research questions:

1. How did outcomes for hotels on Unguja Island change after the new submarine cable was installed compared to outcomes before cable installation?
2. What are the hotel owners and managers' perceptions of changes in hotel outcomes after the cable was installed?

We answer research question 1 using a pre-post analysis of data from repeated surveys of 30 hotels on Unguja Island. We address research question 2 using qualitative data collected from the hotel owners and managers who responded to the post-cable hotel survey.

B. Data sources

The hotels selected for the study were sampled from a list of hotels on Unguja Island. The list contained 306 hotels (based on 2008 data) and was provided by the Zanzibar Commission for Tourism. For purposes of the study, hotels were required to have (1) 10 or more rooms and (2) an international grade of at least one star. This helped us to identify the larger and higher quality hotels that might be more likely to make use of electricity. After applying those restrictions, 45 hotels remained; these were randomly sorted. The Mathematica team made initial contact with the hotels based on the order of that list. If a hotel was out of business, not connected to ZECO's electricity network, or refused to participate in the survey, it was replaced with the next hotel on the list until we obtained our target sample size of 30.

We surveyed the selected 30 hotels three times each before the cable activity began, in the months of June, July, and August 2010. The survey contained mostly quantitative questions about the reliability and quality of electricity the hotels were receiving, and their revenues and costs that might be affected by electricity. CSR Group Africa, Mathematica's data collection partner for the hotel study, resurveyed these hotels—again three times each, in July, August, and September 2014—about 15 months after the new cable was inaugurated.² Two hotels did not respond to the post-cable survey; therefore, we ended up with a total sample size of 28 hotels

² We planned to obtain data for the same months in each period, but the data collection was delayed at follow-up due to problems obtaining clearance from the local government in Zanzibar.

with data for both the pre- and post-cable periods.³ Typically, managers or finance department staff responded to the surveys.

The surveys contained questions about a variety of hotel outcomes and were designed to capture variation across months on relevant questions. The questionnaire contained quantitative and qualitative questions about the reliability and quality of electricity hotels were receiving, as well as their revenues and costs that might have been affected by electricity during the past 30 days.⁴ The survey instrument was pilot tested in May 2010 and revised to incorporate lessons learned during the pilot. The first month of both the pre-cable and post-cable surveys asked questions about hotel characteristics that were not asked in subsequent waves, such as number of rooms and staff.

C. Outcomes and analytic approach

For our analysis, we identified five domains of hotel outcomes: energy costs, revenue, quality of electricity, hotel staffing, and guest satisfaction (Table II.1). These domains and their associated outcomes map to the short- and intermediate-term results described in the conceptual framework in Chapter I. These are the outcomes for which we have data from the pre- and post-cable surveys and that we can reasonably expect to have been affected by the cable activity at the time of the post-cable survey.

Table II.1. Hotel outcomes by domain

Domain	Outcomes
Revenue	<ul style="list-style-type: none"> • Monthly revenue from lodging (adjusted for inflation)^a • Occupancy rate • Room rate • Number of rooms
Energy costs	<ul style="list-style-type: none"> • Total energy costs (adjusted for inflation) • Grid electricity cost • Generator, diesel, and other costs^b • Electrical device repair and replacement costs • Presence and number of electrical devices
Quality of electricity	<ul style="list-style-type: none"> • Number of outages • Number of voltage fluctuations
Staffing	<ul style="list-style-type: none"> • Total number of staff
Guest satisfaction	<ul style="list-style-type: none"> • Satisfaction rate^c

^a Monthly revenue from lodging is the product of the occupancy rate, room rate, and number of days in the month.

^b Other costs include kerosene, bottled gas, charcoal, firewood, solar power, batteries, candles, and flashlights.

^c The satisfaction rate is the percentage of hotels not reporting a cancellation, shortened stay, or complaint due to electricity problems.

³ The 2 hotels that did not respond were similar to the other 28 hotels in terms of the average number of staff and number of rooms; however, they had lower revenues but higher energy costs. Appendix C contains selected characteristics of the two hotels that did not participate in the post-cable activity survey.

⁴ The June 2010 survey also contained qualitative questions aimed at helping respondents describe the experiences of the hotels during the blackout that lasted from December 2009 to March 2010 on Unguja and the various coping strategies utilized. The Zanzibar baseline report (Hankinson et al. 2011) contains findings from these data.

When estimating the differences in hotel outcomes before and after the new cable, we use regression models with hotel fixed effects to account for time-invariant characteristics of the hotels. Because the pre-cable and post-cable surveys were administered during a different set of months, we have two analytic month sets: overlapping months (July and August in both years) and non-overlapping ones (June 2010 and September 2014). We specify two regression models to account for the different months in which the survey was fielded in the pre- and post-cable periods. The first regression model uses an equation of the following form that estimates the differences in hotel outcomes using hotel survey data for all months.

$$(1) \quad Y_{it} = \beta_0 + \beta_1 \text{POST}_t + \alpha_t + \delta_i + e_{it}$$

where

Y_{it} is the outcome for hotel i in month t ,

β_0 is the intercept,

POST_t is a dummy variable identifying periods after the cable is completed,

β_1 is an estimate of the pre-post difference in outcome Y_{it} ,

α_t are fixed-month effects for July and August, assumed constant across years,

δ_i are hotel fixed effects, also assumed to be constant across years, and

e_{it} is the error term.

To examine the influence of the non-overlapping months on the estimates, we use the following equation:

$$(2) \quad Y_{it} = \beta_0 + \beta_2 \text{POST}_t + \pi \text{POST}_t * \text{OTHER}_t + \alpha_t + \delta_i + e_{it}$$

where

β_2 is an estimate of the effect of the cable activity in the overlapping months (July and August),

OTHER_t is a dummy for the non-overlapping months (June 2010 and September 2014),⁵ and

π is the estimate of the effect of the cable activity in the non-overlapping months (June 2010 and September 2014).

In the main body of the report, we focus on results from the overlapping months. The differences in estimated outcomes using all months may be biased due to differences in June and September. However, the results are consistent across both models for most outcomes and we

⁵ We do not separately control for the variable “other” from the interaction term because, in combination with the July and August dummy variables, it is collinear with the intercept.

note when the estimated effects are sensitive to model specification. Appendix A contains the results from both models.

A bias could also arise in the estimated differences based on July and August data since some hotels did not respond to all items in the post-cable survey. To help ensure that the July/August data provide balanced comparisons of measures across years, we use data for hotels that responded to the relevant item at both baseline and follow-up rounds of the survey. This was done separately for each outcome so that all analyses based on overlapping months maintain this balance.

We used a price deflator to convert all outcomes measured in U.S. dollars into constant December 2014 dollars. Specifically, we used the National Consumer Price Index, available from the National Bureau of Statistics, Tanzania, to adjust the dollar amounts. Before applying the inflation adjustments, we converted all values reported in Tanzanian shillings (TZS) to U.S. dollars using an exchange rate of TZS 1,411 = US \$1 in 2010, and TZS 1,662 = US \$1 in 2014.

The first wave of the post-cable survey also contained qualitative questions designed to probe hotel staff on the effects of the cable activity on revenue, staffing, and operations. We reviewed the discussion transcripts and identified major themes that emerged across respondents. These themes centered on energy quality, increased competition in the hotel sector, the price of electricity, and views on ZECO's customer service.

III. HOTEL OUTCOMES BEFORE AND AFTER THE CABLE

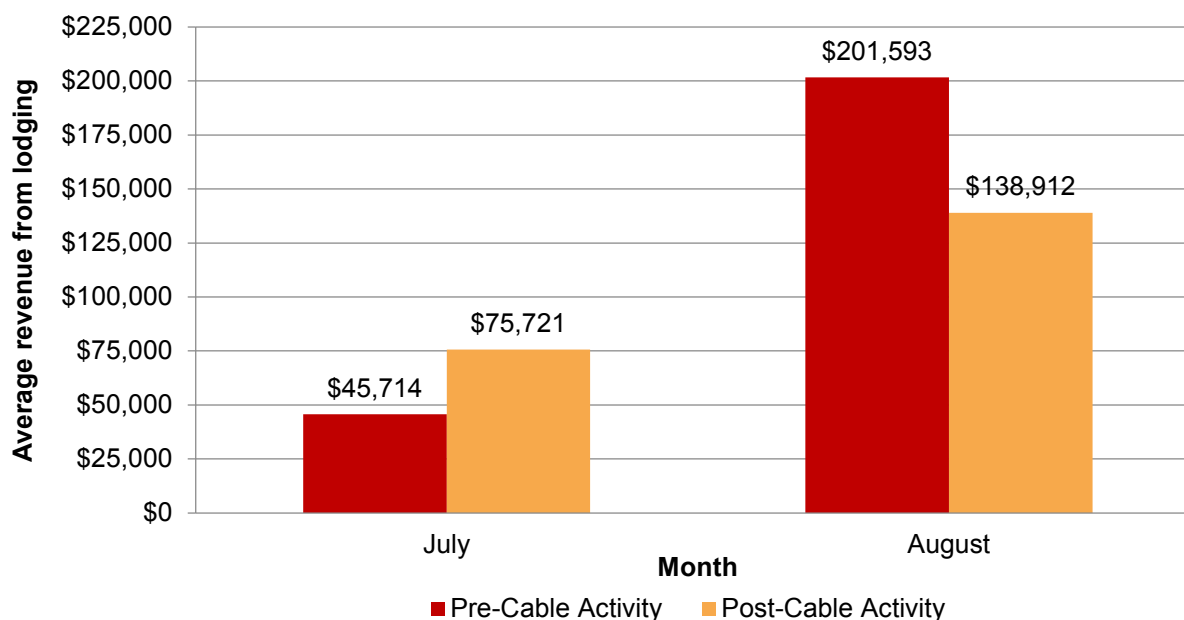
This chapter describes the differences in selected hotel outcomes between the pre- and post-cable periods. We present descriptive statistics for hotel outcomes in five domains: revenue, energy expenditure, electricity quality, staffing, and guest satisfaction. Estimates from the regression models that control for hotel and time effects supplement the descriptive statistics. Tables with the regression-adjusted differences in hotel outcomes are shown in Appendix A. Appendix B presents the full regression output for five key outcomes: monthly revenue from lodging, total energy expenditures, number of outages, number of staff, and guest satisfaction.

A. Outcomes related to hotel revenue

1. Hotel revenues did not change significantly between the pre- and post-cable period

Although revenues increased on average in the post-cable activity period, the difference is not statistically significant and varied greatly across months (Figure III.1). August 2010 was the month with the highest revenue, which reflects a high occupancy rate (57 percent) and the highest average room rate (\$143) across all months. This drove a decrease across years in the overlapping months, even after regression-adjustment. The estimated differences are not precise because of the substantial variation in the monthly revenues.

Figure III.1. Revenue from lodging before and after the cable



Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Notes: The month listed is the month during which the survey was fielded. The survey asked about occupancy and room rate in the past 30 days. A total of 17 hotels responded to questions about occupancy and room rates in July and 22 in August.

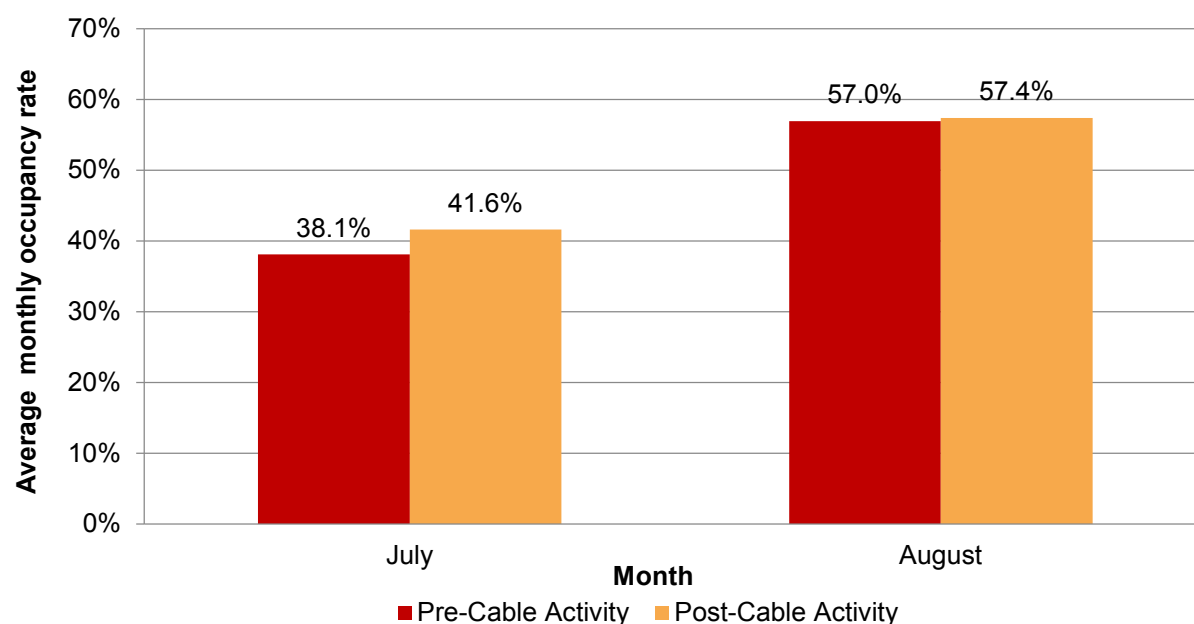
Factors beyond the installation of the new cable and electricity prices may have affected the observed changes in revenues. For example, the Zanzibar International Film Festival (ZIFF) takes place over the course of a week each summer, but the week chosen differs across years. It occurred in July 2010 and June 2014. The spike in the August 2010 revenues reported in the survey may reflect the influx of tourists for the festival in July, since the August survey numbers cover revenues in the past 30 days, which includes the time that the ZIFF took place. We would also expect to see an increase in July 2014 revenues, but a number of hotels—including higher-end ones—did not provide either room or occupancy rate information for this month. We consequently may not have fully captured the effect of the 2014 ZIFF.

The effect of Ramadan on tourism is another factor that may explain some of the variation. In 2010, Ramadan occurred between August 11 and September 9. Our August data would not have captured this period, because the survey asked about rates in the previous 30 days. In 2014, however, Ramadan occurred between June 29 and July 27—a period that would have mostly been captured in our August 2014 data. During Ramadan, most shops and restaurants close during the day; tourism may decrease during this time. If this is the case, then our August 2014 revenues may reflect a decrease in tourism that was not captured in the 2010 surveys.

2. Hotel occupancy rates did not change in the overlapping months

Occupancy rates in July and August, the two months common to both years of data collection, were similar before and after the cable activity (Figure III.2). In these months, the regression-adjusted estimate suggests a difference of 1.8 percentage points, but the difference is not statistically significant.

The results were sensitive, however, to the inclusion of the non-overlapping months. Occupancy rates were 23 percent in June 2010 compared with 54 percent in September 2014. This may, in part, be a reflection of the peak tourist season, which generally starts in mid-June and ends in October. Results from the regression model that includes data for all months suggest that occupancy rates in the post-cable period increased by 12.5 percentage points compared with the pre-cable period, and the difference is statistically significant at the 1 percent level. (See Appendix Table A.1 for detailed results.)

Figure III.2. Occupancy rates before and after the cable

Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Notes: The month listed is the month during which the survey was fielded. The survey asked about occupancy in the past 30 days. A total of 21 hotels responded to the question about occupancy rates in July and 26 in August.

3. The average room rate fluctuated monthly

The average daily rate for hotel rooms was 23 percent lower after the completion of the cable activity compared to before. The difference was due almost entirely to the August 2010 average room rate of \$143 that was about 55 percent higher than the average rate in any other month (Table III.3). This may reflect the effect of the ZIFF on room rates. Results from the regression analysis align with the descriptive findings. The regression-adjusted estimate suggests a \$28 decrease in average room rate in the overlapping months that was significant at the 1 percent level.

The results do appear sensitive to the inflation adjustment, however. We reran the full regression model without an inflation adjustment and room rates were estimated to decrease in the post-cable period but the result was not statistically significant.

Table III.1. Hotel room rates before and after the cable

	July	August	Average across months
Pre-cable average room rate	\$93	\$143	\$120
Post-cable average room rate	\$89	\$94	\$92

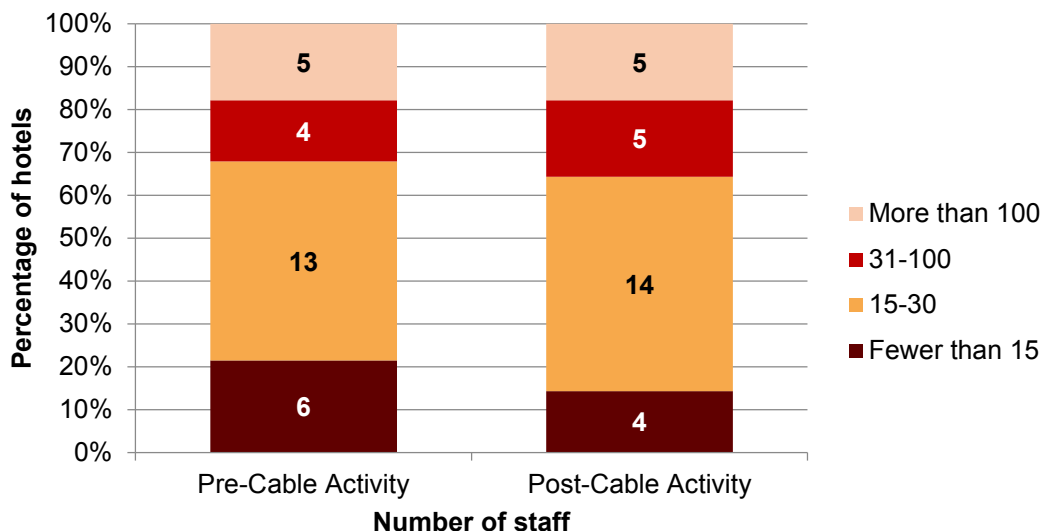
Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Notes: The month listed is the month during which the survey was fielded. The survey asked about room rates in the past 30 days. A total of 21 hotels responded to room rate questions in July and 24 in August.

4. Hotels did not add rooms after the cable was installed

The size of the hotels was similar before and after the cable activity (Figure III.3). The hotels had 51 rooms on average in both the pre and post period and there was little change in the median number of rooms. Sufficient time may not have passed to observe infrastructure improvements such as adding new rooms. However, the two hotels that were unable to participate in the follow-up survey were undergoing renovations.

Figure III.3. Distribution of surveyed hotels by number of rooms before and after the cable



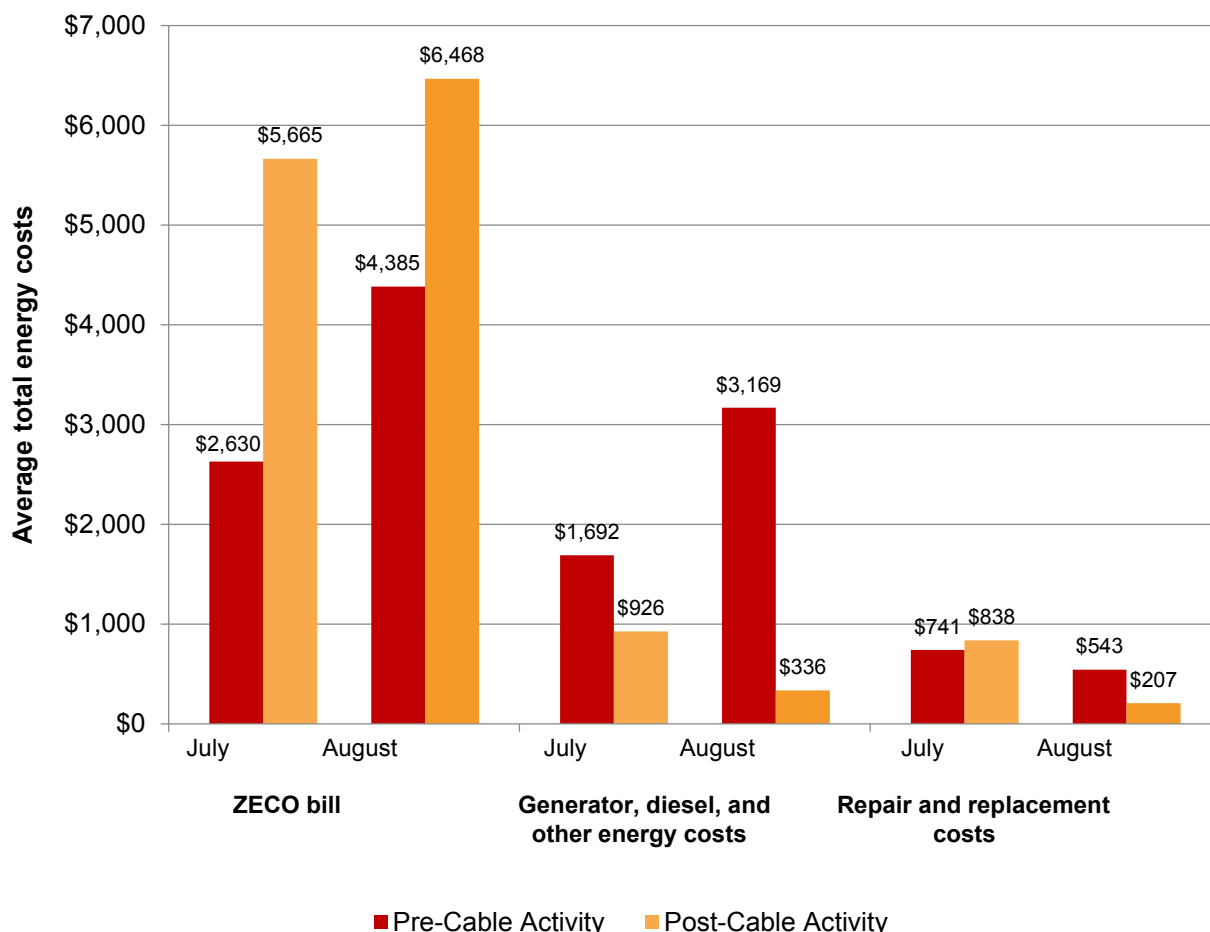
Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Note: Data on number of rooms were available from 28 hotels.

B. Hotels spent more on grid electricity, but there is no evidence of an overall reduction in energy expenditures

ZECO bills were the largest component of total energy cost and increased in the post-cable activity period (Figure III.4). We found that electricity bill paid to ZECO in the overlapping months increased by an estimated \$2,583, which is likely due to a combination of increased consumption and the increased tariffs. This was statistically significant at the 1 percent level. Non-ZECO energy costs were substantially lower during the period after the installation of the cable, although the change in the level was not statistically significant. On average, the electricity bill from ZECO was 35 percent of total energy costs before the installation of the new cable, whereas it was 90 percent in the period after the installation. Electricity-related repair and replacement costs were the smallest component of total energy costs in both the pre- and post-periods, and do not show any statistically significant change between pre- and post-cable periods.

Figure III.4. Composition of total energy costs before and after the cable activity



Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Notes: The month listed is the month during which the survey was fielded. The survey asked about energy usage in the past 30 days. There were 18 hotels with sufficient data to calculate total energy costs.

However, our regression results do not point to evidence that total energy expenses changed after the completion of the cable activity. Total energy costs increased by an estimated \$147 in the post-cable period, but we did not see a clear pattern emerge across months (Table III.2). Average total energy costs in the pre-cable activity period were lower in July than in the post period (\$3,787 compared to \$6,207) but were higher in August (\$9,219 compared to \$7,092). The higher occupancy rate in August 2010 may be a factor influencing the total energy costs in that month.⁶ Because many respondents were unwilling to share information about electricity used by the hotels, we were also unable to obtain sufficient data on the amount of electricity used before and after the cable activity to assess changes in electricity consumption.

⁶ One hotel with a 95 percent occupancy rate spent over \$183,000 on diesel for its generator in June. However, even if the non-overlapping months are included the increase is not statistically significant. See Appendix Table A.2 for detailed results.

Table III.2. Hotel energy costs before and after the cable

	July	August	Average across months
Pre-cable average energy costs	\$3,787	\$9,219	\$6,503
Post-cable average energy costs	\$6,207	\$7,092	\$6,650

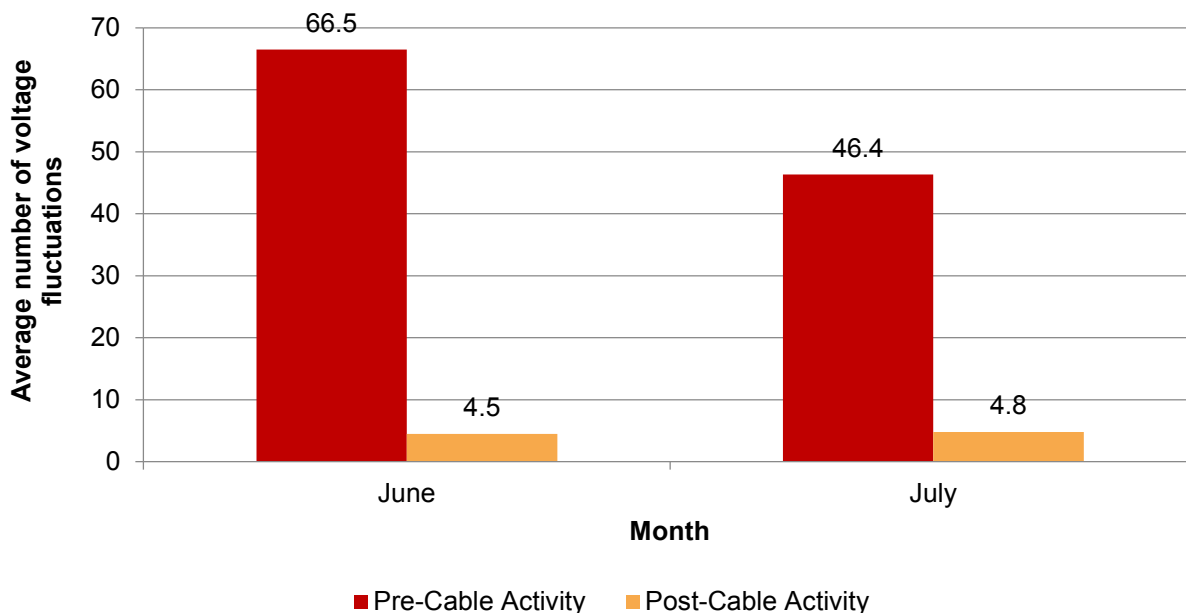
Source: Pre- and post-cable surveys of 28 hotels on Unguja Island

Notes: The month listed is the month during which the survey was fielded. The survey asked about energy usage in the past 30 days. There were 18 hotels with sufficient data to calculate total energy costs.

C. Outcomes related to quality of electricity

1. The number of voltage fluctuations and outages decreased significantly

After the installation of the new cable the number of voltage fluctuations declined noticeably, based on information provided by respondents to the hotel surveys (Table III.5). Results from the regression analysis also show large and statistically significant differences. The estimated number of fluctuations across all months was 4.7, compared to an average of almost 56.4 in the pre-cable period.

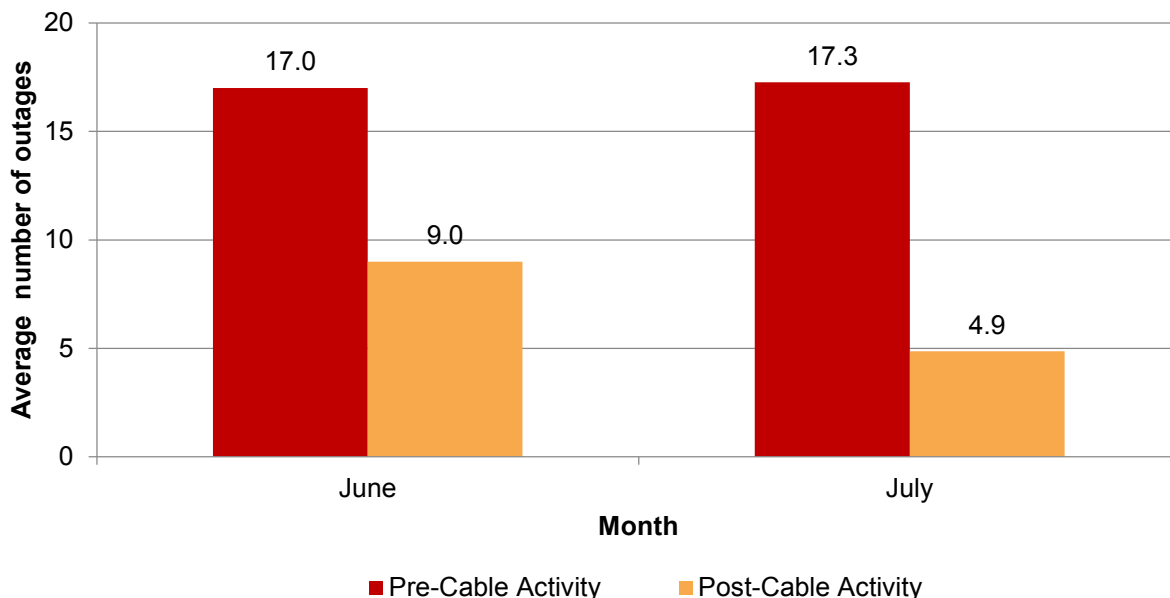
Figure III.5. Voltage fluctuations before and after the cable

Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Notes: The month listed is the month during which the survey was fielded. The survey asked about voltage fluctuations in the past 30 days. A total of 12 hotels responded to questions about voltage fluctuations in July and 11 in August round.

We also see a reduction in the number of outages in the post-cable period (Figure III.6). The results show a statistically significant decrease of 10.6 outages on average in the post-cable period from an average of 17.2 outages before the new cable was installed.⁷

Figure III.6. Changes in outages before and after the cable activity



Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Notes: The month listed is the month during which the survey was fielded. The survey asked about outages in the past 30 days. A total of 16 hotels responded to questions about outages in July and 23 in August.

2. Hotels tended to use more electric appliances after the completion of the cable activity

The percentage of rooms with selected electrical appliances typically increased after the completion of the cable activity (Table III.3). Most notably, the percentage of rooms with an air conditioner was higher in the post-cable period, but the difference is not statistically significant. The percentage of rooms with a hot water kettle increased from 46 percent to 64 percent; the increase is statistically significant at the 10 percent level.

⁷ The surveys also included questions on the duration of outages. However, we have concerns about the quality of these data in the pre-cable period. Respondents were able to answer in minutes or hours, but the reported units were not identified in the pre-cable survey data. Our analysis suggests that some respondents reported minutes and others reported hours, making it difficult to confidently estimate the duration of outages.

Table III.3. Hotel rooms with electric appliances before and after the cable

Amenities	Percentage of rooms with device	
	Pre-cable period	Post-cable period
Fan	86	86
Air conditioner	86	93
TV	46	54
Refrigerator	75	68
Hot water kettle	46	64
Hair dryer	54	54

Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Table III.4 shows a general increase in the number of electrical appliances used in hotel common areas. The regression results suggest that the number of air conditioners, refrigerators, water heaters, and pool pumps increased in the post-cable period, and the increases are statistically significant at the 5 percent level. The number of TVs also increased in the post-cable period, and the increase is significant at the 10 percent level. The decrease in the number of fans, although not statistically significant, may reflect the decision of hotels to replace fans with air conditioners.

Table III.4. Electric appliances in hotel common areas before and after the cable

Amenities	Mean number of amenities	
	Pre-cable activity	Post-cable activity
Fan	12.9	9.8
Air conditioner	8.3	15.8**
TV	1.3	3.9*
Refrigerator	6.1	9.9**
Computer	8.1	13.3
Computer accessories	5.5	5.4
Water pump	3.1	3.7
Water heater ^a	2.9	7.1**
Pool pump	2.2	3.4**
Stove/oven ^a	2.3	3.4

Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

^a Reported by 27 hotels.

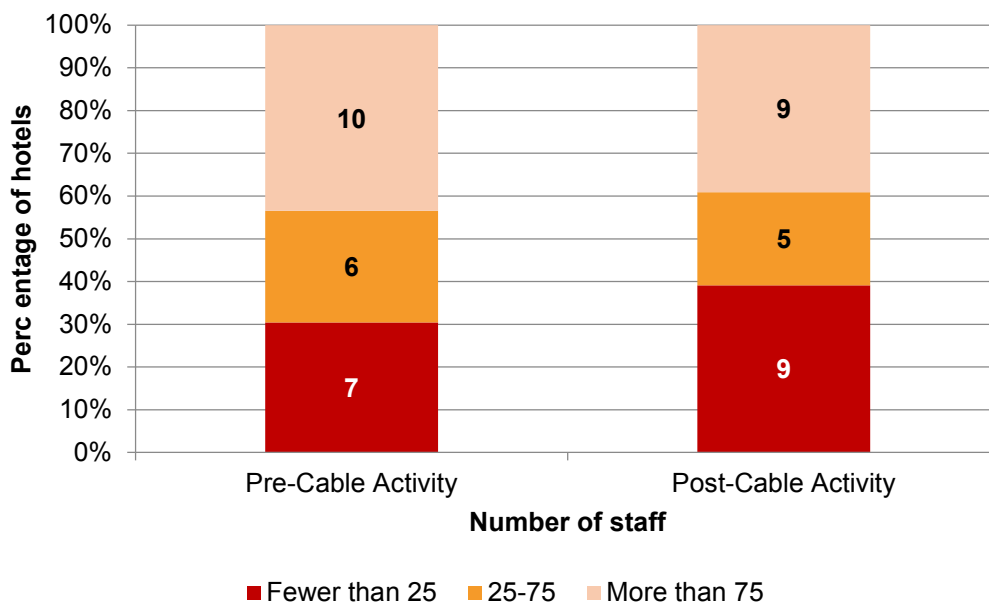
***/**/* The pre-post difference is statistically different from zero at the .10/.05/.01 level using a two-tailed t-test.

D. The cable activity did not influence hotel staffing levels

The difference in the average number of staff was small and not statistically significant, but the median number of staff decreased from 62 to 37 (Figure III.7). If the cable activity increased revenues then we might expect hotels to hire more staff, but it is possible that insufficient time

has passed to observe changes in staffing levels. The stability of the average and the decrease in the median suggest that the larger hotels raised the overall average but more hotels had lower number of staff in the post-cable period. The regression results find no statistically significant differences in the average number of staff across years.

Figure III.7. Distribution of hotels by number of employees before and after the cable

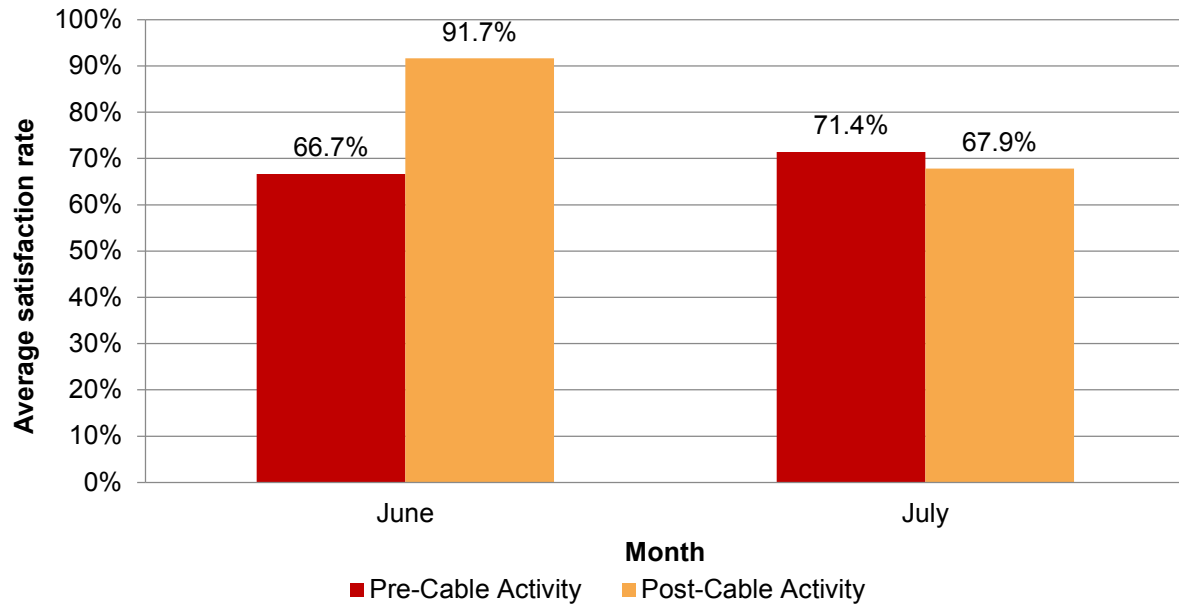


Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Notes: Data on number of staff were available from 23 hotels.

E. Changes in guest satisfaction were sensitive to the months included in the analysis

The differences in guest satisfaction were not statistically significant across the overlapping months, but significant when all months were included. Figure III.8 shows that in the pre-cable activity period guest satisfaction rates were consistent across months. The post-cable satisfaction rate was similar to the pre-cable rate in August, but much higher in July. The satisfaction rates in the non-overlapping months of June and September were 67 percent and 96 percent, respectively. As a result, there was a statistically significant increase in satisfaction when all months were included in the regression model. (See Appendix Table A.4 for detailed results.)

Figure III.8. Guest satisfaction before and after the cable

Source: Pre- and post-cable surveys of 28 hotels on Unguja Island.

Notes: The month listed is the month during which the survey was fielded. The survey asked questions related to guest satisfaction in the past 30 days. A total of 24 hotels responded to questions about guest satisfaction in July and 28 in August.

IV. RESPONDENT VIEWS ON THE EFFECTS OF THE CABLE ACTIVITY

This chapter presents findings from the analysis of qualitative data from the post-cable survey, which provide information on respondent perceptions of the quality and reliability of electricity and whether changes in electricity quality affected hotel operations and revenues.

A. Electricity was more reliable, but increases in the price of electricity offset potential savings in fuel costs

Almost all respondents reported that the electric power supply is more reliable now than before installation of the new cable. Respondents reported that blackouts were less frequent and of shorter duration and that there had been almost no outages lasting more than 24 hours. Respondents who had experienced an outage that lasted more than 24 hours were quick to note that the outage resulted from an unusual situation (for example, a large storm) and that the power was restored relatively quickly. For instance, one respondent reported "...the power cuts we experienced in the past have been drastically reduced... power is more stable now." Another respondent indicated, "They have improved the service a lot. Before, there were a lot of blackouts and now the situation is much better... This month there was one power cut only, which lasted for 12 hours and the others were only for a short time." These improvements gave respondents the sense that grid power is "more stable" than it had been previously, and that it is a reliable energy source.

However, respondents were concerned about the price of electricity even after reduced expenses from not needing to run their generators as much. Several respondents reported less frequent use of generators due to the increased stability of electrical power. This led to moderate savings in fuel costs, but the savings did not offset increases in the cost of electricity.⁸ One respondent noted, "... from 2011 when I joined the company, we used to have power failure and in most cases we used generators but since then I can say there are improvements at least. We don't have power failures like we used to have before." Another respondent indicated, "...after 2013 there have been changes on the cable; there are no power cuts, no blackouts now, and the consumption of fuel/diesel is less because there is no power cut, and the quality of power is stable now." When asked about energy prices, most respondents replied that the unit price of electricity had increased dramatically since early 2013 and they felt that current energy prices were too high. Furthermore, they reported that the savings in fuel costs were not enough to offset the increased price of electricity. According to one respondent, "...it has gone up a lot. I would say and I confidently say directly that our electricity charges in the time I have been here have doubled."

B. An increased competitive landscape affected hotel performance more than access to more-reliable electricity

Many respondents said that numerous new hotels had been built on the island, but there were mixed reports on whether tourist activities had expanded. Regarding new tourist activities, one respondent reported "...tourist activities are also on the rise because people are introducing

⁸ As noted earlier, ZECO and MCC agreed to a tariff increase to help improve ZECO's financial condition. The tariff increase became effective from June 1, 2012.

more water sports like kites and everything”; another indicated, “Tourist activities are increasing day to day.” However, several respondents indicated that no new tourist attractions had been established and a few respondents indicated that tourism had decreased due to recent incidents of violence.

Many respondents indicated that the construction of new hotels, coupled with the perceived decline in tourism, has had a more significant impact than changes to the electrical power grid. One respondent noted, “There is an increasing number of hotels... the more hotels increased, the more decreased in income... if there are twenty tourists arriving here, then people will start to fight for them.” In fact, many respondents noted that they had been renovating their hotels, changing their management structure, reducing the number of employees, and increasing staff wages.⁹ Although these changes were sometimes associated with the increased reliability of electric power, more often they were described as routine improvements or as improvements that were necessary due to changes in the competitive landscape of the hotel industry on the island.

C. Perceptions of ZECO’s customer service were mixed

Some respondents indicated that they were pleased with ZECO. When asked about the quality of service provided by ZECO, one respondent replied, “It is fine, when we do get outages we phone them; they usually are able to tell us what the problem is and they can estimate how long it could be before it is up to run anything.” Another responded, “They are very cooperative, they are very attentive when we call, they respond attend to our problems....”

However, several respondents had concerns about ZECO’s responsiveness to complaints. The following quotes capture the general sentiment of these concerns:

ZECO in the past year after changing the cable has been doing well. Of course customer care is a little though [sic] for them because even if we call, it takes them a long time to respond and to give the service, but the quality of power for this past one year has been very good....

...the new cable has enhanced the quality of power on the island, no doubt.... But more importantly, ZECO services in terms of customer relations are very poor. I will give you an example: in my private residence in this village, a transformer was broken, and it took them two months to replace that transformer.... ZECO does not properly manage any problem in the distribution system. They don’t care, that is the biggest problem.

Friday, Saturday, and Sunday they don’t respond, actually. You can forget if you have power breakage; it will get fixed on Monday.

Some respondents also voiced concerns about the billing process. These concerns seemed to center around ambiguities about the calculation of bills, and a desire for information that would allow them to check bills for accuracy. For example:

⁹ Respondents noted that wage increases were tied to legislation that regulates private sector wages.

[S]ometime the bill they are very high, sometime they are low [sic], yet we always use the same amount, or just slightly different, but there are big changes on the bill. We requested to know exactly how to calculate our usage on the meter and how it works. We asked for them to inform the reception when one of their staff comes to read and calculate our bill on the meter so that one of my staff can go and record the meter, but we have never come across any of their staff coming to the reception to inform us. Surprisingly, every end of the month we get the bill, so I don't know how they calculate the bills. I don't know, it might be guesswork.

It's very difficult because we want to have our meter inside, and it's difficult to know our usage because the meter is placed outside of our building, and we don't have a key! So basically we cannot see electricity usage, but we do have to pay the bills, they say! We can't correct what they say are our costs! I don't know because I can't check it myself, so that is among of the things that I think are not good with the service. The billing system is also another issue; they delay providing invoices so we cannot see our consumption costs. I paid for the past three months and still I don't have the invoices; I think they could improve their services.

However, ZECO staff indicated that it is standard procedure to include the meter reading on the customer bill, and for ZECO staff to check the customer bill for reading or calculation errors. Moreover, the choice to install meters on the outside of a hotel is driven by the need to facilitate access for ZECO staff should a problem arise. ZECO staff also suggested that customers are permitted to be present during meter reading.

In general, respondents seem pleased with the improvements to the quality and reliability of electricity provided by ZECO. Their concerns about the billing process and ZECO's responsiveness to issues seem related to communication issues. Respondents who were pleased with the customer service provided by ZECO indicated that they were able to reach ZECO when they had an issue and felt confident that their bills were accurately calculated. The opposite is true for respondents who were dissatisfied with the service.

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V. CONCLUSIONS

As part of the energy project in Tanzania, MCC invested in a new submarine cable connecting Zanzibar's Unguja Island to the mainland and in improving related electricity infrastructure. The new cable is estimated to have a 40-year lifespan and will greatly reduce the probability of debilitating blackouts such as the one experienced between December 2009 and March 2010. (See Hankinson et al. 2011 for details on the blackout and the hotel industry.)

Using data from pre- and post-cable hotel surveys, this report assesses how the installation of the new cable influenced outcomes for the hotel industry and what the hotel owners and managers' perceptions are in this regard. This chapter summarizes the findings from the analysis presented in this report, and discusses some implications of these findings.

A. Summary of findings

The quantitative and qualitative analyses both indicate that the cable activity had a positive influence on the quality of the electricity. The quantitative analysis shows that the cable was associated with decreases in the number of fluctuations and outages. Respondents noted in the interviews that the electricity was generally more reliable and there were fewer outages. They also noted that the outages tended to be shorter in duration.

Hotel staff indicated that the hotel's nonelectric energy use decreased. Respondents said that hotels relied less on generators because the number of outages had decreased. While not explicitly examined in this report, less reliance on generators could have long-term benefits in the form of reduced air pollutants. Also, the survey data showed a reduction in nonelectric energy expenses, but the difference was not statistically significant.

Hotels spent more on electricity in the post-cable period. However, we do not have a clear understanding of what was driving the expenditures. In the post-cable period, hotels invested in electricity-consuming appliances such as air conditioners, refrigerators, and water heaters. Unfortunately, many respondents were unwilling to share information about electricity consumption by the hotels; so we could not assess the trends in actual consumption over time. Over the same period, ZECO also raised the price of electricity, as stipulated in an agreement with MCC, to improve ZECO's financial health. During the interviews respondents acknowledged that prices have risen sharply over time. ZECO raised prices in mid-2012 (Daily News 2012), and again in 2014 after the price at which ZECO purchases electricity from TANESCO increased (Sweet Crude Reports 2014). The combination of increased appliance use and more expensive electricity likely explain the larger electric bills in the post-cable period.

There was no discernible change in average hotel revenue, which may be related to factors other than the cable activity. The variation in revenues across the pre- and post-cable period was large enough that we cannot confidently conclude that revenues differed between the two periods. Apart from seasonality in tourism, other factors such as the Zanzibar International Film Festival and Ramadan may have confounded the changes in revenues we observe between the pre- and post-cable period.

During the qualitative interviews, respondents also pointed to increased competition in the hotel sector and its negative effect on individual hotel's business and revenues. Many

respondents reported that the number of new hotels on the island has had a bigger impact on hotel operations than did changes to the electrical power grid. Although their comments reflect what each hotel may have experienced individually, increased competition potentially indicates that the hotel and tourist sectors of the economy are healthy. A future research question could be to what extent the increase in hotel construction is related to the cable activity. Some respondents indicated that hotels were decreasing their workforce, which may reflect financial difficulties. There was some support for this in the quantitative data. Although we did not find statistically significant changes in the average number of staff, larger hotels seemed to have added staff whereas smaller hotels reduced the number of staff.

We found suggestive evidence of greater guest satisfaction between the pre- and post-cable period. While the data suggest a positive shift over time, the estimated improvements in guest satisfaction were sensitive to the months included in the analysis.

Small sample sizes and item nonresponse affected our ability to detect the pre-post differences in hotel outcomes with precision. Some hotels refused to answer revenue-related questions; the survey team indicated that these hotels tended to be larger ones. The 7 hotels without revenue data in July 2014 had an average of 80 rooms, whereas the remaining 21 hotels had 41 rooms on average. This nonrandom item nonresponse means that our estimates may not be fully representative of the initial full sample of 30 hotels.

B. Implications

A key reason for installing the new interconnector cable was to reduce the chances of prolonged blackouts in the future. The cable has an expected lifespan of 40 years (Dineen and Silke 2012). In addition, the old cable resulted in two long blackouts in recent years. This information suggests that the new cable has the potential to reduce blackouts. However, we could not address this issue empirically because blackouts are few and far between, and are not amenable to a rigorous impact evaluation.

The findings from the study suggests some positive changes that occurred in the hotel sector in Zanzibar since the installation of the new submarine cable, but they do not provide evidence of impacts. As discussed above, the changes include some improvements in the quality of electricity, reduction in non-electric energy use through less reliance on generators, increased investment in electric appliances, and building of new hotels. Because of the pre-post design of the analysis, we cannot definitively attribute these changes to the new cable and the estimated differences in hotel outcomes between the two periods cannot be interpreted as providing evidence of impacts of the cable activity. It is possible that some of these changes would have occurred during this time even without the new cable as the economic environment and other factors evolved.

This study could only capture short-term changes in outcomes because the follow-up hotel survey was conducted less than two years after the cable was completed. Many of the broader benefits may take substantially longer to occur. For example, the new cable increased the capacity of the local utility (ZECO). This could enable ZECO to support increases in the island's electricity demand that may not be fully realized for many years.

This evaluation of the Zanzibar cable activity has a few important lessons for future evaluations of large infrastructure projects that benefit almost all residents in a particular location. First, in the absence of a counterfactual, the case study approach of selecting a sector or industry which is a large contributor to the economy can provide useful insights into the influence of the project. In the Zanzibar hotel study, our analysis was able to identify some of the changes that occurred for the hotels in Zanzibar since the installation of the new cable.

Second, external factors related to the selected sector need to be taken into consideration during the case-study design phase. For instance, in the hotel study, substantial variation in revenues that were potentially due to Ramadan and a high-profile tourist event limited our ability to derive conclusions with confidence about the changes in hotel revenues. This difficulty may be hard to overcome so MCC should be aware that it may be challenging to estimate impacts on certain outcomes, such as revenue, in situations like this.

Third, it may make sense to consult with engineering experts on certain issues, such as the likely impact of the new cable and other cable-related activities on the probability of future blackouts. Dineen and Silke (2012) provided information on the expected lifespan of the cable and details on the proposed upgrades to the substation and distribution networks. However, it might be useful to have an assessment of the probability of future blackouts after the cable activities are complete to account for potential deviations from the initial design. While an evaluation firm, like Mathematica, could conduct such assessments, it might be more appropriate to have them done by MCC engineering staff.

Finally, the mixed-methods approach we used (by asking respondents both quantitative and qualitative questions) is feasible and provides complementary information. For example, the qualitative data enabled us to find out about the negative effects of increased tariffs and greater competition on hotel revenues—information that we would not have obtained in the quantitative section—whereas the quantitative data enabled us to describe whether or not certain outcomes changed in ways that were greater than what might be expected to occur by chance—information that we could not obtain using qualitative data.

This study provides a first cut at describing the potential benefits of the cable activity, and future research could provide useful additional information. Depending on the perceived importance of this topic, MCC may want to consider conducting follow-up studies. For example, it may be possible to have engineers assess whether or not the cable appears to be functioning as expected and/or if there is any evidence of more wear and tear than normal. Such changes could have implications for the expected future performance and lifespan of the cable. Also, a longer-term follow-up survey of the hotel industry might be better able to capture changes related to increased investments in the hotel industry and/or decreased use of generators, especially if the ones purchased before the cable was installed are not replaced when they wear out. Finally, with a more comprehensive survey of ZECO customers it may be possible to assess how fully the increased capacity of the cable is being used and what implications that increase may have for electricity use in Zanzibar.

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APPENDIX A

REGRESSION-ADJUSTED DIFFERENCES IN HOTEL OUTCOMES

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Table A.1. Regression results for revenue-related outcomes

	Pre-cable mean	Regression-adjusted post-cable mean	Difference	Standard error	p-Value
Average occupancy rate					
All months	39.3%	51.8%	12.5%***	3.8%	0.00
Overlapping months	48.5%	50.3%	1.8%	4.4%	0.68
All months minus overlapping months	-9.2%	1.5%	-10.7%***	-	0.00
Average monthly room rate					
All months	\$115	\$98	-\$17**	\$8	0.04
Overlapping months	\$120	\$91	-\$28***	\$10	0.01
All months minus overlapping months	-\$4	\$7	-\$11*	-	0.06
Number of rooms^a	50.96	50.89	-.07	5.70	0.99
Average monthly revenue					
All months	\$99,552	\$126,310	\$26,757	\$24,691	0.28
Overlapping months	\$133,646	\$111,367	-\$22,278	\$29,523	0.45
All months minus overlapping months	-\$34,093	\$14,943	\$49,036***	-	0.01

Source: Mathematica survey of 28 hotels on Unguja Island.

Notes: The table shows results from regression models with hotel fixed effects. Data in the “overlapping months” row plus data in the “all months minus overlapping months” row may not equal the “all months” row due to rounding.

^a Only the initial pre- and post-cable surveys asked about the number of rooms.

***/**/* The pre-post difference is statistically different from zero at the .10/.05/.01 level using a two-tailed t-test.

Table A.2. Regression results for energy expenditure-related outcomes

	Pre-cable mean	Regression-adjusted post-cable mean	Difference	Standard error	p-Value
Total energy-related costs					
All months	\$9,536	\$6,749	-\$2,787	\$3,318	0.40
Overlapping months	\$6,503	\$6,650	\$147	\$4,221	0.97
All months - overlapping months	\$3,033	\$100	\$2,934	-	0.26
Grid electricity cost: ZECO bill					
All months	\$3,564	\$6,435	\$2,871***	\$718	0.00
Overlapping months	\$3,463	\$6,046	\$2,583***	\$915	0.01
All months minus overlapping months	\$100	\$389	-\$288	-	0.61
Generator, diesel, and other costs					
All months	\$4,788	\$411	-\$4,376*	\$2,581	0.09
Overlapping months	\$2,461	\$619	-\$1,842	\$3,146	0.56
All months minus overlapping months	\$2,327	-\$208	\$2,534	-	0.17
Repair and replacement costs					
All months	\$599	\$379	-\$220	\$177	0.22
Overlapping months	\$642	\$522	-\$120	\$217	0.58
All months minus overlapping months	-\$43	-\$143	\$100	-	0.43

Source: Mathematica survey of 28 hotels on Unguja Island.

Note: The table shows results from regression models with hotel fixed effects. Data in the “overlapping months” row plus data in the “all months minus overlapping months” row may not equal the “all months” row due to rounding.

***/**/* The pre-post difference is statistically different from zero at the .10/.05/.01 level using a two-tailed t-test.

Table A.3. Regression results for electricity quality-related outcomes

	Pre-cable mean	Regression-adjusted post-cable mean	Difference	Standard error	p-Value
Number of voltage fluctuations					
All months	55.7	6.0	-49.6***	10.3	0.00
Overlapping months	56.9	4.7	-52.2***	14.3	0.00
All months minus overlapping months	-1.2	1.4	-2.6	-	0.79
Number of outages					
All months	20.1	3.6	-16.5***	4.3	0.00
Overlapping months	17.2	6.6	-10.6*	5.4	0.05
All months minus overlapping months	3.0	-2.9	-5.9*	-	0.08
Percentage of rooms with electric amenity					
Fan	85.7%	85.7%	-	5.1%	1.00
Air conditioner	85.7%	92.9%	7.1	5.0%	0.16
TV	46.4%	53.6%	7.1	7.1%	0.33
Refrigerator	75.0%	67.9%	-7.1	7.1%	0.33
Hot water kettle	46.4%	64.3%	17.9*	9.0%	0.06
Hair dryer	53.6%	53.6%	-	7.3%	1.00
Number of electric amenities in common area					
Fan	11.8	10.7	-1.0	1.7	0.5
Air conditioner	12.7	24.3	11.6**	4.7	0.0
TV	1.8	3.4	1.7	1.1	0.2
Refrigerator	6.1	9.9	3.8**	1.8	0.0
Computer	9.0	14.8	5.8	3.7	0.1
Computer accessories	6.6	6.4	-0.2	0.9	0.8
Water pump	3.5	3.7	0.3	0.5	0.6
Water heater	5.8	14.2	8.4**	3.4	0.0
Pool pump	3.9	5.1	1.2	0.8	0.1
Stove/oven	3.8	5.1	1.4*	0.7	0.1

Source: Mathematica survey of 28 hotels on Unguja Island.

Note: The table shows results from regression models with hotel fixed effects. Data in the “overlapping months” row plus data in the “all months minus overlapping months” row may not equal the “all months” row due to rounding.

***/**/* The pre-post difference is statistically different from zero at the .10/.05/.01 level using a two-tailed t-test.

Table A.4. Regression results for staffing

	Pre-cable mean	Regression-adjusted post-cable mean	Difference	Standard error	p-Value
Total number of staff	88.0	91.0	3.0	7.1	0.68

Source: Mathematica survey of 28 hotels on Unguja Island.

Note: Only the initial pre- and post-cable surveys asked about the number of rooms.

***/**/* The pre-post difference is statistically different from zero at the .10/.05/.01 level using a two-tailed t-test.

Table A.5. Regression results for guest satisfaction

	Pre-cable mean	Regression-adjusted post-cable mean	Difference	Standard error	p-Value
Satisfaction rate					
All months	68.4%	85.0%	16.6**	6.6%	0.01
Overlapping months	69.2%	78.8%	9.6	8.0%	0.23
All months minus overlapping months	-0.8%	6.2%	7.0	-	0.13

Sources: Mathematica survey of 28 hotels on Unguja Island.

Note: The table shows results from regression models with hotel fixed effects. Data in the “overlapping months” row plus data in the “all months minus overlapping months” row may not equal the “all months” row due to rounding. We also ran a logistic regression to test the robustness of the satisfaction rate results and found that the results are substantively similar.

***/**/* The pre-post difference is statistically different from zero at the .10/.05/.01 level using a two-tailed t-test.

APPENDIX B

FULL REGRESSION-ADJUSTED DIFFERENCES IN HOTEL OUTCOMES FOR REVENUES, EXPENDITURES, NUMBER OF OUTAGES, NUMBER OF STAFF, AND GUEST SATISFACTION

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Table B.1. Full fixed-effects regression results for selected outcomes

Variable	Total revenue	Total energy costs	Number of outages	Total staff	Satisfaction rate
Post-cable activity	26,757 (24,691)	-2,787 (3,318)	-16.51*** (4.349)	3 (7.118)	0.166** (0.0656)
July	10,854 (32,851)	-3,421 (4,154)	0.257 (6.170)	n.a. n.a.	-0.0402 (0.0834)
August	71,999** (29,884)	-5,805 (4,374)	-3.148 (5.161)	n.a. n.a.	-0.120 (0.0790)
Constant	72,243*** (24,197)	12,749*** (3,253)	21.96*** (4.169)	16 (17.44)	0.740*** (0.0672)
Hotel-month observations	124	119	126	50	156
R-squared	0.075	0.027	0.136	0.962	0.068

Source: Mathematica survey of 28 hotels on Unguja Island.

Notes: The table shows results from regression models with hotel fixed effects. Standard errors in parentheses. Number of staff was asked in the first month of both the baseline and follow-up surveys

***/**/* The pre-post difference is statistically different from zero at the .10/.05/.01 level using a two-tailed t-test.

n.a. = not applicable

Table B.2. Full fixed-effects regression results for selected outcomes with interaction term for post-cable activity and non-overlapping month

Variable	Total revenue	Total energy costs	Number of outages	Total staff	Satisfaction rate
Post-cable activity	-22,278 (29,523)	147.1 (4,221)	-10.59* (5.418)	3 (7.118)	0.0962 (0.0796)
July	83,635** (40,921)	-7,447 (5,484)	-7.333 (7.423)	n.a. n.a.	0.0722 (0.111)
August	144,469*** (38,673)	-10,030* (5,766)	-10.92 (6.693)	n.a. n.a.	-0.00730 (0.108)
Post-cable activity *non-overlapping months	140,542*** (49,982)	-7,646 (6,814)	-15.97* (8.902)	n.a. n.a.	0.212 (0.139)
Constant	25,021 (28,759)	15,387*** (4,010)	26.73*** (4.904)	16 (17.44)	0.662*** (0.0838)
Hotel-month observations	124	119	126	50	156
R-squared	0.148	0.041	0.164	0.962	0.085

Source: Mathematica survey of 28 hotels on Unguja Island.

Notes: The table shows results from regression models with hotel fixed effects. Standard errors in parentheses. Number of staff was asked in the first month of both the baseline and follow-up surveys

***/**/* The pre-post difference is statistically different from zero at the .10/.05/.01 level using a two-tailed t-test.

n.a. = not applicable

APPENDIX C

**SELECTED CHARACTERISTICS OF TWO HOTELS NOT SURVEYED
IN THE POST-CABLE PERIOD**

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Table C.1. Comparison of selected pre-cable activity characteristics of the 2 hotels that did not respond to the follow-up survey and the remaining 28 hotels

Characteristic	Nonrespondent hotels (N = 2)	Respondent hotels (N = 28)
Number of staff	87	85
Number of rooms	50	51
Revenue from lodging	\$43,564	\$99,552
Total energy costs	\$9,536	\$3,199
Number of outages	8.3	20.1
Number of fluctuations	62.7	55.7
Satisfaction rate	17%	68%

Source: Pre- and post-cable surveys of 30 hotels on Unguja Island.

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APPENDIX D

COMMENTS FROM STAKEHOLDER REVIEW AND
MATHEMATICA RESPONSES

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Table D.1. Comments from stakeholder review and Mathematica responses

Page Number	Comment	Mathematica Responses
ZECO		
General Comment	ZECO is on the opinion that the document to a greater extent, covers all important elaborations required for the energy evaluation conducted by experienced researcher (Mathematica) from Washington.	Thank you for your thoughts on the report.
General Comment	As far as ZECO's Customer services is concerned, the researcher conducted several interrogations with different stakeholders especially hotel operators having different, opinion, experience in Zanzibar power sector compared to how it was before, the researcher's conclusion may not lead to reality for some extent. Despite the fact that ZECO's Customer services have been drastically improved as claimed by some interviewers, we do agree that more effort is needed to reach satisfactory level.	We agree that the respondents do not represent views of all hotels or the general population; we did not find it necessary to change anything in the report.
Page 3 - A Overview of the cable activity	Invested amount by MCC for cable activity is \$28M [Follow up comment from TANESCO: USD 28 mil is the contract price with VISCAS. What is the issue here? Clarify]	MCC documentation indicates the total amount was \$65 million.
Page 3 - A Overview of the cable activity	Overhead line distance between Fumba to Mtoni is 37km—not correct [Follow up comment from TANESCO: Can you check this? The report said 22 kms Ras Fumba to Mtoni. 37km is for the submarine cable according to this report.]	37 kilometers is the length of overhead transmission lines from Ubungo to a cable landing station adjacent to the existing Ras Kilomoni substation on the mainland, and from Ras Fumba in Zanzibar, where the submarine cable comes onshore, to Mtoni near Stone Town. We have updated the report to reflect this.
Page 3 - A Overview of the cable activity	Activity also installed 22km of distribution lines on Unguja Island—this is not done in Zanzibar [Follow-up comment from TANESCO: 132kv is distribution voltage to some countries e.g. Uk. Therefore what is meant here is acceptable.]	We are unsure about what the comment implies; we didn't make any changes in the report.
Page 17 - E: Changes in guest satisfaction were sensitive to the months included in the analysis.	In figure III.8 month of August on Post-Cable satisfaction rate and Pre-Cable satisfaction rate not shown the only month of June and July were shown.	As noted in the outcomes and analytic approach section of the report, we focus on results from the overlapping months in the main report. The differences in estimated outcomes using all months may be biased due to differences in June and September. However, the results are consistent across both models for most outcomes and we note when the estimated effects are sensitive to model specification. Appendix A contains the results from both models.

Page Number	Comment	Mathematica Responses
Page 19 - IV: Respondent views on the effects of the cable activity	For my view is much better to include figures on Respondents views so to be easily understood and not wasting too much time to read stories.	The quantitative survey data allows us to estimate changes in energy costs, revenue, quality of electricity, hotel staffing, and guest satisfaction. The qualitative interviews provide a window into possible reasons for the changes. We view these approaches as complementary and that together they provide a fuller picture on the changes after the installation of the undersea cable.
Page 19 - IV: Respondent views on the effects of the cable activity	What is needed is to group the respondents views of the same from different respondents and make statistics for it so as to make graphs.	The nature of the qualitative data did not lend itself to presentation in a graphical format. However, the qualitative data were coded and analyzed using NVivo analysis software so that key themes could be identified.
Page 19 - Reliability	Most hotels have agreed that after commissioning of Second Subsea Cable, reliability of power supply from grid has been improved than it were before, but they have to be aware that, in order to reach the optimal level of reliability both quality power from outside (grid) and proper internal wiring must be fulfilled. But, some customers use sub-standard internal wiring system thus they do not fully utilize stable power from the grid and indeed they are still suffering from unreliable power supply.	We agree that in order for customers to take full advantage of more reliable electricity proper wiring is required. We have added the following footnote: "It is important to note that while the cable activity may improve the potential reliability of electricity, actual reliability is affected by a number of other factors that the cable activity is not directly changing—for example, the quality of internal wiring in hotels, and the quality of the electricity generation and distribution systems."
Page 19 - Unit Price	Most hotels have agreed that after commissioning of Second Subsea Cable, reliability of power supply from grid has been improved than it were before, but they have to be aware that, in order to reach the optimal level of reliability both quality power from outside (grid) and proper internal wiring must be fulfilled. But, some customers use sub-standard internal wiring system thus they do not fully utilize stable power from the grid and indeed they are still suffering from unreliable power supply.	Same as above
Page 20 - Customer Relations	In general, ZECO's Customer relations is not as bad as mentioned by one respondent, however it needs some improvement to reach the required standard. In the effort to improve customer relations, ZECO is in the final preparation for launching its common call center to properly handling customer queries and provide clear guidance to her esteemed customers.	We acknowledge that the respondents do not represent views of all hotels or the general population
Page 20 - Customer Relations	Furthermore, official inauguration of ZECO Customer Charter is expected to kickoff before the end of January 2015 to help customers understand their right as well as all services provided by ZECO in respect to time.	Thank you for the additional information.

Page Number	Comment	Mathematica Responses
Page 20 - Billing	<p>Under normal circumstances, monthly bills depend on power consumptions (kW) and number of hours used (hrs). Customer can use similar equipments having the same kW but the big difference is a number of hours used between may be July and August which makes different bills.</p> <p>Regarding to billing calculations, ZECO billing system makes calculations obtained from meter reading which clearly shown in the bills and before delivered them to the customers, meter readers check the bills for any reading or calculation errors.</p>	<p>We acknowledge that consumption and appliance efficiency are factors in the bill.</p> <p>We recognize that the situations described by the respondents may not represent the situations for all customers. To address the reviewer comments, we have added the following in the text: “ZECO staff indicated that it is standard procedure to include the meter reading on the bill, and for ZECO staff to check the bills for reading or calculation errors.”</p>
Page 20 - Access to Meter	<p>For the sake of security, ZECO prefers to install meters outside customer’s premises to deny easy access to the meter due to problem of power stealing from the meter. However, customer is allowed to be present during meter reading to see his/her monthly consumption. Indeed, the meter reading is also shown in the customer’s bill and written in the meter cards for comparison purposes.</p>	<p>Thank you for the clarification. We have added the following in the text:</p> <p>“the choice to install meters on the outside of a hotel is driven by the need to facilitate access for ZECO staff should a problem arise. ZECO staff also suggested that customers are permitted to be present during meter reading.”</p>
MCA-T Outreach		
General Comment	<p>I am not happy to learn that “Electricity is reliable, but savings in fuel costs did not generally offset the increased price of electricity” If we could have time we could make a household interview/survey to see the outcome at that level, otherwise the report is ok</p>	<p>Respondents in the qualitative interviews reported that the quality of the electricity improved, but that the price increases were a challenge. However, we do not have a clear understanding of what was driving the expenditures. In the post-cable period, hotels invested in electricity-consuming appliances such as air conditioners, refrigerators, and water heaters. But as respondents indicated, tariffs increased. The combination of increased appliance use and more expensive electricity likely explain the larger electric bills in the post-cable period.</p> <p>A household survey or expanded business survey, along with interviews with ZECO staff, could provide some additional insights into the changes in the prices of electricity. However, since the cable activity benefited all residents of the island, a credible counterfactual group could not be identified, and the evaluation could not have established the extent to which the new interconnector cable led to changes on consumption. Given the lack of prospect for a rigorous impact evaluation, Mathematica and MCC agreed to not invest additional evaluation resources to conduct a household survey.</p>

Page Number	Comment	Mathematica Responses
MCA-T Monitoring and Evaluation		
General Comment (mostly page 3)	MCC is working on confirming the final specs of the Zanzibar Interconnector Activity. The Activity value, lengths of overhead/cable lines, and mention of distribution lines in the project description may have to be amended.	We revised the text with the updated information received from MCC.
General Comment	Please title the evaluation in accordance with the Activity name, i.e. Evaluation of the Zanzibar Interconnector Activity: Findings from the Zanzibar Hotel Study	We propose the following revision: "Evaluation of the Zanzibar Cable Activity: Findings from the Hotel Study"
MCC - Economic Analysis		
General Comment	Although I accept the point about no valid counterfactual, did you consider collecting any data from hotels on the mainland, perhaps in Dar es Salaam, to enable you to see broader trends in Tanzania's hotel and tourism industry and try to separate those effects out of the analysis?	The heavily tourist driven economy of Zanzibar and the resulting lack of sufficiently similar comparison group along with the small sample size led us to use a case study approach. Also, we looked into the possibility of getting data on broader trends in the tourism industry, but we did not find consistent data over several years to assess trends.
Page 1	"(3) social gains in education and health"—This depends on the extent of the outages and the backup energy sources being used. If people are running generators or using batteries during blackouts, there is a low probability of any health or education benefits. If people are sitting in the dark or burning kerosene lamps in the absence of power, then the benefits are more likely. Either way, the benefit stream is likely to be small.	We acknowledge that social gains are related to the extent of blackouts and backup energy sources, but do not feel a revision to the text is required.
Page 8	"Before applying the inflation adjustments, we converted all values reported in Tanzanian shillings (TZS) to U.S. dollars using an exchange rate of TZS 1,411 = US \$1 in 2010, and TZS 1,662 = US \$1 in 2014."—Did you consider making PPP adjustments? Why or why not?	Since we are not making cross-country comparisons we feel that a PPP adjustment is not required. The assumptions in the PPP adjustment could change over time and could affect our analyses.

Page Number	Comment	Mathematica Responses
Pages 12, 17	<p>(p. 12) “Hotels did not add rooms after the cable was installed”—This is just one form of potential investment for hotels, and possibly the one least likely to be correlated with reduced energy costs, due to the permanent nature of the investment and the lag time associated with construction.</p> <p>(p. 17) “The cable activity did not influence hotel staffing levels”—Although not as difficult to change as the number of rooms, it seems that the hotels invested in improving amenities instead—</p> <p>(p. 15) “Hotels tended to use more electric appliances after the completion of the cable activity”. Do you think that it may be too early to see changes in number of rooms and staffing? If you came back in 3 years, would you expect to find changes in those indicators too?</p>	<p>We recognize that sufficient time may not have passed to see changes in staffing or infrastructure. However, the two hotels that did not respond to the follow-up survey were both undergoing significant infrastructure improvements. We have added the following text to the report to clarify the point:</p> <p>“Sufficient time may not have passed to observe infrastructure improvements such as adding new rooms. However, the two hotels that were unable to respond to the follow-up survey were undergoing renovations.”</p> <p>“If the cable activity increased revenues then we might expect hotels to hire more staff, but it is possible that sufficient time has not passed to observe changes in staffing levels.”</p>
Page 12	<p>“there is no evidence of an overall reduction in energy expenditures”—Do we know the quantity of energy the hotels consumed before and after the project? More reliable electricity service does not necessarily lead to an overall decrease in energy costs, but rather a per-unit (\$/kWh) decrease in energy costs, as grid power replaces diesel generation. Consumers may pocket this savings, but it is likely that they will expend some of it on additional electricity consumption. This is referred to as the rebound effect or Jevons Paradox, and the resulting consumer surplus represents a benefit to the consumer. Therefore, while it is important to know how much each consumer is spending on energy, we also want to know how much they are consuming. A hotel that spends \$250 on 1,000 kWh is better off than a hotel that spends \$250 on 500 kWh.</p>	<p>We acknowledge that consumption is an important aspect to understand. However, several large hotels refused to provide this information and we could therefore not examine consumption. We have noted in the report that we were unable to obtain these data.</p>

Page Number	Comment	Mathematica Responses
Page 19	<p>“they reported that the savings in fuel costs were not enough to offset the increased price of electricity.” Table A.2 seems to show mixed results on this claim, as the diesel savings is larger for “all months” but insignificant for “overlapping months.” Did you ask them directly whether they would prefer to go back to the “before project” situation (i.e. lower energy costs, but less reliable electricity service)? It is implied, but perhaps they would respond differently if it is presented as a choice. It would be interesting to know, because we often face a dilemma when trying to improve the reliability of power grids. Consumers complain about the quality of service, but then complain when tariffs are raised to levels that could actually improve that service. Did they understand that they are not paying ZECO for the full cost of the electricity, and that increased tariffs are related (or should be related) to improved service?</p>	<p>Understanding how a respondent would decide between a choice between the pre- and post-cable situation is a useful line of questioning. However, we did not ask the hotels about this in the follow-up survey. We agree that it would be useful to include these types of questions in future evaluations.</p>
Pages 19-20	<p>“Tourist activities are increasing day to day.” However, several respondents indicated that no new tourist attractions had been established and a few respondents indicated that tourism had decreased due to recent incidents of violence.” Would it be possible to obtain statistics on the number of tourists to Zanzibar to verify one of these claims? It seems like a relatively simple solution that could cut through some of the differences in perception.</p>	<p>We agree that understanding the broader context of tourism would be useful, but we were unable to find reliable statistics over time.</p>
Page 23	<p>“less reliance on generators could have long-term benefits in the form of reduced exposure to harmful exhaust fumes.”—This seems pretty speculative. Wouldn’t most of the generators be running outside the hotel in areas where the fumes were somewhat away from people?</p>	<p>Thank you for the comment. We were thinking more about air pollutants. We have made the following revision: “[L]ess reliance on generators could have long-term benefits in the form of reduced air pollutants.”</p>

Page Number	Comment	Mathematica Responses
Page 23	<p>“However, we do not have a clear understanding of what was driving the expenditures.” One aspect was the tariff increase. MCC encouraged ZECO to raise tariffs to improve the sustainability of the system. MCC’s compact contained a condition precedent that stated: “Prior to the disbursement for the Zanzibar interconnector activity covering the quarter beginning January 1, 2012, ZECO shall implement a tariff revision that recovers full cost (i.e. at least the sum of cost of sales, operating expenses, debt services and capital expenditures (which shall at least equal asset depreciation expense).” ZECO did not meet this CP, which would have required an approximate 100% increase in the tariff, but they agreed to an 85% increase phased in over the span of a year. I do not recall whether they fully implemented the tariff increase or only partially. Aside from the tariff increase, it could have been a change in consumption of electricity. Do we know how much each hotel consumed?”</p>	<p>Thank you for the clarification. We will incorporate this into the introduction to provide context and mention throughout the report as relevant.</p> <p>We agree that electricity consumed is an important aspect of understanding the factors behind increased energy expenditure. However, several large hotels refused to provide electricity consumption data, and therefore, we could not examine consumption.</p>
Pages 23-24	<p>“During the qualitative interviews, respondents also pointed to increased competition in the hotel sector and its negative effect on business and revenues.” There may have been negative effects on individual hotels, but increased competition seems to indicate a positive outlook for Zanzibar’s tourism sector, correct? Presumably, more competition means new investment in the sector (through new hotels or improvements to existing ones), which could improve the guest experience and attract more guests. Increased competition could also mean lower prices for consumers.</p>	<p>Thank you for the comment. We have added the following text: “Although their comments reflect on what each hotel may have experienced individually, increased competition potentially indicates that the hotel and tourist sectors of the economy are healthy.”</p>

Page Number	Comment	Mathematica Responses
Pages 25	<p>“Third, it may make sense to consult with engineering experts on certain issues, such as the likely impact of the new cable on the probability of future blackouts. While an evaluation firm, like Mathematica, could conduct such interviews, it may make more sense to have those done by MCC engineering staff.” - Someone must have assessed this, right? Rather than discussing whose responsibility it is, why doesn't the report just state what the engineering experts' estimates were? If nobody asked for an expert's assessment, we should probably ask why not.</p>	<p>We do cite an ESBI report that indicates the cable's lifespan, but to our knowledge an independent engineering study has not been conducted. If studies were conducted or will be in the near future, we are happy to review and update the report as needed. We have revised the text as follows:</p> <p>“[I]t may make sense to consult with engineering experts on certain issues, such as the likely impact of the new cable and other cable-related activities on the probability of future blackouts. Dineen and Silke (2012) provided information on the expected lifespan of the cable and details on the proposed upgrades to the substation and distribution networks. However, it might be useful to have an assessment of the probability of future blackouts after the cable activities are complete to account for potential deviations from the initial design. Although an evaluation firm, like Mathematica, could conduct such assessments, it might be more effective and appropriate to have them done by MCC engineering staff.”</p>

Note: MCA-T Energy and MCA-T Director of Environment and Social Impact (DESI) reviewed the report, but did not have any comments.

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