The impacts of rural electrification on labor supply and income: experimental evidence with solar lamps in Tanzania

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Anna Margret Aevarsdottir*, Nicholas Barton† and Tessa Bold‡

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Abstract

Energy, in particular electricity, is a viewed as a key component to economic development but nearly 1.3 billion individuals have no access to electricity. Grid expansion cannot currently meet the demands of many of these, including 530 million people in, primarily rural, sub-Saharan Africa. We provide experimental evidence on the impacts of non-grid small scale electrification through the use of a large scale randomized control trial. We offer randomized subsidies to 30 randomly selected households in each of 60 schools towards a solar lamp with a mobile phone charging point. We find that the lamps positively affect not only on immediate outcomes such as expenditure on lighting and mobile phone charging, but also on intermediate results including labor supply as well as final outcomes such as household income.

*anna.aevarsdottir@iies.su.se
†barton@econ.uni-frankfurt.de
‡tessa.bold@iies.su.se

1 Introduction

There is a general consensus that energy, in particular electricity, is a key input to economic development. Despite this consensus nearly 1.3 billion individuals around the world lack access to electricity, of those, over 600 million reside in sub-Saharan Africa (IEA, 2013, 2014). In addition, based on current grid expansion plans and high population growth, it is estimated that 530 million people in, primarily rural, sub-Saharan Africa will remain without grid connection for the next 30 years (IEA, 2014). In order to address these challenges the Sustainable Energy for All global initiative, launched in 2012, aims to extend electricity access to poor both through grid and non-grid small scale electrification, especially in SSA. All this is done in hope to unlock the development potential of electrification seen in context of developed countries. However, despite the apparent high potential, there is little robust evidence on the household level welfare effects of non-grid energy solutions, such as solar power. This paper aims to contribute evidence to this question.

The availability of electricity and other complementary investments, in particular lighting, is thought to affect development outcomes in a number of ways. The final outcomes of interests to policy makers are typically outcomes such as improved learning and education, increased labour supply and household income as well as better health. However, the pathways through which electricity affects the final outcomes of interest can be characterized by a number of intermediate outcomes which themselves may also be informative and interesting. These intermediate outcomes include, but are not limited to, additional productive hours for businesses, market work and study, improved productivity during existing work and study hours, improved access to information (via mobile phones, radios and internet), more efficient business practices through better access to communication technology and improvements in quality of life both as experienced subjectively and also objectively through improved indoor air quality as households switch from a relatively dirty energy source to

a cleaner source. A number of papers have shown – mainly outside of SSA – that with improvements in grid electricity such improvements in intermediate and final outcomes do indeed materialize, but have also pointed out the importance of complementary enabling conditions for the full benefits of electrification to arise. These findings include increases in female employment (Dinkelman, 2011; Grogan and Sadanand, 2013) and improvements in education (Khandker et al., 2013; Khandker and Samad, 2012) and health (Barron and Torero, 2014). Lenz et al. (2016) find that reductions in energy expenditure. All of these papers, however, focus on how grid connectivity influences outcomes and only one – from El Salvador (Barron and Torero, 2014), a considerably richer country than Tanzania – provides experimental evidence. Despite these positive findings of grid access relatively little robust evidence exists on comparative impacts of solar energy access.

In this paper we provide, to our knowledge, the first comprehensive evidence on the impact of rural electrification in a Sub-Saharan African setting on labor market outcomes, business practices and household income, based on a randomized controlled trial conducted in Tanzania.[1] In the experiment, households were randomly supplied with solar lamps (or rather differing subsidies to buy such lamps). The solar lamps offered are fitted with a USB charging point and with a daily charge the lamps have enough capacity to provide the household with bright light[2] for several hours and a small amount of power - enough to, for example, charge a mobile phone.

Using our experimental design we test how the supply of solar-powered lighting affects a range of intermediate as well as 'final' outcomes of interest. These outcomes include immediate outcomes such such as lighting and fuel expenditure, more intermediate ones

[1] A handful of other studies (Furukawa, 2014; Kudo et al., 2015; Hassan and Lucchino, 2017) have explored the educational impacts of access to solar energy in rural contexts with mixed results. With regards to immediate impacts, Grimm et al. (2016b) find that solar lamps reduce energy expenditure and lead households to substitute away from poor quality, high emission light sources

[2] The lamps on offer provide up to 160 lumens of usable light substantially more than a traditional kerosene lamp

such as labor market participation especially of women, and final outcomes in the form of household income. These variables were collected during an extensive household level survey.

As expected, household expenditure on lighting decreases as does expenditure on phone charging, both of which are clearly directly impacted by the ownership of a solar lamp sold as part of the study. The total savings accumulated over a two year period would be enough to pay for the lamp, without taking any other benefits into account. Having more reliable access to mobile phones also increases use of mobile money. Adults work more outside of the household and in jobs in which they can earn money. This increase includes more females working in jobs to earn money. Comfortingly, adolescents do not increase their labour supply nor drop out of school more. Owning a lamp appears to create new opportunities by which households can increase their income, in small part by exploiting the opportunity to charge others money for using the mobile phone charger. Not only do households report a higher income, but the respondents who have a solar lamp also report feeling happier with their current situation in life.

2 Setting and Program Description

In partnership with GiveWatts, an NGO working in Kenya and Tanzania, we designed a randomized field experiment in which households in rural Tanzania were offered the chance to purchase solar powered lamps with solar panels. In our study the lamps were offered at different levels of subsidization at the household level. The lamps are fitted with a mobile phone charging point and with a daily charge the lamps have enough capacity to provide the household with light for several hours and a small amount of power - enough to, for example, charge a mobile phone.

It may seem that this is a rather limited intervention given that the solar panels and lamps offered in our study are only able to provide a clean source of lighting and a limited

amount of power. However, it has been documented that even for rural households in sub-Saharan Africa with grid connections electricity consumption is generally quite low, typically in the range 50 and 100kWh per person per year. To put these numbers in context, annual consumption of 50kWh per person for a five person household would for example power a mobile phone, two compact fluorescent light bulbs and a fan for approximately five hours a day (IEA, 2014). These low levels of energy consumption despite grid connections lend support to the idea that decentralized energy solutions with minimal infrastructure investments can serve as a short run energy solution in rural areas where demand for energy and willingness-to-pay is low.

Our partner organization has been working with primary schools in rural Kenya since 2010 to provide solar power energy solutions to households in off-grid areas. Recently they have expanded their operations into the Northern part of Tanzania. The NGO operates based on the following protocol: first the NGO establishes a partnership with each school to facilitate the distribution of the lamps and collection of payments. The NGO officer then organizes a meeting with parents of children in the school to demonstrate how the lamps work and explain the price and payment structure of the lamps. The process of distributing the solar lamps and collecting payments from households is then managed jointly by the Parent Teacher Association in the school and a local agent from the NGO. The standard NGO model in Kenya provides the lamps at the recommended retail price of 3500 KSh ($37). Households are offered the lamps on credit and can repay over a number of months. The payment structure is such that households make an initial payment amounting to roughly a third of the total price and then pay the remainder of the cost in instalments over a 3 month period. The roll-out in Tanzania will follow a similar model and prices, with the major difference being that each of the four instalments are equal, at 20,000 TSh ($9.2). Repayment rates in Kenya are quite high with roughly 95% of lamps repaid in full. Despite the lamps being cost-effective when compared with alternative fuel sources, take up at full

price is rather low at an average of 10% across GiveWatts program schools.

3 Experimental Design

We designed our experiment with two factors in mind. First was the ability to estimate a demand curve for solar lamps. By offering the lamps to households at differing price levels, we can gain a relatively crude impression of the demand curve for solar lamps. Second we can then use the variation in demand for lamps at different prices to induce variation in lamp ownership. Where people receive a high subsidy, we can use this for an intention-to-treat estimation for the effects of lamp ownership.

3.1 Sample Selection

The evaluation sample consists of 2067 households in the catchment area of 69 primary schools in the district of Magu in Tanzania. The selection of Magu district was based on the expansion plans of our partner organization and the timing of the project funding. Based on the program structure of our partner organization the sample selection required a two step selection where we first selected schools to be part of the study and then selected households connected to each selected school.

3.1.1 Selection of schools

The selection of schools was randomized based on a list of all public schools in Magu district provided by the Ministry of Education and Vocational Training (MoEV) in Tanzania. From the list we randomly selected 69 schools to participate in our study. Of the 69 schools 60 were randomly selected to receive the subsidy treatment. The remaining 9 schools serve as control schools, but were eligible for the standard GiveWatts program.

3.1.2 Selection of students and households

From each of the selected schools we collected student rosters. From the student rosters we randomly selected 30 students per school. All households of students selected for the study were sent a letter introducing GiveWatts and informing them of the possibility of participating in our study and asking the student's parents to come to the school for a baseline interview. The letters were distributed to the students during school hours. Some students were not present at the distribution of letters. If a student was not present the next student from the randomized student list was selected as a replacement. As it is unlikely that student absence is purely random we will attempt to measure the extent of this selection effect by this using grade data from the school, if available, along with attendance data prior to the implementation of the program. In spite of possible sample selection of those present, we feel these are the households who would be likely to purchase lamps in the first place and as such are a representative sample of the households of interest to the study in the Mwanza region, given that households would have to have children attending school to purchase a lamp any way.

3.2 Treatment Assignment

Our main treatment instrument is a subsidy for a solar lamp, inducing variation in take-up of purchasing solar lamps.

3.2.1 Assignment of treatment at school level

The 69 schools selected to be part of our study were assigned to one of the three following treatment categories, each with different percentage subsidies available:

1. High average subsidy: $S_1 = \{0, 50, 100\}$

2. Low average subsidy: $S_2 = \{0, 25, 100\}$

3. No subsidy (Control schools)

We randomly assigned 30 schools to treatment arm A, with a high average subsidy, and 30 schools to treatment arm B, with low average subsidy. The remaining 9 schools are assigned to control arm C, without any subsidies.

3.2.2 Assignment of treatment at household level

The treatment assignment of households, their level of subsidy, was determined by a random draw from the set of subsidies S assigned to the school. This randomization took place via a public lottery with the respondents following the baseline interviews. Based on their draw the respondents were presented with a voucher for their assigned subsidy s_i. They could then redeem the voucher by purchasing a lamp from GiveWatts through the school. The voucher was valid for 2 weeks from the date of the draw. During the entire experiment, households were able to buy lamps from GiveWatts at the full unsubsidized price.

In all project schools GiveWatts followed their standard protocol in advertising the information meeting to all households in the school through the teachers and students. During the meeting there was a demonstration of how the lamps and solar panels work and parents were given information on the price and payment structure of the lamp. The introductory meeting was conducted at the school and led by a representative from GiveWatts.

4 Data Sources

The primary sources of data are a baseline survey conducted immediately before treatment assignment and a follow-up survey that was collected approximately 12 months after the baseline survey. Additional sources of data include a brief school survey, administrative data from the schools and administrative data from our partner organization, as well as a midline survey including student testing.

4.1 Baseline Survey

To measure the core outcome variables we conducted an extensive household level survey at baseline before program implementation for all households in the sample. The household survey was administered to a parent (or guardian) of the selected student at the school. The survey featured detailed questions on general household and individual characteristics. The questionnaire also included questions on fuel consumption and expenditures. The expenditure questions are intended to measure the household level savings due to reduced fuel expenditures following the repayment period. The questionnaire also contained a detailed module on economic activity and labour market outcomes for household members these include business activities, employment status, hours of work and earnings. The lamps may also provide household members with new income generating opportunities. Anecdotal evidence from conversations with our partner organization suggests that some households have used the lamps to sell mobile charging time to other households in the area or to rear animals such as chickens. In addition, the lamps may allow home-run businesses to stay open later into the evenings.

4.2 Midline Survey

We re-visted the communities approximately 5-6 months after the baseline survey and conducted midline surveys with about 10% of households in our sample. During this period households selected for the book treatment were also given an additional reader for the students.

4.3 Follow-up Survey

12 months after program implementation we conducted a second household survey for our initial sample households as well as re-testing the students in our sample. The household survey took place at the home of each household, allowing us also to obtain GPS coordinates for each household's domicile. At follow-up we also administered a detailed time-use survey to the parents and the selected students. This allows us to analyze the impact of the solar lamps on intermediate outcomes such as hours spent on income generating activities and study time.

4.4 Other data sources

We collected administrative data from two sources: the study schools and from our partner organization. The data from the schools includes enrolment and attendance data. The data from our partner organization includes take-up data (lamp purchase data) and repayment data.

5 Estimation Strategy

We estimate the treatment effects using the following strategy:

$$Y_{i,t+1} = \alpha + \beta L_i + \pi Y_{i,t} + \epsilon_{i,t+1} \tag{1}$$

where $Y_{i,t+1}$ represents an outcome variable at endline, with $Y_{i,t}$ its baseline value. L_i is the ownership of a lamp, for which we follow two definitions. The first definition is a dummy equal to one when the household purchased a lamp at baseline when given the opportunity. The above OLS regression shows whether those with a lamp are better off in terms of the chosen outcome variable, but does not imply causality as results may reflect a number of possible sources of endogeneity. We therefore exploit the random variation in the subsidies assigned to the households in an Instrumental Variables (IV) setup. Here, we use the take-up estimation as a first stage to predict whether households purchase/own a lamp from our intervention and use these predicted values ($\hat{L}_i$) in a second stage. In Equation 2 we use three alternative definitions for the subsidy variable s_i: the value of the subsidy, a dummy for 50% subsidy or more, and a dummy for a 100% subsidy.

$$L_{i,t} = \alpha + \beta s_i + \epsilon_i \tag{2}$$

$$Y_{i,t+1} = \alpha + \beta \hat{L}_i + \pi Y_{i,t} + \gamma \mathbf{X_{i,t}} + \epsilon_{i,t+1} \tag{3}$$

In this specification we can include specific control variables from the household survey, in particular we control for school fixed effects (which are akin to location effects in our setup), prior solar lamp ownership in conjunction with the highest subsidy as instrument. Alternatively, we run a regression with household fixed effects to control for all household

characteristics remaining constant over time.

$$Y_{i,t} = \nu_i + \gamma_t + \beta \hat{L}_{i,t} + \epsilon_{i,t} \tag{4}$$

In some cases we only have responses at endline in which case we cannot include household fixed effects or the baseline value of an outcome and so use the following specification:

$$Y_{i,t+1} = \alpha + \beta \hat{L}_i + \gamma \mathbf{X_{i,t}} + \epsilon_{i,t+1} \tag{5}$$

6 Results

6.1 Balance at baseline

Across our main treatment variable, the level of subsidy, the sample appears to be balanced on household level variables. There are no significant differences in any of the baseline variables in a regression on the subsidy level and a squared term. These results can be seen in Table 1 and show that the sample is balanced for both demographic and household variables such as household size, female employment, income, bank account ownership, kerosene expenditure, and prior solar lamp ownership.

6.2 First Stage

We explore the take-up of the lamp in more detail in a separate paper (Aevarsdottir et al., 2016), but present the simple take-up regression as the first stage here. In Table 2 it can be seen that the instrument is highly relevant and in each case the F-statistic is over 1000 for owning a lamp, clearly indicating we do not face a weak instruments problem. The first

stage is similarly strong for the case of being able to show the purchased lamp. The subsidy has the desired effect in encouraging households to purchase a solar lamp independent of the instrument used. Column 1 shows the first stage with the value of the subsidy ranging between 0 and 1. The result suggests that a respondent with a 100% subsidy is 85 percentage points more likely to buy the lamp and so around 90% of individuals with the 100% subsidy are predicted to buy the lamp. This also holds true in column 3 where the instrument used is a dummy for having received a 100% subsidy (a voucher worth 80,000 TSh towards the purchase of a lamp). In column two, we use a dummy for having received a 50% or 100% subsidy and find a large effect here as well.

6.3 Immediate Effects of solar lamp ownership

6.3.1 Energy and technology use

One would expect that purchase of a solar lamp means households can reduce their expenditure on lighting and fuel and Table 3 shows that this is indeed the case. Across the board, we see that households saved money that would have been spent on lighting and kerosene otherwise. We find negative and for the most part significant effects on lighting expenditure during the last and in a typical week, ranging from 500-1000 Tanzanian shillings (20-40 cents), or a relative reduction of expenditure by half to two thirds. If we take the conservative value of 500 TSh, as in columns (2) and (3) for a typical weeks spending, a household would save enough to purchase the lamp at the full price over a period of 160 weeks, or roughly three years. Spending on kerosene specifically does not seem to be the bulk of spending on lighting in the households in our sample, but we nonetheless observe a decrease in household spending on on this item, both in the last week and in a typical week. Estimates including household fixed effects appear very noisy with a wide range of effect sizes, but in the value

added specifications in columns (1)-(4) we observe decreased weekly expenditure of between 50 TSh and 100 TSh.

In addition to savings made on lighting, households in possession of a lamp from our intervention also have the opportunity to charge their mobile phone using the lamp, which 67% of lamp owners do. If households have no electricity at home, they typically have to travel to the nearest town or village centre where they pay 100-300 TSh to have their phone charged. If they live far from this centre, they often leave the mobile phone with the shopkeeper who is charging their phone for them. This means they not only face travel costs and time spent in order to get their phone charged this way, but they may also not have access to a mobile phone restricting any potential use of the phone. We estimate the immediate monetary savings from charging with the lamp both for last week and in a typical week (Table 4). The average spent last week by households at endline was 469 TSh, so the effect size of 300-400 TSh reduced expenditures are not only statistically but also economically significant. The results for typical spending are larger still at around 500 TSh for the IV results (columns (2)-(6)), independent of whether school fixed effects or a control for previous solar lamp ownership are included. The fact that there is no discernible change between columns (5) and (6) from the inclusion of a control for previous solar lamp ownership is indicative of the fact that it is unusual for solar lamps available on the market to include the opportunity to charge mobile phones.

Hence if we add the total expenditure reduction on lighting, fuel and mobile phone charging using te most conservative estimates of 900TSh/week, the average household would save enough to purchase the lamp at full price over a period of two years. Given that the lamps have a warranty period of three years, the savings on lighting alone are worth the value of the lamp purchase, without even considering additional benefits that the lamp may bring.

Some households even recognised an opportunity to make additional money and charged money for others to charge their phone with the lamp they now own. 46 of the 760 households with a lamp received money for phone charging, averaging over 6600 TSh per month.

6.4 Intermediate effects of solar lamp ownership

6.4.1 Labour Supply

Owning a clean and marginally free source of light may allow household members to use their time during daylight hours to work outside the household, and shift the time they carry out tasks in the home to the morning or evening. Consistent with this, we find that lamp ownership significantly increases the labor supply of adults in general and women in particular both at the extensive and intensive margin. In Table 5, we find an increase of roughly 5 percentage points in the number of households with at least one adult working outside the home (significant in the OLS and two of the IV specifications). This is equivalent to a 16% increase relative to households that do not own a lamp. The number of households with at least one adult earning income outside the house, which includes the sale of agricultural products produced on the household's own land as well as wage earning jobs outside the home, also increases, though the relative effect is smaller and significant in only one of the IV specifications. Turning to the intensive margin, we positive (and in some cases significant) increases in both the number of adults working outside the home and those earning income outside the home, equivalent to 10-20% compared to the control group.

Lamp ownership may be particularly beneficial for women in terms of allowing them to shift some of the housework to the evening and thereby free up time to work during the day. We test this in Table 6 and indeed find positive effects on the number of households with at least one woman working outside the home (significant in two of the IV specifications) and

on the number of women earning money outside the home (significant in 5 of the IV specifications). Lamp ownership increases the chance that a woman works outside the household by about a third and the number of women earning income outside the home by about 20%. The number of additional females earning is roughly one half of the increase in additional adults earning, indicating that men and women benefit equally from lamp ownership in terms of their labor supply.

While it may be desirable for adult household members to work more outside of the household to earn money, it is less desirable for adolescents to use their time in this way, especially if labor market participation crowded out school attendance and enrollment. It is therefore comforting to see that we do not see any significant changes in adolescents either working or earning income outside the home or being enrolled in school.

6.4.2 Mobile phone use

We previously saw that households are saving money on phone charging. In addition to saving money, they can now likely maintain access to their mobile phone while charging and can be more confident they will have a charged mobile when they need it. If households now have more reliable access to a mobile phone, this could increase their use of mobile money (Mpesa), which may be productivity enhancing. It is not clear whether this should take effect on the extensive margin, i.e. more people use Mpesa at all, or on the intensive margin, i.e. those with Mpesa increase their use of it. We test the effect of a lamp on the overall use of Mpesa in Table 8, where we find no increase in the number of households reporting that they use Mpesa. As part of the endline survey, we also asked about how much money a household saves with Mpesa as well as how much they send and receive. While not universally significant it appears clear that there is a positive trend to saving more with Mpesa for lamp owners in Table 9. The volume received clearly increases significantly, ranging from 42,000

to 64,000 TSh in the IV specifications is also economically significant with average household monthly income equal to around 83,000. Somewhat surprisingly given the previous results, the volume sent is not significantly different despite all coefficients being positive. In spite of the fact that households do not seem to be sending as much as they receive, there is clear evidence of an increased use of Mpesa on the intensive margin.

6.5 Final outcomes

6.5.1 Income

There are two ways in which the solar lamp could increase the household's income: (i) the phone charger could be 'rented' out to others to charger their phone; (ii) as a result of increased labor market participation.

In Table 11 we show estimation results for total household income, which is the sum of the income of all individuals in the household. We find that the coefficient on lamp ownership is positive across all specifications and significant in the specification with the 50% subsidy as an instrument. This would suggest that adults and females are able to work more in jobs where they can earn money as a consequence of lamp ownership. When considering per capita income, we see even more significant income increases. Taking the results from Table 11 as a whole, we can confidently say that income is increasing by 20-30% in households with a solar lamp. Part of this increase is covered by the ability to charge money for phone charging from others, which a small number of people exploited (46 of the 760 households with a lamp). This is shown in Table 10, where we see that essentially nobody makes money from charging phones in the control group reflected in what is essentially a zero income for these people as well. The additional income from charging for those with a lamp ranges from 200-400 TSh, which implies increased income for those who use the lamp in this way

of about 3000TSh a month (or the equivalent of charging ten phones). However, given the small number of people who engage in this practice, it would seem reasonable to conclude that the majority of the income increase works through increased labor supply.

6.5.2 Subjective Well-being

In addition to income, access to lighting may improve people's sense of well-being. Specifically, people may generally feel happier or safer due to having a brighter and cleaner light source. For example, in qualitative surveys at midline it was brought to our attention that some lamp owners used their lamps to check on their animals at night to prevent theft. We test whether the lamp leads to respondents feeling more secure with the use of the survey question from endline, "How safe and secure, on a scale from 0 (very unsafe with constant risk) to 10 (perfectly safe), would you say your household is at home?" Lamp owners do not feel more or less secure than non-lamp owners, as can be seen in Table 12. Also in this table are the results for general satisfaction with life, based on the question "How satisfied, on a scale from 0 (very unhappy) to 10 (very happy) would you say your household is with its current situation?" Here we see a positive effect of around one quarter of a point. This disappears, however, when school fixed effects are included and the effect becomes very close to zero (see columns (5) and (6)).

7 Conclusion

In this paper, we have shown experimental evidence on the impact electrifying rural households, or rather taking the first step along the way of electrification, namely providing with a source of lighting and ability to charge their mobile phones with a solar lamp. We see effects on a number of immediate, intermediate and final outcomes. Households report reduced

expenditure on lighting, fuel and mobile phone charging. The fact that more activities can now take place in the evening frees them up to participate in the labor market during the day and we see positive effects on labor supply for adults and in particular women. With more reliable phone charging, we also see an increase in the use of mobile money (at the intensive margin: more transfers and higher balances). At endline, households with a solar lamp report 20% higher income than those without. A small contribution to this income increase comes from the fact that some households offer the charger to others against a fee, but this percentage is so small that it seems likely that the remainder in the income increase comes about through increased labor market participation.

It therefore seems that solar lamps are a cost-effective way to improve welfare. With the expenditure savings alone, the lamps would have paid for themselves after two years. Yet, in Aevarsdottir et al. (2016), we find that only few households are willing to purchase the lamps at full cost (see also Grimm et al. (2016a)). Understanding why willingness to pay for electrification is so low seems therefore an important issue.

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8 Tables and Figures

Table 1: Balance table - lamp subsidies

	(1) hh size	(2) female empl	(3) hh income	(4) account	(5) kerosene	(6) nonsolar
subsidy	0.06	0.00	146.71	0.08	310.21	0.05
	(0.75)	(0.09)	(106.77)	(0.07)	(240.88)	(0.13)
subsidy2	-0.30	-0.00	-155.87	-0.09	-290.65	-0.03
	(0.71)	(0.09)	(100.38)	(0.07)	(226.39)	(0.12)
Observations	1824	1830	1830	1824	1824	1830
F	2.39	3.30	1.38	3.26	2.68	2.04

Standard errors in parentheses
All regressions include school fixed effects
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: First stage

	(1) Lamp	(2) Lamp	(3) Lamp
Subsidy as percent	0.867***		
	(0.0193)		
50% or more		0.683***	
		(0.0179)	
100%			0.672***
			(0.0205)
Constant	0.0576***	0.114***	0.213***
	(0.0115)	(0.0120)	(0.0115)
Observations	1629	1629	1629
F	2023.6	1464.5	1071.9

Table 3: Impacts on expenditure: lighting

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Light (last week)	-581.031	-322.386	69.561	-757.668	-875.507	-861.964	-498.929	-295.801	154.229	-780.944
	(228.740)**	(307.240)	(333.412)	(362.449)**	(398.422)**	(398.597)**	(243.570)**	(327.140)	(354.871)	(386.217)**
Mean in Control Group	979.728	869.286	701.924	1055.152	1122.311	928.137	766.106	766.106	766.106	766.106
	(155.918)***	(178.867)***	(187.383)***	(196.796)***	(208.915)***	(258.738)***	(85.028)***	(85.047)***	(85.216)***	(85.063)***
Light (typical week)	-484.003	-501.385	-490.835	-613.683	-776.838	-764.570	-1058.223	-1253.462	-1160.478	-1771.321
	(187.372)***	(251.617)**	(272.403)*	(297.055)**	(325.103)**	(325.136)**	(1260.298)	(1692.358)	(1832.151)	(1997.764)
Mean in Control Group	1013.342	1020.660	1016.218	1067.941	1140.666	968.320	5404.751	5404.751	5404.751	5404.751
	(123.232)***	(142.076)***	(148.716)***	(156.868)***	(165.953)***	(204.020)***	(439.960)***	(439.963)***	(439.961)***	(440.003)***
Kerosene (last week)	-53.133	-76.348	-75.375	-69.661	-51.338	-51.907	-.332	-77.740	-132.834	-21.488
	(16.586)***	(22.282)***	(24.078)***	(26.332)***	(28.806)*	(28.835)*	(50.417)	(67.766)	(73.406)*	(80.005)
Mean in Control Group	71.808	81.761	81.344	78.894	75.722	83.168	457.384	457.384	457.384	457.384
	(11.514)***	(13.167)***	(13.735)***	(14.475)***	(15.218)***	(19.250)***	(17.609)***	(17.621)***	(17.646)***	(17.610)***
Kerosene (typical week)	-65.147	-93.325	-91.536	-83.608	-52.222	-54.005	672.980	1062.388	517.822	1517.662
	(19.371)***	(26.048)***	(28.167)***	(30.777)***	(33.218)	(33.236)	(498.575)	(669.780)	(724.405)	(791.830)*
Mean in Control Group	89.450	101.528	100.762	97.363	88.561	107.982	3459.109	3459.109	3459.109	3459.109
	(13.093)***	(15.076)***	(15.760)***	(16.631)***	(17.312)***	(21.512)***	(174.134)***	(174.166)***	(174.139)***	(174.287)***
Obs.	1629	1629	1629	1629	1629	1629	3258	3258	3258	3258
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}		S_i	S_{50}	S_{100}
Value added	X	X	X	X	X	X				
School fixed effects					X	X				
Control: any solar at baseline						X				
Household fixed effects							X	X	X	X

Table 4: Impacts on expenditure: mobile phone charging

	(1)	(2)	(3)	(4)	(5)	(6)
Charging phone (last week)	-306.36	-365.57	-366.92	-381.34	-369.20	-369.05
	(29.86)***	(40.37)***	(43.95)***	(48.16)***	(53.34)***	(53.37)***
Mean in Control Group	469.72	495.31	495.90	502.13	496.88	493.61
	(19.63)***	(22.89)***	(24.09)***	(25.56)***	(27.33)***	(33.73)***
Charging phone (typical week)	-397.13	-525.66	-521.58	-511.14	-437.27	-435.74
	(83.47)***	(112.77)***	(122.75)***	(134.39)***	(149.37)***	(149.44)***
Mean in Control Group	578.34	633.88	632.12	627.61	595.68	560.56
	(54.87)***	(63.94)***	(67.28)***	(71.32)***	(76.54)***	(94.44)***
Obs.	1342	1342	1342	1342	1342	1342
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}
Value added	X	X	X	X	X	X
School fixed effects					X	X
Control: any solar at baseline						X

Table 5: Intermediate impacts related to income generation: adult labor market participation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Anyone working outside the home	.052	.055	.084	.048	.037	.037	.027	.030	.058	.020
	(.024)**	(.032)*	(.035)**	(.038)	(.040)	(.040)	(.029)	(.040)	(.043)	(.047)
Mean in Control Group	.287	.286	.274	.288	.315	.322	.334	.334	.334	.334
	(.017)***	(.019)***	(.020)***	(.021)***	(.022)***	(.026)***	(.010)***	(.010)***	(.010)***	(.010)***
Anyone earning income outside the home	.023	.028	.043	.016	-.006	-.005	.020	.046	.080	.029
	(.022)	(.030)	(.032)	(.035)	(.038)	(.038)	(.032)	(.043)	(.046)*	(.050)
Mean in Control Group	.672	.670	.664	.675	.688	.672	.620	.620	.620	.620
	(.020)***	(.022)***	(.022)***	(.023)***	(.024)***	(.027)***	(.011)***	(.011)***	(.011)***	(.011)***
Number working outside the home	.061	.075	.094	.074	.045	.047	.027	.064	.078	.073
	(.037)*	(.050)	(.054)*	(.059)	(.063)	(.063)	(.046)	(.062)	(.067)	(.073)
Mean in Control Group	.379	.374	.366	.374	.420	.405	.461	.461	.461	.461
	(.027)***	(.030)***	(.031)***	(.033)***	(.034)***	(.040)***	(.016)***	(.016)***	(.016)***	(.016)***
Number earning income outside the home	.058	.129	.166	.114	.070	.073	.070	.244	.264	.297
	(.055)	(.074)*	(.080)**	(.087)	(.096)	(.096)	(.078)	(.106)**	(.114)**	(.125)**
Mean in Control Group	1.138	1.108	1.092	1.115	1.135	1.077	1.138	1.138	1.138	1.138
	(.044)***	(.049)***	(.050)***	(.052)***	(.055)***	(.064)***	(.027)***	(.027)***	(.027)***	(.027)***
Obs.	1629	1629	1629	1629	1629	1629	3258	3258	3258	3258
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}		S_i	S_{50}	S_{100}
Value added	X	X	X	X	X	X				
School fixed effects					X	X				
Control: any solar at baseline						X				
Household fixed effects							X	X	X	X

Table 6: Intermediate impacts related to income generation: female labor market participation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Anyone working outside the home	.016	.040	.062	.032	.009	.007	.002	.036	.061	.026
	(.021)	(.028)	(.030)**	(.032)	(.034)	(.034)	(.025)	(.033)	(.036)*	(.039)
Mean in Control Group	.169	.159	.150	.163	.183	.199	.170	.170	.170	.170
	(.014)***	(.016)***	(.017)***	(.018)***	(.018)***	(.022)***	(.009)***	(.009)***	(.009)***	(.009)***
Obs.	1588	1588	1588	1588	1588	1588	3212	3212	3212	3212
Anyone earning income outside the home	.002	.051	.060	.052	.026	.028	-.011	.051	.059	.072
	(.025)	(.034)	(.037)	(.040)	(.044)	(.044)	(.034)	(.046)	(.050)	(.055)
Mean in Control Group	.449	.428	.424	.428	.443	.421	.381	.381	.381	.381
	(.019)***	(.021)***	(.022)***	(.023)***	(.024)***	(.029)***	(.012)***	(.012)***	(.012)***	(.012)***
Obs.	1588	1588	1588	1588	1588	1588	3212	3212	3212	3212
Number working outside the home	.014	.043	.061	.037	.009	.008	-.008	.033	.056	.028
	(.023)	(.031)	(.034)*	(.037)	(.040)	(.040)	(.028)	(.038)	(.041)	(.045)
Mean in Control Group	.186	.174	.166	.176	.200	.220	.185	.185	.185	.185
	(.016)***	(.018)***	(.019)***	(.020)***	(.020)***	(.025)***	(.010)***	(.010)***	(.010)***	(.010)***
Obs.	1629	1629	1629	1629	1629	1629	3258	3258	3258	3258
Number earning income outside the home	.024	.077	.087	.070	.035	.037	.021	.112	.110	.135
	(.032)	(.043)*	(.047)*	(.051)	(.056)	(.056)	(.045)	(.061)*	(.066)*	(.072)*
Mean in Control Group	.489	.466	.462	.469	.488	.463	.462	.462	.462	.462
	(.023)***	(.026)***	(.027)***	(.029)***	(.031)***	(.036)***	(.016)***	(.016)***	(.016)***	(.016)***
Obs.	1629	1629	1629	1629	1629	1629	3258	3258	3258	3258
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}		S_i	S_{50}	S_{100}
Value added	X	X	X	X	X	X				
School fixed effects					X	X				
Control: any solar at baseline						X				
Household fixed effects							X	X	X	X

Table 7: Intermediate impacts related to income generation: juvenile enrollement and labor market participation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Number working outside the home	-.013	-.008	-.015	-.005	-.007	-.008	-.059	-.020	-.035	-.001
	(.007)**	(.009)	(.010)	(.011)	(.012)	(.012)	(.038)	(.051)	(.055)	(.060)
Mean in Control Group	.023	.021	.024	.019	.020	.028	.459	.459	.459	.459
	(.005)***	(.005)***	(.006)***	(.006)***	(.006)***	(.007)***	(.013)***	(.013)***	(.013)***	(.013)***
Number earning income outside the home	-.014	-.008	-.009	-.010	-.013	-.013	-.019	-.018	-.021	-.027
	(.010)	(.013)	(.014)	(.016)	(.017)	(.017)	(.014)	(.019)	(.020)	(.022)
Mean in Control Group	.040	.037	.037	.038	.039	.038	.033	.033	.033	.033
	(.006)***	(.007)***	(.008)***	(.008)***	(.009)***	(.011)***	(.005)***	(.005)***	(.005)***	(.005)***
Number enrolled	.051	.001	.030	-.048	-.074	-.069	.0008	-.018	-.044	-.017
	(.037)	(.049)	(.053)	(.058)	(.064)	(.064)	(.048)	(.064)	(.069)	(.075)
Mean in Control Group	.338	.358	.347	.378	.397	.333	.673	.673	.673	.673
	(.027)***	(.030)***	(.031)***	(.033)***	(.035)***	(.041)***	(.017)***	(.017)***	(.017)***	(.017)***
Obs.	1629	1629	1629	1629	1629	1629	3258	3258	3258	3258
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}		S_i	S_{50}	S_{100}
Value added	X	X	X	X	X	X				
School fixed effects					X	X				
Control: any solar at baseline						X				
Household fixed effects							X	X	X	X

Table 8: Intermediate impacts related to income generation via improved business practices: mobile money

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Has Mpesa	.012	.019	.047	.012	-.00004	.001	-.002	.003	.033	.011
	(.024)	(.032)	(.035)	(.038)	(.042)	(.042)	(.029)	(.040)	(.043)	(.047)
Mean in Control Group	.351	.348	.337	.351	.370	.355	.622	.622	.622	.622
	(.022)***	(.023)***	(.024)***	(.025)***	(.026)***	(.029)***	(.010)***	(.010)***	(.010)***	(.010)***
Obs.	1627	1627	1627	1627	1627	1627	3256	3256	3256	3256
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}		S_i	S_{50}	S_{100}
Value added	X	X	X	X	X	X				
School fixed effects					X	X				
Control: any solar at baseline						X				
Household fixed effects							X	X	X	X

Table 9: Intermediate impacts related to income generation via improved business practices: mobile money

	(1)	(2)	(3)	(4)	(5)	(6)
Savings	173793.00	274108.70	245444.00	338981.40	368057.80	371741.60
	(119884.40)	(158792.90)*	(171000.10)	(187613.40)*	(212568.10)*	(212743.30)*
Mean in Control Group	46871.71	3732.55	16059.36	-24164.91	-36668.77	-95219.98
	(78616.55)	(90490.60)	(94507.51)	(100197.90)	(109149.70)	(136998.80)
Volume received	27426.08	47420.21	42215.41	60255.39	63082.04	63812.93
	(13328.37)**	(17669.69)***	(19020.73)**	(20907.68)***	(23415.07)***	(23419.78)***
Mean in Control Group	22266.77	13668.61	15906.86	8149.05	6933.50	-4683.58
	(8740.35)**	(10069.35)	(10512.29)	(11166.08)	(12023.20)	(15081.47)
Volume sent	7267.07	30313.37	20070.45	28877.00	22169.53	22958.97
	(16109.96)	(21354.82)	(22982.45)	(25209.92)	(28522.01)	(28531.53)
Mean in Control Group	24681.31	14770.61	19175.42	15388.30	18272.74	5725.11
	(10564.43)**	(12169.38)	(12701.83)	(13463.76)	(14645.52)	(18373.25)
Obs.	879	879	879	879	879	879
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}
Value added	X	X	X	X	X	X
School fixed effects					X	X
Control: any solar at baseline						X

Table 10: Final outcomes : income from charger

	OLS	IV1	IV2	IV3	IV3FE	IV3FES
	(1)	(2)	(3)	(4)	(5)	(6)
Make money fr. charger	.03	.02	.02	.02	.02	.02
	(.006)***	(.008)***	(.009)***	(.009)**	(.01)*	(.01)*
Mean in Control Group	.00	.004	.004	.005	.006	.004
	(.004)	(.004)	(.005)	(.005)	(.005)	(.006)
Obs.	1629	1629	1629	1629	1629	1629
Income fr. charger	222.82	182.67	151.43	177.85	167.01	169.77
	(58.23)***	(78.23)**	(84.65)*	(92.42)*	(102.27)	(102.33)*
Mean in Control Group	1.86e-12	16.96	30.15	18.99	23.57	-12.77
	(37.85)	(43.81)	(45.89)	(48.49)	(51.94)	(63.69)
Obs.	964	964	964	964	964	964
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}
Value added	X	X	X	X	X	X
School fixed effects					X	X
Control: any solar at baseline						X

Table 11: Final outcomes : income

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Household income	109513.300	147286.400	223701.300	167577.000	116990.600	120766.500	133894.800	148516.000	25488
	(85530.760)	(114267.400)	(124321.900)*	(133817.500)	(145815.100)	(145796.200)	(88182.200)	(117846.400)	(128139
Mean in Control Group	699339.500	683565.700	651655.300	675092.500	715983.500	638037.300	99.637	99.637	99.6
	(58017.500)***	(66087.290)***	(69195.370)***	(72205.720)***	(76035.880)***	(91387.520)***	(30264.300)	(30264.570)	(30282
Household income per capita	16402.530	26675.350	33597.830	34050.500	26617.010	26792.780	21761.030	28342.060	39438
	(12084.860)	(16148.070)*	(17570.510)*	(18919.850)*	(20583.740)	(20597.670)	(12528.250)*	(16744.050)*	(18205.
Mean in Control Group	89068.730	84796.190	81917.070	81728.800	87922.480	84697.020	13.081	13.081	13.0
	(8116.261)***	(9259.383)***	(9698.803)***	(10128.510)***	(10642.730)***	(12877.780)***	(4299.717)	(4300.100)	(4302
Obs.	1554	1554	1554	1554	1554	1554	3183	3183	318
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}		S_i	S_5
Value added	X	X	X	X	X	X			
School fixed effects					X	X			
Control: any solar at baseline						X			
Household fixed effects							X	X	X

Table 12: Final outcomes : Subjective Well-being

	(1)	(2)	(3)	(4)	(5)	(6)
Security (0=worst, 10=best)	-.002	-.05	.05	-.11	-.06	-.06
	(.10)	(.13)	(.14)	(.15)	(.16)	(.16)
Mean in Control Group	7.35	7.38	7.33	7.40	7.38	7.33
	(.06)***	(.07)***	(.08)***	(.08)***	(.08)***	(.10)***
Happiness (0=worst, 10=best)	.26	.26	.38	.12	.009	.03
	(.09)***	(.12)**	(.13)***	(.15)	(.16)	(.16)
Mean in Control Group	4.25	4.25	4.20	4.31	4.35	4.13
	(.06)***	(.07)***	(.07)***	(.08)***	(.08)***	(.10)***
Obs.	1627	1627	1627	1627	1627	1627
IV		S_i	S_{50}	S_{100}	S_{100}	S_{100}
Value added	X	X	X	X	X	X
School fixed effects					X	X
Control: any solar at baseline						X

Table 13: Reading results - endline

	OLS	IV1	IV2	IV3	IV1FE	IV2FE	IV3FE	OLSFE	FEIV1	FEIV2	FEIV3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
read-story	-.026	-.007	-.016	.007	.004	-.030	.022	-.006	-.001	-.029	.036
	(.024)	(.032)	(.035)	(.038)	(.035)	(.037)	(.041)	(.034)	(.047)	(.049)	(.052)
read-story	.426	.419	.422	.412	.424	.437	.415	.563	.564	.563	.563
	(.022)***	(.023)***	(.024)***	(.025)***	(.025)***	(.025)***	(.026)***	(.012)***	(.012)***	(.012)***	(.012)***
understand-story	-.008	-.051	-.073	-.057	-.043	-.068	-.055	-.043	-.059	-.116	-.037
	(.025)	(.034)	(.037)*	(.040)	(.037)	(.039)*	(.044)	(.034)	(.048)	(.051)**	(.053)
understand-story	.269	.287	.296	.290	.290	.301	.295	.352	.357	.352	.352
	(.018)***	(.021)***	(.022)***	(.023)***	(.022)***	(.023)***	(.024)***	(.012)***	(.012)***	(.012)***	(.012)***
read-english	-.047	-.008	-.036	.032	.074	.048	.089	-.032	.058	.004	-.002
	(.046)	(.062)	(.068)	(.074)	(.064)	(.067)	(.075)	(.060)	(.083)	(.089)	(.096)
read-english	.269	.252	.264	.234	.239	.249	.232	.762	.772	.762	.762
	(.032)***	(.037)***	(.039)***	(.041)***	(.036)***	(.037)***	(.040)***	(.020)***	(.021)***	(.020)***	(.020)***
understand-english	.011	-.008	-.026	.006	.039	.021	.032	-.039	-.029	-.045	-.074
	(.033)	(.045)	(.050)	(.054)	(.048)	(.051)	(.056)	(.039)	(.054)	(.059)	(.063)
understand-english	.110	.119	.126	.112	.099	.106	.102	.064	.069	.064	.064
	(.022)***	(.026)***	(.028)***	(.029)***	(.027)***	(.028)***	(.030)***	(.013)***	(.014)***	(.013)***	(.013)***
Obs.	1343	1340	1343	1343	1340	1343	1343	2684	2505	2684	2684
Obs.	1331	1328	1331	1331	1328	1331	1331	2675	2497	2675	2675
Obs.	379	378	379	379	378	379	379	1175	1097	1175	1175
Obs.	373	372	373	373	372	373	373	1088	1016	1088	1088

Table 14: Math results - endline

	OLS	IV1	IV2	IV3	IV1FE	IV2FE	IV3FE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
math	.12	-.06	-.002	-.05	-.06	.05	-.04
	(.11)	(.15)	(.16)	(.17)	(.16)	(.16)	(.18)
math	4.72	4.81	4.78	4.80	4.81	4.75	4.79
	(.07)***	(.09)***	(.08)***	(.09)***	(.09)***	(.08)***	(.09)***
Obs.	1439	1340	1439	1439	1340	1439	1439

Table 15: Reading results - midline

	OLS	IV1	IV2	IV3	IV1FE	IV2FE	IV3FE	OLSFE	FEIV1	FEIV2	FEIV3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
read-story	.003	.033	.059	.014	.047	.072	.025	.006	.001	.029	-.036
	(.025)	(.034)	(.037)	(.039)	(.036)	(.038)*	(.042)	(.034)	(.047)	(.049)	(.052)
read-story	.224	.212	.201	.220	.204	.192	.212	.665	.670	.665	.665
	(.023)***	(.025)***	(.026)***	(.027)***	(.026)***	(.026)***	(.028)***	(.011)***	(.011)***	(.011)***	(.011)***
understand-story	.028	.019	.043	-.004	.031	.058	-.001	.043	.059	.116	.037
	(.027)	(.036)	(.039)	(.042)	(.039)	(.041)	(.046)	(.034)	(.048)	(.051)**	(.053)
understand-story	.242	.246	.236	.257	.247	.235	.262	.384	.386	.384	.384
	(.020)***	(.023)***	(.024)***	(.025)***	(.024)***	(.024)***	(.026)***	(.011)***	(.011)***	(.011)***	(.011)***
read-english	-.022	-.011	-.020	.026	-.029	-.042	-.022	.032	-.058	-.004	.002
	(.045)	(.059)	(.063)	(.071)	(.062)	(.064)	(.073)	(.060)	(.083)	(.089)	(.096)
read-english	.805	.800	.805	.784	.811	.817	.808	.256	.248	.256	.256
	(.032)***	(.036)***	(.037)***	(.040)***	(.036)***	(.037)***	(.040)***	(.019)***	(.020)***	(.019)***	(.019)***
understand-english	.049	.067	.069	.057	.018	.016	.026	.039	.029	.045	.074
	(.033)	(.044)	(.047)	(.051)	(.045)	(.047)	(.052)	(.039)	(.054)	(.059)	(.063)
understand-english	.060	.052	.051	.056	.077	.078	.073	.099	.093	.099	.099
	(.022)***	(.026)**	(.027)*	(.028)**	(.025)***	(.026)***	(.028)***	(.012)***	(.012)***	(.012)***	(.012)***
Obs.	1168	1165	1168	1168	1165	1168	1168	2684	2505	2684	2684
Obs.	1165	1162	1165	1165	1162	1165	1165	2675	2497	2675	2675
Obs.	349	348	349	349	348	349	349	1175	1097	1175	1175
Obs.	300	299	300	300	299	300	300	1088	1016	1088	1088

Table 16: Math results - midline

	OLS	IV1	IV2	IV3	IV1FE	IV2FE	IV3FE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
math	.09	.008	-.07	.02	.01	-.10	-.02
	(.08)	(.12)	(.12)	(.13)	(.12)	(.12)	(.13)
math	5.65	5.69	5.72	5.68	5.68	5.73	5.70
	(.05)***	(.07)***	(.07)***	(.07)***	(.07)***	(.06)***	(.07)***
Obs.	1217	1138	1217	1217	1138	1217	1217

Table 17: Reading results - endline

	OLS	IV1FE	IV2FE	IV3FE
	(1)	(2)	(3)	(4)
b-nolampXb-book	-.03	-.02	-.007	-.02
	(.03)	(.04)	(.05)	(.05)
b-lampXb-nobook	-.07	-.04	-.06	-.02
	(.03)**	(.05)	(.06)	(.06)
b-lampXb-book	-.008	.02	-.01	.04
	(.03)	(.04)	(.04)	(.05)
b-nolampXb-book	-.009	-.03	-.01	-.05
	(.03)	(.05)	(.05)	(.05)
b-lampXb-nobook	-.04	-.10	-.11	-.13
	(.04)	(.05)*	(.06)*	(.06)**
b-lampXb-book	.01	-.02	-.04	-.03
	(.03)	(.05)	(.05)	(.05)
Obs.	1343	1340	1343	1343
Obs.	1331	1328	1331	1331

Table 18: Reading results - midline

	OLS	IV1FE	IV2FE	IV3FE
	(1)	(2)	(3)	(4)
b-nolampXb-book	-.03	-.04	-.05	-.02
	(.03)	(.04)	(.05)	(.05)
b-lampXb-nobook	-.02	-.004	.006	-.005
	(.04)	(.05)	(.06)	(.06)
b-lampXb-book	.003	.06	.08	.04
	(.03)	(.04)	(.04)*	(.05)
b-nolampXb-book	-.01	-.04	-.03	-.05
	(.04)	(.05)	(.05)	(.05)
b-lampXb-nobook	.005	-.03	.01	-.07
	(.04)	(.06)	(.06)	(.07)
b-lampXb-book	.04	.05	.07	.02
	(.04)	(.05)	(.05)	(.05)
Obs.	1168	1165	1168	1168
Obs.	1165	1162	1165	1165