Do blackout baby booms exist and why?

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Abstract

Determining whether power outages have significant fertility effects is an important policy question in developing countries, where blackouts are common and modern forms of family planning scarce. Using birth records from Zanzibar, this paper shows that a 2008 month-long blackout caused a significant, 20% increase in the number of births eight to ten months later. The increase is similar across villages that had electricity, regardless of the level of electrification, while villages with no electricity connections saw no changes in birth numbers. This pattern is consistent with the blackout causing a common village shock that increased the overall likelihood of pregnancy. Household surveys confirm that people were more likely to consume their leisure inside the home during the blackout, suggesting a possible linkage between time use and fertility outcomes. While it is unclear whether the baby boom is likely to translate to a permanent increase in the population, the paper highlights an important hidden consequence of power instability in developing countries.

JEL Classification: J13, J22, O15.

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1 Introduction

Do electricity black-outs cause mini-population booms nine months later? The idea that procreation increases when lights go out took hold after the one day 1965 North East black-out, with several hospitals reporting more births nine months after the event (Pollack, 2004), and remains a topic of interest any time there is a significant power outage.[1] The hypothesis that the sudden lack of electricity and television leads to more procreation has generally been discounted for lack of any evidence and for the belief that the ready availability of contraceptive use should keep unwanted pregnancies at bay.

While the lack of evidence may be possibly due to lack of causality in developed countries, it could also be due to the difficulty to match a one-day event to births many months in the future. In fact, the question is more relevant in developing countries, for a number of reasons. First, unlike developed countries where blackouts are rare and often limited in time and space, many countries in the developing world suffer from tremendous power instability. Cities like Lagos in Nigeria are renown for constant power cuts. Other places where service has historically been considered reliable have been in the news for intermittent power or power outages lasting weeks or months, including Addis Ababa, Nairobi, Dar es Salaam, and Johannesburg. Following continuing power troubles, the Ugandan Planning Minister affirmed that "power blackouts were fueling a baby boom" in his country (BBC, 2009). Even an isolated and short lived event–like the two day blackout that affect 600 million Indians in July 2012–could have significant population implications by the sheer number of impacted individuals (BBC, 2012). Second, there are significant barriers to access to effective family planning tools in developing countries, which increase the likelihood that unexpected, blackout-induced sexual activity translates to additional births. Third, the same lack of family planning use increases the likelihood that any temporary increase in fertility could translate to a permanent increase in the population. In Africa, for instance, lifetime fertility

[1] For instance, the same questions arose following the New York City blackout of 1975 and the North East blackout of 2003 (Pollack, 2004).

is heavily influenced by delays in first pregnancy and birth spacing (United Nations, 2009)A one-time, blackout-induced reduction in birth spacing could consequently translate to one more birth during the reproductive lifetime of a woman. A similar result would be obtained if the blackout induced women to anticipate the time of their first pregnancy. Finally, and working against the prediction that fertility responses to blackouts are large, reliance on electricity is much more limited in developing countries. For instance, relatively few have direct access to electricity, either at work or at home; moreover, electricity use tends to be limited, even for those who have direct access to it.[2] To the extent that the effects of the blackout are private–affecting only those whose use of electricity is temporarily deprived–the effective fraction of the population who would respond to a blackout through additional births is lower in developing countries. On the other hand, to the extent that electricity is a public good–and blackouts a public "bad"–every person living in an electrified area could be affected by the lack of electricity.

In this paper, I provide evidence that, at least in Africa, there can be a causal effect of power outages on short-run fertility. The evidence comes from a particular blackout–a month-long, complete blackout affecting the entire island of Zanzibar in Tanzania, between May and June of 2008. The blackout had some appealing features: because it was caused by an unforeseen equipment malfunction, it was completely unexpected; it lasted for four weeks, long enough for sufficient statistical power to detect the impact on fertility; and, since it affected an island, it was very clearly delimited in time and space.[3] To document the implications of this event, I constructed a panel database of births from maternity ward birth records. The data covers two years of births–from January 2007 until May, 2009–and includes the number of weekly births by village or town of maternal residence. The data show a remarkable baby mini-boom–births up 20% on average across all villages–eight to ten months after the event. By merging the birth dataset with additional village level data from

[2] Note here the percentage of ppl with electricity AND fridges, telephones, televisions etcetera.

[3] When the geographic boundaries of an electric power outage are unclear, estimates can be biased by spillover effects from areas that have maintained the electricity service.

the 2002 census and the 2007 labor force survey, I further show that the increase in births happened, as expected, only on villages that had *some* electricity. Surprisingly, however, the increase was remarkably similar across all levels of electrification. That is, the baby mini-boom took place everywhere there was a positive amount of residential electricity in 2002, with no additional increase from increases in electricity coverage. This result is not driven by differences in electricity coverage between 2002 and 2008–2002 coverage is strongly predictive of coverage in 2007–but is consistent with the blackout creating an externality by affecting the fertility outcome of women with and without own use of electricity.

To provide further albeit partial and incomplete evidence in favor of this externality hypothesis, section 6 uses data from a time use survey carried out five months after the event to suggest that the blackout indeed affected time use patterns in ways that are consistent with changes in fertility. In particular, the blackout caused an average decline in the amount of time spent outside of home and an increase in the amount of time spent inside home. A simple descriptive regression of time use indicates that the pre-existing amount of electricity in the community did affect time use choices of men (but not their spouses); the more electricity coverage present in the town of residence, the more time men spent reporting at home during the outage.

The paper fits in a broader literature that studies the implications of modern living standards and leisure on fertility. Much of the literature has focus on the impact of television viewing on fertility. For instance, Jensen and Oster (2010) and La Ferrara et al. (2012) provide some evidence that television programming reduce fertility. They both suggest that television programming provides information about outside social norms, including smaller family sizes. A possibility that is not entertained, and that could play a role in the results of this paper, is that televisions and electricity change leisure patterns in such a way that it reduces procreation. While more evidence is needed to show that the short-run patterns found in this paper are likely to be maintained over the long run, the paper hints at the possibility of electricity use as a tool to reduce unwanted pregnancies.

The rest of the paper proceeds as follows. Section 2 provides a brief overview of the blackout. Section 3 explains the estimation framework. Section 4 describes the birth dataset. Section 5 provides the main fertility results. Section 6 shows the evidence from the time use surveys carried out after the blackout, with section 7 providing concluding remarks.

2 The blackout

The Zanzibar blackout started on May 21, 2008 at approximately 10 p.m. and lasted until June 18, 2008, and was caused by an accidental break in the undersea cable that connects the Zanzibar island substation with the electricity generators on mainland Tanzania (for more details on the blackout, see Burlando [2012]). The event was the longest recorded time without power in Zanzibar's history to that point.

The event caused economic damage: as discussed in the companion paper those employed in occupations using electricity reported a steep drop in earnings and hours worked, and birth weights of children conceived before or around the blackout fell significantly.[4]The power outage only marginally affected other aspects of daily life: it had no impact on work and earnings of households engaged in activities not relying on electricity, little to no effect on consumer good prices, did not cause significant public health problems, and –given that the great majority of the population does not make significant use of electric cookers, fridges, air conditioners, and other domestic electric appliances–it had no impact on cooking patterns. Because neither electric lights nor televisions were available, however, the blackout increased idle time spent inside the home, as detailed in section 6.

[4]Burlando (2012) also discusses some aggregate fertility effects, and does not study the impact of village electricity on fertility.

3 Econometric framework

The first objective of the paper is to estimate the impact of the blackout on the number of births of children conceived during the blackout. This is verified if the cohort conceived between May 21 and June 18, 2008 was more numerous than those conceived before or after, once factors such as seasonality and population growth have been taken into account. The second objective is to test the hypothesis that the size of the affected child cohort varies by the amount of electricity in the village, and explain whether the variation originates because of direct family exposure to the blackout (through losing electricity at home) or because of indirect exposure (though losing electricity in the rest of the village).

One difficulty in performing the above analysis originates from the fact that birth records contain the date of birth, but no other information required to determine the date of conception. One solution is to replace the date of conception with the *expected* date of conception, and thus consider any child born 40 weeks after the blackout as "exposed" to the blackout. This measure might under-report the actual fertility effect if the blackout also affected the rate of premature or delayed births. An alternative measure, which is adopted here, attributes any birth occurring eight to ten months after the blackout (DATE HERE) being the result of a conception during the blackout. This measure captures premature and delayed births. The outcome variable of main interest is y_{vt}, the log of the number of births reported by a town or village v during week t, with the main explanatory variable of interest being BB, whether the births occurred among the "blackout baby" cohort of children born 8-10 months after the blackout. To account for unobserved variation in the frequency of births across time and space, the base model includes village fixed effects α_v and month and year fixed effects δ_t. The baseline regression is

$$y_{vt} = \delta_t + \alpha_v + \beta_1 BB_t + \epsilon_{vt}. \tag{1}$$

where β_1 measures the percentage change of births per week; a positive coefficient would confirm that the cohort BB is indeed larger. While the blackout affected the entire island of Zanzibar, not every village has electricity, and not every village has the same level of residential electricity. To account for the fact that local electricity coverage affects fertility differentially, I estimate the following model:

$$y_{vt} = \delta_t + \alpha_v + \beta_1 BB_t + (\beta_2 NE_v + \beta_3 Ele_v) \times BB_t + \epsilon_{vt}, \tag{2}$$

where the dichotomous variable NE_v indicates whether the village was not electrified, and the continuous variable Ele_v indicates the estimated fraction of residences that use electricity. The coefficient β_1 estimates the common impact of the blackout on the number of births per week on villages that have electricity, thus capturing the common externality that comes from having an electrified village. The difference $\beta_1 - \beta_2$ is the impact of the blackout on villages that have no electricity. To the extent that the blackout was not felt in these areas, we would expect this difference to be zero.[5] Finally, the coefficient β_3 estimates the additional impact of electrification. A positive coefficient is consistent with the hypothesis that direct personal exposure to the blackout affects fertility (through televisions and light bulbs not working, for instance).

To properly regress the above equations, several econometric issues need to be considered. First, the underlying outcome of interest–number of births per week per village–is measured in non-negative integers and has a large number of zero values. An improvement over the standard linear regression would involve estimating the model using a Poisson regression, and this is the method adopted here. Having assumed a log-normal model, the β-estimates are interpreted as percentage changes.

Second, records cover only births occurring at the specific facility, and therefore exclude a large fraction of home and other hospital deliveries.[6] If the amount of deliveries

[5] It is important to note that even non-electrified rural villages could have felt the effects of the blackout, provided, for instance, that it disrupted the work pattern of residents. This channel is likely to be minor: the blackout disrupted jobs that depended on electricity directly, and few rural residents hold these types of jobs.

[6] I estimate that approximately 25% of total births occur at Mnazi Mmoja. The ward delivers 500-900

performed at a hospital is seasonal, the time fixed effects will account for this. However, to the extent that the fertility response to the blackout is not independent of the choice of delivery location, the above results are to be understood as the blackout effect on the sub-population that is likely to deliver at a hospital. If fertility outcomes for this sub-population are more responsive to the blackout, the regressions overestimate the overall fertility effect for the population at large.

Third, errors are likely to be non-standard. To correct for possible autocorrelation in the errors, all poisson regressions report bootstrapped standard errors.

4 Data

The main source of data are records from the Mnazi Mmoja maternity ward in Zanzibar, which delivers approximately 25% of all births in the island. Records include the date of birth (but not date of conception) of the child, and the name, home town, number of prior pregnancies, age and admission date of all expectant mothers (see Burlando [2012] for more details on this data source). Using the name of the hometown, records were matched to the 2002 Census data and the 2007 Zanzibar Labor Force Survey. These two surveys were used to obtain *aggregate* village covariates of electricity use and wealth levels.

The 2002 Census administered two types of questionnaires: the base (or short-form) questionnaire collected demographic information for every household of Zanzibar. One every four enumeration areas (EAs) was selected to receive an expanded (or long-form) questionnaire, which collected information on basic asset ownership and house dwelling characteristic on all EA residents, including whether the residence had a source of electricity. Thus, the Census collected asset ownership information for approximately one quarter of all households. This was the data available for this paper, from which an index of asset ownership for each household, a dummy variable for whether the household dwelling had electricity,

children per month, representing 48% of all children born in health facilities (according to facilities data from the Ministry of Health). It is estimated that 61% of all children in Zanzibar are born at a health facility (NBS 2011).

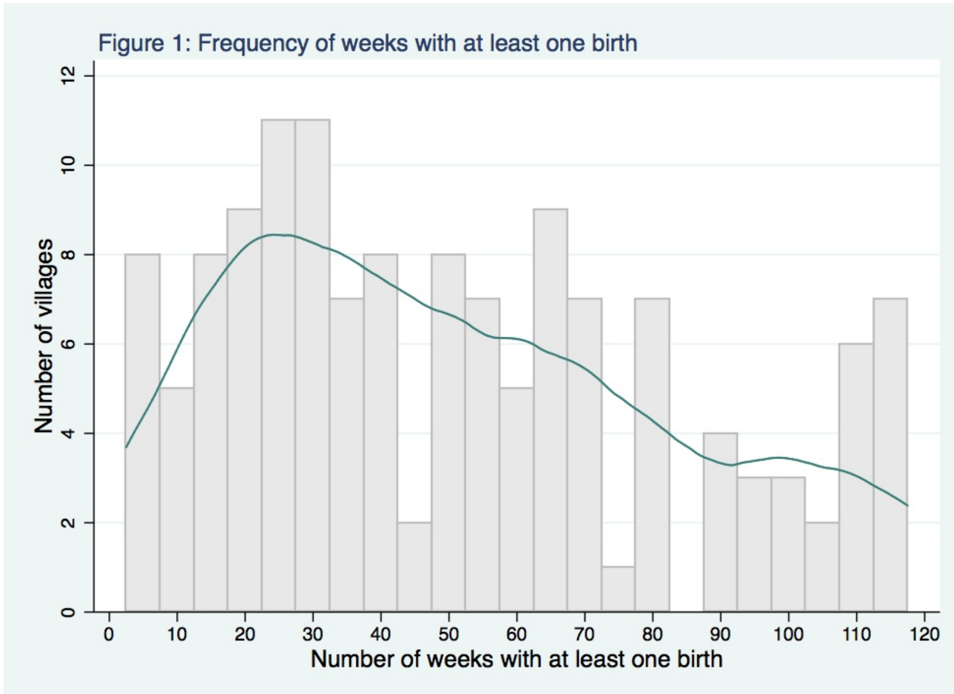


Figure 1: Frequency of weeks with at least one birth

and the size of the household at the time of the Census interview were employed. I then constructed village averages of these three measures. Since the long form survey is representative only at the district level and not at the village level, the constructed average is only an approximation of the true village average.[7] While the information covered by the Census is limited and, by the time the blackout happened, somewhat outdated, it has the benefit of covering almost all villages in Zanzibar, which allow me to assign most births to relevant village characteristics and to estimate regressions over a large number of villages. The 2007 Labor Force Survey (LFS) is a more recent, complete description of household and worker characteristics, but because it was implemented on few enumeration areas, it covers fewer villages.[8] In particular, only 76 LFS villages could be matched. The final data has been reformatted so each observation is a village-week, and the main outcome variable of interest is the number of births in a week in a village. After dropping villages with four positive birth

[7]There is no reason to expect that the lack of representativeness is correlated with the number of births during the blackout in a way that would bias the analysis. Lacking access to the short survey, it is not possible to construct a measure of village population size, or even determine the proportion of village residents that answered the long-form questionnaire.

[8]See Burlando (2012) for a description and more in-depth use of the LFS.

weeks or less, there are 14,500 usable observations, with 70 villages matched to the LFS and 125 matched to the Census.

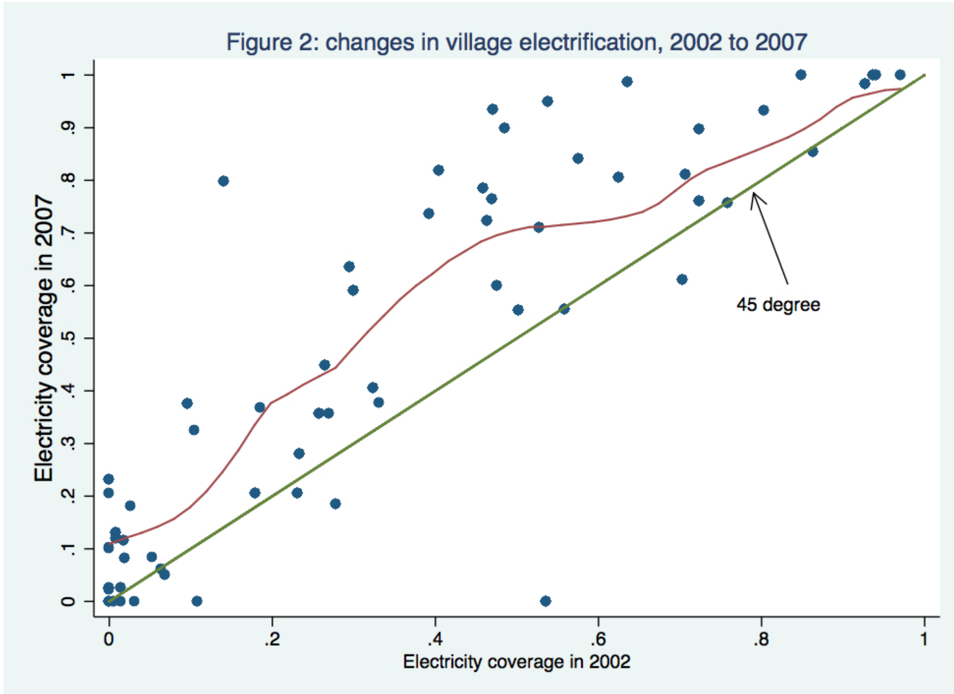
Many villages are represented in the data through a limited number of births. To make this clear, figure 1 shows how often villages have at least one birth per week, and finds that villages with relatively few birth events are more common than villages with many birth events. Such villages are likely to be somewhat remote, or have a small population to begin with, while villages with a significant presence in the facility are more likely to be urban and located near the maternity ward. To the extent that the regression methods adopted compute the relative frequency for exposed cohorts by village, this will not impact the coefficient estimates.

Table 1 provides some summary statistics from the two matched datasets.

Between the two survey years, most villages improved their electricity coverage, with several villages that were not electrified in 2002 received electricity by 2007. Figure 2 provides a scatterplot of the estimated electricity coverage in 2002 versus 2007, for those villages for which I have both Census and LFS data. The figure also overlays a frequency weighted local polynomial smoothed regression. Clearly, most villages either maintained or improved their coverage of electricity; the regression line has an average slope that is very close to 45 degrees, which implies that average improvements in electrification are similar (in the order of 10 to 20%) for villages at all levels of 2002 coverage.

5 Results

Table 2 provides estimates of the impact of the blackout on the blackout baby cohort size. Columns 1-3 focus on births matched to the 2002 Census. Column 1 regresses equation 1 and shows that the cohort of children born 8-10 months later was 19% larger than expected, corresponding to an average 0.2 additional births per week across all villages. Column 2 and 3 reports results from regression 2. The cohort size in villages that were electrified in 2002



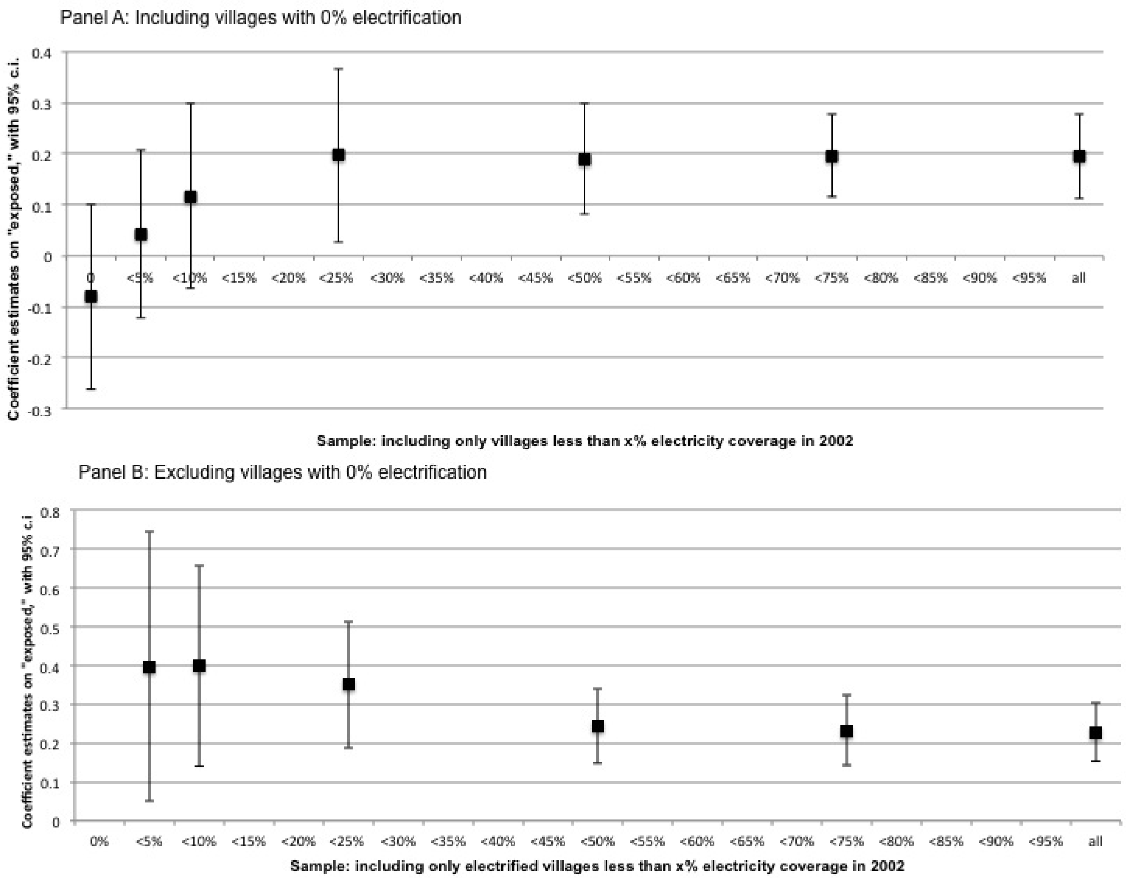
is approximately 26% larger, while the coefficient $\beta_1 - \beta_2$ is not different from zero. Turning to the cohort-village electrification interaction coefficient, the estimated coefficient is also essentially zero. The same is true for regression 3, which adds the available village controls (interaction of average household size and average wealth with the blackout baby cohort). The results suggest that what matters for fertility is the presence of *any* electricity, rather than the amount of electricity present.

Columns 4 through 8 limit the sample size to just the 70 villages surveyed by the LFS. The sample reduction halves the estimated cohort size increase to 9.7% (column 4) and increases the imprecision of the coefficient.[9] Columns 5 and 6 interact exposed birth cohort with 2007 electricity coverage and with the dummy for lack of any electricity in 2007.[10] Again, the findings closely mimic those of columns 2 and 3 (even though the coefficient on the "exposed" dummy is now marginally insignificant). In columns 7 and 8, I replace electricity coverage with two alternative variables: the fraction of the population with a television and

[9]Since LFS villages have more recorded weekly births, however, the regression still indicates that LFS villages added 0.28 births per week, which is a similar level increase to the full sample.

[10]The results are almost identical when identifying villages that were not electrified in 2002.

Figure 3: Coefficient estimates on "exposed" (born 8-10 months after) sample: by fraction on village with electricity in 2002



the fraction of the population working in sectors that use electricity.[11] Again, there is little evidence that living in villages that were more severely impacted by the blackout through the lack of television or lack of work were more likely to respond with more births.

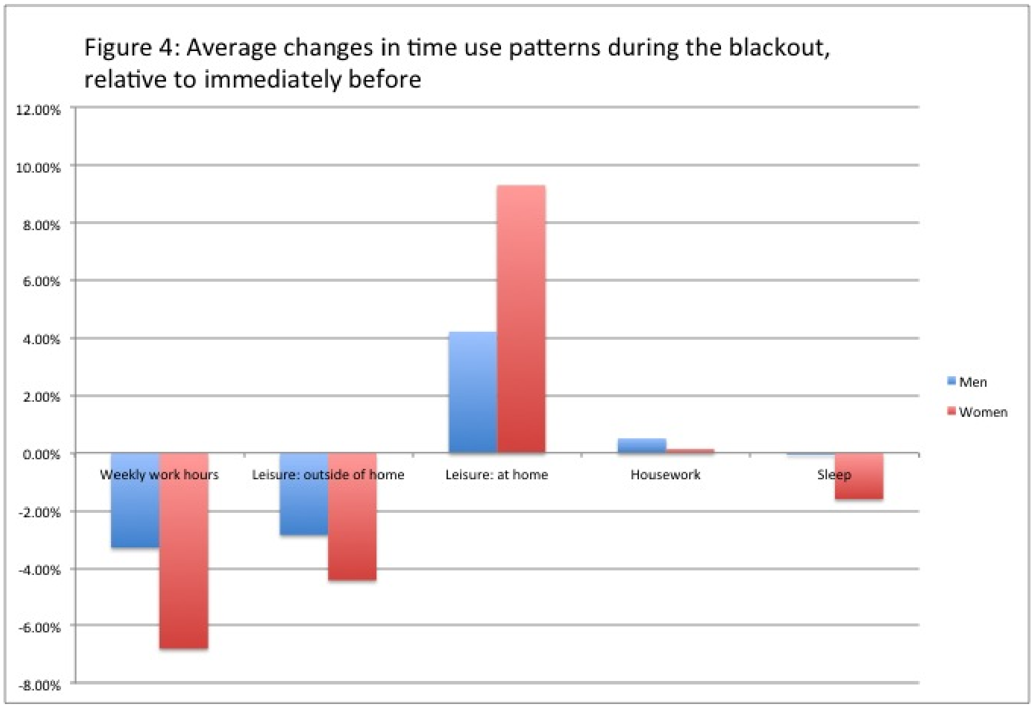
Figure 3 provides visual confirmation that the pattern of births in previously unelectrified villages differs from those that have some electricity, but that the degree of electricity when present does not matter. The figure shows the estimated coefficient on the exposed cohort when the sample is restricted to villages below a certain rate of electrification. As one moves left to right, the estimated coefficient includes villages with higher levels of electricity. Panel A includes in the sample villages with no electricity in 2002. The coefficient is essen-

[11] These sectors are defined as employing managers, professionals, technicians, clerks, plant and machine operators.

tially zero when electrified villages are excluded. As one increases the level of electrification, the coefficient raises sharply, and quickly stabilizes around 0.20. Panel B, on the other hand, excludes all villages that were not electrified. The estimated coefficients start with very large standard errors (due to small sample sizes) but do not change much at all. This pattern seems to strongly suggest that the fertility effect is not driven by the (lack) of private use of electricity, but is rather the result of a common "public good" shock.

Table 4 shows some other important results related to the fertility effect of the blackout. The first column provides some evidence that the birth boom was felt across villages and was not an event isolated to few locations. The column reports the result of a logit regression of the usual covariates on a dummy variable that is equal to one if a village reported *any* birth that week. If the fertility increase was widespread, then we should expect that the likelihood of a village reporting a birth is higher for the affected cohort. This is confirmed by a positive and almost significant coefficient (p-value: 0.10). In column 2, I also report the coefficients from the same regression estimated using a linear probability model, which estimates that the probability of a village reporting a blackout birth is a marginally insignificant 3.2% higher than expected–representing a modest increase over the average probability of 44%.

One unresolved issue from the above is whether the baby boom is likely to translate to a permanent increase in population. A definitive assessment of this would require analyzing fertility some years into the future–something that, with the data available, is not possible. One way to make some headway on this issue is to explore the age and fertility structure of the affected cohort of women. Under the assumption that total fertility increases if either (i) birth spacing falls, or (ii) women become pregnant earlier, the concern that the increase in population is permanent is heightened if the composition of women giving birth eight to ten months later is younger. The remaining two columns of table 4 report the effect of the blackout on the age structure of those giving birth. Column 3 regresses the average age at birth for women in the sample on the explanatory variables, and column 4 regresses



the average age at birth for those women who were at their first pregnancy. The coefficient estimates on "exposed cohort" are negative, suggesting that the composition skews younger– but the standard errors are large. The evidence is thus inconclusive.

6 Possible fertility pathways

The blackout caused a reduction of time spent outside the domestic domain, and an increase in time spent in the domestic domain. This is evident from figure 4, which shows changes in time use for women and men during the blackout, relative to usual time use before the blackout started. (For a detailed explanation of this time use data, refer to the appendix). On average, work hours (which is often an outside of home activity) declined, and so did time spent outside of the home. Domestic leisure, on the other hand, increased by an average of 4% for men and over 9% for women. Sleep and housework patterns did not vary much for either group. The time use evidence is thus consistent with more time at home, as a possible source of fertility increase.

To further explore the implications of the blackout on how couples changed their time allocation, table 5 regresses the difference in the log of leisure time spent at home and outside the home on a number of covariates.[12] The covariates include work/leisure shifters, including use of electricity at home or at work, ownership of domestic leisure substitutes (such as radios, which are generally battery-powered), participation in social and religious activities (participation in ROSCAS, in other community groups, and regular fasting), and other household and individual characteristics which could be correlated with the shape of the utility function with respect to leisure (age, education, family size, wealth). Panel A focuses on domestic leisure, meaning time spent at home not doing chores.[13] Looking at columns 1 and 5, men report an increase in their time spent at home if they have a domestic source of electricity, and if they have an alternative source of diversion that would function during the blackout, such as the radio; whereas women do not. Men are also less likely to spend additional time at home as their wealth level increases, while the opposite is true for women. All other covariates are not statistically significant.

Column 2 and 6 introduce the percentage of the village that had electricity at the time of the 2002 census. Interestingly, the coefficient on overall village electricity is substantially correlated with men's leisure time, while the indicator on whether the household has private use of electricity becomes smaller and statistically insignificant. This suggests that, for men, presence of electricity *in the community* was an important factor in the decision to allocate extra hours to the domestic realm, with the own use of electricity being somewhat secondary. In other words, it is suggestive that lack of electricity exhibits externality effects. This effect is, however, not present for women, whose domestic time use does not vary consistently with electricity.[14]

[12]I explored the effects of the blackout on work in Burlando (2012), and I exclude from the analysis time devoted to housework and sleep because these is much less explainable variation.

[13]Since daily time allocated to different tasks need to sum up to 24 hours, leisure time spent at home and outside the home may be correlated. However, multiple equations estimation methods such as SUR lead to very similar estimates and are not reported.

[14]While it is not clear why electricity would increase time spent at home, a possible channel is that villages with more electricity have lower social capital, thus causing residents to spent less time in the community when faced with an adverse shock. Such a mechanism has been highlighted by Benjamin Olken, who showed that increased media access in Indonesia led to lower participation in social activities (Olken, 2008).

To further explore the relationship between own leisure time and the degree of electricity in the community, columns 3 and 7 introduce a measure of electricity presence in the immediate neighborhood. Each household in the questionnaire was asked how many of the 10 closest neighbors had electricity; denoting by x_{-i} the answer to this question and by x_i whether the respondent has electricity, the measure "percentage immediate neighborhood with electricity" is computed as $\frac{x_{-i}+x_1}{11}$. The addition of this measure does not change the main results: what seems to matter is the overall level of electrification of the community for men, while for women there is no effect. Finally, columns 4 and 8 introduce village fixed effects. While these absorb the village electrification variable and help increase the amount of variance explained by the regression, they do not change the estimated coefficients much from the previous two specifications.

Finally, panel B regresses the change in time devoted to leisure outside of one's home on the same set of covariates. The model here does not fit the data particularly well: across specifications, no explanatory variable is able to capture much of the variation in hours, with the exception of ROSCA participation.[15]

The patterns of time use changes reveal two possible pathways between power outages and fertility. First, the increase in domestic leisure raises the possibility that short-run fertility choices are a function of the quantity, and probably also quality, of time use. In other words, lack of amenities and distractions could favor pregnancies, at least in the short run. Second, time use patterns seemed to have been affected by the overall presence of electricity, at least for men; this could explain why the presence of electricity seemed to be so important in overall fertility trends, although it remains an issue why fertility did not increase proportionally with electricity coverage. Finally, the above pathways are suggestive: the sample size used is small, and the only source of village-level variation of electricity is estimated over just 19 villages. The setup cannot explain whether other aspects (quality of time use, boredom, etc.) played a role.

[15]The negative coefficient on ROSCA could be explained if ROSCAS stopped functioning during the blackout, but I have no evidence around this hypothesis.

7 Conclusion

This paper provides evidence that blackouts can indeed produce baby booms. Using a particularly well-defined and long power outage in the island of Zanzibar, Tanzania, the paper shows that blackout babies born 8-10 months later were 20% more numerous than expected. The blackout provides also important and policy-relevant insights over the distribution of fertility effects: large increases in the number of births were found on villages with electricity, regardless of the degree of electrification; in contrast, birth numbers did not change in areas not served by the electricity network. Such pattern is consistent with the blackout causing a common village shock that reduces the quality of leisure time to all.

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A Time use surveys

The first source of data is a household survey specifically designed to gather information on the blackout. I collected this data five months after the blackout with a team of enumerators from the Government Statistics Agency. The sample consists of 366 randomly selected households in 19 villages and towns in Zanzibar, selected from high, medium and low electricity coverage villages and neighborhoods. 12 survey locations are rural or semi-rural villages from the North, East, and South of the island, and have electricity coverage varying from 0 to 40% of the households. The remaining seven areas are urban and peri-urban neighborhoods of the main town, where between 70% and 100% of households are connected to the grid. I collected the data over a one month period, beginning in November 2008. Respondents were asked about their family structure, asset ownership, income levels, education, religious practices, and use of electricity in their own home and work.

The data used in this paper comes specifically from time use questionnaires, which are a subset of the overall survey. The household head and spouse were interviewed separately for these questions. Those who were employed answered questions about their work hours the month before, the month of, and five months after the blackout. To capture the range of activities carried out, we collected descriptions of each type of income-generating activity separately, and a personal assessment of the number of weekly hours spent doing each activity within each time period.[16]

The Household heads and spouses were also asked to assess how many daily hours they spent in four different categories of time use during the usual weekday: leisure hours spent at home, leisure hours spent outside of home, time spent doing house chores, and working hours. To help estimating time use as accurately as possible, enumerators played a simple game with respondents. They first determined the amount of time available during the day by estimating the time respondents go to sleep and wake up in the morning. Having thus determined how many hours were available during the day, they provided an equal number of pebbles to the enumerators, and the enumerator then provided proceeded to allocate those pebbles on a board with four quadrants representing the four time use categories. The enumerator then prodded and questioned the respondent until they were both satisfied that the board represented a fair assessment of their time use. This process was carried out first to determine the usual hours spent before the blackout; in the second stage, they were asked to update the board by moving the pebbles to reflect changes to time use during the blackout.

[16]Questionnaires are available online at pages.uoregon.edu/burlando/Zanzibar.html.

Table 2: Effect of blackout on number of births per week

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Data source:	2002 Census			2007 Labor force survey				
Village electricity measure:	fraction with domestic electricity (2002)			fraction with domestic electricity (2007)			fraction with tv (2007)	fraction working in electricity-using sectors (2007)
Exposed (β1)	0.195***	0.261***	0.244***	0.097**	0.115	0.113	0.085	0.182**
(born 8-10 months later)	(0.047	(0.059)	(0.061)	(0.045)	(0.071)	(0.080)	(0.073)	(0.083)
Exposed x		-0.158*	-0.135		-0.149	-0.147	-0.135	-0.174
Not electrified in survey year (β2)		(0.085)	(0.097)		(0.114)	(0.122)	(0.105)	(0.109)
Exposed x		-0.131	-0.107		-0.017	-0.014	0.071	-0.621
Electricity measure (β3)		(0.138)	(0.248)		(0.086)	(0.137)	(0.181)	(0.446)
Observations	14,500	14,500	14,500	4,442	4,442	4,442	4,442	4,442
Month and year f.e.	YES	YES	YES	YES	YES	YES	YES	YES
Village f.e.	YES	YES	YES	YES	YES	YES	YES	YES
Village controls x Exposed	NO	NO	YES	NO	NO	YES	YES	YES
Number of villages	125	125	125	70	70	70	70	70
β1-β2		0.103	0.109		-0.034	-0.034	-0.050	0.008
P-value of Chi-test: Exposed in non-electrified villages =0		0.16	0.32		0.72	0.78	0.69	0.94

Bootstrapped errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes:
Poisson regressions on weekly number of births per village matched to the 2002 Census. Controls include village wealth and average number of household members. Village wealth is the village average of an index of 13 items or dwelling characteristics collected in the 2002 census. Both wealth and number of household member have mean zero.
Sample in columns 4-8 restricted to villages sampled by the 2007 labor force survey.
Fraction working in electricity using sectors: managers, professionals, technicians, clerks, plant and machine operators

Table 4: Other fertility outcomes

	(1)	(2)	(3)	(4)
Estimation method	Logit	LPM	OLS	OLS
Sample	Full 2002 Census		Restricted to observations with births-Full Census	
Outcome variable	Dummy: any birth in week		Average age	Average age, only first-time mothers
Exposed cohort	0.204	0.032	-0.456	-0.122
	(0.125)	(0.02)	(0.370)	(0.346)
Exposed x	-0.028	0.003	1.150**	-0.309
Not electrified in 2002	(0.172)	(0.032)	(0.573)	(0.717)
Month and year f.e.	YES	YES	YES	YES
Village f.e.	YES	YES	YES	YES
Village controls	YES	YES	YES	YES
Average dep. var.	0.44	0.44	26.5	22.5
Observations	14,036	14,500	6,742	4,389
Number of shehiaid	121	125	125	125
P-value of test: Exposed in non-electrified villages=0	0.3	0.24	0.19	0.48

Robust errors in parentheses

*** p<0.01, ** p<0.05, * p<0.

Table 5: Change in log leisure hours spent during blackout

Panel A: Leisure spent at home	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Men				Women			
Household has electricity	0.240**	0.163	0.173	0.197	0.062	0.077	0.067	0.139
	(0.101)	(0.099)	(0.110)	(0.141)	(0.077)	(0.096)	(0.107)	(0.115)
Household has radio	0.085**	0.108***	0.110**	0.092**	-0.017	-0.020	-0.019	0.013
	(0.032)	(0.036)	(0.038)	(0.039)	(0.046)	(0.043)	(0.043)	(0.058)
Participates in Rosca	-0.087	-0.052	-0.047	-0.093	0.075	0.072	0.068	0.054
	(0.090)	(0.097)	(0.100)	(0.115)	(0.054)	(0.053)	(0.049)	(0.046)
Participates in other community organization	0.078	0.090	0.092	0.096	-0.060	-0.063	-0.061	-0.078
	(0.085)	(0.086)	(0.083)	(0.099)	(0.059)	(0.065)	(0.069)	(0.070)
Fasts regularly	0.098	0.094	0.098	0.056	-0.017	-0.020	-0.018	0.011
	(0.101)	(0.096)	(0.096)	(0.091)	(0.053)	(0.050)	(0.050)	(0.057)
Household assets	-0.054**	-0.063**	-0.058**	-0.043	0.042*	0.043*	0.038*	-0.005
	(0.024)	(0.022)	(0.022)	(0.027)	(0.022)	(0.022)	(0.020)	(0.020)
Percentage village electrified in 2002		0.269**	0.362**			-0.045	-0.140	
		(0.108)	(0.155)			(0.127)	(0.255)	
Percentage immediate neighborhood with electricity			-0.128	-0.322			0.130	-0.077
			(0.152)	(0.236)			(0.289)	(0.222)
Demographic controls	YES	YES	YES	YES	YES	YES	YES	YES
Village f.e.	NO	NO	NO	YES	NO	NO	NO	YES
Observations	330	330	325	325	334	334	332	332
R-squared	0.037	0.051	0.050	0.112	0.120	0.121	0.123	0.248
Panel B: Leisure spent outside of home	Men				Women			
Household has electricity	0.027	0.051	0.072	-0.007	-0.030	-0.028	-0.009	-0.081
	(0.098)	(0.109)	(0.111)	(0.123)	(0.053)	(0.060)	(0.070)	(0.079)
Household has radio	-0.022	-0.029	-0.028	-0.037	-0.003	-0.004	-0.002	-0.025
	(0.026)	(0.029)	(0.029)	(0.033)	(0.052)	(0.053)	(0.053)	(0.058)
Participates in Rosca	-0.094**	-0.105**	-0.109**	-0.147**	-0.101	-0.101	-0.092	-0.073
	(0.036)	(0.038)	(0.040)	(0.058)	(0.059)	(0.059)	(0.054)	(0.052)
Participates in other community organization	0.048	0.044	0.049	0.030	0.057	0.057	0.061	0.070
	(0.054)	(0.059)	(0.058)	(0.065)	(0.060)	(0.062)	(0.067)	(0.067)
Fasts regularly	-0.041	-0.040	-0.033	-0.083	-0.066	-0.066	-0.070	-0.077
	(0.041)	(0.039)	(0.036)	(0.053)	(0.078)	(0.080)	(0.083)	(0.101)
Household assets	0.004	0.007	0.009	0.027	-0.011	-0.011	-0.003	0.024
	(0.024)	(0.025)	(0.024)	(0.027)	(0.014)	(0.014)	(0.011)	(0.017)
Percentage village electrified in 2002		-0.085	0.027			-0.004	0.161	
		(0.156)	(0.187)			(0.081)	(0.131)	
Percentage immediate neighborhood with electricity			-0.131	0.009			-0.214	0.038
			(0.161)	(0.115)			(0.158)	(0.172)
Demographic controls	YES	YES	YES	YES	YES	YES	YES	YES
Village f.e.	NO	NO	NO	YES	NO	NO	NO	YES
Observations	333	333	328	328	337	337	335	335
R-squared	0.028	0.031	0.035	0.114	0.076	0.076	0.083	0.158

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1