The Effect of Deforestation on Time Allocation: Evidence from Indian Households

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Abstract

How does deforestation affect the time allocation of women? Most studies examine the effect of firewood collection on deforestation. In this study, we look at the effect of reduced forest cover on female time allocation in fuel wood collection as well as in wage-earning and domestic production activities. We use household data from India to show that reduced forest cover has a significant effect in increasing the time women spend to collect fuel wood as well as in reducing the time they devote to domestic economic activities. However, the effect on wage-earners is not significant. These results, even though preliminary, have important policy implications. They suggest that in areas where there are ample opportunities for women to be employed in wage-earning jobs, deforestation may not impact their domestic time allocation. However, in regions where women are engaged in small-scale household production, the decrease in forest cover may have adverse economic impacts on the household, since women have to spend extra time collecting their energy resources.

JEL classification: O12, O18, Q48

Keywords: India, Labor market, Fuel collection, Energy and Development, Environmental degradation

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1 Introduction

A large share of the population in developing countries relies on the environment for their basic needs, such as food and energy (UNDP, 2011). Men and especially women spend many hours a day collecting firewood and other forest resources for their basic survival. Both poor and better-off households engage in this activity, especially the former, who do not earn enough income to buy all their goods and services from the market. However, they may also participate as sellers of food and energy resources when these resources become scarce. Studies have shown that these environmental resources represent an important part of the income of rural households (Cavendish (2000); Kamanga et al. (2009); Gunatileke and Chakravorty (2003)). Thus, understanding whether and how environmental degradation affects welfare is important in order to determine its impact on economic growth. The literature has mostly focused on the reverse relation, i.e. the impact of development on environmental degradation. In this paper, we study the impact of deforestation on decisions of participation to the labor market.

The majority of studies on deforestation focus on its global impacts, greenhouse gas emissions (a fifth of which are generated by deforestation) and the reduction in biodiversity through the extinction of many species (Burgess et al. (2012); Cropper and Griffiths (1994)). One aspect of deforestation which is often overlooked concerns its impact on individuals through a decrease in the availability of forest resources, especially fuelwood. When households are faced with this situation, they reduce their consumption and spend more time in collection (Cooke (998a)). Natural resource collection is predominantly a female activity (Kumar and Hotchkiss (1988); Cooke (998b); Bandyopadhyay et al. (2011)) who may belong to poor as well as wealthier households (Baland et al. (2010)). However, women are not the only members in the household involved in environmental goods collection (fuel and water). This is also the case for children. Children's school attendance may be negatively affected by the scarcity of natural resources and the resulting increase in the hours devoted to collection (Wagura Ndiritu and Nyangena (2010)). Nankhuni and Findeis (2003) show that children from the most environmentally degraded districts of central and southern Malawi are less likely to attend school. One of the main results of this paper consists in showing that collection behavior is shaped by three elements: (i) the stock of forest, (ii) the distance from the closest town and (iii) whether the household is selling or buying firewood. As a consequence the impact of a reduction in the forest stock on time allocation is going to differ according to the status of the household in terms of distance from the town and buying or selling behaviour.

Our objective is to study whether an increase in the time dedicated to natural resource collection – generated by deforestation and thus fuel scarcity – has an impact on labor supply. Households adapt to fuel scarcity by adjusting fuelwood consumption, using substitutes or, as is often the case, investing longer hours in the collection of fuelwood. The extra time dedicated to the collection of natural ressources affects participation in other activities, such as leisure or labor supply. Therefore, a deterioration in the access to forest resources, measured by the time spent collecting fuel, may lead to less time for productive activities, especially for women.

Between 2000 and 2012 global forests have experienced a net loss of 1.5 million squared kilometers, roughly the size of the state of Alaska (Hansen et al. (2013)). Globally, more than 1.6 billion people rely in varying degrees on forests for their livelihood. Our study focuses on India, which is the tenth largest country in the world in terms of forest coverage with about 68 million hectares, roughly 20.8% of its surface (FAO (2010)). Forests represent an important resource for people in India. 200 million people rely on forests for livelihood, according to the Ministry of Environment and Forest. 23 percent of the population using fuelwood get it directly from the forest. India is the largest consumer of firewood in the world, total annual consumption for the country is estimated at 216.42 million tons (Forest Survey of India report, 2011). 40% of the country energy needs are satisfied with fuelwood. However, a large share of this fuelwood is grown and managed outside forests, current consumption is about five times higher than what can be sustainably removed from indian forests. In spite of this, an estimated 41% of India's forest cover has been degraded in the past decade, many areas which used to be considered as *dense forest* are now considered *open forest*.[1] Pressure on India's forest comes from many sources, particularly the increase in the population from 390 million in 1950 to 1 billion in 2001 and the overutilization of resources. As pointed out in Foster and Rosenzweig (2003) population growth does not seem to have contributed to a decrease in the total amount of forest cover, yet the per capita availability of forest went from roughly 0.07 ha per capita – already among the lowest endowments worldwide – in 1990 to 0.05 ha per capita in 2011. Forests are unevenly distributed in the country: only 6 out of 35 states account for 50% of the forest area, whereas 8 other states supply less than 0.05% of the forest area (see Table A.1 in the Appendix). The federal government is committed not only to preserve existing forests but also to develop new ones. Under the Constitution of India, national and state governments share jurisdiction for forestry. The government has established a network of more than 500 protected areas to preserve the country's biodiversity and natural habitat. The national forest policy sets the goal of bringing one-third of the country land mass under forest cover. This target is not reached today, but we can observe an increase in forest coverage in several states and the development of a Joint Forest Management with the objective to develop a sustainable management of forests.

The hypothesis tested in this paper is whether and how the decision to collect fuel

[1] For an area to be classified as *dense forest* more than 40% of it has to be covered by vegetation.

– which depends on its scarcity – affects the individual's decision to participate in the labor market. In this framework, the decision to collect resources may be endogenous, there may be some factors motivating both decisions, the one to collect and the one to participate in the labor market. To avoid this problem, we use an instrumental variable approach. In this way we are able to isolate the variation in the probability of collecting forest products which comes from resource scarcity. The decrease in the availability of resources, in this case deforestation, is negatively correlated with the time needed to reach the resource, i.e. the forest. Therefore, we instrument the decision to collect and the time invested in collection with the distance (measured in minutes) from the collection site. The intuition is that if reaching the collection location takes longer, more time has to be invested in collection and this may affect labor market's decisions.

Our results suggest that natural resource scarcity leads both, men and women to spend more time collecting forest products, and increases the time they spend in wage activities. However, deforestation does not seem to affect the probability of being involved in the family farm or in the family business. In line with the theoretical model presented in Section 3, we then investigate the role of urban areas in shaping rural collection behaviors. In order to do this, we split the sample between buyers and sellers of firewood. As expected, a deterioration in the availability of firewood has a different impact on the two groups. While both groups react to the deterioration by increasing the time they devote to wage earning activities, sellers reduce the time they consacrate to family activities.

The literature on the impact of deforestation on individual decision-making is sparse. A few papers examine the relationship between fuel wood collection and the labor market. Because of data availability, the majority of these papers focus on Nepal. Amacher et al. (1996) show that labor supply is related to the household's choice to collect or purchase fuel wood. In their study, Nepalese households living in the Tarai region and purchasing fuel are very responsive to an increase in fuel wood prices and labor opportunities. These households rapidly switch from purchasing fuel wood to using household time – originally dedicated to labor market activities – to replace purchased fuelwood with collected fuelwood. In contrast, collecting households do not react so quickly to a change in firewood price. Moreover, Kumar and Hotchkiss (1988) show the negative impact of deforestation on womens farm labor input. In the same way as it has been done for fuelwood collection, some studies focus on water collection and show its impact on womens activities. Ilahi and Grimard (2000) use simultaneous equations to model the choice of women living in rural Pakistan between water collection, market-based activities and leisure. The distance to a water source has a positive impact on the proportion of women involved in water collection and has a negative impact on their participation in income-generating activities. However, results diverge in other studies.

Lokshin and Yemtsov (2005), using double differences, show that rural water supply improvements in Georgia between 1998-2001 had a significant effect on health but not on labor supply. Also, Koolwal and van de Walle (2013), using a cross country analysis, find no evidence that improved access to water leads to greater off-farm work for women. Unlike fuel, water has no substitute and demand is likely to be inelastic. Therefore, the behavior of households following scarcity of water or scarcity of natural resources (as fuelwood) may differ. However, these papers show that collection activities are not necessarily linked to labor market supply and can have an impact only on leisure.

2 Forest Cover in India

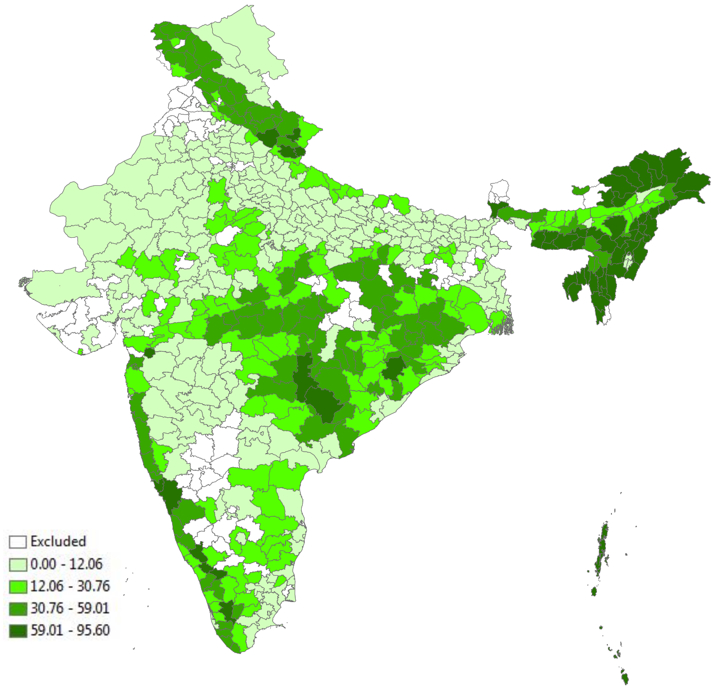
Information on forest cover – our proxy for environmental degradation – comes from the 2001 and the 2005 Forest Survey of India reports. These reports provide periodic assessments of forest cover in the country. They contain information on forest coverage and on deforestation by state and by district biannually. The information included in the two reports we use is based on satellite images from 2000 and 2004. These images are analyzed using GIS technology at a scale of 1:50,000. The lowest level of disaggregation at which this data is available is the district. Our data cover 368 districts, and in 2004 roughly a fifth of the area of the average district was covered by forest.[2]

In 2004, the country forest cover was estimated at 20.6% (Forest Survey of India, 2005). Table A.1 and Figure 1 show the large degree of heterogeneity in forest coverage among states and districts. Table A.1 reports forest coverage for all the states and for the entire country for 2000 and 2004. Forest coverage varies enormously across states, going from Haryana – with only 4% of its surface covered by forest – to Lakshadweep – with over 86% covered by forest. The majority of the reduction in forest cover is taking place in areas of dense coverage (with a canopy density of 40% and above), while open areas (i.e. forest cover having a canopy density between 10 to 40 %) are increasing. Figure 1 shows that this heterogeneity is also found at the district level. In spite of the fact that the National Forest Policy of 1988 set the goal of bringing one third of the landmass of the country under forest cover, there has been significant deforestation in the last decade. Figure 2 shows the rate of deforestation across Indian districts between 2000 and 2004. Roughly 41% of forest coverage has been degraded to some degree. Recently, the Indian government has strengthened its commitment even further. The new objective is to double the rate of restored forest coverage by 2020. Achieving this objective would result in the sequestration of 6.35% of India's annual greenhouse gas emissions (equivalent to removing 43 milion tons of CO_2 per year).[3]

[2] The average district forest cover was $1,100km^2$, and the average district surface is $5,800km^2$.

[3] Natural Resource Defence Council.

Figure 1: Forest cover 2005.



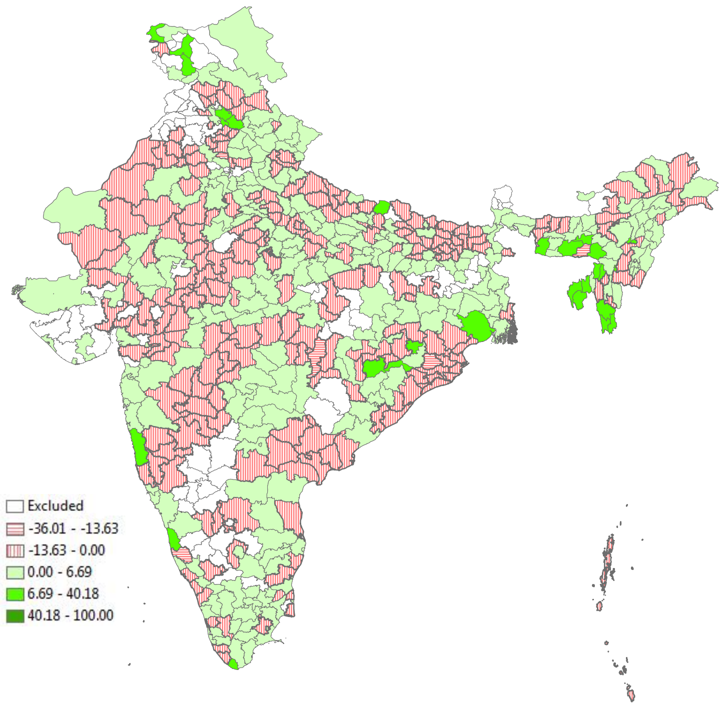
Notes: The numbers represent percent of district area under forest cover.
Source: ESRI ArcGIS World Package, Geocommons and 2005 Forest Survey of India.

3 A Simple Theoretical Model

In this section, we model the choice of a typical household i that must allocate time to collect firewood to satisfy its energy needs. We assume that firewood is primarily sold in the nearby city. Hence prices are set in the market located in the city. Suppose the price of firewood delivered in the city is given by p. Let the household we model be located in a village that is at distance x from the city. The city is assumed to be a point in space. Suppose unit transport costs of firewood denoted by d. Then the price at location x is given by $p - dx$. Prices decline in villages located farther from the city.

Let the utility derived from consuming firewood and other energy needs be given by $u_i(q_i + \theta q_k)$ where $u_i(\cdot)$ is a strictly increasing concave function which suggests that a higher consumption of fuelwood increases utility but at a decreasing rate. Here q_i is the amount of firewood used by a household and q_k is the quantity of an alternative energy that the household uses. This may be kerosene or dung or agricultural residue or any other type of cooking fuel. The parameter θ denotes the energy efficiency of this alternative fuel. For now, we do not specify whether θ is smaller or larger than one.

Figure 2: Deforestation between 2000 and 2004.



Notes: The numbers represent percent variation of forest cover.
Source: ESRI ArcGIS World Package, Geocommons, 2001 and 2005 Forest Survey of India.

If this fuel is kerosene, θ is likely to be greater than unity because it is more efficient that firewood. However if it is crop residue, it will be a value smaller than one. Note that the utility function is subscripted by i which represents the heterogeneity among households. Household-specific characteristics such as income or size may affect the shape of the utility function. Let the reservation wage of the household be given by $\bar{w}_i$, that is, each household may have a different reservation wage for time spent in collecting. Each household is endowed with $\bar{t_i}$ units of time. For example, households with more members may have a higher endowment of time. The household allocates time between collecting firewood and working for wages so that

$$t_w + t_c \leq \bar{t_i}, \tag{1}$$

where t_c is the time spent collecting firewood. The volume of firewood collected per unit time is given by f_i where the subscript represents the distance of household i from the local forest. Each household in our model can decide whether to collect firewood, and if so, the quantity it will collect. If it collects more than what it needs, it can sell the residual firewood in the market at given price $p - dx$. Households are price takers in the market for firewood, which is a reasonable assumption. The price of the alternative fuel (e.g., kerosene) is given by p_k. The maximization problem of the household can be written as

$$\max_{q_i, q_c, q_k, t_w} U_i(q_i + \theta q_k) + \bar{w}_i t_w + (p - dx)(q_c - q_i) - p_k q_k \tag{2}$$

subject to (1) and $q_c = f_i t_c$. The choice variables are the time spent collecting for each household t_i, the quantity of firewood consumed by the household q_i, the alternative energy bought q_k, and the time spent working for wages for each houshhold, t_w. Let us attach a Lagrangian multiplier λ to the inequality (1). Then we get

$$L = U_i(q_i + \theta q_k) + \bar{w}_i t_w + (p - dx)(q_c - q_i) - p_k q_k + \lambda(\bar{t_i} - t_w - t_c). \tag{3}$$

the first order conditions are

$$U_i'(x) \leq p - dx \ (= 0 \text{ if } q_i > 0) \tag{4}$$

$$\theta U_i'(x) \leq p_k \ (= 0 \text{ if } q_k > 0) \tag{5}$$

Lets us discuss what these necessary conditions tell us. Note that the price of firewood $p - dx$ is a parameter and depends on the location of the household with respect to the city. If the price is high, the household will consume relatively small amounts of it. If the household consumes positive amounts of kerosene to complement its use of firewood, then (5) must hold with equality, so that $u_i'(x) = \frac{p_k}{\theta}$. For kerosene, the value of θ is likely to be greater than one. Hence, for a household to use both fuels, the price of firewood will be lower than the price of kerosene, or $\theta(p - dx) = p_k$. If kerosene is too expensive, the household will use only firewood and $U_i'(x) = p - dx < p_k$. Furthermore,

$$p - dx \leq \lambda \ (= 0 \text{ if } q_c > 0) \tag{6}$$

$$\bar{w_i} \leq \lambda \ (= 0 \text{ if } t_w > 0) \tag{7}$$

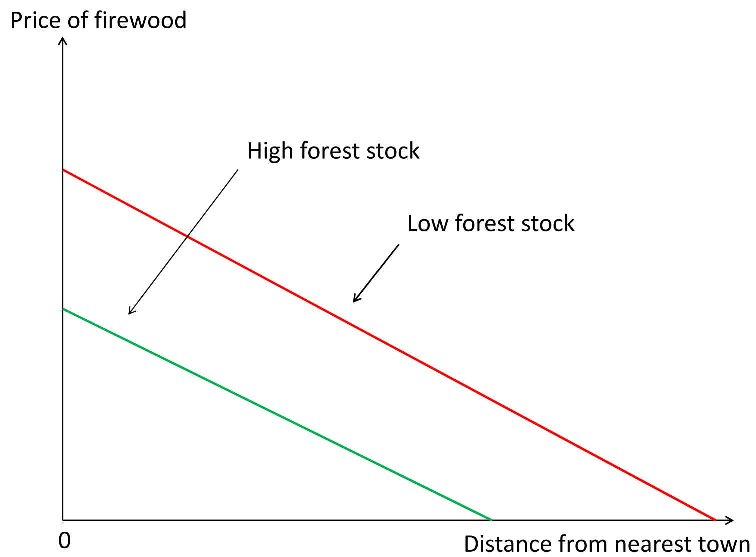
Next the question is, which households collect? And, who buys and who sells? Note that from (6), if the household collects then it must be the case that $p - dx = \lambda$, that is, the price of firewood in the village must equal the shadow price of time, denoted by λ. If the shadow price of time of the household is low, which may be the case, for example, if their labor endowment is high (a bigger family, for example), then λ is likely to be lower, in which case the time spent collecting would be high. If the household collects a lot of firewood, they may consume a small fraction and sell the rest, which adds to their utility in the form of increased revenue. The trade-off between working to earn wages and collecting is shown in equation (7): If their wages are too low, then $\bar{w}_i < \lambda$ in which case, $t_w = 0$ and the household spends all its time collecting firewood.

Finally, note that as the distance from the market increases, the price of firewood falls. Thus we expect to see less firewood being supplied by sellers, since their price is now lower. This means that they should invest more time in alternative wage-earning opportunities. For buyers of firewood, the price is lower, hence they should buy more of it. These relationship are shown in Figure 3.

We can summarize these results with the following proposition:

Proposition: *The price of firewood decreases with distance from the nearest city. Sellers of firewood located closer to the city supply more of it but buyers buy less. Farther from the city, more time is invested in alternative occupations. Households located closer to forests will collect more and work less in alternative jobs.*

Figure 3: Price of firewood as a function of the distance from the nearest town and the forest stock



4 Data

We use a nationally representative cross-section of the Indian population, the Indian Human Development Survey (IHDS). This data was collected between 2004 and 2005. The database contains information at the individual, household and village level for 41,554 households living in urban and rural areas. We focus our attention exclusively

Table 1: Proportion of Women engaged in Wood Collection and in the Labor Force

	Not participanting in the labor force	Participating in the labor force	Total
Not collecting	6.9%	5.1%	12.0%
Collecting	35.3%	52.7%	88.0%
Total	42.2%	57.8%	100%

Table 2: Proportion of Men engaged in Wood Collection and in the Labor Force

	Not participanting in the labor force	Participating in the labor force	Total
Not collecting	7.2%	32.5%	39.7%
Collecting	9.9%	50.4%	60.3%
Total	17.1%	82.9%	100%

on the 26,734 households living in rural India. The survey is representative at the national level, but not necessarily at smaller geographical units. Therefore, we complete our dataset with district level information about the labor market constructed from the 2004 Indian National Service Scheme (NSS) survey.

Our study focuses on women and men of working age (between 15 and 65 years old) living in rural areas. This leaves us with a cross-section containing 17,876 women and 20,211 men.[4] As we pointed out earlier, the focus of this paper is on the impact of fuel scarcity on labor market participation. Table 1 and table 2 report the proportion of women and men who participate in the labor market and who are involved in resource collection, respectively. A large majority of working age women living in rural areas is involved in natural resource collection - roughly 90%. 57.8% of the women included in the sample also participate in the labor market. It is very uncommon for a woman to be involved in the labor market and not in fuel collection, this happens only to 5.1% of the women in our sample. The picture is slightly different for men. Only 60% of men are involved in natural resource collection, while 83% participate in the labor market. 32.5% of the men in our sample participate in the labor market, but are not involved in natural resource collection.

Roughly a fifth of our sample lives in districts which experienced at least some degree of deforestation (i.e. which lost forest cover) between 2002 and 2004. The use of firewood as a source of energy is extremely widespread in rural India. Table 3 shows that irrespective of whether the district experienced deforestation or not, roughly 97% of the households use firewood. However, this is not the only source of energy. About 90% of our sample also uses kerosene and 70% use electricity. Not surprisingly, in districts

[4]The drop from 26,734 households to a sample containing only 17,876 women and 20,211 men is due to the lack of village-level information for many of the surveyed villages.

Table 3: Comparison of Women living in Districts with Negative and Positive Change in Forest Cover

	Women			Men		
	Districts experiencing deforestation	Districts not experiencing deforestation	Difference in percentage points	Districts experiencing deforestation	Districts not experiencing deforestation	Difference in percentage points
Firewood use	98.2%	96.2%	2***	96.9%	94.8%	2.1***
Firewood purchase	9.9%	9.2%	0.7	10.4%	9.7%	0.7
Crop use	19.0%	24.5%	−5.5***	23.4%	26.1%	−2.7***
Electricity use	73.5%	69.5%	4.0***	76.4%	66.7%	9.7***
Kerosene use	92.7%	88.2%	4.5***	85.6%	87.6%	−2.0***
LPG use	11.8%	16.7%	−4.9***	14.7%	16.5%	−1.8***
Resource collection	88.1%	88.0%	0.1	51.6%	62.3%	−10.7***
Labor market	65.5%	56.1%	9.4***	83.2%	82.9%	0.3
Farm activities	45.7%	40.4%	5.3***	52.1%	55.9%	−3.8***
Wage activities	39.2%	26.8%	12.4***	56.7%	51.4%	5.3***
Poverty	27.1%	24.9%	2.2**	23.4%	22.7%	0.7

Notes: *** p<0.01, ** p<0.05, * p<0.1

which experienced deforestation, a bigger share of households have to buy firewood. As expected, participation in natural resource collection is higher in districts that have experienced deforestation. The intuition is straightforward, deforestation increases the distance that people have to cover in order to collect fuel and therefore more people need to be involved. Collection happens both from land owned by the household and from the village commons.

Table 4 reports descriptive statistics of the variables employed in the estimation. The variables of interests exhibit a high degree of dispersion (high standard deviation). Our households include on average 6 members, and roughly 45% of the women included in the sample have some degree of education. Roughly 2/3 of each household is older than 15. The majority of the households studied live in villages with a population between 1,001 and 5,000.

5 Empirical approach and results

5.1 Identification

Identification presents two separate issues. First, we have to deal with the high number of zeros in the dependent variable. Many of the women in our sample do not participate in the labor market. Second, we have do deal with the endogeneity of the time spent in collection of natural resources.

Following the approach suggested in Angrist (2001), we do not want to use two-part models due to the difficulty of interpreting part 2 in a casual sense. At the same time, we do not want to condition on positive outcomes. As with two-parts models, it would not be possible to interpret the results in a casual way. Therefore, we split our problem in

Table 4: Descriptive statistics

Variable	Women				Men			
	Mean	**St. Dev.**	**Min**	**Max**	**Mean**	**St. Dev.**	**Min**	**Max**
Percentage working in family activities	0.41	0.49	0.00	1.00	0.55	0.50	0.00	1.00
Percentage working as salary or other	0.29	0.45	0.00	1.00	0.52	0.50	0.00	1.00
Percentage who collect natural resources	0.88	0.32	0.00	1.00	0.60	0.49	0.00	1.00
Firewood price (/kg in Rs)	1.64	2.02	0.01	40.00	1.69	2.50	0.01	99.00
Age	34.49	14.10	15.00	65.00	34.29	14.09	15.00	65.00
1-5 years of schooling	0.15	0.36	0.00	1.00	0.19	0.39	0.00	1.00
6-10 years of schooling	0.23	0.42	0.00	1.00	0.40	0.49	0.00	1.00
11-15 years of schooling	0.06	0.23	0.00	1.00	0.13	0.34	0.00	1.00
Households size	6.41	3.35	1.00	38.00	6.44	3.30	1.00	38.00
Percentage of older than 15	71.79	20.32	14.29	100.00	73.32	20.44	16.67	100.00
Hindu	0.89	0.32	0.00	1.00	0.86	0.35	0.00	1.00
Household income per cons unit (Rs)	13,591	20,512	2.26	830,000	13,950	20,743	2.26	718,750
Electricity use	0.70	0.46	0.00	1.00	0.69	0.46	0.00	1.00
Firewood use	0.97	0.18	0.00	1.00	0.95	0.21	0.00	1.00
Crop use	0.23	0.42	0.00	1.00	0.26	0.44	0.00	1.00
Kerosene use	0.89	0.31	0.00	1.00	0.87	0.33	0.00	1.00
Lgp use	0.16	0.36	0.00	1.00	0.16	0.37	0.00	1.00
Employment program in the village	0.88	0.32	0.00	1.00	0.86	0.35	0.00	1.00
Conflict	0.46	0.50	0.00	1.00	0.48	0.50	0.00	1.00
Distance to town (in km)	14.4	11.07	1.00	85.00	14.7	11.2	1.00	85.00
Village population between 1,001 and 5,000	0.57	0.50	0.00	1.00	0.58	0.49	0.00	1.00
Village population over 5,000	0.16	0.37	0.00	1.00	0.16	0.37	0.00	1.00
Daily unskilled wage rate (Rs)	47.32	19.87	6.00	150.00	91.92	163.58	6.00	999.00
District unemployment rate	1.73	2.32	0.00	20.39	1.63	2.23	0.00	20.39
Urban population in the district	0.20	0.12	0.01	0.76	0.20	0.13	0.00	0.76

Notes: The sample includes 17,876 women and 20,211 men.

two. We first analyse decisions, i.e. the impact of collecting on the participation in the labor market. In this case, collection and labor market particiaption are both denoted by dummy variables. We then proceed to analyse the impact of hours spent in collection on hours spent in the labor market.

Fuel collection, be it the probability of doing it or the time spent doing it, may depend on factors that affect contemporaneously not only collection activities but also labor market activities. For example an individual may be living in an area which is growing faster. If this is the case, by running a simple logit or Ordinary Least Squares (OLS) regression we would not be identifying a causal relationship. We deal with this endogeneity issue by using an instrumental variable approach. Collection is instrumented with the distance (expressed in minutes) from the collection location. Distance from the collection location is a good proxy of deforestation, the two variables are negatively correlated. In order to account for the possibility that this relationship may not be linear we use as instruments the distance in minutes and its squared value. Data on the variation of forest cover (i.e. deforestation or reforestation) are available only at the district level. Using the distance to the collection location we capture part of the heterogeneity in the change in forest cover within districts. This instrument works particularly well for the Indian case, since Indian's rural households tend to own the house they live in, and this house is passed on though generations. Therefore, even if the location was endogenous to forest cover when the house was built, it is plausible to think that it is not anymore the case. Migration rates in rural India are extremely low (National Sample Survey Office (2010)).

Distance from the forest does not have a direct impact on labor market participation. The only channel through which a higher distance from the collection location may affect labor market decisions is that people who have to collect fuelwood have to invest more time in it. Therefore, the first stage regressions of our instrumental variable analysis have the following form

$$C_{ihvds} = \alpha + \delta_s + \beta_1 D_{hvds} + \beta_2 D^2_{hvds} + B'_{ihvds}\gamma_1 + X'_{hvds}\gamma_2 + G'_{vds}\gamma_3 + R'_{ds}\gamma_4 + \varepsilon_{ihvds} \quad (8)$$

where C may denote whether the individual collects firewood or not, or the time an individual spends in fuelwood collection; D denotes the distance from the collection location and ε is an error term. Individual, household, village, district and state are indexed i, h, v, d and s respectively. Thus, δ_s represents a set of state fixed-effects. B denotes a matrix of individual specific controls, X a matrix of household specific controls, G one of village-specific controls and R of district-specific controls. At this point, one has to notice that our observations are at the individual level, yet our instrument varies only at the household level. Therefore, the interpretation of the results has to take into account that the identifying variation is at the household level. Even in the case in which C is a binary variable, we estimate the first stage using OLS, to avoid running what Angrist and Pischke (2009) call a *forbidden regression*.

Table 5 reports the results of the first stage estimation for women. The table reports results for the dummy variable case, i.e. the probability of collecting, in columns (1) to (3); and for the case using hours spent in collection activities in columns (4) to (6). In both cases, the model in equation (8) is estimated first only with state-specific fixed effects, then with individual- and household-specific controls, and finally with also village- and district-specific controls. The results suggest that the scarcity of fuel wood generated by a reduction of the forest cover – represented by longer distances to the collection location – has a positive and statistically significant effect both on the probability that an individual is involved in its collection and on the time he spends doint it. Column (3) shows us that a one percent increase in the distance from the collection location leads to a 0.8 percent increase in the probability of collecting; while column (6) tells us that an increase of one percent in the distance results in an increase of 2.1% of the hours spent in collection activities. These impacts are very robust to the addition of the different controls and statistically significant at the 1% level. The square of the distance is also statistically significant at the 1% level, but negative. Therefore, the positive impact of the distance on collection behavior decreases in importance the further away is the collection location.

First stage estimation results for men are contained in Table 6. The estimates are extremely similar to those obtained for women, slightly smaller in magnitude. This may be driven by the fact that women are mainly responsible for firewood collection, as we observed from Table 1 and Table 2 and as also pointed out by Kumar and Hotchkiss (1988), Cooke (998b) and Bandyopadhyay et al. (2011). A 1% increase in the distance from the collection location leads to a 0.6% increase in the probability of collecting and to a 1.3% variation in collection time.

We now turn to the main part of the analysis, the impact of collection activities – i.e. a degradation of the forest stock – on labor market outcomes. We proceed in two steps. First we analyse the impact on the probability of participation and second, on the hours supplied to the labor market.

5.1.1 Impact of resource collection on the probability to enter the labor market

Y is a binary variable taking value 1 if an individual participates in the labor market and 0 otherwise. C, our variable of interest, denotes whether an individual collects firewood or not and $\hat{C}$ represents the fitted values coming from the first stage regression (equation 8). Our logit specification takes the following form

$$\begin{aligned} P[Y_{ihvds} &= 1 \mid \alpha, \delta_s, \beta, \gamma_1, \gamma_2, \gamma_3, \gamma_4, \hat{C}_{ihvds}, B_{ihvds}, X_{hvds}, G_{vds}, R_{ds}] \\ &= \Phi\left(\alpha + \delta_s + \beta\hat{C}_{ihvds} + B'_{ihvds}\gamma_1 + X'_{hvds}\gamma_2 + G'_{vds}\gamma_3 + R'_{ds}\gamma_4\right). \quad (9) \end{aligned}$$

where individual, household, village, district and state are represented by indexes i, h, v, d and s respectively. Thus, δ_s represents a set of state fixed-effects. B denotes a matrix of individual specific controls, X a matrix of household specific controls, G one of village-specific controls and R of district-specific controls. The coefficient of interest is β.

Tables 9, 10 and 11 show the results for women, while Tables 12, 13 and 14 focus on the men in our sample. Results are similar accros the two gender groups.

Focusing on women, we first report results for all labor market activities in Table 9. Columns (1) to (4) show coefficient estimates for the logit specification. In column (1) we only control for state fixed effects, we subsequently introduce individual and household controls, in column (2), and village and district controls, in columns (3) and (4). Columns (1), (2) and (4) present instrumental variable specifications, while column (3) presents the results of a simple OLS regression. Surprisingly, an increase in the probability of collection has a positive impact on the probability of participating in the

Table 5: First stage regression women

	Dependent variable:					
	Probability of collecting			Hours spent collecting		
	(1)	(2)	(3)	(4)	(5)	(6)
distance from collection (min)	0.009***	0.009***	0.008***	0.022***	0.021***	0.021***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
distance from collection^2 (min)	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age of the individual		−0.000	−0.001		−0.000	0.000
		(0.001)	(0.001)		(0.002)	(0.002)
age2		−0.000	0.000		−0.000	−0.000
		(0.000)	(0.000)		(0.000)	(0.000)
school between 1-5 years		−0.011	−0.012		−0.031*	−0.029*
		(0.008)	(0.008)		(0.017)	(0.016)
school between 6-10 years		−0.013	−0.013		−0.039*	−0.038*
		(0.009)	(0.009)		(0.020)	(0.020)
school between 11-15		−0.051***	−0.051***		−0.122***	−0.121***
		(0.017)	(0.016)		(0.031)	(0.030)
size of the households		−0.002	−0.003		−0.002	−0.002
		(0.002)	(0.002)		(0.005)	(0.005)
percentage of persons aged 15 years and more		−0.000	−0.000		−0.001	−0.000
		(0.000)	(0.000)		(0.000)	(0.000)
hindu		0.014	0.012		−0.001	0.001
		(0.021)	(0.021)		(0.034)	(0.033)
household income per consumption unit (in log)		−0.005	−0.006		−0.018*	−0.017
		(0.005)	(0.005)		(0.011)	(0.010)
electricity use		−0.029***	−0.024**		−0.054**	−0.041*
		(0.010)	(0.010)		(0.023)	(0.023)
firewood use		0.207***	0.216***		0.153**	0.163**
		(0.037)	(0.035)		(0.077)	(0.074)
crop use		0.017	0.022*		0.123***	0.128***
		(0.013)	(0.013)		(0.030)	(0.030)
kerosene use		−0.040***	−0.034**		0.088**	0.094**
		(0.015)	(0.015)		(0.039)	(0.039)
lgp use		−0.066***	−0.065***		−0.137***	−0.139***
		(0.015)	(0.015)		(0.032)	(0.032)
employment program in the village			0.017			0.030
			(0.020)			(0.061)
conflict			−0.035***			−0.007
			(0.010)			(0.025)
distance to town (in log)			−0.016*			−0.014
			(0.009)			(0.018)
1001 - 5000 inhbts in the village			−0.053***			−0.058*
			(0.013)			(0.035)
more than 5000 inhbts			−0.102***			−0.112**
			(0.023)			(0.048)
daily women unskilled wage rate (in log)			0.000			−0.005
			(0.018)			(0.040)
unemployment rate in the district			−0.006*			−0.021***
			(0.004)			(0.007)
% of urban population in the district			−0.033			−0.258*
			(0.059)			(0.136)
State F.E.	yes	yes	yes	yes	yes	yes
Observations	17,876	17,876	17,876	17,876	17,876	17,876
F-stat first stage	84.27	75.36	78.56	313.73	265.39	267.35

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: First stage regression men

	Dependent variable:					
	Probability of collecting			Hours spent collecting		
	(1)	(2)	(3)	(4)	(5)	(6)
distance from collection (min)	0.007^{***}	0.006^{***}	0.006^{***}	0.015^{***}	0.014^{***}	0.013^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
distance from collection^2 (min)	-0.000^{***}	-0.000^{***}	-0.000^{***}	-0.000^{***}	-0.000^{***}	-0.000^{***}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age of the individual		0.002	0.001		0.001	0.001
		(0.001)	(0.001)		(0.002)	(0.002)
age2		−0.000	−0.000		−0.000	−0.000
		(0.000)	(0.000)		(0.000)	(0.000)
school between 1-5 years		−0.000	−0.003		−0.007	−0.007
		(0.013)	(0.013)		(0.022)	(0.022)
school between 6-10 years		0.009	0.007		−0.007	−0.007
		(0.013)	(0.013)		(0.023)	(0.023)
school between 11-15		−0.011	−0.005		−0.049	−0.040
		(0.018)	(0.018)		(0.030)	(0.030)
size of the households		0.010^{***}	0.010^{***}		0.016^{***}	0.016^{***}
		(0.002)	(0.002)		(0.004)	(0.004)
percentage of persons aged 15 years and more		0.002^{***}	0.001^{***}		0.002^{***}	0.002^{***}
		(0.000)	(0.000)		(0.001)	(0.001)
hindu		0.021	0.003		−0.002	−0.018
		(0.025)	(0.025)		(0.039)	(0.039)
household income per consumption unit (in log)		−0.002	−0.003		−0.002	−0.003
		(0.008)	(0.008)		(0.013)	(0.013)
electricity use		-0.042^{**}	-0.040^{**}		-0.063^{*}	-0.057^{*}
		(0.018)	(0.017)		(0.034)	(0.033)
firewood use		0.235^{***}	0.230^{***}		0.240^{***}	0.251^{***}
		(0.052)	(0.050)		(0.083)	(0.085)
crop use		0.037^{*}	0.038^{*}		0.069^{*}	0.079^{**}
		(0.020)	(0.021)		(0.037)	(0.039)
kerosene use		0.002	−0.002		0.116^{**}	0.128^{**}
		(0.030)	(0.029)		(0.054)	(0.055)
lgp use		-0.086^{***}	-0.081^{***}		-0.122^{***}	-0.115^{***}
		(0.024)	(0.024)		(0.040)	(0.040)
employment program in the village			−0.019			−0.030
			(0.031)			(0.051)
conflict			−0.014			0.026
			(0.019)			(0.032)
distance to town (in log)			−0.001			−0.006
			(0.015)			(0.024)
1001 - 5000 inhbts in the village			-0.071^{***}			-0.101^{**}
			(0.026)			(0.046)
more than 5000 inhbts			-0.117^{***}			-0.181^{***}
			(0.039)			(0.063)
daily women unskilled wage rate (in log)			0.048			0.111^{*}
			(0.033)			(0.057)
unemployment rate in the district			−0.005			-0.020^{*}
			(0.006)			(0.010)
% of urban population in the district			0.214^{**}			0.236
			(0.090)			(0.160)
State F.E.	yes	yes	yes	yes	yes	yes
Observations	18,035	18,035	18,035	18,035	18,035	18,035
F-stat first stage	33.53	26.42	25.56	73.02	58.53	55.53

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Relationship between forest cover and fuel wood price

	Fuelwood price (Rs/ 10 kg)
Forest cover $< 100km^2$	19.28
Forest cover $> 100km^2$ and $< 500km^2$	15.77
Forest cover $> 500km^2$ and $< 1500km^2$	15.19
Forest cover $> 1500km^2$	15.15
Forest cover changes negatively between 2002 and 2004	13.52
Forest cover does not change between 2002 and 2004	16.47
Forest cover changes positively between 2002 and 2004	17.70
Forest cover represents less than 5% of geographical area	10.39
Forest cover represents more than 5% of geographical area	25.06

Table 8: Relationship between forest cover and fuel wood price

	Distance to town < 20km	Distance to town ≥ 20km – < 30km	Distance to town ≥ 30km
Percentage of women who collect natural resources	88.9%	85.7%	85.1%
Percentage of women working	55.6%	61.5%	68.6%
Percentage of men who collect natural resources	58.6%	62.7%	67.7%
Percentage of men working	82.4%	83.9%	85.3%
Firewood price (Rs/10kg)	17.26	15.38	14.61

labor market. An increase of 1% in the probability of participating in natural resource collection increases the probability to participate in the labor market by 18.4%. This result is robust across specifications and statistically significant at the 1% level.

In order to understand where this coefficient is coming from, we separate labor market participation between participation in family activities, i.e. related to the family farm or a family business, and wage earning activities. These results are presented in Table 10 and Table 11. The positive effect comes completely from an increase in the probability of participanting in a wage earning activity. A one percent increase in the probability of collection, increases the probability of participating in wage activities by 21.2%, and again this result is robust across specifications and statistically significant at the 1% level. Participation in family activities is instead unaffected by collection.

Coefficient estimates for men are very similar. The impact of an increase in the probability of collecting has a positive, yet not statistically significant, impact on the probability of participating in the labor market. A further split between entrepreneurial activities and wage earning activities shows a slightly different picture than the one observed for women. While an increase in the probability of collection does not seem to affect the probability of participating in an entrepreneurial activity, a 1% increase in the probabililty of collection increases the probability of working by 26.5%. Thus, the impact on men's participation in the labor market seem to be more pronounced.

5.1.2 Impact of resource collection on the time spent in the labor market

It will now be interesting to investigate whether the same effects are observed for the amount of hours spent in the labor market.

H denotes an individual's labor supply; HC represents the hours spent by an individual in firewood collection and $\hat{HC}$ represents the fitted values coming from the first stage regresion, i.e. equation 8. The specification of the second stage takes the following form

$$H_{ihvds} = \alpha + \delta_s + \beta \hat{HC}_{ihvds} + B'_{ihvds}\gamma_1 + X'_{hvds}\gamma_2 + G'_{vds}\gamma_3 + H'_{ds}\gamma_4 + u_{ihvds}. \quad (10)$$

where individual, household, village, district and state are represented by indexes i, h, v, d and s respectively. Thus, δ_s represents a set of state fixed-effects. B denotes a matrix of individual specific controls, X a matrix of household specific controls, G one of village-specific controls and R of district-specific controls. Again, the coefficient of interest is β.

Results for all labor market activities for women are reportes in Table 9. Columns (5) to (8) show coefficient estimates for labor supply. In column (5) we only control for state fixed effects, we subsequently introduce individual and household controls, in column (6), and village and district controls, in columns (7) and (8). Columns (5), (6) and (8) present IV specifications, while column (7) presents the results of a simple OLS regression. The results obtained for the proability of participating in the labor market are confirmed. An increase in the time spent in collection has a positive impact on labor supply. An increase of 1% in collection time increases the labor supply by 12.9%. This result is robust across specifications and statistically significant at the 1% level.

As before, we separate labor supply between supply to family activities and to wage earning activities. These results are presented in Table 10 and Table 11. As before, the positive impact on labor supply comes from an increase in the time supplied to wage earning activities. A one percent increase in the time spent in collection, increases the time supplied to wage activities by 21.2%, and again this result is robust across specifications and statistically significant at the 1% level. Participation in family activities is instead unaffected by collection.

Here is where the men's coefficients show a slight difference from the women's. As in the case of women, an increase in the time spent in collection has a positive, and statistically significant at the 5%, effect on labor supply. A 1% increase in the distance form the collection location increases by 15.9% the time men spend in the labor market. Yet, when splitting the impact between entrepreneurial and wage activities, we observe a difference in the men's reaction. An increase by 1% in the time dedicated to collection reduces the time dedicated to entrprneurial activities by 19.9%, and this is statistically significant at the 5% level. Finally, focusing on wage earning activities, we observe that a 1% increase in collection time increases time spent in wage earning activities by 38.1%.

Several factors may lay behind these results. At first, the positive impact on wage earning activities following a decrease in environmental quality may seem counterintuitive, especially in lights of the results of Cooke (998a). Yet, in light of our theoretical model, these results are not surprising. 50% of urban people in India still use fuelwood as a source of energy. Progressive forest degradation, pushes the price of fuelwood up, as shown in Table 7. Data on firewood price come from the IHDS survey and are disaggregated at the village level. The price of firewood is also a proxy for environmental degradation. A heavier rate of deforestation results in higher scarcity of firewood and therefore higher prices, as we can observe from Table 7. The price of firewood is on average higher (19.5 Rs/10kg) in districts that did experience deforestation between 2002 and 2004 then in districts that experienced reforestation (13.4 Rs/10kg). The price difference is also significant between districts where forest cover represents less than 5% of the geographical area (26.2 Rs/10kg) and those with a higher share (15.8 Rs/10kg). This price increase has several implications. According to our model, a consequence of a decrease in the stock of forest is that people are going to collect more, because of the increase in price. Another consequence of the increase in the price of fuelwood is that more and more people living in urban areas may switch to alternative sources of energy. This process generates a negative income shock for people living in rural areas surrounding cities who used to collect wood and sell it to people living in the city. This income reduction indirectly arising from deforestation may be what pushes more people living in rural areas toward getting wage paying jobs.

A corollary to this explanations is the possibility of greater availability of wgae paying jobs in areas characterized by a lower environmental quality, be it in the forestry industry or in agriculture. In areas experiencing higher rates of deforestation the forestry industry may be generating more wage paying jobs. We do observe a higher GDP coming from forestry in districts characterized by higher deforestation. A similar impact can be observed for the agricultural sector. A decrease in the forest cover allows for the formation, and an easier exploitation, of bigger farms. Therefore, this increase in the average farm size generates more wage paying agricultural jobs.

5.2 Role of urban areas

As mentioned above, and highlighted by the theoretical model, the explanation of the positive effect of deforestation on the amount of labor supplied to wage earning activities originates within cities. Cities, together with forest cover, are the main drivers of the price of firewood (see Table 8).

Table 9: All activities women

	Dependent variable:							
	Probability of working				Hours spent working			
	IV (1)	IV (2)	OLS (3)	IV (4)	IV (5)	IV (6)	OLS (7)	IV (8)
Natural resource collection	0.332*** (0.052)	0.219*** (0.060)	0.121*** (0.018)	0.184*** (0.059)				
Hours spent collecting					0.301*** (0.049)	0.160*** (0.049)	0.063*** (0.023)	0.129*** (0.047)
age of the individual		0.057*** (0.002)	0.058*** (0.002)	0.058*** (0.002)		0.159*** (0.005)	0.160*** (0.005)	0.160*** (0.005)
age2		−0.001*** (0.000)	−0.001*** (0.000)	−0.001*** (0.000)		−0.002*** (0.000)	−0.002*** (0.000)	−0.002*** (0.000)
school between 1-5 years		−0.075*** (0.014)	−0.074*** (0.014)	−0.072*** (0.014)		−0.215*** (0.033)	−0.208*** (0.033)	−0.204*** (0.032)
school between 6-10 years		−0.161*** (0.015)	−0.163*** (0.015)	−0.160*** (0.015)		−0.459*** (0.036)	−0.458*** (0.036)	−0.451*** (0.036)
school between 11-15		−0.267*** (0.023)	−0.270*** (0.022)	−0.263*** (0.022)		−0.750*** (0.058)	−0.746*** (0.058)	−0.732*** (0.057)
size of the households		−0.019*** (0.002)	−0.019*** (0.002)	−0.019*** (0.002)		−0.056*** (0.006)	−0.056*** (0.005)	−0.056*** (0.005)
percentage of persons aged 15 years and more		−0.001*** (0.000)	−0.001*** (0.000)	−0.001*** (0.000)		−0.004*** (0.001)	−0.004*** (0.001)	−0.004*** (0.001)
hindu		0.090*** (0.021)	0.095*** (0.021)	0.094*** (0.021)		0.231*** (0.047)	0.235*** (0.047)	0.235*** (0.047)
household income per consumption unit (in log)		−0.001 (0.007)	−0.000 (0.007)	0.000 (0.007)		0.061*** (0.016)	0.061*** (0.016)	0.062*** (0.016)
electricity use		−0.057*** (0.016)	−0.042*** (0.015)	−0.040** (0.016)		−0.161*** (0.035)	−0.129*** (0.034)	−0.125*** (0.034)
firewood use		0.131** (0.060)	0.172*** (0.051)	0.151*** (0.055)		0.395*** (0.089)	0.444*** (0.084)	0.422*** (0.082)
crop use		0.031* (0.018)	0.042** (0.017)	0.039** (0.017)		−0.027 (0.042)	0.007 (0.039)	−0.005 (0.040)
kerosene use		−0.015 (0.023)	−0.016 (0.022)	−0.015 (0.022)		−0.075 (0.052)	−0.057 (0.050)	−0.065 (0.050)
lpg use		−0.054** (0.021)	−0.062*** (0.021)	−0.057*** (0.022)		−0.187*** (0.048)	−0.196*** (0.047)	−0.183*** (0.047)
employment program in the village			0.050* (0.029)	0.049* (0.029)			0.096 (0.066)	0.095 (0.067)
conflict			−0.008 (0.014)	−0.007 (0.014)			−0.082** (0.032)	−0.082** (0.032)
distance to town (in log)			0.039*** (0.010)	0.040*** (0.010)			0.083*** (0.024)	0.083*** (0.023)
1001 - 5000 inhbts in the village			−0.084*** (0.019)	−0.081*** (0.019)			−0.175*** (0.045)	−0.171*** (0.045)
more than 5000 inhbts			−0.161*** (0.026)	−0.153*** (0.028)			−0.321*** (0.064)	−0.310*** (0.065)
daily women unskilled wage rate (in log)			0.007 (0.022)	0.008 (0.022)			−0.020 (0.051)	−0.019 (0.051)
unemployment rate in the district			−0.020*** (0.004)	−0.019*** (0.004)			−0.044*** (0.008)	−0.042*** (0.008)
% of urban population in the district			−0.077 (0.069)	−0.078 (0.069)			−0.060 (0.168)	−0.052 (0.167)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	17,876	17,876	17,876	17,876	17,876	17,876	17,876	17,876
F-stat first stage	84.27	75.36		78.56	313.73	265.39		267.35
Hansen J					0.611	0.275		0.499
p value					0.4343	0.5997		0.4798

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Family activities women

	Dependent variable:							
	Probability of working				Hours spent working			
	IV	IV	OLS	IV	IV	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Natural resource collection	0.121**	0.053	0.062***	0.003				
	(0.056)	(0.064)	(0.019)	(0.062)				
Hours spent collecting					0.041	−0.005	0.008	−0.050
					(0.048)	(0.051)	(0.023)	(0.048)
age of the individual		0.042***	0.043***	0.043***		0.105***	0.106***	0.106***
		(0.002)	(0.002)	(0.002)		(0.004)	(0.004)	(0.004)
age2		−0.001***	−0.001***	−0.001***		−0.001***	−0.001***	−0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
school between 1-5 years		0.004	0.014	0.012		0.012	0.034	0.031
		(0.013)	(0.013)	(0.013)		(0.031)	(0.030)	(0.030)
school between 6-10 years		−0.022	−0.012	−0.015		−0.061*	−0.038	−0.044
		(0.014)	(0.014)	(0.014)		(0.032)	(0.031)	(0.031)
school between 11-15		−0.136***	−0.119***	−0.124***		−0.337***	−0.287***	−0.299***
		(0.022)	(0.022)	(0.022)		(0.049)	(0.047)	(0.048)
size of the households		−0.002	−0.002	−0.002		−0.007	−0.007*	−0.008*
		(0.002)	(0.002)	(0.002)		(0.005)	(0.004)	(0.004)
percentage of persons aged 15 years and more		−0.000*	−0.001*	−0.001**		−0.001**	−0.001**	−0.001**
		(0.000)	(0.000)	(0.000)		(0.001)	(0.001)	(0.001)
hindu		0.097***	0.106***	0.106***		0.222***	0.231***	0.230***
		(0.022)	(0.021)	(0.022)		(0.048)	(0.047)	(0.047)
household income per consumption unit (in log)		−0.018**	−0.014*	−0.014*		−0.009	−0.002	−0.004
		(0.007)	(0.007)	(0.007)		(0.018)	(0.017)	(0.017)
electricity use		0.004	0.029*	0.028*		0.035	0.082**	0.078**
		(0.016)	(0.016)	(0.016)		(0.035)	(0.034)	(0.035)
firewood use		0.121**	0.123***	0.136***		0.274***	0.274***	0.294***
		(0.056)	(0.045)	(0.047)		(0.084)	(0.070)	(0.075)
crop use		0.064***	0.068***	0.070***		0.069*	0.075**	0.086**
		(0.018)	(0.018)	(0.018)		(0.039)	(0.037)	(0.037)
kerosene use		−0.036	−0.039*	−0.041*		−0.072	−0.076	−0.069
		(0.024)	(0.022)	(0.023)		(0.053)	(0.050)	(0.050)
lgp use		0.008	0.019	0.014		0.011	0.038	0.027
		(0.022)	(0.021)	(0.022)		(0.048)	(0.046)	(0.047)
employment program in the village			0.045	0.045			0.103	0.104*
			(0.029)	(0.029)			(0.063)	(0.063)
conflict			0.002	0.000			−0.048	−0.048
			(0.015)	(0.015)			(0.034)	(0.034)
distance to town (in log)			0.057***	0.056***			0.118***	0.118***
			(0.012)	(0.012)			(0.025)	(0.025)
1001 - 5000 inhbts in the village			−0.087***	−0.090***			−0.163***	−0.166***
			(0.020)	(0.021)			(0.049)	(0.049)
more than 5000 inhbts			−0.208***	−0.213***			−0.454***	−0.464***
			(0.026)	(0.026)			(0.070)	(0.071)
daily women unskilled wage rate (in log)			−0.050**	−0.050**			−0.129**	−0.130**
			(0.025)	(0.025)			(0.055)	(0.056)
unemployment rate in the district			−0.020***	−0.020***			−0.037***	−0.039***
			(0.005)	(0.005)			(0.007)	(0.008)
% of urban population in the district			0.013	0.014			0.189	0.182
			(0.081)	(0.081)			(0.203)	(0.205)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	17,876	17,876	17,876	17,876	17,876	17,876	17,876	17,876
F-stat first stage	84.27	75.36		78.56	313.73	265.39		267.35
Hansen J					0.000	0.107		0.055
p value					0.9901	0.7430		0.8142

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Wage activities women

	Dependent variable:							
	Probability of working				Hours spent working			
	IV	IV	OLS	IV	IV	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Natural resource collection	0.345***	0.213***	0.081***	0.212***				
	(0.041)	(0.042)	(0.012)	(0.042)				
Hours spent collecting					0.341***	0.207***	0.078***	0.212***
					(0.045)	(0.045)	(0.020)	(0.045)
age of the individual		0.030***	0.030***	0.030***		0.083***	0.083***	0.083***
		(0.002)	(0.002)	(0.002)		(0.004)	(0.004)	(0.004)
age2		−0.000***	−0.000***	−0.000***		−0.001***	−0.001***	−0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
school between 1-5 years		−0.076***	−0.077***	−0.076***		−0.284***	−0.294***	−0.286***
		(0.008)	(0.008)	(0.008)		(0.032)	(0.032)	(0.031)
school between 6-10 years		−0.151***	−0.153***	−0.150***		−0.504***	−0.522***	−0.509***
		(0.009)	(0.009)	(0.009)		(0.035)	(0.035)	(0.034)
school between 11-15		−0.146***	−0.151***	−0.147***		−0.536***	−0.573***	−0.545***
		(0.011)	(0.011)	(0.011)		(0.051)	(0.052)	(0.051)
size of the households		−0.025***	−0.026***	−0.025***		−0.060***	−0.059***	−0.059***
		(0.002)	(0.002)	(0.002)		(0.005)	(0.005)	(0.005)
percentage of persons aged 15 years and more		−0.001***	−0.002***	−0.001***		−0.004***	−0.004***	−0.004***
		(0.000)	(0.000)	(0.000)		(0.001)	(0.001)	(0.001)
hindu		0.015	0.016	0.017		0.083**	0.084**	0.085**
		(0.014)	(0.014)	(0.014)		(0.042)	(0.041)	(0.041)
household income per consumption unit (in log)		0.003	0.002	0.003		0.058***	0.054***	0.057***
		(0.006)	(0.006)	(0.006)		(0.016)	(0.015)	(0.016)
electricity use		−0.089***	−0.089***	−0.085***		−0.261***	−0.261***	−0.253***
		(0.012)	(0.012)	(0.012)		(0.035)	(0.035)	(0.035)
firewood use		0.041	0.074**	0.044		0.158**	0.216***	0.171***
		(0.039)	(0.030)	(0.035)		(0.065)	(0.064)	(0.062)
crop use		−0.014	−0.006	−0.012		−0.076**	−0.050	−0.073**
		(0.012)	(0.012)	(0.012)		(0.036)	(0.035)	(0.036)
kerosene use		0.004	0.002	0.006		−0.044	−0.021	−0.037
		(0.019)	(0.020)	(0.019)		(0.046)	(0.045)	(0.046)
lpg use		−0.121***	−0.130***	−0.123***		−0.262***	−0.293***	−0.267***
		(0.012)	(0.011)	(0.012)		(0.039)	(0.037)	(0.039)
employment program in the village			0.002	0.002			0.006	0.003
			(0.018)	(0.018)			(0.053)	(0.055)
conflict			−0.006	−0.002			−0.039	−0.040
			(0.010)	(0.010)			(0.030)	(0.031)
distance to town (in log)			0.005	0.007			−0.000	0.001
			(0.007)	(0.007)			(0.021)	(0.021)
1001 - 5000 inhbts in the village			−0.031**	−0.023			−0.082*	−0.074*
			(0.014)	(0.014)			(0.042)	(0.043)
more than 5000 inhbts			−0.013	0.003			−0.000	0.022
			(0.020)	(0.021)			(0.062)	(0.063)
daily women unskilled wage rate (in log)			0.007	0.009			0.038	0.040
			(0.016)	(0.016)			(0.050)	(0.051)
unemployment rate in the district			−0.008**	−0.006*			−0.016**	−0.011
			(0.003)	(0.003)			(0.007)	(0.007)
% of urban population in the district			−0.133***	−0.130***			−0.358**	−0.342**
			(0.047)	(0.047)			(0.150)	(0.155)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	17,876	17,876	17,876	17,876	17,876	17,876	17,876	17,876
F-stat first stage	84.27	75.36		78.56	313.73	265.39		267.35
Hansen J					0.416	0.490		0.518
p value					0.5191	0.4840		0.4718

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 12: All activities men

	Dependent variable:							
	Probability of working				Hours spent working			
	IV (1)	IV (2)	OLS (3)	IV (4)	IV (5)	IV (6)	OLS (7)	IV (8)
Natural resource collection	0.106***	0.073**	0.004	0.058				
	(0.037)	(0.035)	(0.006)	(0.037)				
Hours spent collecting					0.187***	0.168**	−0.012	0.159**
					(0.063)	(0.065)	(0.016)	(0.068)
age of the individual		0.044***	0.042***	0.044***		0.256***	0.256***	0.256***
		(0.001)	(0.001)	(0.001)		(0.005)	(0.005)	(0.005)
age2		−0.001***	−0.001***	−0.001***		−0.003***	−0.003***	−0.003***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
school between 1-5 years		0.018***	0.023***	0.019***		0.063**	0.065**	0.070**
		(0.007)	(0.007)	(0.007)		(0.028)	(0.028)	(0.028)
school between 6-10 years		−0.024***	−0.019**	−0.023***		−0.099***	−0.103***	−0.096***
		(0.007)	(0.008)	(0.007)		(0.029)	(0.029)	(0.029)
school between 11-15		−0.118***	−0.115***	−0.116***		−0.491***	−0.499***	−0.485***
		(0.014)	(0.015)	(0.014)		(0.043)	(0.043)	(0.043)
size of the households		−0.007***	−0.005***	−0.006***		−0.032***	−0.029***	−0.032***
		(0.001)	(0.001)	(0.001)		(0.004)	(0.004)	(0.004)
percentage of persons aged 15 years and more		−0.001***	−0.001***	−0.001***		−0.005***	−0.005***	−0.005***
		(0.000)	(0.000)	(0.000)		(0.001)	(0.001)	(0.001)
hindu		0.010	0.009	0.009		0.024	0.026	0.030
		(0.010)	(0.010)	(0.010)		(0.049)	(0.049)	(0.049)
household income per consumption unit (in log)		0.027***	0.023***	0.027***		0.238***	0.239***	0.240***
		(0.003)	(0.003)	(0.003)		(0.018)	(0.018)	(0.018)
electricity use		−0.003	−0.007	−0.001		−0.054*	−0.058**	−0.048
		(0.007)	(0.007)	(.)		(0.029)	(0.028)	(0.029)
firewood use		0.010	0.026	0.015		0.084	0.147*	0.086
		(0.022)	(0.021)	(0.023)		(0.083)	(0.075)	(0.082)
crop use		0.009	0.007	0.010		−0.062**	−0.037	−0.057*
		(0.007)	(0.007)	(0.007)		(0.032)	(0.029)	(0.032)
kerosene use		0.004	0.016	0.006		0.016	0.051	0.026
		(0.010)	(0.012)	(0.010)		(0.050)	(0.049)	(0.051)
lgp use		−0.028***	−0.026**	−0.027**		−0.137***	−0.147***	−0.121***
		(0.011)	(0.011)	(0.010)		(0.044)	(0.043)	(0.044)
employment program in the village			0.004	0.007			0.029	0.035
			(0.010)	(0.010)			(0.046)	(0.049)
conflict			0.000	0.002			−0.009	−0.013
			(0.006)	(0.005)			(0.027)	(0.027)
distance to town (in log)			0.004	0.002			0.028	0.029
			(0.004)	(0.004)			(0.018)	(0.019)
1001 - 5000 inhbts in the village			−0.014*	−0.011			−0.029	−0.010
			(0.008)	(0.008)			(0.032)	(0.035)
more than 5000 inhbts			−0.037***	−0.030**			−0.067	−0.031
			(0.012)	(0.013)			(0.050)	(0.054)
daily women unskilled wage rate (in log)			−0.006	−0.004			−0.042	−0.059
			(0.009)	(0.008)			(0.043)	(0.045)
unemployment rate in the district			−0.005***	−0.005***			−0.023***	−0.019**
			(0.002)	(0.002)			(0.008)	(0.008)
% of urban population in the district			0.021	0.015			0.221	0.173
			(0.029)	(0.030)			(0.139)	(0.144)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	18,035	18,035	18,035	18,035	18,035	18,035	18,035	18,035
F-stat first stage	33.53	26.42		25.56	73.02	58.53		55.53
Hansen J								
p value								

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 13: Family activities men

	Dependent variable:							
	Probability of working				Hours spent working			
	IV (1)	IV (2)	OLS (3)	IV (4)	IV (5)	IV (6)	OLS (7)	IV (8)
Natural resource collection	−0.096	−0.053	0.036**	−0.099				
	(0.071)	(0.084)	(0.014)	(0.085)				
Hours spent collecting					−0.214	−0.124	0.037	−0.199**
					(0.000)	(0.100)	(0.022)	(0.099)
age of the individual		0.041***	0.041***	0.042***		0.135***	0.135***	0.134***
		(0.002)	(0.002)	(0.002)		(0.005)	(0.005)	(0.005)
age2		−0.000***	−0.000***	−0.000***		−0.001***	−0.001***	−0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
school between 1-5 years		0.094***	0.111***	0.099***		0.288***	0.313***	0.306***
		(0.012)	(0.013)	(0.012)		(0.037)	(0.037)	(0.037)
school between 6-10 years		0.115***	0.134***	0.123***		0.350***	0.379***	0.370***
		(0.013)	(0.014)	(0.013)		(0.040)	(0.040)	(0.040)
school between 11-15		0.051***	0.068***	0.062***		0.115**	0.166***	0.146***
		(0.017)	(0.019)	(0.018)		(0.051)	(0.050)	(0.051)
size of the households		0.014***	0.016***	0.015***		0.041***	0.038***	0.042***
		(0.002)	(0.002)	(0.002)		(0.006)	(0.005)	(0.005)
percentage of persons aged 15 years and more		0.001***	0.001***	0.001***		0.003***	0.002***	0.003***
		(0.000)	(0.000)	(0.000)		(0.001)	(0.001)	(0.001)
hindu		0.060***	0.068***	0.060***		0.152**	0.166***	0.161***
		(0.022)	(0.023)	(0.022)		(0.059)	(0.058)	(0.060)
household income per consumption unit (in log)		−0.004	−0.010	−0.000		0.007	0.020	0.018
		(0.007)	(0.007)	(0.007)		(0.022)	(0.022)	(0.022)
electricity use		0.053***	0.073***	0.071***		0.179***	0.234***	0.220***
		(0.017)	(0.019)	(0.017)		(0.048)	(0.047)	(0.048)
firewood use		0.054	0.021	0.064		0.156	0.095	0.178*
		(0.051)	(0.045)	(0.049)		(0.109)	(0.097)	(0.108)
crop use		0.071***	0.051***	0.073***		0.092**	0.067	0.095**
		(0.016)	(0.017)	(0.016)		(0.047)	(0.045)	(0.047)
kerosene use		−0.010	0.018	−0.016		0.052	0.015	0.049
		(0.023)	(0.026)	(0.022)		(0.069)	(0.066)	(0.067)
lgp use		0.021	0.055***	0.030		0.099*	0.172***	0.135**
		(0.020)	(0.020)	(0.020)		(0.057)	(0.053)	(0.056)
employment program in the village			0.007	0.032			0.013	0.004
			(0.026)	(0.026)			(0.067)	(0.069)
conflict			0.001	−0.002			−0.013	−0.006
			(0.015)	(0.014)			(0.039)	(0.039)
distance to town (in log)			0.052***	0.049***			0.133***	0.131***
			(0.012)	(0.011)			(0.030)	(0.030)
1001 - 5000 inhbts in the village			−0.057***	−0.066***			−0.099*	−0.125**
			(0.022)	(0.021)			(0.057)	(0.058)
more than 5000 inhbts			−0.210***	−0.204***			−0.449***	−0.498***
			(0.030)	(0.030)			(0.082)	(0.083)
daily women unskilled wage rate (in log)			−0.059**	−0.052**			−0.145**	−0.121*
			(0.025)	(0.024)			(0.065)	(0.067)
unemployment rate in the district			−0.011***	−0.014***			−0.028***	−0.034***
			(0.004)	(0.004)			(0.009)	(0.009)
% of urban population in the district			−0.059	−0.014			−0.038	0.028
			(0.084)	(0.082)			(0.228)	(0.237)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	18,035	18,035	18,035	17,876	18,035	18,035	18,035	18,035
F-stat first stage	33.53	26.42		25.56	73.02	58.53		55.53
Hansen J								
p value								

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 14: Wage activities men

	Dependent variable:							
	Probability of working				Hours spent working			
	IV	IV	OLS	IV	IV	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Natural resource collection	0.374***	0.277***	−0.014	0.265***				
	(0.061)	(0.077)	(0.014)	(0.079)				
Hours spent collecting					0.533***	0.338***	−0.029	0.381***
					(0.099)	(0.097)	(0.023)	(0.100)
age of the individual		0.065***	0.065***	0.065***		0.190***	0.189***	0.189***
		(0.002)	(0.002)	(0.002)		(0.006)	(0.006)	(0.006)
age2		−0.001***	−0.001***	−0.001***		−0.003***	−0.003***	−0.003***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
school between 1-5 years		−0.089***	−0.097***	−0.089***		−0.224***	−0.243***	−0.230***
		(0.014)	(0.015)	(0.014)		(0.040)	(0.040)	(0.040)
school between 6-10 years		−0.204***	−0.211***	−0.206***		−0.531***	−0.560***	−0.543***
		(0.013)	(0.015)	(0.013)		(0.042)	(0.040)	(0.042)
school between 11-15		−0.288***	−0.306***	−0.293***		−0.804***	−0.853***	−0.818***
		(0.015)	(0.017)	(0.015)		(0.056)	(0.054)	(0.056)
size of the households		−0.031***	−0.030***	−0.031***		−0.087***	−0.080***	−0.087***
		(0.002)	(0.002)	(0.002)		(0.006)	(0.006)	(0.006)
percentage of persons aged 15 years and more		−0.003***	−0.003***	−0.003***		−0.009***	−0.009***	−0.010***
		(0.000)	(0.000)	(0.000)		(0.001)	(0.001)	(0.001)
hindu		−0.004	−0.006	−0.002		−0.031	−0.040	−0.031
		(0.021)	(0.022)	(0.020)		(0.066)	(0.063)	(0.066)
household income per consumption unit (in log)		0.035***	0.037***	0.035***		0.211***	0.206***	0.209***
		(0.008)	(0.008)	(0.008)		(0.024)	(0.023)	(0.024)
electricity use		−0.115***	−0.130***	−0.119***		−0.326***	−0.362***	−0.337***
		(0.014)	(0.015)	(0.014)		(0.043)	(0.041)	(0.044)
firewood use		−0.051	0.025	−0.052		−0.043	0.073	−0.071
		(0.037)	(0.032)	(0.037)		(0.100)	(0.088)	(0.105)
crop use		−0.043***	−0.022	−0.042***		−0.143***	−0.098**	−0.147***
		(0.016)	(0.017)	(0.016)		(0.050)	(0.046)	(0.051)
kerosene use		0.011	0.009	0.013		−0.033	0.025	−0.035
		(0.024)	(0.029)	(0.025)		(0.077)	(0.074)	(0.078)
lgp use		−0.119***	−0.157***	−0.122***		−0.370***	−0.436***	−0.373***
		(0.019)	(0.020)	(0.019)		(0.056)	(0.055)	(0.057)
employment program in the village			0.028	0.018			0.075	0.091
			(0.023)	(0.022)			(0.064)	(0.071)
conflict			0.012	0.016			0.036	0.025
			(0.013)	(0.013)			(0.036)	(0.038)
distance to town (in log)			−0.006	−0.008			−0.031	−0.029
			(0.010)	(0.009)			(0.027)	(0.028)
1001 - 5000 inhbts in the village			−0.019	0.010			−0.022	0.023
			(0.021)	(0.020)			(0.057)	(0.061)
more than 5000 inhbts			0.027	0.057**			0.148*	0.233***
			(0.026)	(0.027)			(0.076)	(0.081)
daily women unskilled wage rate (in log)			−0.003	−0.009			0.004	−0.038
			(0.024)	(0.024)			(0.064)	(0.069)
unemployment rate in the district			−0.004	−0.001			−0.005	0.006
			(0.004)	(0.004)			(0.011)	(0.012)
% of urban population in the district			0.064	−0.007			0.227	0.112
			(0.075)	(0.073)			(0.215)	(0.234)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	18,035	18,035	18,035	17,876	18,035	18,035	18,035	18,035
F-stat first stage	33.53	26.42		25.56	73.02	58.53		55.53
Hansen J								
p value								

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 15: Collection time for sellers and buyers (women)

	Dependent variable: collection time	
	Sellers	Buyers
	(1)	(2)
Distance from collection	0.212^{***}	0.315^{***}
	(0.043)	(0.055)
Distance to town	-0.009^{***}	-0.002
	(0.002)	(0.002)
Dist collection*Dist town	0.072^{***}	-0.004
	(0.028)	(0.031)
Controls	yes	yes
State FE	yes	yes
Observations	8,740	2,379

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 15 and Table 16 seems to confirm the predictions of our theoretical model. Both tables are organized in the same manner, yet Table 15 focuses on the women sample and Table 16 on the men sample. We split between potential sellers of firewood (people who do not buy firewood) in column (1) and buyers in column (2). In this regression we include all the usual controls but we add an interaction between the distance from the collection location, which is our proxy for the forest stock, and the distance from the town. Let us start by analyzing the behaviour of women. As predicted by the theory, we observe that a decrease in the stock of forest, i.e. an increase in the distance from the collection location, has a positive impact on the time spent in collection. A 1% increase in the distance increases collection time by 21.2% for sellers and by 31.5% for buyers. Both these increases are generated by the increase in the price of firewood resulting from a decrease in the forest stock. The increase in price makes it more interesting for both categories to collect more, for the sellers in order to increase their profits and for the buyers in order to keep their expenses at bay. As expenceted, distance from the closest town does not have an impact on buyers, yet it reduces the time spent in collection for sellers, because the price they are able to fetch decreases as they move away from the city. A one percent increase in the distance from the closest town results in a decrease by 0.9% in collection time. The interaction term instead is positive. As the stock of forest goes down, it becomes interesting to collect and sell firewood also for people living further away from the city, because of of the price increase. At equal distance from the town, a 1% increase in the distance from the collection location increases collection time by 7.2%. All these coefficients are statistically significant at the 1% level.

Moving now to men, Table16, we observe a very similar behavior. The main difference resides in the fact that, men who are potentially selling firewood, are not directly impacted by the quality of the environment. The only channel through which a reduction

Table 16: Collection time for sellers and buyers (men)

	Dependent variable: collection time	
	Sellers	Buyers
	(1)	(2)
Distance from collection	0.059	0.184^{***}
	(0.058)	(0.063)
Distance to town	-0.006^{**}	-0.002
	(0.003)	(0.002)
Dist collection*Dist town	0.075^{**}	0.002
	(0.037)	(0.037)
Controls	yes	yes
State FE	yes	yes
Observations	8,800	2,361

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

in the forest cover affects them, is through the distance from the city. As the stock of forest decreases, the threshold price which makes collecting financially interesting moves further and further away from the city. As a consequence, men start spending more and more time in collection activities.

The next step in disentangling what is happening in the data consists in analysing the response of buyers and sellers of firewood. These two categories are likely to react in different ways to a reduction in the forest cover. In our database we know how much every household spends on firewood. Therefore, we are able to identify who the buyers are. At the same time, we are also able to identify potential sellers, as households who do not buy any firewood.

5.2.1 Sellers

Results for sellers are presented in Table 17 for the women sample, and in Table 18 for the men sample. Columns (1) to (4) present results for the probability of participating in the labor market, while columns (5) to (8) show the labor supply coefficients. Columns (1) and (5) report first stage results. Let us start by focusing on the women sample. A one percent increase in the distance from the collection location increases the porbability of collecting by 0.4%, while the same increase in the distance increases time spent in collection by 1.6%. As before, the square of the distance from the collection location is negative, implying that the time spent in collection increases in the distance from the collection location but at a decreasing rate. Interestingly, in column (5) we can observe a negative and statistically significant at the 1% level coefficient on the distance from the closest town. An increase of 1% in the distance from the closes town, decreases by 6.8% the time spent collecting. This coefficient was not statistically significant in Table 5, nor it will be statistically significant when looking at firewood buyers. According to this coefficient, it seems that cities (urban areas) may be playing a role in our story. The further potential firewood sellers live from a city, the less firewood they collect, therefore distance from the closest demand pole matters. Results for men are relatively similar. A 1% increase in the distance increases the probability of collecting by0.3% and the time spent in collection by 1.1%, and these coefficients are statistically significant at least at the 5% level. The coefficient on the distance from the closest town is negative also in the case of men, yet it is not statistically significant.

Focusing on second stage regressions, columns (6) to (8), we note that interestingly, for sellers, there is no aggregate labor supply effect from an increase in the time spent in collection. This is true both for men and for women. An impact emerges when we split between family and wage earning activities. A one percent increase in the time spent in collection decreases time spent in family related activities by 26.8% for women, and with a p value of 0.014 this coefficient is highly stitistically significant. The same is true for men, with a bigger coefficient, a decrease of 39.9%. Therefore, firewood sellers seem to respond to a decrease in forest availability by decreasing the time they devote to family businesses. On the other hand, a 1% increase in collection time increases the time spent in wage earning activities by women by 16.5%. Yet, this coefficient is only statistically significant at the 10% level. The men's coefficient is bigger in magnitude, a 1% increase in collection time leads to an increase in time spent in wage earning activities of 52.4%. This increase may derive from the fact that it is more difficult to make enough money through the sale of firewood when the forest cover is reduced, and therefore, individuals have to complement with activities earning a wage. Hours spent in wage activities seem to be independent from the distance from urban centers. A reduction in environmental quality seems to generate some degree of substitution between entrepreneurial activities and wage earning activities for potential firewood sellers. Part of this substitution could also be explained by the increase in th difficulty to provide a sufficient level of income to the family through firewood sales.

5.2.2 Buyers

Results for buyers are presented in Table 19 for women and in Table 20 for men. As before, results for the probability of participating in the labor market are presented in columns (1) to (4) and labor supply coefficients in columns (5) to (8); first stage results are in columns (1) and (5). A one percent increase in the distance from the collection location increases the porbability of collecting by 1.8%, while the same increase in the distance increases time spent in collection by 2.5%. These numbers are statistically significant at the 1% level, and it is no surprise that their magnitude is bigger than the one found for sellers. As seen in Table 7, a decrease in the forest cover generates an increase in firewood price. A high enough increase in the price, could push several

Table 17: Potential sellers (women)

	Dependent variable:							
		Probability of collecting				Hours spent collecting		
	First	Tot	Fam	Wage	First	Tot	Fam	Wage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
distance from collection (min)	0.004***				0.016***			
	(0.001)				(0.001)			
distance from collection^2 (min)	−0.000***				−0.000***			
	(0.000)				(0.000)			
Natural resource collection		0.032	−0.342*	0.366**				
		(0.177)	(0.201)	(0.182)				
Hours spent collecting						−0.094	−0.268**	0.165*
						(0.095)	(0.110)	(0.093)
age of the individual	−0.000	0.057***	0.042***	0.034***	−0.000	0.174***	0.113***	0.094***
	(0.001)	(0.003)	(0.003)	(0.011)	(0.002)	(0.007)	(0.006)	(0.006)
age2	−0.000	−0.001***	−0.001***	−0.000***	−0.000	−0.002***	−0.001***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
school between 1-5 years	−0.004	−0.061***	0.020	−0.080***	−0.012	−0.202***	0.032	−0.294***
	(0.009)	(0.020)	(0.020)	(0.031)	(0.021)	(0.049)	(0.047)	(0.046)
school between 6-10 years	−0.013	−0.182***	−0.019	−0.179***	−0.039*	−0.538***	−0.050	−0.621***
	(0.009)	(0.020)	(0.019)	(0.065)	(0.022)	(0.051)	(0.047)	(0.050)
school between 11-15	−0.069***	−0.329***	−0.166***	−0.195**	−0.157***	−0.937***	−0.397***	−0.711***
	(0.019)	(0.033)	(0.032)	(0.081)	(0.037)	(0.082)	(0.076)	(0.073)
size of the households	−0.001	−0.019***	0.002	−0.031***	0.000	−0.063***	0.001	−0.077***
	(0.002)	(0.003)	(0.003)	(0.010)	(0.004)	(0.008)	(0.007)	(0.006)
percentage of persons aged 15 years and more	−0.000	−0.001***	−0.000	−0.002***	−0.001	−0.005***	−0.001	−0.005***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
hindu	−0.036*	0.073***	0.110***	−0.001	−0.074*	0.203***	0.302***	−0.002
	(0.019)	(0.028)	(0.029)	(0.024)	(0.040)	(0.066)	(0.066)	(0.067)
household income per consumption unit (in log)	0.001	0.013	−0.003	−0.004	0.004	0.082***	0.014	0.050**
	(0.006)	(0.009)	(0.010)	(0.009)	(0.013)	(0.023)	(0.026)	(0.023)
electricity use	−0.020*	−0.060***	0.028	−0.103***	−0.024	−0.170***	0.105*	−0.333***
	(0.011)	(0.020)	(0.024)	(0.034)	(0.029)	(0.046)	(0.055)	(0.052)
firewood use	0.472***	0.265**	0.335***	−0.064	0.526***	0.633***	0.671***	−0.001
	(0.062)	(0.110)	(0.051)	(0.108)	(0.082)	(0.136)	(0.136)	(0.124)
crop use	0.015	0.019	0.062**	0.011	0.089**	0.007	0.085	−0.001
	(0.014)	(0.023)	(0.026)	(0.021)	(0.036)	(0.056)	(0.059)	(0.058)
kerosene use	−0.051***	−0.002	−0.071**	0.047	0.036	−0.059	−0.134*	0.024
	(0.015)	(0.031)	(0.034)	(0.033)	(0.050)	(0.068)	(0.075)	(0.072)
lpg use	−0.044**	−0.046	0.043	−0.142**	−0.102***	−0.179**	0.098	−0.348***
	(0.018)	(0.030)	(0.033)	(0.055)	(0.036)	(0.072)	(0.076)	(0.057)
employment program in the village	0.027	−0.028	−0.013	−0.045	0.159***	−0.042	0.035	−0.122
	(0.025)	(0.033)	(0.039)	(0.035)	(0.057)	(0.087)	(0.102)	(0.092)
conflict	−0.009	−0.008	−0.005	−0.005	0.018	−0.060	−0.036	−0.038
	(0.011)	(0.019)	(0.021)	(0.016)	(0.029)	(0.045)	(0.051)	(0.046)
distance to town (in log)	−0.016	0.035**	0.051***	0.021	−0.068***	0.103***	0.134***	0.027
	(0.010)	(0.014)	(0.017)	(0.014)	(0.024)	(0.033)	(0.037)	(0.034)
1001 - 5000 inhbts in the village	−0.023	−0.070***	−0.090***	−0.015	−0.035	−0.152**	−0.183**	−0.042
	(0.014)	(0.025)	(0.029)	(0.023)	(0.041)	(0.061)	(0.075)	(0.064)
more than 5000 inhbts	−0.044*	−0.160***	−0.215***	−0.016	−0.055	−0.338***	−0.469***	−0.030
	(0.024)	(0.038)	(0.040)	(0.032)	(0.062)	(0.090)	(0.116)	(0.096)
daily women unskilled wage rate (in log)	0.013	−0.017	−0.052	−0.001	0.022	−0.089	−0.145*	0.000
	(0.017)	(0.029)	(0.033)	(0.026)	(0.048)	(0.071)	(0.080)	(0.079)
unemployment rate in the district	0.001	−0.018**	−0.017**	−0.013	−0.025**	−0.049***	−0.042***	−0.021
	(0.005)	(0.007)	(0.007)	(0.008)	(0.010)	(0.017)	(0.015)	(0.014)
% of urban population in the district	0.043	−0.054	0.032	−0.137	−0.138	−0.054	0.085	−0.268
	(0.054)	(0.088)	(0.110)	(0.085)	(0.168)	(0.237)	(0.299)	(0.223)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	8,740	8,740	8,740	8,740	8,740	8,740	8,740	8,740
F-stat first stage	13.27	13.27	13.27	13.27	91.70	91.70	91.70	91.70

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 18: Potential sellers (men)

	Dependent variable:							
		Probability of collecting				Hours spent collecting		
	First	Tot	Fam	Wage	First	Tot	Fam	Wage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
distance from collection (min)	0.003**				0.011***			
	(0.001)				(0.002)			
distance from collection^2 (min)	−0.000***				−0.000***			
	(0.000)				(0.000)			
Natural resource collection		0.126*	0.352*	0.021				
		(0.072)	(0.180)	(0.201)				
Hours spent collecting						0.113	−0.399*	0.524**
						(0.133)	(0.206)	(0.219)
age of the individual	0.005***	0.039***	0.040***	0.064***	0.007**	0.248***	0.139***	0.177***
	(0.002)	(0.001)	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.008)
age2	−0.000***	−0.000***	−0.000***	−0.001***	−0.000**	−0.003***	−0.002***	−0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
school between 1-5 years	0.003	0.018**	0.081***	−0.076***	−0.005	0.084**	0.272***	−0.194***
	(0.017)	(0.009)	(0.016)	(0.020)	(0.029)	(0.038)	(0.050)	(0.054)
school between 6-10 years	0.006	−0.023**	0.116***	−0.194***	−0.001	−0.084**	0.369***	−0.522***
	(0.017)	(0.010)	(0.018)	(0.019)	(0.030)	(0.038)	(0.054)	(0.058)
school between 11-15	0.001	−0.103***	0.069***	−0.295***	−0.044	−0.456***	0.135*	−0.799***
	(0.022)	(0.019)	(0.024)	(0.023)	(0.038)	(0.056)	(0.070)	(0.082)
size of the households	0.009***	−0.006***	0.013***	−0.028***	0.015***	−0.030***	0.051***	−0.092***
	(0.003)	(0.001)	(0.003)	(0.004)	(0.005)	(0.006)	(0.008)	(0.010)
percentage of persons aged 15 years and more	0.002***	−0.001***	0.000	−0.002***	0.004***	−0.005***	0.005***	−0.011***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
hindu	−0.049	0.028*	0.137***	−0.024	−0.076	0.080	0.294***	−0.090
	(0.032)	(0.016)	(0.031)	(0.034)	(0.052)	(0.074)	(0.093)	(0.105)
household income per consumption unit (in log)	−0.002	0.026***	0.005	0.020**	−0.001	0.244***	0.054*	0.169***
	(0.010)	(0.004)	(0.010)	(0.010)	(0.018)	(0.024)	(0.030)	(0.030)
electricity use	−0.037*	0.008	0.096***	−0.135***	−0.071*	−0.013	0.231***	−0.331***
	(0.022)	(0.009)	(0.024)	(0.020)	(0.041)	(0.039)	(0.067)	(0.059)
firewood use	0.296***	−0.015	−0.013	−0.012	0.325***	0.006	0.352*	−0.275
	(0.059)	(0.032)	(0.094)	(0.084)	(0.092)	(0.136)	(0.204)	(0.204)
crop use	0.012	0.001	0.053**	−0.013	−0.011	−0.004	0.126*	−0.087
	(0.028)	(0.009)	(0.023)	(0.023)	(0.051)	(0.041)	(0.070)	(0.073)
kerosene use	0.016	0.003	−0.035	0.048	0.148**	0.014	−0.040	0.055
	(0.034)	(0.014)	(0.031)	(0.038)	(0.061)	(0.066)	(0.093)	(0.108)
lgp use	−0.103***	−0.008	0.118***	−0.159***	−0.104*	−0.097	0.194**	−0.399***
	(0.032)	(0.014)	(0.028)	(0.034)	(0.053)	(0.062)	(0.081)	(0.084)
employment program in the village	−0.073*	−0.002	−0.031	0.018	−0.044	−0.006	−0.146	0.092
	(0.039)	(0.013)	(0.033)	(0.034)	(0.070)	(0.064)	(0.102)	(0.102)
conflict	0.042*	0.005	−0.005	0.027	0.106**	0.042	0.072	0.028
	(0.023)	(0.008)	(0.021)	(0.019)	(0.042)	(0.038)	(0.062)	(0.060)
distance to town (in log)	0.004	0.005	0.053***	−0.003	−0.025	0.046*	0.139***	−0.014
	(0.017)	(0.005)	(0.016)	(0.013)	(0.030)	(0.025)	(0.044)	(0.042)
1001 - 5000 inhbts in the village	−0.048	−0.002	−0.013	−0.030	−0.062	−0.022	−0.098	−0.009
	(0.031)	(0.010)	(0.030)	(0.029)	(0.059)	(0.045)	(0.082)	(0.088)
more than 5000 inhbts	−0.063	−0.017	−0.146***	0.007	−0.122	−0.031	−0.405***	0.203*
	(0.048)	(0.014)	(0.048)	(0.036)	(0.084)	(0.071)	(0.124)	(0.113)
daily women unskilled wage rate (in log)	0.098**	−0.012	−0.037	−0.038	0.223***	−0.103*	0.033	−0.212*
	(0.040)	(0.012)	(0.035)	(0.038)	(0.071)	(0.060)	(0.102)	(0.109)
unemployment rate in the district	−0.007	−0.006**	−0.013**	−0.003	−0.029**	−0.033**	−0.050***	0.009
	(0.009)	(0.003)	(0.007)	(0.007)	(0.014)	(0.017)	(0.017)	(0.024)
% of urban population in the district	0.269***	0.026	0.001	0.061	0.259	0.294*	0.290	0.103
	(0.100)	(0.037)	(0.113)	(0.107)	(0.195)	(0.164)	(0.321)	(0.317)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	8,800	8,800	8,800	8,800	8,800	8,800	8,800	8,800
F-stat first stage	7.21	7.21	7.21	7.21	16.30	16.30	16.30	16.30

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

buyers to reduce the quantities bought and start collecting. The same is true for men, the increases are of 1.4% and 1.7% for probability and time, respectively. According to our theoretical model, distance from the nearest urban area should have a negative impact on collection, because of the decrease in price as you move further out. Yet, this is a second order effect. The coefficient on distance in column (5) is in fact negative, yet it is not statistically significant. Here again, the same is true for the regression concerning the men in the sample.

Let us focus on the second stage regressions for women. Columns (6) tells us that an increase of 1% in the time spent collecting increases labor supply by 20.8%, this coefficient is statistically significant at the 5% level. The corresponding increase in the probability of participating in the labor market is of 14%. When we proceed to disentangle the two different types of activities, we find results which are similar to those observed in Table 10 and Table 11. The increase in labor supply, is completely driven by an increase in the time spent in wage earning activities, which goes up by 18.1%. No statistically significant change is observable for family activities. This reaction is simply explained by the increase in the price of firewood. Wood becomes more expensive and, therefore, on the one hand people are more likely to start collecting and on the other hand they are going to work more, in order to absorb the price shock. Interestingly, men's labor supply is not affected, the coefficients are positive but not statistically significant. It seems that for households which are buying firewood, an increase in the price – generated by an increased scarcity – only pushes the women to increase their labor supply, but not the men. Only the probability that a men participates in wage earning activities is affected, it goes up by 15.4%, and this effect is statistically significant at the 5% level.

6 Conclusion

The goal of this paper is to study the impact of deforestation on male and female labor market decisions in rural India. The majority of papers on deforestation focus on its negative environmental impact, and do not look at the impact that natural resource scarcity may have on people who heavily rely on it for cooking and for heating.

Our results show that an increase in the distance from the collection location – which is often the result of a reduction in the forest coverage – increases the probability that both, men and women, will be involved in wage earning activities. This is true for household selling and buying firewood. Yet, selling households, in response to a deterioration of the availability of forest products, decrease the time devoted to family activities.

Table 19: Buyers (women)

	Dependent variable:							
		Probability of collecting				Hours spent collecting		
	First	Tot	Fam	Wage	First	Tot	Fam	Wage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
distance from collection (min)	0.018***				0.025***			
	(0.001)				(0.002)			
distance from collection^2 (min)	−0.000***				−0.000***			
	(0.000)				(0.000)			
Natural resource collection		0.140**	0.088*	0.072*				
		(0.064)	(0.051)	(0.039)				
Hours spent collecting						0.208**	0.073	0.181**
						(0.083)	(0.068)	(0.083)
age of the individual	−0.001	0.055***	0.038***	0.020***	0.002	0.131***	0.085***	0.060***
	(0.003)	(0.006)	(0.004)	(0.003)	(0.004)	(0.012)	(0.010)	(0.010)
age2	0.000	−0.001***	−0.000***	−0.000***	−0.000	−0.002***	−0.001***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
school between 1-5 years	−0.000	−0.067**	0.017	−0.068***	−0.020	−0.166**	0.055	−0.248***
	(0.024)	(0.034)	(0.032)	(0.016)	(0.039)	(0.084)	(0.072)	(0.077)
school between 6-10 years	−0.003	−0.083**	0.022	−0.100***	−0.051	−0.249***	0.051	−0.358***
	(0.024)	(0.034)	(0.031)	(0.017)	(0.037)	(0.080)	(0.063)	(0.068)
school between 11-15	−0.086**	−0.213***	−0.137***	−0.067**	−0.129**	−0.489***	−0.228***	−0.278**
	(0.038)	(0.051)	(0.042)	(0.029)	(0.055)	(0.138)	(0.082)	(0.139)
size of the households	−0.004	−0.018***	−0.001	−0.021***	−0.005	−0.049***	−0.003	−0.050***
	(0.007)	(0.005)	(0.005)	(0.004)	(0.010)	(0.010)	(0.010)	(0.009)
percentage of persons aged 15 years and more	−0.001**	−0.001	−0.000	−0.001**	−0.001	−0.004**	−0.001	−0.003**
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)	(0.002)
hindu	0.044	0.001	0.013	−0.001	−0.006	0.055	0.048	0.036
	(0.038)	(0.044)	(0.040)	(0.027)	(0.048)	(0.094)	(0.082)	(0.080)
household income per consumption unit (in log)	−0.042***	−0.024	−0.036**	0.010	−0.045**	0.015	−0.057	0.074**
	(0.012)	(0.017)	(0.016)	(0.009)	(0.020)	(0.040)	(0.038)	(0.030)
electricity use	0.047*	−0.090**	−0.005	−0.078***	0.021	−0.200**	−0.010	−0.227***
	(0.028)	(0.035)	(0.033)	(0.023)	(0.048)	(0.081)	(0.072)	(0.073)
crop use	0.035	0.077*	0.121***	−0.063***	0.135***	0.058	0.211***	−0.184**
	(0.040)	(0.044)	(0.037)	(0.022)	(0.064)	(0.095)	(0.075)	(0.074)
kerosene use	0.073	−0.015	0.009	−0.011	0.210***	0.048	0.107	−0.058
	(0.046)	(0.060)	(0.058)	(0.043)	(0.080)	(0.126)	(0.117)	(0.110)
lgp use	−0.089***	−0.048	0.018	−0.080***	−0.057	−0.168*	0.041	−0.272***
	(0.033)	(0.039)	(0.036)	(0.018)	(0.045)	(0.087)	(0.077)	(0.069)
employment program in the village	−0.038	0.046	0.062	−0.019	0.056	0.083	0.127	−0.038
	(0.054)	(0.059)	(0.049)	(0.030)	(0.068)	(0.127)	(0.131)	(0.081)
conflict	−0.120***	−0.025	−0.012	−0.003	−0.024	−0.133*	−0.056	−0.071
	(0.026)	(0.032)	(0.029)	(0.019)	(0.043)	(0.070)	(0.062)	(0.064)
distance to town (in log)	−0.011	0.026	0.042**	−0.016	−0.043	0.042	0.072	−0.046
	(0.020)	(0.020)	(0.020)	(0.011)	(0.028)	(0.046)	(0.046)	(0.038)
1001 - 5000 inhbts in the village	−0.147**	−0.151***	−0.118***	−0.043	−0.174***	−0.357***	−0.304***	−0.112
	(0.037)	(0.051)	(0.045)	(0.031)	(0.061)	(0.107)	(0.112)	(0.084)
more than 5000 inhbts	−0.123***	−0.179***	−0.209***	0.003	−0.030	−0.387***	−0.554***	0.056
	(0.044)	(0.054)	(0.037)	(0.036)	(0.081)	(0.128)	(0.117)	(0.109)
daily women unskilled wage rate (in log)	−0.035	0.020	−0.070*	0.041	−0.135**	0.025	−0.212***	0.191**
	(0.038)	(0.039)	(0.038)	(0.027)	(0.063)	(0.091)	(0.081)	(0.087)
unemployment rate in the district	−0.014	−0.019*	−0.025***	0.002	−0.039**	−0.018	−0.030**	0.014
	(0.014)	(0.010)	(0.008)	(0.005)	(0.018)	(0.019)	(0.012)	(0.015)
% of urban population in the district	−0.073	−0.160	−0.052	−0.141**	0.113	−0.365	0.073	−0.553**
	(0.149)	(0.143)	(0.142)	(0.071)	(0.210)	(0.331)	(0.306)	(0.271)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379
F-stat first stage	106.10	106.10	106.10	106.10	134.12	134.12	134.12	134.12

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Table 20: Buyers (men)

	Dependent variable:							
		Probability of collecting				Hours spent collecting		
	First	Tot	Fam	Wage	First	Tot	Fam	Wage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
distance from collection (min)	0.014***				0.017***			
	(0.001)				(0.002)			
distance from collection^2 (min)	−0.000***				−0.000***			
	(0.000)				(0.000)			
Natural resource collection		0.032	−0.048	0.154**				
		(0.044)	(0.077)	(0.071)				
Hours spent collecting						0.156	−0.019	0.191
						(0.120)	(0.158)	(0.171)
age of the individual	−0.003	0.053***	0.031***	0.071***	−0.012***	0.273***	0.106***	0.213***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.015)	(0.014)	(0.014)
age2	0.000	−0.001***	−0.000***	−0.001***	0.000***	−0.003***	−0.001***	−0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
school between 1-5 years	−0.045*	0.050**	0.205***	−0.073*	−0.083**	0.158**	0.487***	−0.178*
	(0.027)	(0.022)	(0.035)	(0.039)	(0.037)	(0.080)	(0.096)	(0.107)
school between 6-10 years	0.047*	−0.021	0.172***	−0.219***	0.028	−0.088	0.455***	−0.578***
	(0.027)	(0.024)	(0.035)	(0.032)	(0.037)	(0.080)	(0.093)	(0.100)
school between 11-15	0.006	−0.166***	0.087*	−0.296***	0.011	−0.578***	0.150	−0.782***
	(0.038)	(0.043)	(0.048)	(0.037)	(0.053)	(0.115)	(0.119)	(0.135)
size of the households	0.005	−0.007***	0.021***	−0.026***	0.014*	−0.033***	0.049***	−0.081***
	(0.006)	(0.003)	(0.005)	(0.005)	(0.008)	(0.011)	(0.015)	(0.016)
percentage of persons aged 15 years and more	0.001	−0.001	0.001	−0.002***	0.000	−0.005***	0.003	−0.008***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
hindu	−0.016	−0.006	−0.018	0.026	−0.056	−0.045	−0.050	0.082
	(0.039)	(0.025)	(0.041)	(0.039)	(0.053)	(0.097)	(0.118)	(0.119)
household income per consumption unit (in log)	−0.014	0.025**	−0.032*	0.050***	−0.014	0.198***	−0.083	0.248***
	(0.016)	(0.010)	(0.017)	(0.017)	(0.020)	(0.045)	(0.051)	(0.049)
electricity use	−0.004	−0.023	0.024	−0.094***	−0.010	−0.110	0.199*	−0.355***
	(0.037)	(0.021)	(0.043)	(0.033)	(0.057)	(0.076)	(0.113)	(0.088)
crop use	0.066	0.011	0.160***	−0.123***	0.177**	−0.056	0.350***	−0.351***
	(0.046)	(0.019)	(0.041)	(0.038)	(0.073)	(0.080)	(0.103)	(0.124)
kerosene use	−0.040	−0.040	0.074	−0.146***	0.033	−0.089	0.262*	−0.421**
	(0.068)	(0.030)	(0.063)	(0.050)	(0.100)	(0.150)	(0.156)	(0.183)
lgp use	0.022	−0.024	0.041	−0.106***	0.025	−0.055	0.195*	−0.262**
	(0.034)	(0.021)	(0.038)	(0.036)	(0.048)	(0.094)	(0.105)	(0.113)
employment program in the village	−0.009	0.044	0.105*	−0.006	0.070	0.136	0.228	0.024
	(0.063)	(0.047)	(0.061)	(0.057)	(0.083)	(0.151)	(0.185)	(0.162)
conflict	−0.147***	−0.027	0.002	−0.010	−0.115**	−0.179**	−0.029	−0.102
	(0.035)	(0.021)	(0.036)	(0.033)	(0.049)	(0.083)	(0.092)	(0.095)
distance to town (in log)	0.020	0.013	0.063***	−0.020	−0.017	0.051	0.123*	−0.003
	(0.025)	(0.012)	(0.023)	(0.018)	(0.034)	(0.046)	(0.066)	(0.057)
1001 - 5000 inhbts in the village	−0.032	−0.024	−0.090*	0.028	−0.014	−0.140	−0.297*	0.055
	(0.064)	(0.032)	(0.054)	(0.047)	(0.094)	(0.121)	(0.164)	(0.153)
more than 5000 inhbts	−0.060	−0.028	−0.208***	0.069	−0.030	−0.118	−0.604***	0.188
	(0.076)	(0.038)	(0.057)	(0.058)	(0.105)	(0.141)	(0.179)	(0.191)
daily women unskilled wage rate (in log)	−0.015	−0.025	−0.110**	0.014	−0.010	0.039	−0.220	0.187
	(0.050)	(0.026)	(0.045)	(0.053)	(0.076)	(0.114)	(0.142)	(0.134)
unemployment rate in the district	0.004	0.001	−0.013**	0.002	−0.016	0.018	−0.008	0.019
	(0.011)	(0.004)	(0.007)	(0.009)	(0.012)	(0.018)	(0.019)	(0.028)
% of urban population in the district	0.112	−0.032	−0.210	0.051	0.075	−0.243	−0.645	0.151
	(0.148)	(0.075)	(0.151)	(0.140)	(0.212)	(0.343)	(0.435)	(0.479)
State F.E.	yes	yes	yes	yes	yes	yes	yes	yes
Observations	2,361	2,361	2,361	2,361	2,361	2,361	2,361	2,361
F-stat first stage	55.23	55.23	55.23	55.23	50.74	50.74	50.74	50.74

Notes: All estimations contain a constant. Standard errors in parentheses are clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

References

Amacher, G., Hyde, W., and Kanel, K. (1996). Household Fuelwood Demand and Supply in Nepal's Tarai and Mid-Hills: Choice between Cash Outlays and Labor Opportunity. *World Development*, 24(11):1725–1736.

Angrist, J. (2001). Estimations of Limited Dependent Variable Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Practice. *Journal of Business & Economic Statistics*, 19(1):2–16.

Angrist, J. and Pischke, J.-S. (2009). *Mostly Harmless Econometrics: an Empiricist's Companion*. Princeton University Press.

Baland, J.-M., Bardhan, P., Das, S., Mookherjee, D., and Sarkar, R. (2010). The Environmental Impact of Poverty: Evidence from Firewood Collection in Rural Nepal. *Economic Development and Cultural Change*, 59(1):23–61.

Bandyopadhyay, S., Shyamsundar, P., and Baccini, A. (2011). Forests, Biomass Use and Poverty in Malawi. *Ecological Economics*, 70(12):2461–2471.

Burgess, R., Hansen, M., Olken, B., Potapov, P., and Sieber, S. (2012). The Political Economy of Deforestation in the Tropics. *The Quarterly Journal of Economics*, 127(4):1707–1754.

Cavendish, W. (2000). Empirical Regularities in the Poverty-Environmental Relationship of Rural Households: Evidence from Zimbabwe. *World Development*, 28(11):1979–2003.

Cooke, P. (1998a). Intrahousehold Labor Allocation Responses to Environmental Good Scarcity: A Case Study from the Hills of Nepal. *Economic Development and Cultural Change*, 46(4):807–30.

Cooke, P. (1998b). The Effect of Environmental Good Scarcity on Own-Farm Labor Allocation: the Case of Agricultural Households in Rural Nepal. *Environment and Development Economics*, 3(04):443–469.

Cropper, M. and Griffiths, C. (1994). The Interaction of Population Growth and Environmental Quality. *American Economic Review*, 84(2):250–54.

FAO (2010). Global Forest Resource Assessment - Main Report. FAO Forestry Paper 163.

Foster, A. and Rosenzweig, M. (2003). Economic Growth and the Rise of Forests. *The Quarterly Journal of Economics*, 118(2):601–637.

Gunatileke, H. and Chakravorty, U. (2003). Protecting Forests Through Farming. A Dynamic Model of Nontimber Forest Extraction. *Environmental & Resource Economics*, 24(1):1–26.

Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A., Tyukavina, A., Thau, D., Stehman, S. V., Goetz, S. J., Loveland, T. R., Kommareddy, A., Egorov, A., Chini, L., Justice, C. O., and Townshend, J. R. G. (2013). High-Resolution Global Maps of 21st-Century Forest Cover Change. *Science*, 342(6160):850–853.

Ilahi, N. and Grimard, F. (2000). Public Infrastructure and Private Costs: Water Supply and Time Allocation of Women in Rural Pakistan. *Economic Development and Cultural Change*, 49(1):45–75.

Kamanga, P., Vedeld, P., and Sjaastad, E. (2009). Forest Incomes and Rural Livelihoods in Chiradzulu District, Malawi. *Ecological Economics*, 68(3):613–624.

Koolwal, G. and van de Walle, D. (2013). Access to Water, Women's Work, and Child Outcomes. *Economic Development and Cultural Change*, 61(2):369 – 405.

Kumar, S. and Hotchkiss, D. (1988). Consequences of Deforestation for Women's Time Allocation, Agricultural Production, and Nutrition in Hill Areas of Nepal:. Research reports 69, International Food Policy Research Institute (IFPRI).

Lokshin, M. and Yemtsov, R. (2005). Has Rural Infrastructure Rehabilitation in Georgia Helped the Poor? *World Bank Economic Review*, 19(2):311–333.

Nankhuni, F. and Findeis, J. (2003). Natural Resource Collection Work and Schooling in Malawi. 2003 Annual Meeting, August 16-22, 2003, Durban, South Africa 25829, International Association of Agricultural Economists.

National Sample Survey Office, Ministry of Statistics & Programme Implementation, G. o. I. (2010). Migration in india 2007-2008. NSS report 533.

Wagura Ndiritu, S. and Nyangena, W. (2010). Environmental Goods Collection and Childrens Schooling: Evidence from Kenya. Discussion Papers dp-10-18-efd, Resources For the Future.

Table A.1: Forest cover by state

	2000			2004			Δ		
State	Dense	Open	Total	Dense	Open	Total	Dense	Open	Total
Andaman & Nicobar Islands	0.80	0.04	0.84	0.73	0.08	0.80	-0.07	0.03	-0.04
Andhra Pradesh	0.09	0.07	0.16	0.09	0.07	0.16	-0.005	0.004	-0.001
Arunachal Pradesh	0.54	0.18	0.72	0.57	0.22	0.80	0.04	0.04	0.07
Assam	0.13	0.11	0.24	0.10	0.15	0.26	-0.03	0.04	0.01
Bihar	0.04	0.02	0.06	0.03	0.03	0.06	-0.003	0.001	-0.001
Chandigarh	0.04	0.03	0.07	0.08	0.05	0.13	0.04	0.02	0.06
Chhattisgarh	0.28	0.14	0.42	0.29	0.13	0.41	0.006	-0.01	-0.004
Dadra and Nagar Haveli	0.31	0.14	0.45	0.26	0.18	0.45	-0.04	0.05	0.004
Daman & Diu	0.01	0.04	0.05	0.02	0.06	0.08	0.004	0.02	0.02
Delhi	0.03	0.05	0.07	0.04	0.08	0.12	0.01	0.03	0.04
GOA	0.16	0.13	0.29	0.15	0.14	0.29	-0.01	0.01	-0.0002
Gujarat	0.04	0.03	0.08	0.03	0.04	0.07	-0.01	0.01	-0.002
Haryana	0.03	0.01	0.04	0.01	0.02	0.04	-0.01	0.01	-0.004
Himachal Pradesh	0.19	0.07	0.26	0.16	0.10	0.26	-0.03	0.03	0.0002
Jammu & Kashmir	0.06	0.04	0.09	0.05	0.05	0.09	-0.01	0.01	-0.0004
Jharkhand	0.16	0.17	0.34	0.14	0.20	0.34	-0.02	0.03	0.01
Karnataka	0.14	0.06	0.19	0.11	0.07	0.18	-0.02	0.01	-0.01
Kerala	0.30	0.10	0.40	0.25	0.15	0.40	-0.05	0.05	0.001
Lakshadweep	0.86	0.00	0.86	0.47	0.31	0.78	-0.40	0.31	-0.08
Madhya Pradesh	0.14	0.11	0.25	0.13	0.11	0.25	-0.01	0.01	-0.004
Maharashtra	0.10	0.05	0.15	0.09	0.06	0.15	-0.01	0.01	-0.00002
Manipur	0.26	0.50	0.76	0.29	0.48	0.76	0.03	-0.03	0.01
Meghalaya	0.25	0.44	0.69	0.32	0.44	0.76	0.06	-0.003	0.06
Mizoram	0.42	0.41	0.83	0.30	0.59	0.89	-0.12	0.18	0.06
Nagaland	0.32	0.48	0.80	0.35	0.47	0.83	0.03	-0.004	0.02
Orissa	0.18	0.13	0.31	0.18	0.13	0.31	0.001	-0.004	-0.003
Pondicherry	0.07	0.003	0.07	0.03	0.05	0.09	-0.04	0.05	0.012
Punjab	0.03	0.02	0.05	0.01	0.02	0.03	-0.02	-0.001	-0.02
Rajasthan	0.02	0.03	0.05	0.01	0.03	0.05	-0.005	0.004	-0.001
Sikkim	0.34	0.11	0.45	0.34	0.12	0.46	0.003	0.01	0.01
Tamilnadu	0.10	0.07	0.16	0.10	0.08	0.18	-0.0001	0.01	0.01
Tripura	0.33	0.34	0.67	0.48	0.30	0.78	0.15	-0.04	0.10
Uttar Pradesh	0.04	0.02	0.05	0.02	0.03	0.06	-0.01	0.01	0.002
Uttaranchal	0.36	0.09	0.45	0.34	0.11	0.46	-0.01	0.02	0.01
West Bengal	0.07	0.05	0.12	0.07	0.07	0.14	-0.003	0.02	0.02
India	0.13	0.08	0.20	0.12	0.09	0.21	-0.01	0.01	0.003

A Appendix Figure