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THE IMPLICATIONS OF WATER AND ELECTRICITY SUPPLY FOR THE TIME ALLOCATION OF WOMEN IN RURAL GHANA

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ABSTRACT

This paper investigates the time allocation of women in Ghana as a trade-off between domestic chores and market-oriented activities when households are provided with water and electricity infrastructure. Using the Ghana Living Standards Survey, Round Four, we find that the time spent on remunerated activities increases when households are provided with electricity, while the supply of water reduces the time burden faced by rural women.

JEL classification: D13, J22, H41, Q25.

Keywords: poverty, time allocation, basic services provision.

INTRODUCTION

In developing countries, social norms guide intra-household divisions of labour and use of time. Time allocation is largely influenced by gender, inasmuch as work opportunities are distinct for women and men. Female income poverty is often linked to time poverty. Women spend several hours a day performing domestic chores and caring for other household members. Releasing time constraints would enable women to engage in productive activities (participate in labour markets), dedicate more time to other domestic activities (such as childcare or caring for elderly members), pursue further education, or have some leisure (which in turn contributes to better health).

The disproportionate burden of domestic activities on women, in turn, is exacerbated by a lack of basic infrastructure. The provision of infrastructure, mainly water and electricity, has the potential to reduce the time burden women face. The saving includes time spent on loading and unloading water, purifying it, and walking to and from the water source. Furthermore, access to safe water improves overall household living conditions through its associated benefits, such as reducing waterborne diseases, lowering infant mortality and preventing the threat of violent aggression towards women on their way to water sources, which are often located some distance from their homes.

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This paper shows how greater access to water and electricity changes women's time allocation among paid activities (labour market), unpaid activities (domestic chores) and leisure. The paper contributes to the literature on gender-based time poverty by providing empirical evidence from rural Ghana. It is structured as follows: Section 2 briefly reviews the literature on infrastructure and gender bias. Section 3 discusses the conceptual framework. Section 4 presents the data and empirical models. The results of the empirical exercise are provided in Section 5. Section 6 offers concluding remarks.

1 INFRASTRUCTURE AND TIME USE IN THE LITERATURE

There is a consensus that better basic infrastructure improves living standards. Additionally, there is a growing awareness that the time spent on activities such as fetching water or wood represents not only a decline in households' well-being but also significant forgone income if the time saved were to be spent on paid activities. Whittington et al. (1990) have estimated that the value that households in a Kenyan village place on the time they spend collecting water amounts to the wage rate of an unskilled worker. This has important implications for household income poverty.

Improvements in living standards arising from access to infrastructure are both direct and indirect. Direct impacts stem from a clear cause-and-effect relationship whereby clean water, sanitation and proper collection of disposables, for instance, give rise to improved health and a better quality of life. Indirect effects stem from the extra time available to households as a result of their access to basic services, and their ability to use that additional time in order to improve their living standards: further education, better household care, participation in the labour market, or even more leisure.

Thus far, however, the literature has not reached an empirical consensus on the relationship between infrastructure and access to labour markets. Using the Pakistani household living standards survey of 1991, Ilahi and Grimard (2000) show that poor rural infrastructure (lack of access to water) reduces the time that women devote to market-oriented activities and increases their total work time. This implies that water provision in these communities encouraged not only a move towards market-oriented work among women, but also an increase in the time available for leisure. While the first result has the potential to reduce income poverty, the s econd is important for the elimination of women's time deprivation.

Time, being a limited resource, involves a trade-off between competing activities. When individuals struggle to find time, apart from their working duties, the constraint is known as time poverty. Bardasi and Woodon (2006) suggest the thresholds of 70.5 and 94 hours a week.[1] They use a 2002–2003 time-use survey of Guinea to analyse the determinants of the probability of individuals being time-poor as a function of personal, household and location characteristics. Analysing Guineans aged 15 and above they find that women have a 3 percentage-point higher probability of being time-poor than men; being a woman in the countryside adds 10 percentage points to this probability. The authors argue that this time-poverty gender bias is caused by the rising demands of household care and by a lack of access to basic infrastructure.

Coloumbe and Wodon (2008) investigate the distribution of working hours for adults (male and female) aged between 25 and 64 in Ghana, using data for 1991, 1998 and 2005. They argue that women are more likely to be time-poor than men, but that having access to infrastructure does not significantly affect the total number of hours that women work. They suggest, however, that better access to infrastructure may lower the domestic work burden as time is reallocated to women's participation in productive activities—which potentially could help alleviate income poverty.

In summary, there is some evidence that access to basic infrastructure helps reduce income poverty. The relationship, however, is not always evident. More empirical evidence is therefore needed, and further research is required.

3 THE THEORETICAL FRAMEWORK

Studies of time allocation are often based on Becker's (1965) utility model. We closely follow Ilahi and Grimard (2000), wherein water consumption explicitly enters the household consumption model. In our extension, besides testing whether poor water-supply infrastructure affects women's time allocation, we also investigate the role of electricity supply.

We consider the household as a unitary entity that combines time and market-purchased goods to produce commodities that comprise the household utility function. The household maximises its utility depending on the goods and leisure time consumed. Consumption, *ci*, is determined by a home production function as follows:

$$c_i = c(W_i, x_i, t_i^h; \gamma_i), \tag{1}$$

where W_i is the amount of water consumed by household *i*, x_i is a set of market-purchased goods, t_i^h is the time allocated to home goods (domestic chores) production, and γ_i is the home production technology parameter.

Water consumption, *W*, depends on household water production, largely influenced by how much time households allocate to collecting water, t_i^w.[2] This task is usually performed by one or a few household members, who first choose whether or not to collect water, and then decide how many hours to spend doing so. The amount of water consumed also depends on the infrastructure available for water collection, α_i, which considers both household and community characteristics faced by household *i*. Households in communities served by the utility network may spend much less time fetching water than if members had to walk a couple of miles to reach the water source.

$$W_i = f(t_i^w; \alpha_i). \tag{2}$$

The household's problem is to decide on the consumption level and the time allocated to each activity (water production, t^w; market labour, t^m; household activities, t^h; and leisure, t^l) according to its preferences (τ_i) and constrained by its available income (market wage, *w*; and non-labour income, *V*), plus a daily time endowment, *T*.

$$\begin{aligned} &\max_{c_i, t_i^l} u_i = u(c_i, t_i^l; \tau_i) \\ &s.t.\ \ t_i^w + t_i^m + t_i^h + t_i^l \leq T \\ &\quad x_i \leq w_i t_i^m + v_i \end{aligned} \tag{3}$$

The solution yields the optimum set of time and goods demand functions:

$$\begin{aligned} t^{j*} &= t^{j*}(w, v, \tau, \alpha, \gamma) \\ x^* &= x^*(w, v, \tau, \alpha, \gamma) \end{aligned} \tag{4}$$

where $j = w, m, h, l$.

Our aim is to understand the effects of changes in community and household-level access to water and electricity infrastructure on women's allocation of time to collecting water, domestic activities, market-oriented activities and total work.

It is important to be aware of the differences between access to water and electricity. Lack of direct access to water means that households' daily water needs must be met by collecting water. Some household members thus have to devote part of their time to that task. Electricity has no perfect substitute such as between piped and collected water. But access to it improves productivity and therefore allows the reallocation of time spent on each type of work.

4 DATA AND EMPIRICAL MODEL

4.1 DATA

We use data from the Ghana Living Standards Survey, Round Four (GLSS 4). The survey was carried out during 11 consecutive months between March 1998 and February 1999 by the Ghana Statistical Service. The survey-sampling design entailed two stages. First, the 300 Enumeration Areas (EAs) were chosen using the probability-proportional-to-size method based on the number of households in the EA. In the second stage, 20 households in each EA were systematically selected, giving the total of 6,000 households surveyed.

In this study we analyse the time use of a sample of 3,799 households in the 190 rural communities surveyed. We focus on rural areas because of the low rate of access to water and electricity.[3] More specifically, we are interested in individuals between 25 and 59 years old, corresponding to a sample of 2,858 women and 2,052 men. This cohort ideally reflects an individual's productive age—that is, those who have finished school and are not yet considered elderly.[4] To define the lower age boundary for our sample we evaluate empirically the proportion of women still studying. If women are attending school they are expected to have limited participation in both the labour market and domestic activities. We restrict our sample to individuals in the economically productive age, measured as the ability to work with no mandatory educational time constraints. Although the illiteracy rate in rural Ghana is high and most rural Ghanaian women do not reach secondary school, it is estimated that 61.7 per cent of women above 15 years of age had attended school for some period during the year

before the survey. This proportion declines with age, reaching a share of less than 1 per cent for women aged 25. This is then taken as our lower bound benchmark. Moreover, our definition of elderly is based on the threshold of 60 years old, in line with Ghana's National Pension Scheme threshold for a Ghanaian to formally retire.[5]

A total of four models are estimated using the sample of rural individuals. First we examine men and women's determinants of time allocation to total hours worked. Then we focus on women's use of time in fetching water, domestic work and market work. The time spent fetching water corresponds to the weekly hours a woman spends, individually, on that task. Domestic chores are measured as the weekly hours spent on unpaid activities such as ironing clothes, childcare, washing vehicles, sweeping, disposing of garbage, cooking, shopping for the household, running errands, washing dishes, housekeeping, and hours fetching water and wood. Market work is computed as the weekly hours spent on any productive, paid, or market-oriented activity. Finally, the total hours of work comprise the time spent on paid and unpaid activities.

Access to water is internationally recognised as the availability per person of "at least 20 litres a day of clean water from a source less then 1 kilometre from their home" (UNDP, 2006: 80–81). This classification also emphasises that water must be obtained from an "improved source", including piped water, public taps, standpipes, boreholes, protected wells, protected springs and rainwater.[6] From a human welfare perspective, piped water fulfils the requirements for water provision: quantity is not rationed, quality is reliable and the distance to the household is the shortest.

Because of the survey structure, we define access to water according to the household's distance from the main source of drinking water, rather than relying solely on the improved water source classification. Given our interest in the time spent fetching water, our access definition strictly follows an effort-requirement perspective: a household has access to water if none of its members would have to walk in order to obtain drinking water. Households therefore have access to water if they are at zero distance from the water source. If the distance is greater than zero, household members would have to expend effort and time fetching water. These households are considered as not having access to water. Moreover, a question about distance to the water source was posed to households consuming water from wells (with or without a pump) or rivers/lakes. However, those who said they consume water from indoor plumbing, an internal standpipe, a public standpipe, a water vendor, a water truck, neighbouring private outdoor taps or from rainwater were not asked to report the distances, and thus they are considered as having access to water.

At the aggregate level, a community is considered as having water infrastructure if more than 50 percent of its households have indoor access to drinking water. Community-level variables avoid endogeneity problems, since the same non-observed features that affect households' time allocation can affect their decisions about access to infrastructure (electricity, water and distance from the water source). Excluding the household itself from the calculation of these variables is an alternative in order to clean up the effect of household decisions on the construction of the variables. The same non-observed features that affect individuals' time allocation may affect their decisions about whether or not to connect to infrastructure and the kind of provision (electricity, water and distance from the water source).

Hence the set of control variables in our analysis (see Table 1) can be arranged in five large groups: (i) individual characteristics—age, education (none, primary, secondary and tertiary), dummies for household head and whether the woman is the head's spouse; (ii) demographic

composition of the household—number of children (disaggregated by gender and age) and other adult household members (men, women and elderly); (iii) household asset holdings and per capita income (excluding the individual himself/herself), in order to account for living standards; (iv) community infrastructure, accounting for the presence of water and electricity infrastructure, distance to the water source and to the nearest market, and community income level (excluding the household itself); and (v) seasonal and regional dummies to capture differences in climatic conditions.

TABLE 1

Variables, Summary Statistics

	Mean	Std. dev.
Individual characteristics		
Age (years)	37.55	9.19
Education—none*	0.62	0.48
Education—primary*	0.15	0.36
Education—secondary*	0.19	0.40
Education—tertiary*	0.03	0.17
Head*	0.25	0.43
Spouse*	0.64	0.48
Household demographic composition		
Children—0/3 years old	0.67	0.80
Children—4/6 years old	0.61	0.73
Girls—7/10 Years old	0.38	0.59
Girls—11/14 years old	0.33	0.57
Boys—7/10 years old	0.44	0.66
Boys—11/14 years old	0.33	0.59
Other adult women	0.63	0.95
Adult men	1.19	1.03
Elderly	0.24	0.50
Household assets		
Land ownership*	0.37	0.48
Durable goods (GHS)	3,592,778.0	1.38E+07
Enterprise goods (GHS)	1,963,210.0	2.89E+07
Per capita income (GHS)	11,940.6	24801.57
Community infrastructure		
Per capita income (GHS)[a]	18,450.5	17562.2
Distance from nearest market (km)	8.40	22.05
Electricity*	0.18	0.39
Water*	0.19	0.40
Distance from water source (km)	0.37	0.52
Region/climate		
Region—coastal*	0.22	0.42
Region—forest*	0.47	0.50
Region—savannah*	0.31	0.46
Dry*	0.46	0.50

Source: Ghana Living Standard Survey, Round 4.

Notes: * Dummy variables. [a] Excluding the household's own income.

Education captures an individual's productivity potential. Hence further years of schooling are expected to raise women's market productivity. As education increases, so do the opportunity costs of staying at home. It is therefore expected that both the probability of women engaging in the labour market and the time they will spend in it are higher.

Being the household head involves a greater responsibility for household income. Women heads of household are more likely to engage in the labour market than women who are not heads, and thus they have less time for domestic chores. It is expected that the presence of other household members, especially other adult women and men, or grown children, may lessen the burden of household tasks on women if these tasks can be shared. Traditionally, the spouse of a household head has a greater social responsibility for domestic chores within the household than other women. Hence they are likely to spend more time on domestic activities than other women within the household.

The number and ages of the children a woman cares for affect both the decision to collect water and the time spent doing so. Small children are likely to demand more attention than older children, and thus women may have less time to collect water or to engage in the market. It is also common for older children to help with domestic chores. Moreover, having a grown child may lessen the probability and the time a woman spends fetching water, since this is an activity often performed by older children. The child's gender also raises an important issue: the opportunity cost often leads boys towards other productive tasks, and thus girls tend to have a disproportionably greater burden of fetching water. Older household members usually increase both the domestic workload and the amount of water consumed in the household. But they may not be capable of collecting water or helping with domestic chores.

As regards household assets, land ownership and enterprise goods capture women's opportunity to set up home-based activities. Although they do not imply explicit engagement in formal, paid, market work, these activities contribute to household earnings. They also compete for time with household chores, and thus women in households with greater assets are expected to do less domestic work. Durable goods and household per capita income are proxies for household assets and living standards. We expect that women in wealthier households will spend less time doing housework.

Community per capita income captures average local living standards and the level of economic activity. Richer communities are likely to offer better opportunities for paid work, influencing women's decision to enter the labour market. Thus households in wealthier communities are less likely to spend hours fetching water or doing domestic activities. The further the distance and the higher the community income, the greater the probability that women will work in paid activities and the longer the hours spent on those activities.

Having electricity is expected to have an uncertain result. On the one hand, it could improve the productivity of both the market work and the housework. Hence it could reduce the time devoted to work. On the other hand, electricity provision enables several economic activities to be developed, thereby expanding the opportunities for market work. Moreover, electricity provides households with "longer days", allowing individuals to dedicate more hours to study, to work and even to domestic tasks. The provision of electricity, therefore, has an ambiguous effect on the total hours worked.

Finally, we include regional dummies to capture different weather conditions that have particular effects on water availability and the average distance to the water source. Coastal areas were considered the baseline category and are less water-scarce than savannah and dry regions. Since the survey was carried out throughout a whole year it was necessary to control for the dry season, when access to water and wood is expected to be more difficult.

4.2 EMPIRICAL MODEL SPECIFICATION

Almost all the individuals in the sample, 95.4 per cent of women and 93 per cent of men, perform some kind of work (domestic and/or market work). Ninety-four per cent of the women perform some kind of domestic work, so there is no selection process involved in these activities. An ordinary least square regression is used to assess the determinants of total work and domestic work.

Some 64 per cent of the women in the sample fetch water and 77.4 per cent work in market activities. We expect the profile of women who engage in these activities to be different from those who do not. Thus there may be a selection process in deciding whether or not to collect water, and whether or not to enter the labour market. We use the Heckman procedure to correct for sample selection bias. This two-stage model first accounts for a woman's decision whether or not to collect water, followed by her choice of how many hours to devote to this activity (if she has decided to collect). Similarly, the model of hours devoted to market work accounts first for the selectivity and then for the amount of time women allocate to market work (for those who have decided to enter the labour market). The instruments used in both models are the distance from the nearest market and the presence of community water infrastructure.

The reduced-form equations based on model (4) are estimated as follows:

$$T_i^j = \theta_0 + \theta_1 I_i + \theta_2 H_i + \theta_3 A + \theta_4 C_i + \theta_5 R + \varepsilon \qquad \forall\ j = w, h, m, t \tag{5}$$

where the dependent variable *T* stands for the time spent on water collection, housework, market work and total work in the four models respectively. *I* stands for the set of individual characteristics, *H* is the set of household demographic composition, *A* stands for household assets, *C* for a set of community infrastructure and, finally, *R* captures the regional and climate characteristics.

4.3 DESCRIPTIVE STATISTICS

In poor rural areas of developing countries, children start working at an early age, forgoing the time needed to acquire an education. The lack of social protection schemes (pension funds and formal work ties) forces individuals to work until a late age. The workload, however, varies throughout an individual's life. Changes in productivity or in opportunity costs are the main causes of variations in an individual's working time. Apart from that, the nature of distinct activities contributes to what we call a "workload gender bias". In traditional societies, the woman is given the responsibility for domestic tasks and other unpaid activities (such as school meetings, social work and care for family members). Most of these tasks have to be carried out throughout a household's whole lifetime. A woman's time burden is greatest when

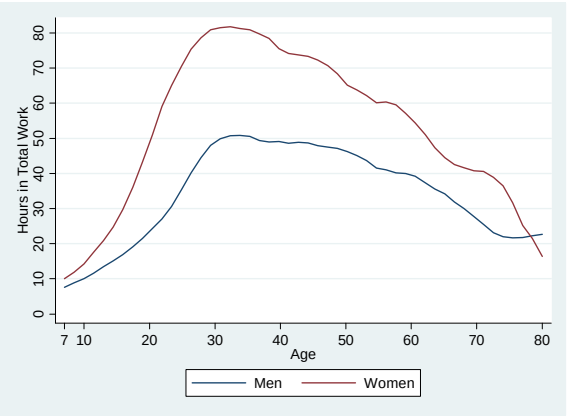
she bears her first children, and when she has several children—common in rural areas—the older children help the woman with the household tasks, including caring for their siblings. The man is responsible for earning the household income in rural societies. When retirement programmes are present, men's workload declines drastically when they reach old age. The productive life cycle of men and women then tends to differ, given the nature and duration of both market and domestic work. In the absence of social assistance programmes, however, men continue to work even beyond retirement age.

Figure 1 introduces a non-parametric estimation of hours of work, at different ages, for individuals in rural Ghana. Though the trends of total workload over time are alike for men and women, and though they peak at similar ages (about the thirties), the number of hours worked differs remarkably. In the most productive age period, women work for about 80 hours a week, which is 60 per cent more than men. Disaggregating the total work clearly reveals the source of the disparity: there is a difference in the time that women and men spend on unpaid work, even after taking into account the greater workload for men in paid work.

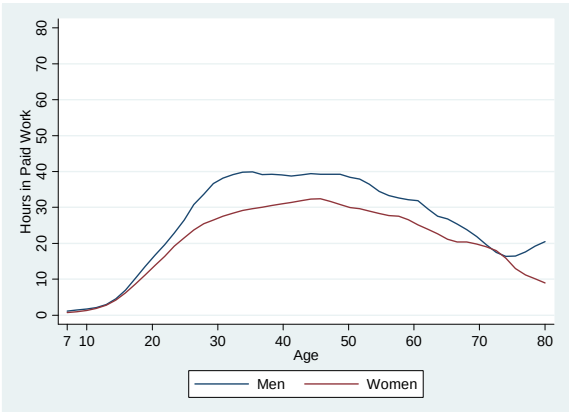
FIGURE 1

Workload throughout the Life of Women and Men in Rural Ghana

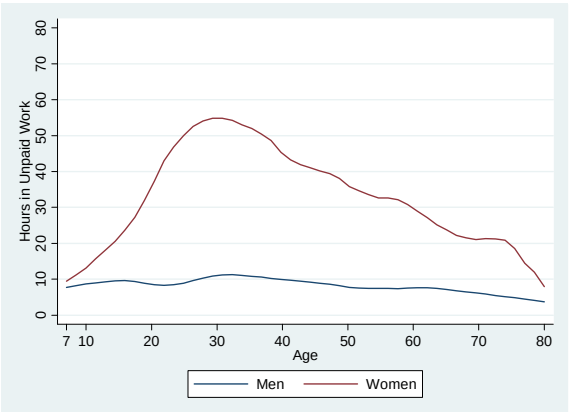
a. Total work



b. Paid work



c. Unpaid work



Note: Non-linear estimates using Ghana Living Standards Survey, Round 4.

Table 2 presents the infrastructure profile of rural Ghana, classified into three regions. Access to water and electricity services is low and unequally distributed: in the best served area, 42 per cent of households have indoor access to water; in the worst case, less than 5 per cent are covered. In this latter region, the poorest and driest part of the country, individuals walk longer both to fetch water and to reach the nearest market than people do in other rural regions in Ghana. There is also an extremely low coverage rate for electricity access: 28 per cent of households in coastal regions and only 3.1 per cent in the savannah.

TABLE 2

Regional Household Characteristics in Ghana

	Rural coastal	Rural forest	Rural savannah
Proportion of population	14.5	32.1	20.4
Households with access to water (%)	42.2	24.2	4.6
Average distance to main water source (km)	0.28	0.28	0.55
Households with access to electricity (%)	28.0	24.7	3.1
Average per capita income (in GHS)	23287.8	22793.7	12063.2
Average distance to nearest market (km)	7.77	10.89	11.98

Source: Authors' calculations based on GLSS 4.

Note: (*) deflated according to Ghana Central Bank.

As discussed above, the lack of infrastructure may have different impacts on men and women. Household chores usually entail a sharp division of labour based on gender and age, especially in poor areas and traditional societies. Women are often responsible for household care, which often includes water provision. In rural Ghana, about 64 per cent of women between 25 and 59 years of age old fetch water, while only about 16.5 per cent of men do so (see Figure 2.a). This activity can consume more than 50 hours a week for 2.6 per cent of women.

Figures 2.b and 2.c present the weekly hours worked in domestic and market activities by women and men between the ages of 25 and 59. Men's time use is more oriented to market work than to any other activity. For women, on the other hand, domestic work is time-intensive: almost 30 per cent of women, versus 1.2 per cent of men, spend more than 60 hours a week on this activity.

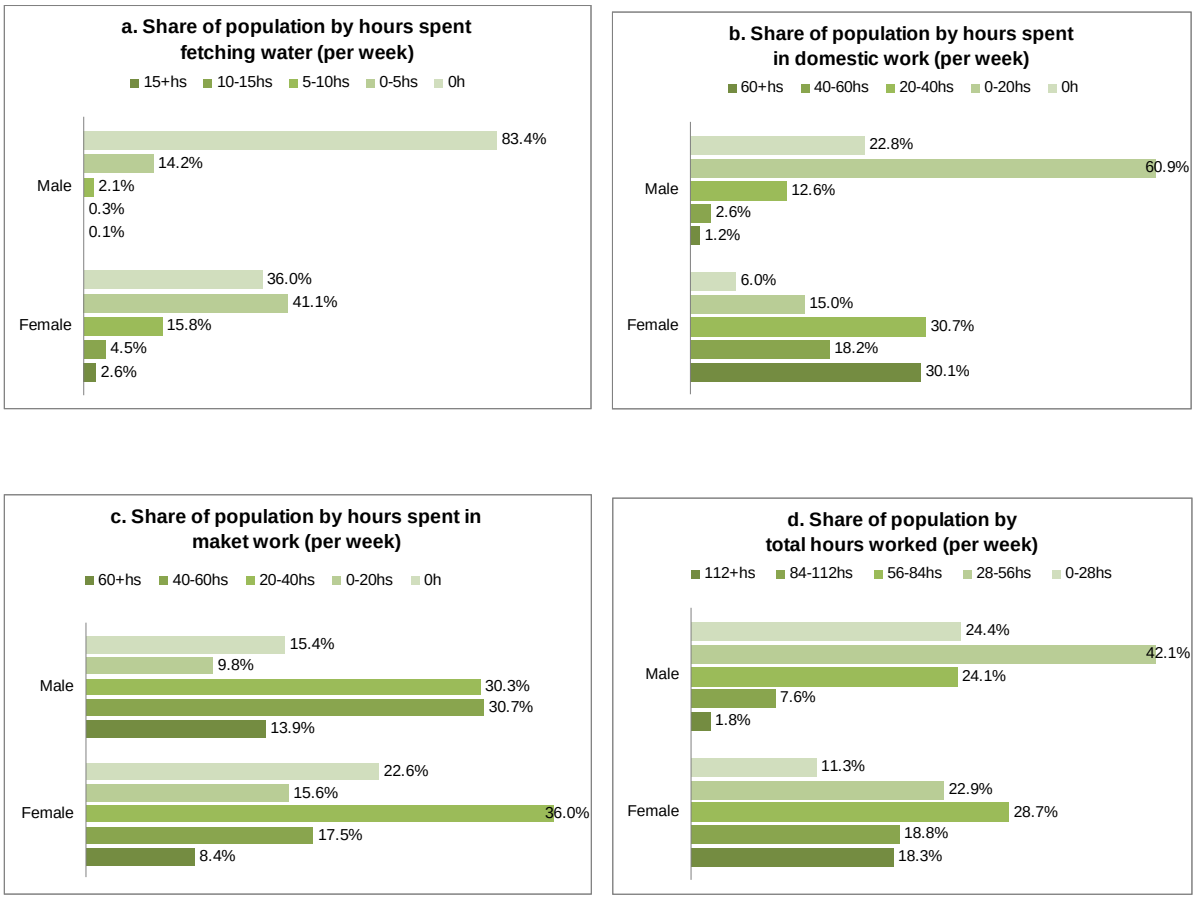
This paper characterises time poverty according to the time available for an individual's proper sleeping and leisure time (which includes time for personal care). Considering the human need for eight hours of sleep a day, time-poor individuals would spend between zero and four hours a day on leisure. Having discounted sleeping time, therefore, a total workload of between 84 and 112 hours a week (12 and 16 hours a day) characterises time poverty. Working beyond 112 hours a week is to be in a state of extreme time poverty. Individuals in this range have to sacrifice their proper sleeping time and, consequently, their health.

The allocation of time to both market and domestic activities reveals the burden faced by women in terms of total hours worked. Women are time-poorer than men (see Figure 2.d), such that 37 per cent can be considered time-poor (working more than 84 hours a week). About half of these work more than 112 hours a week and are considered extremely time-poor. Some 11 per cent of women seem to be rich in time, working up to 28 hours per week—on average, 4 hours a day. The percentage of "time-rich" men is twice that of women. The largest

proportion of women, 29 per cent, work between eight and 12 hours a day. Only 2 per cent of men are extremely time-poor. The largest proportion of men (about 40 per cent) work between 28 and 56 hours a week or four to eight hours a day, while 23 per cent of women are in the same situation. In summary, women are time-poorer than men most particularly because they are responsible for household chores (see Figure 1). Hence women's workload seems to be exacerbated by a lack of infrastructure, given that activities such as fetching water are female labour-intensive.

FIGURE 2

Time Allocation of Women and Men in rural Ghana



Source: Authors' calculations based on Ghana Living Standards Survey, Round 4.

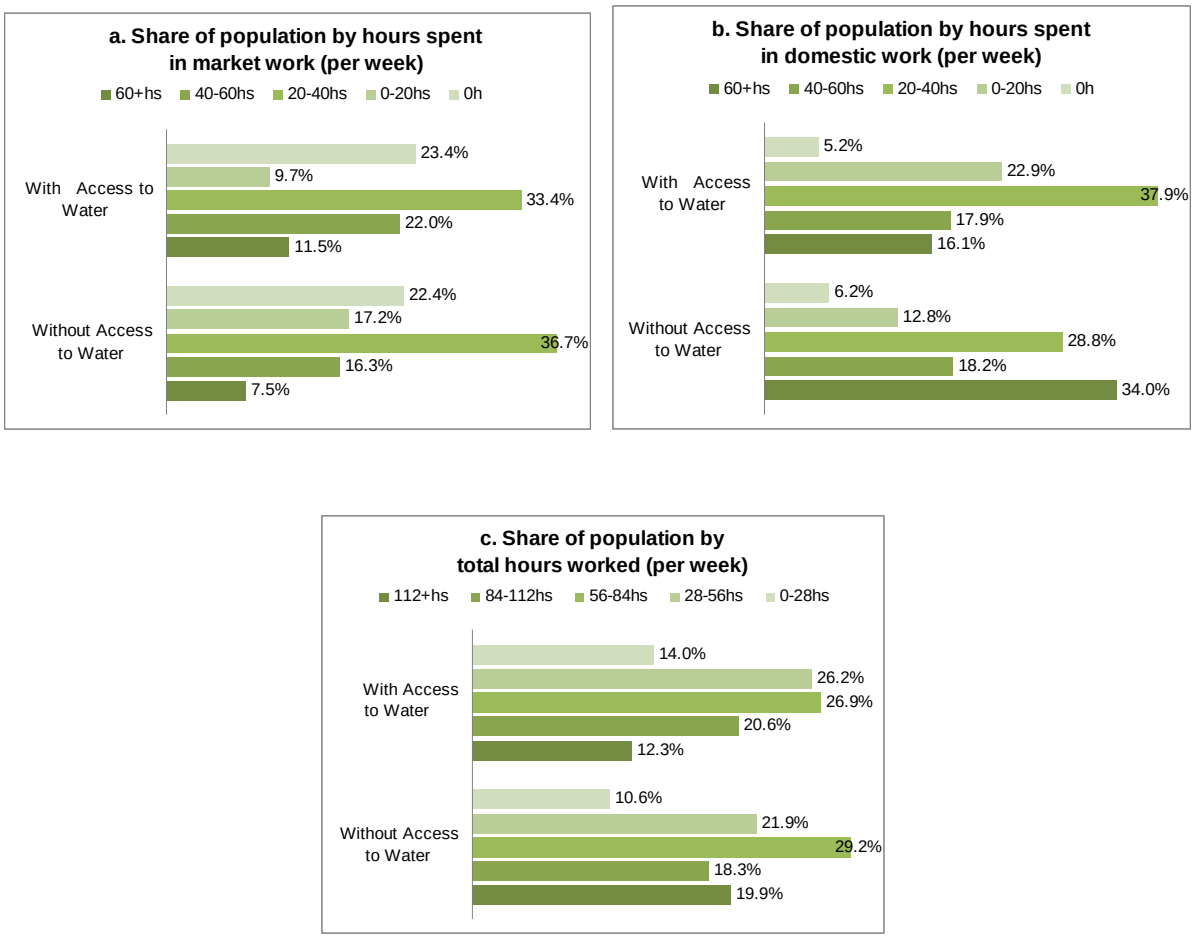
Note: Sample of individuals between 25 and 59 years old.

To verify how the lack of infrastructure affects women's time allocation, we compare women with and without indoor access to water. A slightly higher percentage of women with access to water are also engaged in the paid labour market. Once they engage in any market-oriented activity, however, women spend more time on it than those without indoor access to water (Figure 3.a). On the other hand, and as expected, lacking access to water substantially increases the time women spend on domestic chores (Figure 3.b). Consequently, considering the total hours worked, Figure 3.c suggests that access to water is associated with a potential alleviation of female time poverty. Though access to water increases the time spent on market

work, it reduces the time spent on domestic chores more than proportionally. As a result, women spend less time working overall.

FIGURE 3

Women's Time Allocation and Access to Water

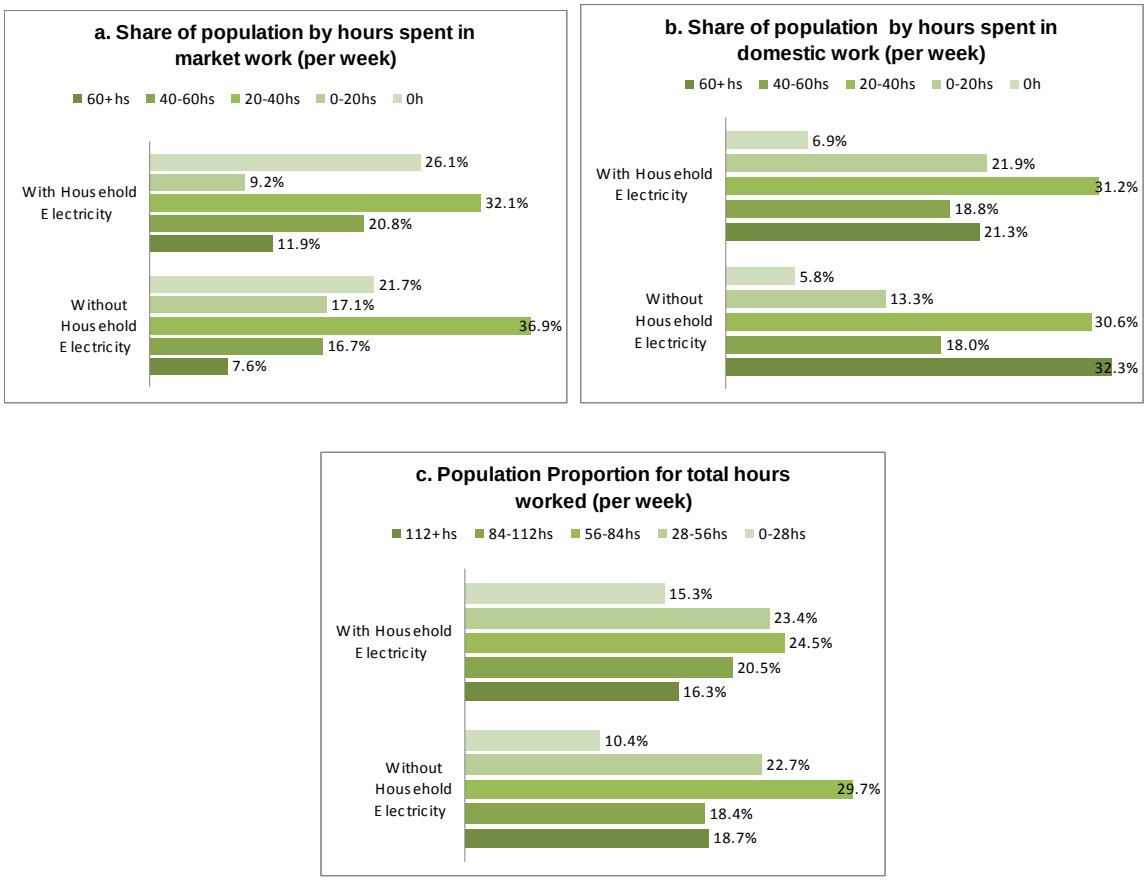


Source: Authors' calculations based on Ghana Living Standards Survey, Round 4.
Note: Sample of women between 25 and 59 years old.

Figure 4 depicts the relationship between having access to electricity and women's time allocation. Unlike the effect of access to water on participation in the labour market, access to electricity increases the number of hours women spend on paid work and their decision to engage in the market. Women in households without electricity spend more time on domestic work, whereas those with electricity dedicate more time to market activities. As a result, the total time worked seems to be similar for both groups of women. The difference between them indicates the gains from each activity, since women in the labour market are likely to be paid while domestic chores are unpaid.

FIGURE 4

Women's Time Allocation and Access to Electricity



Source: Authors' calculations based on Ghana Living Standards Survey, Round 4.

Note: Sample of women between 25 and 59 years old.

5 RESULTS

Although the data point to a link between women's time allocation and access to infrastructure, the causal relationship should be explored. We investigate the determinants of time allocation in total, domestic, water-fetching and market activities, controlling for personal, household and community characteristics.

We start by analysing the determinants of the total hours worked by women and men. Having observed that women are more likely to be time-poor than men, we focus on women's time use, disaggregating their workload into paid (market work) and unpaid (domestic work) activities. Mindful of the impact of infrastructure on women's time burden, we additionally investigate the determinants of the time that women spend fetching water.

5.1 DETERMINANTS OF TOTAL HOURS WORKED

Total hours worked is the weekly time spent on unpaid and paid work. The total time worked increases with age. The model suggests the rate is slightly increasing for women aged between 25 and 59, although for men it seems that workload increases at a declining rate. Education has

a significant impact on the total hours that women work, but seems not to influence men's total work time. Women who attended secondary school work more total hours than women with no education. Tertiary education has the opposite effect: highly educated women work fewer hours. The following subsections test whether education is important in expanding the time allocation of women in the market. As expected, heads of household have more responsibility for family income and thus work longer hours. The effect seems to be stronger and more significant for men. Being the spouse of the head also imposes a time burden on both women and men. Again, the effect is stronger for men, indicating that being a spouse has a greater impact on hours worked for men than for women.

The number of children and elderly significantly increases women's total work, while men's working hours seem to be unaffected. Boys have a greater impact on increased female work than girls, since the latter are more likely to help women with domestic activities and thereby lessen women's burden.

Land ownership is an important asset in rural areas. In our samples, however, land does not seem to be important in determining the total time men work. Nonetheless, women in households that own land are likely to work fewer hours. Surprisingly, durable goods, enterprise goods and the income level of households do not seem to influence the total hours dedicated to work.

As regards community infrastructure, households in regions with higher per capita income tend to work longer hours. A shorter distance to the nearest market increases women's total work. This might be because of better opportunities in those areas, leading both women and men to find remunerated opportunities easily. Electricity in the community seems to have a positive impact only on men's working hours, while access to water seems to reduce only women's total work. Nevertheless, longer distances to the water source significantly increase, at a declining rate, the total time worked by both women and men, with a stronger effect on the latter. Finally, a seasonal dummy suggests that during the dry season men tend to work fewer hours, while women do not benefit from workload relief. In rural areas, seasonality in work is naturally expected when economies heavily rely on agriculture.

As regards the total hours worked, three general conclusions and further questions arise:

i. The household demographic composition influences women's total working hours. Additional adult women in the household may reduce the workload of both men and women, while additional men seem to have no impact on an individual's working hours. Children, in particular, increase women's total workload. Boys increase a woman's work more than proportionally than girls. Men's time allocation is unaffected by children, except for a significant result for those aged between four and six. A remaining question is how children affect women's total working hours. Do they disproportionately increase as women dedicate more time to childcare (increasing mainly domestic work), or does having children encourage women to engage in the paid labour market in order to raise household income? These matters will be analysed from Sections 5.2 onwards.

ii. Education plays a significant role in determining women's hours of work, despite the non-significant effect for men. A hypothesis is that education increases the

opportunity cost of staying at home. Hence, will an increase in productivity from education push women towards engaging in the labour market instead of dedicating more time to domestic chores?

iii. Finally, the provision of community water and electricity infrastructure seems to have distinct effects on the work of men and women. While access to water relieves women's work burden, electricity increases work opportunities for men.

TABLE 3

Determinants of Total Hours Worked

	Women			Men		
Individual characteristics						
Intercept	3.287	(0.222)	***	2.092	(0.355)	***
Age	0.035	(0.011)	***	0.058	(0.018)	***
Age squared	0.000	(0.000)	***	-0.001	(0.000)	***
Primary	-0.004	(0.033)		0.005	(0.058)	
Secondary	0.067	(0.031)	**	-0.030	(0.046)	
Tertiary	-0.158	(0.073)	**	-0.098	(0.061)	
Head	0.095	(0.048)	**	0.423	(0.083)	***
Spouse	0.160	(0.043)	***	0.427	(0.142)	***
Household demographic composition						
Children—0/3 years old	0.085	(0.016)	***	0.035	(0.026)	
Children—4/6 years old	0.063	(0.016)	***	0.055	(0.027)	**
Girls—7/10 years old	0.046	(0.019)	**	0.044	(0.033)	
Girls—11/14 years old	0.011	(0.020)		-0.003	(0.035)	
Boys—7/10 years old	0.089	(0.017)	***	-0.005	(0.030)	
Boys—11/14 years old	0.035	(0.019)	*	-0.025	(0.034)	
Women	-0.068	(0.014)	***	-0.047	(0.024)	**
Men	0.001	(0.013)		0.002	(0.023)	
Elderly	0.051	(0.025)	**	-0.021	(0.049)	
Household assets						
Land	-0.040	(0.024)	*	-0.011	(0.038)	
Home goods	-1.29E-09	(0.000)		2.23e-09	(0.000)	
Enterprise goods	-6.78E-11	(0.000)		-2.39e-11	(0.000)	
Per capita income	1.14E-07	(0.000)		6.87e-07	(0.000)	
Community infrastructure						
Per capita income	3.51E-06	(0.000)	***	3.54e-06	(0.000)	***
Electricity	0.020	(0.040)		0.207	(0.065)	***
Water	-0.086	(0.043)	**	-0.018	(0.071)	
Distance to the nearest market	-0.001	(0.001)	**	5.69e-06	(0.001)	
Distance to the water source	0.200	(0.060)	***	0.295	(0.099)	***
Squared dist. to the water source	-0.045	(0.020)	**	-0.073	(0.034)	**
Region/climate						
Rural Forest	0.009	(0.030)		0.099	(0.049)	**
Rural Savannah	0.034	(0.034)		-0.025	(0.056)	
Dry	0.015	(0.022)		-0.067	(0.036)	*
	Number of obs = 2792			Number of obs = 2052		
	F (29, 2762) = 12.28			F(29, 2022) = 5.89		
	Adj R-squared = 0.1049			Adj R-squared = 0.0647		

Source: Authors' calculations based on Ghana Living Standards Survey, Round 4.

Note: Standard errors in parentheses. Significant at *** 1, **5 and * 10 per cent.

5.2 DETERMINANTS OF HOURS SPENT ON DOMESTIC ACTIVITIES

This section and the next two focus strictly on women's time use. For our sample of women aged 25 to 59 we disaggregate the total hours of work into hours performing domestic chores, fetching water and engaged in a productive paid activity. An ordinary least squares (OLS) model analyses the determinants of hours spent by women on domestic activities. Concerning education, there are no significant differences between women without formal education and with primary or secondary education. Having tertiary education, however, implies less time spent on domestic activities. Unsurprisingly, being the head's spouse implies spending greater time on domestic chores because, culturally, spouses are expected to be responsible for the household care. Having other women in the same household lessens a woman's burden, since tasks are likely to be shared. Nevertheless, the presence of other men does not significantly reduce the time women spend on domestic chores.

TABLE 4

Determinants of Hours Worked on Domestic Activities

	Hours spent on unpaid work		
Individual characteristics			
Intercept	3.481	(0.267)	***
Age	-0.004	(0.014)	
Age squared	0.000	(0.000)	
Primary	-0.020	(0.039)	
Secondary	0.017	(0.037)	
Tertiary	-0.239	(0.088)	***
Head	0.041	(0.058)	
Spouse	0.246	(0.051)	***
Household demographic composition			
Children—0/3 years old	0.148	(0.019)	***
Children—4/6 years old	0.096	(0.019)	***
Girls—7/10 years old	0.041	(0.023)	*
Girls—11/14 years old	0.017	(0.024)	
Boys—7/10 years old	0.102	(0.021)	***
Boys—11/14 years old	0.021	(0.023)	
Women	-0.125	(0.017)	***
Men	0.004	(0.015)	
Elderly	0.095	(0.030)	***
Household assets			
Land	-0.108	(0.029)	***
Home goods	-4.22E-10	(0.000)	
Enterprise goods	2.29E-10	(0.000)	
Per capita income	-6.26E-07	(0.000)	
Community infrastructure			
Per capita income	3.11E-06	(0.000)	***
Distance from market	-0.002	(0.001)	***
Electricity	0.021	(0.048)	
Water	-0.142	(0.051)	***
Distance to the water source	0.373	(0.072)	***
Squared distance to the water source	-0.112	(0.025)	***
Region/climate			
Rural forest	0.087	(0.036)	**
Rural savannah	0.144	(0.040)	***
Dry	0.107	(0.027)	***
Number of observations	2754		
F (29, 2724)	27.12		
Adj R-squared	0.2158		

Source: Authors' calculations based on Ghana Living Standards Survey, Round 4.
Note: Standard errors in parentheses.

Children up to the age of ten significantly increase the time women spend on domestic activities. The workload is even more intense in the presence of small children aged 0–3 and of elderly household members. They require more attention and care.

The only household asset that seems to significantly reduce time on domestic chores is land ownership. With regard to community-level infrastructure, access to electricity does not influence the time women spend on domestic activities. Community per capita income and the distance to the nearest market have opposite signs than expected. Community access to water significantly reduces the time women spend on domestic activities. As the distance to the water source increases, the amount of time spent on domestic activities also increases at a declining rate. This could be related to a larger proportion of time devoted to fetching water, a matter that is explored in Section 5.3. Finally, regional dummies are positive and significant, indicating a relatively larger share of time devoted to domestic activities in the rural savannah. During the dry season the time women devote to domestic activities tends to increase, since we suspect that both paid opportunities shrink and water becomes scarcer, demanding more time for water collection.

5.3 DETERMINANTS OF HOURS SPENT FETCHING WATER

The lack of indoor water infrastructure leads households to collect water from alternative external sources. This activity is usually regarded as a domestic chore, since it is non-monetary: household members are not paid, although they spend a large proportion of time carrying water. To analyse the (time) opportunity cost for women caused by a lack of water infrastructure, it is useful to investigate the determinants of their time use disaggregated by water collection. Of our sample of 2,858 rural Ghanaian women, 1,854 spent some time fetching water in the surveyed reference week. A two-step analysis is necessary to correct the selection bias. The model first analyses the probability of a woman fetching water, and then it investigates how much time she will dedicate to that task.

Having secondary education reduces both the probability that a woman fetches water and the time she spends doing so. Tertiary education, however, does not significantly determine the probability of fetching water, although it has a strong negative and significant impact on the time spent: although more educated woman may help the household to collect water, they tend to spend fewer hours doing so. The head's spouse is more likely to fetch water than other women in the household, but we found no differences relating to the time spent on that activity and the household relationship (spouse/head). The number of children aged 0 to 3 increases the female selection probability, while having older children, either boys or girls, or other adult men or women at home, reduces it. Adults are additional labour force in the household, possibly sharing the workload of fetching water. In contrast, the presence of young children and elderly members increases the household's demand for water, and consequently demands that more time be spent on providing it, with no counterpart help.

With regard to household per capita income, as expected we find that in richer households there is a lower probability that women fetch water. Higher community per capita income, however, is positively related to a higher probability of women fetching water. At first sight this result may seem contradictory, since we expect living in a wealthier neighbourhood to be associated with better living conditions and thus a greater likelihood of having access to water. On the other hand, living in a community with higher income, and perhaps with better water infrastructure, increases the probability of engaging in water-intensive activities.

Moreover, once it becomes easier to collect water, women spend less time doing so, and there are more incentives for other women to engage in that activity than to consider costly alternatives such as buying water from a water truck.

TABLE 5

Determinants of Hours Spent Fetching Water

	Hours fetching water			Probability of fetching water		
Individual characteristics						
Intercept	1.077	(0.454)	**	1.428	(0.522)	***
Age	0.005	(0.024)		-0.024	(0.027)	
Age squared	0.000	(0.000)		0.000	(0.000)	
Primary	-0.103	(0.067)		0.065	(0.078)	
Secondary	-0.120	(0.066)	*	-0.149	(0.071)	**
Tertiary	-0.584	(0.159)	***	-0.018	(0.164)	
Head	-0.090	(0.102)		-0.169	(0.106)	
Spouse	-0.075	(0.088)		0.168	(0.094)	*
Household demographic composition						
Children—0/3 years old	-0.085	(0.031)	***	0.091	(0.038)	**
Children—4/6 years old	-0.027	(0.032)		0.058	(0.038)	
Girls—7/10 years old	0.046	(0.040)		-0.057	(0.045)	
Girls—11/14 years old	0.081	(0.047)	*	-0.301	(0.046)	***
Boys—7/10 years old	0.152	(0.036)	***	-0.045	(0.040)	
Boys—11/14 years old	0.009	(0.042)		-0.136	(0.043)	***
Women	0.023	(0.031)		-0.167	(0.031)	***
Men	0.026	(0.028)		-0.055	(0.029)	*
Elderly	0.104	(0.050)	**	0.061	(0.056)	
Household assets						
Land	-0.106	(0.049)	**	-0.056	(0.055)	
Home goods	-7.55E-11	(0.000)		-3.93E-09	(0.000)	*
Enterprise goods	-4.29E-10	(0.000)		-5.22E-09	(0.000)	
Per capita income (excluding woman's)	8.94E-07	(0.000)		-3.74E-06	(0.000)	***
Community infrastructure						
Per capita income	-2.95E-06	(0.000)	*	5.16E-06	(0.000)	***
Distance from market				0.001	(0.001)	
Electricity	0.182	(0.074)	**	0.177	(0.091)	*
Water				-0.335	(0.091)	***
Distance to the water source	0.757	(0.107)	***	0.098	(0.145)	
Squared dist. to the water source	-0.208	(0.037)	***	-0.010	(0.050)	
Region/climate						
Rural forest	0.173	(0.062)	***	-0.076	(0.066)	
Rural savannah	0.372	(0.073)	***	0.549	(0.082)	***
Dry	0.077	(0.045)	*	0.050	(0.052)	
Number of observations	2858			athrho	-0.797	(0.130) ***
Censored observations	1004			lnsigma	0.009	(0.033)
Uncensored observations	1854			rho	-0.662	(0.073)
Wald chi2 (27)	242	***		sigma	1.009	(0.034)
chi2 (1)	6.49	**		lambda	-0.668	(0.094)

Source: Authors' calculations based on Ghana Living Standards Survey, Round 4.

Note: Standard errors in parentheses.

Living in a community with access to electricity increases both the probability of fetching water and the hours women spend doing so. On the other hand, women living in a community where more than 50 per cent of households have an indoor water connection are less likely to

undertake this task. As expected, a greater distance from the water source increases the time spent fetching water.

Women living in the rural savannah are more likely to have to collect water. The time spent on this chore is also significantly higher in the rural savannah and the rural forest than in the coastal zone. A possible explanation is that conditions in the savannah are poorer than in the other two regions. In other words, the rural savannah is the poorest and driest region, has the lowest proportion of households with access to indoor water, and on average has the worst access to markets and waters sources. Additionally, its population is likely to have the poorest health and education conditions.

5.4 DETERMINANTS OF HOURS SPENT ON MARKET ACTIVITIES

Table 6 shows the probability of women being engaged in any paid work and the determinants of hours worked at market activities. Because of unobserved characteristics influencing women's decision to participate in the labour market, we use a Heckman procedure to correct the selection bias. Land ownership, distance from the nearest market and the community's level of water infrastructure are used as instrumental variables.

Age affects positively and at a decreasing rate the probability of female paid work, and it is inversely related to the time spent on that activity. Women with primary and secondary education dedicate more hours to paid work than women without schooling. Unsurprisingly, women with higher education are more likely to engage in the labour market and to work fewer hours than their less educated counterparts. The returns to higher education are expected to be larger, and thus there is an incentive for women with higher education to enter the labour market. These women, nevertheless, work fewer hours than less educated women because of higher pay.

Female household heads and the head's spouse are also more likely to engage in the labour market, although spouses work fewer hours. Children significantly influence the probability of women entering the labour market, but they do not affect the number of hours spent on paid work. Small children constrain women from market-oriented activities, especially if these involve working outside the home. Having older children, however, positively influences the probability of women engaging in the labour market.

With regard to household assets, as expected, enterprise goods have a positive impact on the probability of engaging in market activities since women have the chance to set up family businesses. This suggests that the time women spend on income-generating activities declines with the increase in household assets. Household per capita income (excluding women's remuneration) has a positive effect on the time women spend on paid work.

Community water access is negatively related to the probability of female paid work, while greater distance from the water source is positively related to longer hours spent at market activity. This latter finding might be because of a negative effect of distance on the decision to fetch water, and the trade-off associated with these two activities. Electricity in the community does not seem to influence the decision to participate in market activities, but for those women already engaged in such activities the availability of electricity in the community encourages them to work longer hours.

Women living in the rural savannah are less likely to engage in market activities but, once they are in the market, they tend to work more hours than women from both the rural forest and rural coastal areas. In contrast, women in the rural forest spend, on average, the least time in market activities compared to the other regions in rural Ghana.

TABLE 6

Determinants of Hours Spent on Market Activities

	Hours doing paid work			Probability of doing paid work		
Individual characteristics						
Intercept	4.466	(0.286)	***	-1.638	(0.500)	***
Age	-0.051	(0.015)	***	0.117	(0.026)	***
Age squared	0.001	(0.000)	***	-0.001	(0.000)	***
Primary	0.073	(0.042)	*	-0.028	(0.077)	
Secondary	0.112	(0.039)	***	0.018	(0.073)	
Tertiary	-0.250	(0.091)	***	0.325	(0.175)	*
Head	-0.055	(0.061)		0.430	(0.106)	***
Spouse	-0.094	(0.054)	*	0.295	(0.092)	***
Household demographic composition						
Children—0/3 years old	0.027	(0.020)		-0.080	(0.036)	**
Children—4/6 years old	-0.031	(0.020)		0.066	(0.038)	*
Girls—7/10 years old	-0.009	(0.024)		0.065	(0.047)	
Girls—11/14 years old	-0.024	(0.025)		0.081	(0.048)	*
Boys—7/10 years old	0.009	(0.022)		0.086	(0.042)	**
Boys—11/14 years old	-0.014	(0.024)		0.119	(0.048)	**
Women	1.18E-02	(0.017)		0.018	(0.033)	
Men	0.034	(0.016)	**	-2.83E-02	(0.031)	
Elderly	0.031	(0.031)		-5.30E-02	(0.055)	
Household assets						
Land				0.034	(0.046)	
Home goods	-1.95E-10	(0.000)		-2.46E-09	(0.000)	
Enterprise goods	-1.54E-09	(0.000)	***	8.10E-09	(0.000)	**
Per capita income	1.08E-06	(0.000)		2.36E-06	(0.000)	*
Community infrastructure						
Per capita income	9.61E-06	(0.000)	***	-6.36E-06	(0.000)	***
Distance from market				-0.001	(0.001)	
Electricity	0.134	(0.044)	***	-0.125	(0.093)	
Water				-0.168	(0.083)	**
Distance to water source	0.219	(0.068)	***	-0.164	(0.149)	
Squared dist. to water source	-0.075	(0.024)	***	0.124	(0.058)	**
Region/climate						
Rural forest	-0.108	(0.036)	***	0.059	(0.070)	
Rural savannah	0.110	(0.042)	***	-0.383	(0.078)	***
Dry	0.130	(0.029)	***	-0.274	(0.054)	***
Number of observations	2858		athrho	-1.619	(0.082)	***
Censored observations	534		lnsigma	-0.347	(0.018)	***
Uncensored observations	2324		rho	-0.924	(0.012)	
Wald chi2 (26)	265.7 ***		sigma	0.706	(0.013)	
chi2 (1)	143.97 ***		lambda	-0.653	(0.018)	

Source: Authors' calculations based on Ghana Living Standards Survey, Round 4.

Note: Standard errors in parentheses.

6 CONCLUSION

Table 7 summarises the empirical results regarding the provision of water and electricity infrastructure on the time women spend on different activities.

TABLE 7

Impact of Infrastructure Provision on Women's Time Allocation

	Domestic work	Market work	Total work
Having community water provision	Decreases	Decreases *the probability of participation*	Decreases
Shorter distance from the water source	Decreases	Decreases *the hours for those employed* Does not affect the *probability of participation*	Decreases
Having community electricity provision	No effect	Increases *the hours for those employed* Does not affect the *probability of participation*	No effect

Source: Authors' estimates.

From the empirical exercise above, we conclude that access to electricity tends to increase the time spent on income-generating activities, although it does not affect the probability of engaging in such work. Since more than 75 per cent of women in rural Ghana are already engaged in market work, improving electricity access may further increase the time women dedicate to income-generating activities. Hence, public policies aimed at increasing the supply of electricity could help reduce income poverty in rural Ghana through an increase in household income stemming from women's participation in the labour market. Nevertheless, for a greater and universal impact, the empirical exercise suggests that electricity provision must be accompanied by some policy that encourages women to enter the labour market or engage in income-generating activities, such as those policies related to educational training and childcare facilities. However, total hours of work and domestic work do not seem to be significantly affected. Thus our model does not provide evidence that improving electricity access would reduce time poverty among women, although potentially it would reduce income poverty.

Access to water has a significant impact on women's time use. Evidence has shown that rural Ghanaian women are time-poor and that a lack of access to infrastructure increases the time they spend on domestic activities. Having access to water would reduce the burden women face. Indeed, our empirical exercises suggest that providing households with an indoor water supply could relieve some overloaded women. Living in a community with access to water significantly reduces the time women dedicate to domestic work and, consequently, women are less time-poor because of the fewer hours spent on total work.

The shorter the distance from the water source, the less time women spend on both domestic and total work. This translates into a lower total workload and thus lower time poverty. This suggests that reducing the distance between households and the water source may effectively alleviate women's time poverty.

One can argue that some activities, such as fetching water, are part of a socialisation practice: women get together in a moment of independence and freedom. We are aware that this is culturally a sensitive issue, and one that certainly deserves careful consideration. Above any biased judgement, the argument of this paper is that all women and men should have access to the opportunity of fulfilling their basic needs (such as water, electricity and sanitation, though this latter issue was not covered here). This paper advocates granting individuals the option of choosing between alternative sources. Our premise is that everyone's time is precious. The hours saved by not having to load and unload tons of water—which is often unhealthy and not an income-generating task—could be used more efficiently if women were able to do other productive activities (such as paid work) and improve their living conditions. What we have tried to emphasise is the economic relevance of extending the choices that women (and individuals in general) have by simply providing them with basic infrastructure, since development means expanding the freedoms that people enjoy.

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NOTES

1. They define the time-poverty lines on the basis of the median working hours of all adults in their sample: the lower bound is 1.5 times the median and the upper bound is twice the median.

2. This study does not consider the time that households spend treating water, nor how the intra-household bargaining in the division of labour happens.

3. The GLSS 4 did not include questions about water provision to the population located in Accra.

4. Basic education in Ghana consists of 12 years: six years of primary school, three years of junior high, and three years of senior secondary school. The 2007 education reform lowered the universal basic education to 11 years.

5. Source: http://www.ssnit.com. Accessed, May 2009.

6. For further definitions, see the Joint Monitoring Programme of UNICEF and WHO at http://www.wssinfo.org.

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